# Technical Meeting of the Institution

*held at*

*The Institution of Electrical Engineers*

*Tuesday, December 7th, 1965*

The President (Mr. J. P. COLEY) in the chair

The Minutes of the Technical Meeting held on 2nd November, 1965, were read and approved.

The President introduced and welcomed to the meeting Mr. J. L. Reeves (Technician Member) who was present for the first time since his election to membership.

A welcome was also extended to members of the Stratford S. & T. Technical Society who were present at the meeting.

The President then requested Mr. D. S. Jewell to read his paper entitled " Modern Level Crossing Protection."

# Modern Level Crossing Protection

*By D. S. JEWELL**

## 1. INTRODUCTION

Over the past decade, there has been a noticeable change in the method of working crossings of roads by railways on the level. This has arisen from the need of the railways to cheapen the cost of their installations, and also the need to operate these installations in the face of ever growing road traffic, so that rail traffic will not be delayed. But above all there has been an ever-increasing requirement to reduce or eliminate the staff solely employed to control such crossing, in order to reduce working expenses and to compensate for the difficulty in obtaining and holding the staff required, particularly in isolated places.

It is intended in this paper to outline a set of principles for controlling both the road and the rail traffic at crossings, as well as to give more detailed comment on some of the designs already developed for use on British Railways. The former, although it may only be an approximation, must be attempted, since, without reasonably concise knowledge as to what is required, it is impossible to ensure that the equipment is correctly designed, and does not, on its own account, introduce features which are undesirable.

## 2. PRINCIPLES

If a public road is concerned, there is a clear legal responsibility on the part of the railway to make sure that it is safe before road users cross, and the railway is entitled to prevent use of the crossing only when trains are approaching.

These requirements sometimes apply also to private roads, where, in convey-

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ancing land for the construction of the railway, the landowner reserved to himself the right to have the crossing attended, and the gates therefore opened for him.

Crossing over roads to farms however fall into the category of occupation crossings, and these are normally provided with field type gates opening away from the railway ; and the user has the responsibility of opening and closing these gates and for seeing that it is safe to cross. The same conditions apply in the case of accommodation crossing from field to field on either side of the railway.

Level crossings of all kinds are most numerous where the terrain is generally level ; and where it is almost flat the fact that there is good intervisibility of rail and road is a considerable safeguard, particularly for those crossings which are unattended.

Where conditions are more suitable, over or under bridges are frequently found to replace crossings of all kinds, including those from field to field. These are clearly more expensive to provide and maintain and can only be considered where a crossing on the level would otherwise be out of the question.

The first principle put forward is that the degree of safeguards provided should be determined by the current user, and not by the historical status of a crossing.

*2.1. The User.*

When considering the user one appears to be concerned with the probability of a road vehicle or pedestrian having to be stopped otherwise he would be in peril of being in contact with a train. This probability usually varies according to the time of day, and perhaps also, to the season of the year ; an extreme case being that of a crossing only used twice a day to and from an isolated factory. It is obviously not practical to vary the safeguards, and they must be based on the maximum user ; but it is suggested that this should be the number using the crossing in the peak hour, rather than the maximum instantaneous rate of usage, which would be inexact and impractical to obtain.

It can be argued that the greatest danger lies when the road user is by himself and there are no other road users, anyone of whom may react to the crossing warnings, and thereby alert the remainder. On the other hand, the fewer the road users, the less distractions there are to those who are using the crossing.

It is perhaps too early to fix an exact definition of the term user, but, for the present at any rate, this shall, from the point of view of the road user, be expressed as the number of vehicles in the peak hour.

*2.2. The Number and Length of Trains*

So far, reference has only been made to the road side of the user, but the total user will also be proportional to the number of trains over the crossing, and, on the same arguments, this should be the sum of all trains in all directions in the peak hour.

Unless there is a succession of trains at minimum service intervals of one and a half to two minutes, the frequency of trains in the same direction would not seem to affect the safety of the crossing, since the usual service interval will be large compared with the operating time of the crossing, i.e. the time for which the crossing is closed to road traffic for one train.

Apart from the time taken to close the road crossing, which might be termed the warning and operating portions of the cycle, there is the time taken by the train itself to clear the crossing, once it has reached it. A 60 wagon train (equivalent to 20 coaches) is a quarter of a mile in length and takes 30 seconds to clear the crossing at 30 m.p.h. Assuming that the warning and operating portions of the cycle take 30 sec. the road is closed for one minute, for half of which it is obvious to the road user that the road is physically blocked.

Even with this time of closure and trains at five minute intervals, four intermediate minutes are left for the free passage of road traffic.

If the service interval is nearer the minimum of one and a half to two minutes, it is most likely that multiple unit passenger trains are concerned, and these are both shorter and faster. Hence, although the shorter service interval reduces the time available for the passage of road traffic, less of this time will be absorbed in the passing of the train. It would appear that with a three minute service interval, about two and a half

Fig. 1. Prototype British Railways half-barrier.

minutes should be available in which road traffic can use the crossing. Most lines are, however, double and, although there would appear to be no difficulty in working a crossing with a five minute service in both directions, it would be impractical to do this if the interval in both directions were only three minutes, unless it could be guaranteed that the trains from the two directions arrived at the crossing simultaneously.

*2.3. The Traffic Moment.*

The total effect of the road and rail user can be expressed as the product of the road vehicles in the peak hour and the number of trains. The latter is theoretically the number in their own peak hour, and this may not coincide with the road peak. Practical information is at present limited, and the product of road vehicles and trains over a crossing in twenty-four hours is normally used. This is termed the Traffic Moment and varies between a few thousand to one or two million.

*2.4. Quick Response.*

If a crossing is used intensively, it is clear that the warning devices of impending closure of the road and the physical impediment finally cutting off the road must operate within close and constant time limits. These requirements can be obtained only by using light booms, working between the vertical and the horizontal transversely across the road.

In addition, the exits from crossings must always be kept clear, so that traffic will not back up over the railway. If this occurred, it would be perfectly safe, providing supervision of the crossing is retained, i.e. the crossing is not closed to road traffic, until it has been seen to be clear.

The change in the condition of a crossing must not be so quick that it is not made plain to road users ; but a matter of five or more seconds is sufficient for this purpose. Special consideration must, however, be given to pedestrians, whose speed of clearing the railway, once they are on the crossing, is relatively limited.

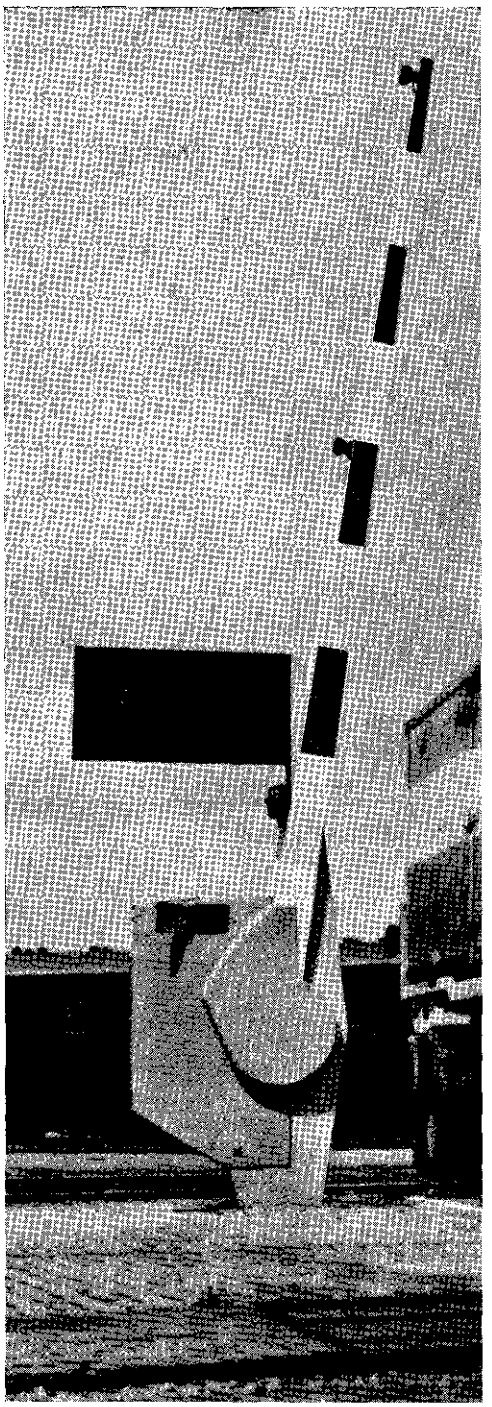

Fig. 2. Prototype B.R. half-barrier in raised position.

*2.5. Further Principles.*

The second principle should therefore be that the road exits from the crossing must always be kept clear, and that the crossing must always be briskly opened and closed to road traffic. Nevertheless there must be adequate warning before the crossing is closed to road traffic.

A third principle, one which is closely associated with the second, is that the road surface and other items such as lighting over the crossing must be as good, if not better, than those of the road to either side, so that the progress of road users, vehicles and pedestrians will in no way be impeded. If road traffic is intense, it is necessary to consider physical separation of at least the carriageways in opposing directions, so as to assist the flow of traffic over the crossing.

## 3. AUTOMATIC OPERATION

Automatic operation of crossings is to be preferred, since this will ensure brisk operation, and it will also eliminate the human element from the point of view of safe working. Automatic operation is also essential, if it is desired to make the railway signalling itself automatic. There is therefore sufficient bias towards automatic operation, to quote this as the fourth principle.

If automatic operation is applied, the installation must operate by itself, and impose no special obligations on train drivers, apart from the basic requirement, common to all railway operation, of a driver stopping if he sees an obstruction on the line ahead. The obstruction in this case would of course be the result of a road breakdown or accident on the crossing.

It must also be unnecessary for railway operating staff to exercise detailed supervision of automatic crossings, although they must exercise general supervision, including that of ensuring that the crossing is opened to road users in between its use by trains.

Automatic operation adds particular emphasis to keeping the exits of the crossing clear, in as much as road users could be shut in on the crossing. It is therefore current practice in Great Britain to provide a half-barrier over the carriageway on the approach side only.

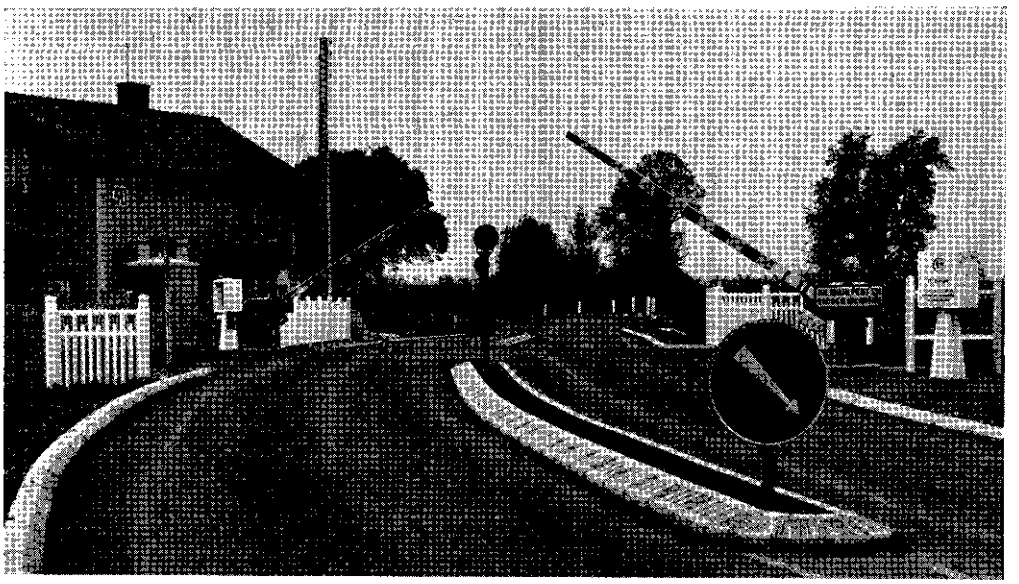

Fig. 3. French National Railways: half-barrier crossing with separated carriageways.

This involves a considerable modification to the established practice of fencing in the railway completely, and it will take time for the alteration to be generally accepted, particularly in built-up areas. That it is safe, and requires only reasonable road discipline, seems to be above question, and it can be anticipated that, in a few years' time, half-barriers will be accepted for use on a wide scale.

*3.1. Reduced Safeguards.*

For crossings with the larger Traffic Moments, mention has been made of the operation of warning devices, followed by the descent of a light boom or barrier to close the road physically, both operations being of relatively short duration. By this means the need for obedience is made plain to all road users, and road users are only stopped for a minimum of time. When the Traffic Moment is less, it should be possible to reduce the safeguards, in accordance with the first principle enunciated earlier.

It must be accepted, at present at any rate, that safeguards of the same general nature must usually be provided; that is a warning device plain to road users, operating for a short period in advance of the road itself being physically closed. In the ultimate, where both road and rail traffic are very light, and the road has a good view of approaching trains, no physical signals might be acceptable, but, even in this case, it would probably be necessary to restrict the speed of trains approaching the crossing to provide an adequate margin of safety.

If the road traffic is appreciable, and the rail traffic still very light, it appears necessary to provide physical signals, if only to preserve the confidence of road users : a matter, it may be said, which is somewhat apart from the reasonable obligations of British Railways.

From the general standpoint, it must be accepted that the road user has to be confronted with a minimum of variation in the way he is made aware that he is approaching a crossing, and in the way he is told that the crossing is being closed and remains closed to him.

*3.2. The More Onerous Conditions.*

The provision in general of full safeguards covers another point, which arises from the determination of the amount of rail traffic. This can of course be measured by a count of the actual number of trains, and adjustment made for any large seasonal variations.

There can however be considerable alteration in the number, type and speed

of trains, due to diversion or a speed restriction in the vicinity and this can occur at short notice. In the absence of the appropriate safeguards, it would appear that trains might have to be warned to approach the crossing at restricted speed, so that they could, if necessary, stop short of the crossing. This could well be crippling to the operation of the railway and is another reason for maintaining the full safeguards.

Diversions or speed restrictions might well apply for at least seven days per annum, or two per cent of the time, and it would not therefore be reasonable to ignore them.

*3.3. The Waiting Period.*

In addition to standardising the type and duration of the warning devices and the method of closing the crossing, the principle of brisk operation, which is so essential to the correct use of crossings, will only be ensured if operation takes place so that the train appears at the crossing within a reasonable time after closure. If the train is long and slow, and subsequently takes an appreciable time to clear the crossing, it may annoy the waiting road users, but it would not invite them to attempt a crossing, even if there were no physical barrier across the road.

The ideal is for operation of the safeguards to be adjusted to suit the running of each individual train, so that the crossing is closed only a short time before the train reaches it. This margin or waiting time represents a factor of safety which it is, of course, necessary to include.

Prediction of the exact passage of a train must be a continuous process, since the speed can vary up and down, as the train accelerates or brakes, and either of these can occur within wide limits at any time.

*3.4. Speed Discrimination.*

Although a sophisticated method based on continuous assessment of the train performance has been developed in the U.S.A., British Railways have so far attempted only a straightforward measurement of speed on the approach to the crossing, to determine whether it is a fast or a slow train. The slow train, however, has to be sufficiently slow that, if it accelerated immediately on leaving the speed measuring section, it still could not arrive before the waiting period had elapsed after the road had been closed.

British Railways are at present concerned with this speed discrimination for two main reasons : delaying the operation of automatic crossings for slow-running through trains on high speed routes, and delaying operation in respect of trains, and particularly heavy freight trains, starting away from signals up to a mile away on the approach to the crossing and still accelerating. In order to maintain the necessary flexibility, the provision of speed discrimination for the second purpose is to be allied with the number of slow accelerating trains using the line, also bearing in mind the number of like trains which might be diverted to it at short notice, and not solely with the number of these trains recorded as having been stopped, unless the records themselves cover the whole range of experience. If the apparatus for speed discrimination were both cheap and simple, there would not appear to be much argument about it being more universally provided.

## 4. MANNED BARRIERS

Close timing is essential to the operation of all crossings, and not only of those with automatic half barriers. Many of the existing crossings are adjacent to signal boxes and are operated from them. Until recently the swinging gate has been the standard for closing the road, the gates also alternatively closing across the railway.

Barriers can only operate across the road, but there seems to have been no difficulty in foregoing the fencing of the railway over the road crossing, except that grids are often provided to prevent animals from straying up or down the railway.

If barriers are provided, the heavy connections underneath the roadway and the road stops required for gates are no longer necessary, even if the barriers are still operated directly from the existing gate wheel. Also, because of the lesser weight of the barrier boom, and therefore less inertia, it is possible to achieve times of operation close to the reasonably short period which is desired, and which is reached by power operation. If the usual warning devices precede the operation of

Fig. 4. French National Railways : double half-barrier crossing.

the barriers, there is no physical difficulty in closing the road briskly when required.

Because the crossing is directly supervised or manned, it is necessary for the railway signals to be kept at danger, and only cleared when the road has been closed. To avoid delaying trains, it is necessary for this to be done in advance of their approach ; hence there is little difference in the time for which the crossing is closed, whether gates or barriers are provided, except that the barriers will themselves be moved more quickly.

## 5. IMPROVED WARNING

It would be expensive but not impractical to provide warning of the approach of through trains to the sighting point of the distant signal protecting the crossing. This would mean the crossing being closed whilst the train was about a mile and a half to two miles away. Although a fast train at 60 m.p.h. or more would keep the crossing closed and waiting for about two minutes, trains of lower speed would considerably lengthen this period. The train stopping in a station adjacent to the crossing presents less difficulty, but it is the low and medium speed freight trains which present a particular difficulty.

If automatic warning of the approach of trains were provided, the only reason for keeping direct control of the crossing would seem to be that the local conditions require complete closure of the railway on both sides, or that the exits from the crossings cannot always be kept clear. If the crossing could be arranged for automatic working, the half barriers could be installed and left to work automatically, providing the signals had been cleared. Such a refinement would not assist the operation of the railway or save staff, and it is to be noted that the expenditure is one solely associated with the road.

## 6. AUTOMATIC CONTROLS AND STOP SIGNALS

Crossings have been operated automatically by the occupation of track circuits, usually reinforced by mechanical treadles working with them and placed at the running-on ends. It is desirable to eliminate the treadles, and it may then be necessary to use the higher voltage type of track circuit, to ensure instantaneous operation, particularly if the rails have not been run over for some time.

As the length of controlling track circuit can be up to about ¾ miles, there will be many crossings where stop signals will come within this distance, and there is also the case, already outlined, where the crossing is adjacent to station platforms.

Should such a stop signal be at danger, operation of the crossing must be delayed at least until the signal has been cleared, and preferably until the train has actually re-started. It would appear that only with multiple unit trains, and then electric rather than diesel, can it be reasonably assumed that a train will move forward within seconds of the signal being cleared. With all other trains, critical seconds will be expended before the train again proceeds.

As with all safety devices, the most onerous conditions have to be covered, and it would be insufficient to meet only the conditions of the average train, although it would, in all truth, be difficult to define this latter. Thus, if the crossing is operated from a reduced length of track circuit, it is necessary to ensure that a train accelerating at the maximum practical rate cannot beat the cycle of events at the crossing. This means in practice that the signal cannot be closer to the crossing than about 250 yards.

If the signal is further from the crossing, safety is ensured, but trains will tend to arrive at the crossing after lengthened waiting periods, and these are, of course, to be deprecated.

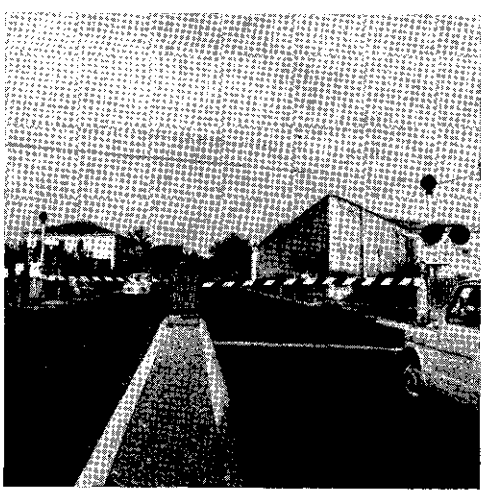

Fig. 6. Italian State Railways : half-barrier crossing with separated carriageways.

*6.1. Signal Controls.*

Once a train has "struck-in," that is reached the operating point for the crossing and the signal is still at danger, the signal must not be cleared subsequently until the speed has been reduced to a level appropriate to the shorter distance ahead of the signal left for operating the crossing automatically. If this shorter distance is 250 yards, the train will have to be brought virtually to a stand. If the value is greater than 250 yards, the train will again have to be brought virtually to a stand, or, and this is more difficult,—the speed on the approach to the signal is proved to be below a certain value, before the signal is cleared.

The alternative is to start the crossing cycle when the controls of the signal clear, and to clear the signal aspect after the crossing cycle has been sufficiently under way to ensure that the train can never beat it. The train is assumed to be braking as though to stop at the signal, and then to accelerate at maximum rate once the aspect has cleared.

If the signal is closer to the crossing than 250 yards, automatic operation on a shortened distance is unacceptable, and the cycle should be completed and the road closed before the aspect can be cleared.

If a driver should fail to respond to clearance of the signal aspect, excessive waiting time will result at the crossing, but there seems to be less objection to this, if the signal is in the immediate vicinity of the crossing, when the train will usually be visible to road users.

In general, it can be said that, although special arrangements may sometimes be necessary, it would be unwise to ignore the principle of retaining automatic operation by the moving trains themselves, whenever possible. The only exception appears to be the case of a signal adjacent to the crossing, where the barriers must close the road before the signal can be cleared; but in this case the road user should be well aware that there is a train in the vicinity.

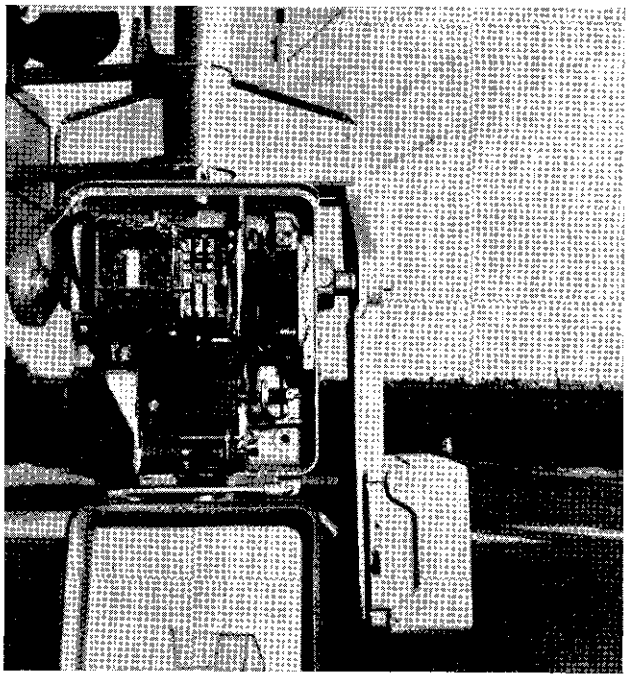

Fig. 6. Italian State Railways : half-barrier operating mechanism.

## 7. B.R. DESIGN OF AUTOMATIC HALF-BARRIER

Based on the principles which have been enumerated, the British Railways Board embarked on the design of an automatic half-barrier, with the aim of establishing, in the first place, a standard profile or elevation by which the road user could always identify this type of crossing, wherever it might be used. This profile was determined by an Industrial Design Consultant commissioned by the Board's Director of Industrial Design, and is something, in my opinion, of which the Board can be justly proud. Neither over elaborate nor too stark, it impresses itself on the road user.

The half-barrier boom is constructed of timber, the two main members being joined at the tip, and each member is carried back to a face plate attachment on either side of the main reinforced concrete pillar. Rigidity is important, and apart from providing an adequate section for the main members, these being tapered to reduce weight, the triangular shape, in plan, of the complete assembly provides additional stability, particularly in a lateral direction. This is necessary to meet windage, and to prevent the most economical brands of timber from distorting unduly.

### *7.1. Balance.*

The half-barrier is designed to have the same longitudinal axis from counterbalance to tip so that there will be minimum difficulty in balancing it. Balancing has to be within fairly close limits if the half-barrier is to stay down positively when there are gusts of wind tending to throw it up from the horizontal position, and also if it is not to be too heavy to lift in an emergency to free something trapped underneath it by its descent.

Since the half-barrier works automatically, it must be arranged to " fail safe," and this means that it must descend under the influence of gravity. In order to provide maximum torque when the half-barrier is near vertical, separate bias weights have been provided, below and on an axis at right angles to that of the main members, so as to have maximum effect when the half-barrier is near vertical. The value of the torque has been chosen to ensure descent under the

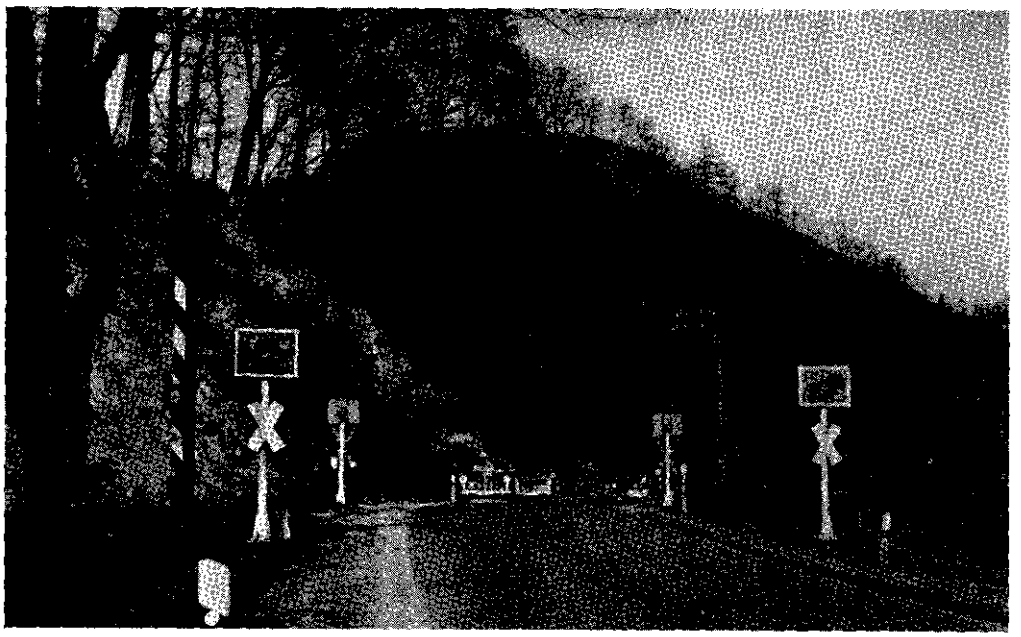

Fig. 7. West German Federal Railways ; Crossing protected only by fixed signs and flashing lights.

worst weather conditions including gale winds end-on to the half-barrier, although latterly the top and bottom edges of the main members have also been deliberately rounded to reduce the windage.

By courtesy of the Motor Industry Research Association wind tunnel tests were carried out with an actual half-barrier 12 feet in length at wind speeds of up to 80 m.p.h.

*7.2. Bearings.*

The faceplates to which the main members are attached, and the tail carrying the balance weights form a common fabrication in the present production model. This is carried in "Glacier" metal bearings and moves between adjustable rubber stops. These bearings require no lubrication or maintenance.

Electrical contacts detecting the position of the half-barrier and cutting out the power driving circuit are obtained, on the same production model, by a rod driving a standard railway signalling circuit controller.

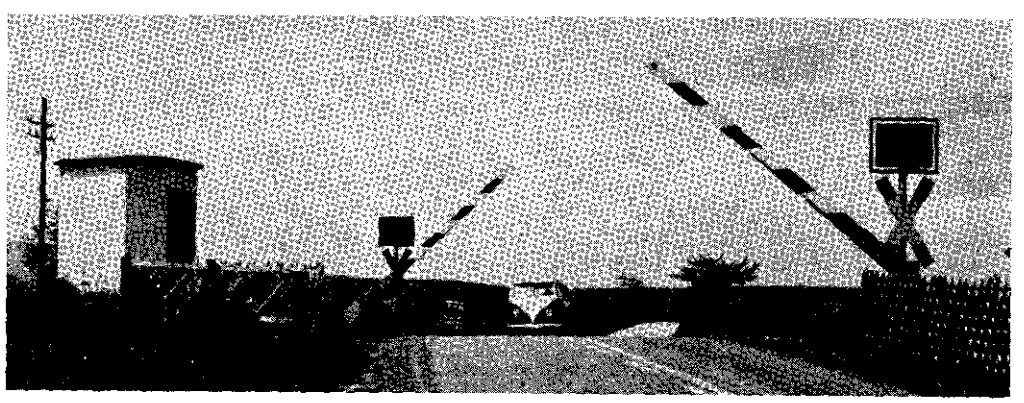

Fig. 8. West German Federal Railways : Crossing with half-barrier.

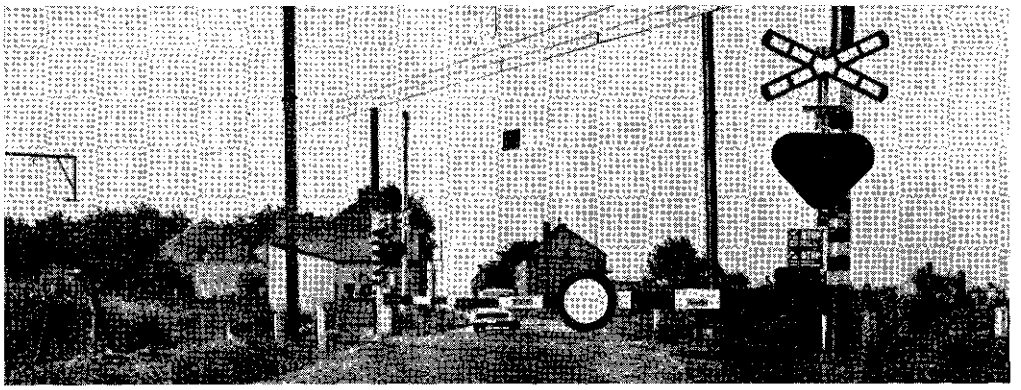

Fig. 9. Belgian National Railways : half-barrier crossing.

*7.3. Power Transmission.*

The half-barrier is raised by driving a hydraulic ram from a small electrically-driven rotary pump. Pressure is subsequently maintained by a non-return valve, provided that a parallel spill-over valve, which is solenoid controlled, remains energised. So long as the electric control circuit for the crossing is energised, this solenoid valve will remain energised.

When the control circuit is broken, and after the warning period has elapsed, the solenoid valve is released, and fluid is forced back by the weight on the ram through the parallel spill-over path. This path is provided with a preset and sealed orifice, and it is this which determines the time of descent.

This form of transmission has been well tried and is held to have the following advantages :

(a) the forces applying when there is an obstruction to the free movement of the half-barrier can easily be limited by a relief valve, and subsequent performance is not affected

(b) the holding of the half-barrier in the near-vertical position is only a question of holding a valve closed, and there are no locking devices which have to be engaged (and may jam)

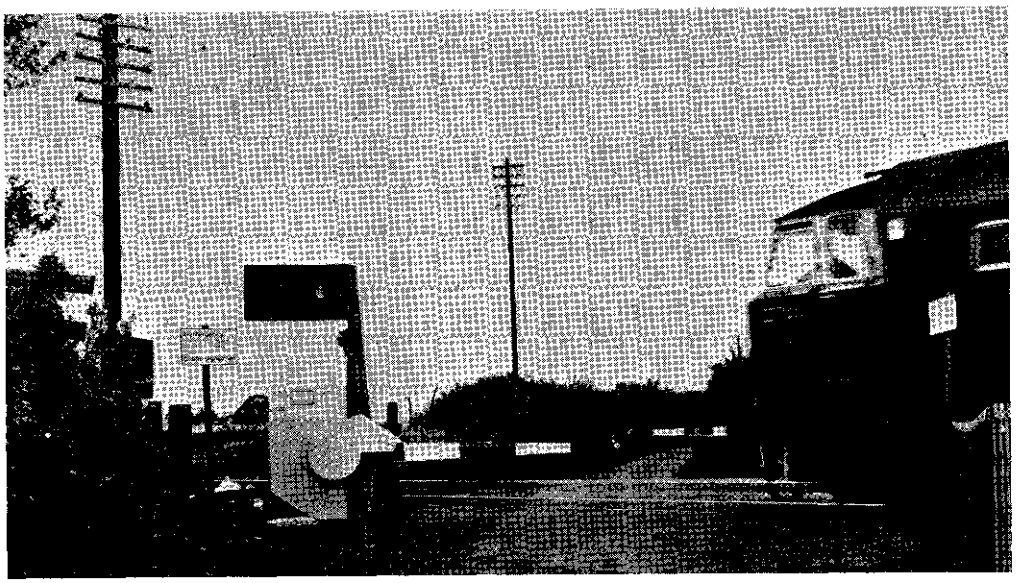

Fig. 10. British Railways : installation of Mark I half-barriers.

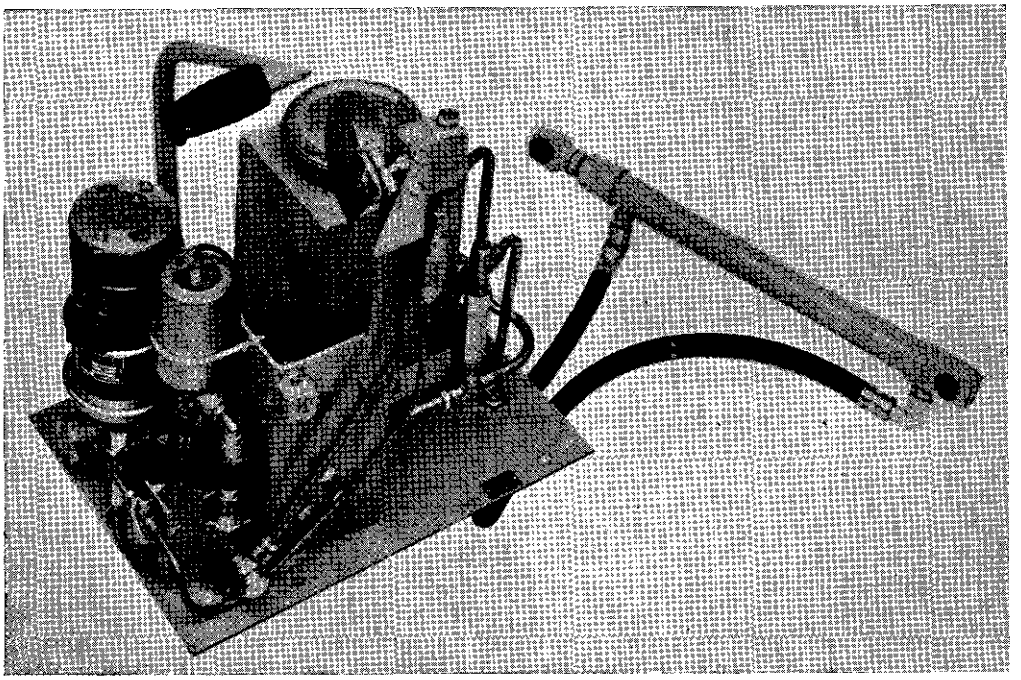

Fig. 11. British Railways : hydraulic transmission of Mark II half-barrier operating mechanism.

(c) descent is by gravity, and the fluid flow provides an accurate control of the time.

In addition, the hydraulic pack, which is a self-contained unit and can be fitted and changed as such, incorporates a small hand pump. This is a very effective method of raising the half-barrier, when there is a failure of the electrical supply, and of retaining the half-barrier near vertical, without having to resort to mechanical bolts or locks. These latter can be misused or forgotten, and should be eliminated.

Direct electric drives are not ruled out ; but it appears that these would be hard put to reach the overall performance being obtained from hydraulic transmission.

*7.4. Warning Lights.*

Warning that the half-barriers are about to descend is given by pairs of alternately-flashing red lights, one each side of the carriageway, the right hand pair also being normally on the far side of the railway (and then conveniently housed on the further half-barrier). These are flashed with an overlap between the two lights, so that any failure of the flashing mechanism cannot result in no light being shown. If there is a failure, a steady red light is still, of course, a stop signal.

With increases in the volume and speed of road traffic, the stopping power of these signals is becoming more important, even though it has been made plain to the road user that he is approaching a crossing. As the power supply has to be based on batteries, because a standby is essential, there are limits to the amount of power which can be utilised to light these signals. Normally colour light signalling units are of too narrow a beam to be satisfactory.

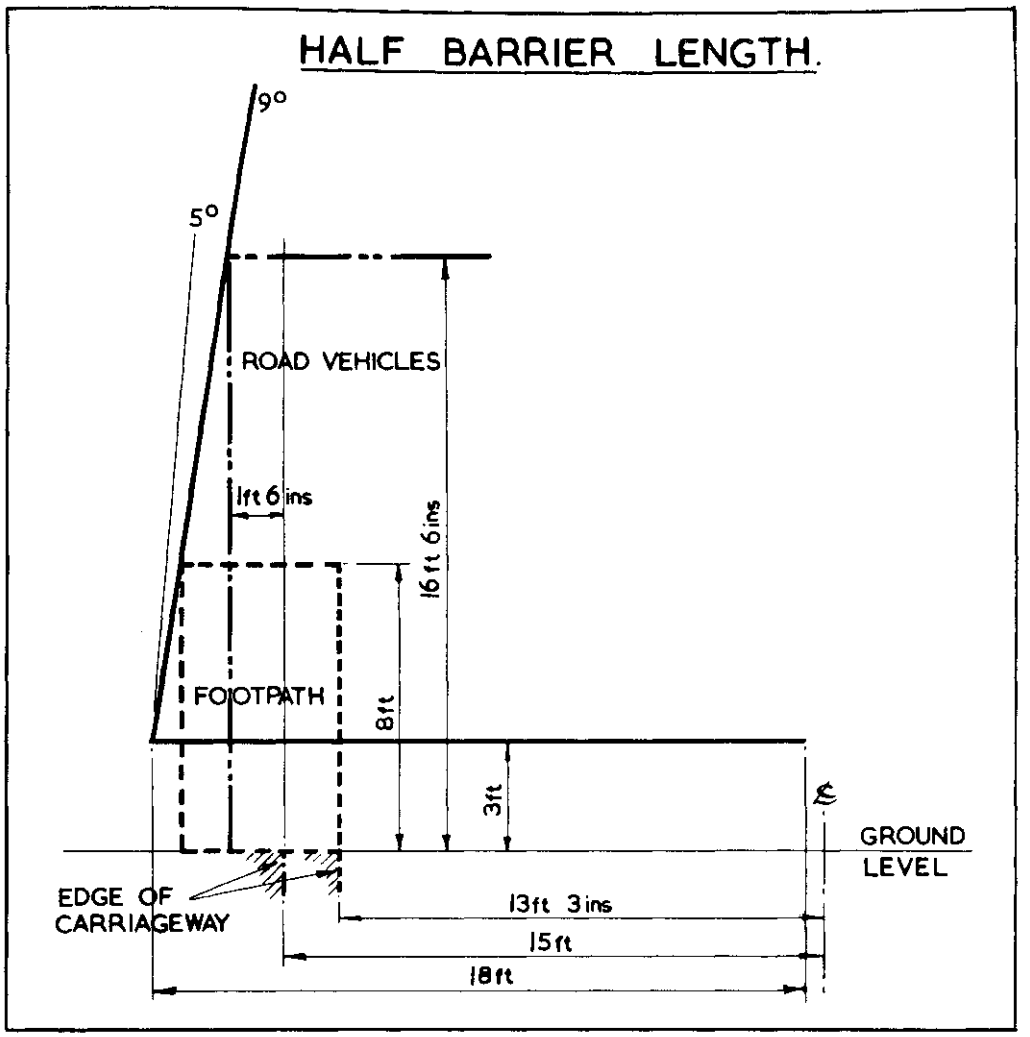


Fig. 12. Diagram relative to lengths of half barriers.

## 8. CONCLUSION

This paper has perhaps dealt with matters rather generally; but it would have been of less value, it is thought, to have dealt on the particular technical difficulties which have arisen so far. Other difficulties will undoubtedly occur, and will require the co-operation of all concerned, to ensure their rapid solution.

The lifting barrier must be incorporated in our established techniques, with or without other devices such as flashing red lights, as soon as possible. In its form as an automatic half-barrier, it is currently an urgent necessity, which has to be adjusted to meet the many varied situations, according to where it is required operationally.

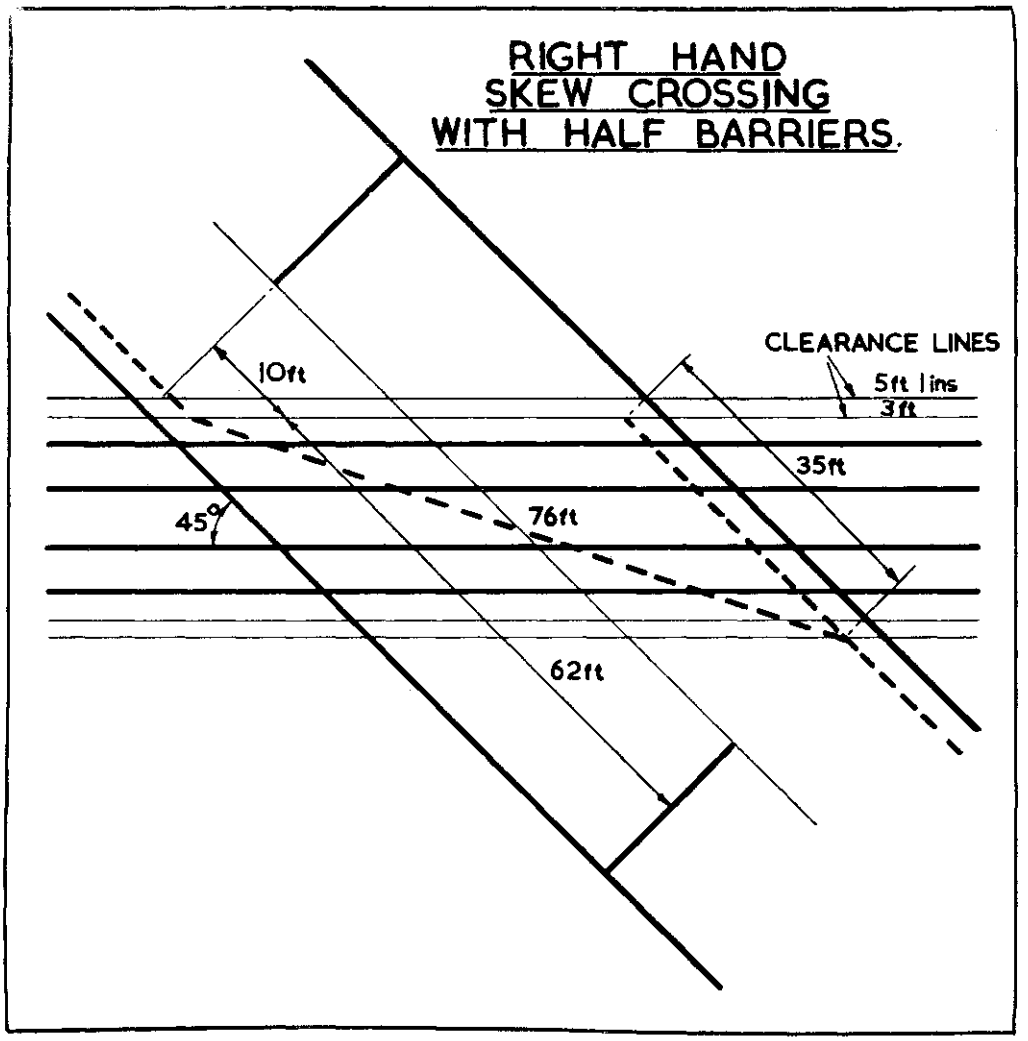


Fig. 13. Positioning of half barriers on skew crossings.

*8.1. Acknowledgements.*

The British Railways' work to implement these policies has been greatly assisted by directives and interpretations issued by the Ministry of Transport, and particularly by the work of the Railway Inspectorate.

The detailed engineering design of the automatic half-barrier has been carried by the Chief Signal and Telecommunications Engineer, Western Region at Reading, and he has also been responsible for the initial production. The hydraulic transmission has been engineered by Messrs. Smith's Jacking Systems based on earlier designs used by the Western Region.

The Author is grateful to his colleagues both on the regions and at the Board's Headquarters for the progress made in these new techniques, without which it would not have been possible to present this paper, and to Mr. A. W. Woodbridge, Chief Signal and Telecommunications Engineer, British Railways Board for his encouragement, and his permission to put this paper in front of you.

## DISCUSSION

**Colonel D. McMullen** opened the discussion by saying that Mr. Jewell had ranged very widely in his written paper over a big subject, and he had told them a lot about various types of crossings. He had even ventured to mention the very difficult, if not almost insoluble private crossing, but he had talked mainly about automatic half barrier crossings, and that was the type to which Colonel McMullen confined his comments.

That type of crossing was economic to the railways because it saved staff. It saved a lot of time to road traffic, and it was safe. On the economic side he thought that at a typical three-shift crossing where the cost of the road works was not very high, the cost of installation could be recovered in two to three years and they could not wish for a return much better than that.

So far as road traffic was concerned the automatic half barrier could improve traffic flow enormously, and could reduce delays on a busy road by up to 75 per cent.

Where safety was concerned the automatic half barrier eliminated, as Mr. Jewell had said, accidents caused by the human element. Of course they had recently had a very unfortunate case of that. Colonel McMullen thought he was not speaking out of turn as it was announced in the press, in saying that the tragic collision at Angmering was the result of the human failure of a gate keeper. Last year they had a very unfortunate one at Nantwich when a driver ran past signals, and there were many others.

He remembered some time ago talking with Monsieur Walter, the Signal Engineer of the S.N.C.F. about that type of crossing, and he made a rather neat observation. He said that he considered the electrical relay was more reliable than the human relay.

Colonel McMullen then gave a very short history of how they became keen on half barriers. In 1956 a joint British Railways-Ministry of Transport mission visited the Continent and he had the honour to lead the mission. When they came back they produced requirements for automatic half barriers. They had seen them in Holland and in France—at that time Belgium had not got any—and in those requirements they restricted the use of half barriers to lines where speed did not exceed 60 m.p.h., and where road traffic was not very busy. But that made it difficult for the railways to find suitable sites to put their crossings. So in 1962 they sent another joint mission to the Continent, that time led by his colleague Colonel Reed, and it was on that occasion that they realised the full potentialities of automatic half barriers, particularly at level crossings on very busy roads.

Consequently they revised requirements drastically. Generally they considered the equipment could be made suitable with proper highway adaptations in some cases such as central reservations, of which they had seen some examples in Mr. Jewell's slides, for almost any crossing, however high the speed of trains and however heavy the road traffic.

He had intended to speak of what they really consider their five main principles for automatic half barriers, but Mr. Jewell had already mentioned some of them. He mentioned the brisk sequence of the lighting up of the flashing lights and the falling of the barriers and the passage of the train. The importance of that was, of course, to ensure that road users would not become impatient and zig-zag.

It was on their first visit to the Continent that they were told of a case of a man who was going to the funeral of his father who had been killed zig-zagging at a particular automatic half barrier crossing —on his way back from the funeral the same man zig-zagged round it himself and he was killed. Zig-zagging was a thing which one must avoid at all costs, and the best way of doing it was by ensuring that people would not become impatient and get the urge to do it.

Mr. Jewell had mentioned that, and Colonel McMullen added that where there was a wide difference in the speed of trains on a line, it would be necessary to introduce speed discrimination so as to ensure that the difference in the interval after the barriers had fallen to the arrival of a train was not too great for both slow and fast trains.

There was one essential principle which they had always expounded and that was that half barriers—(barriers covering only half the road)—must be used with automatic working, and conversely that auto-

matic working was suitable only with half barriers. There was a partial exception to that. Another one, of course, was that they must ensure that road traffic did not block back on to a crossing. Again the layout of the highway must be correct.

Lastly, he thought that the most important thing was that the equipment must contain all the necessary safeguards, and be as simple, and absolutely as reliable as possible. There were others of course, as Mr. Jewell mentioned. They were to ensure that a similar picture was present at all crossings of that type ; that the barriers were conspicuous and the lights were properly focused ; that the highway had got a good surface ; these were the most important ones.

The exception to which he referred when he was talking about the principle of using half barriers only with automatic working, was where a crossing was adjacent to a station platform where some trains had to stop. In such cases the initiation of the half barrier sequence for stopping trains, in one direction only, would be either by the train crew or by the station staff. But in normal working that must be the only exception to the principle.

He had mentioned the prevention of cars blocking back on a crossing. It was a *must*. Also, of course, the exits must be opened to ensure that if anyone did zig-zag round a barrier he would not be trapped on the crossing. As far as the highway was concerned it was of the utmost importance that the layout was correct. That was so as to make quite sure there were no road accidents on, or anywhere near the crossing. To ensure that it was often necessary to straighten the highway and sometimes to widen it. At present that had to be paid for by the railway, but they were hoping that there might be some modification of the arrangement. He thought that where highway traffic considerably benefits, the highway authorities should pay.

He then spoke of the reliability of the equipment. They now had about 50 such installations and he thought there were about 100 in the pipeline. There had been great opposition to the installation of automatic half barriers at some crossings by some local authorities, and in some cases the opposition had been intense and it had raised great emotions. In one particular case at Lichfield near Stafford, the Highway Authority went as far as to forbid the County Surveyor to carry out the essential road works, with a result that the Region could not install the barriers, and he had to revoke a statutary Order which he had signed for that crossing.

Local Authorities object mainly on two grounds. Primarily they object because of the danger to pedestrians—particularly to young children. One had to take cognizance of that and one could help matters by providing self-closing wickets and sometimes guard rails, but as far as young children were concerned they endeavoured to preach the gospel that it was just as dangerous for them to wander on a road as it was to wander on a crossing, and they should not be allowed to do either.

Apart from pedestrians, however, many local authorities had objected to the equipment as such and consider it dangerous. In his view, what would do more harm than anything else to the advancement of that type of modern equipment would be an accident resulting from a failure of the equipment. It could put the programme back by several years. He stressed very strongly the immense importance of ensuring that the equipment was as complete and as reliable as was possible. The economic value of automatic half barriers was great and it would in his opinion be quite unjustifiable to skimp the equipment in any way.

There was much antagonism to that type of crossing when it was started in Holland, but when they came to realise the benefits to be derived from it, the pendulum swung right round and there was then pressure on the Netherlands Railways to introduce them everywhere. He thought that the same thing would probably happen in this country providing of course the equipment was reliable. He could not see any reason himself why most of the 3,000 odd public level crossings on British Railways should not in the course of time, become automatic crossings.

He then referred to one of Mr. Jewell's slides—it was Figure 4 in his paper—which showed a double half barrier crossing on the S.N.C.F.—was that an automatically worked crossing? He hoped it was not. The S.N.C.F. had only two crossings of that type and they were experimental.

They were set very strongly against using anything but single half barriers with automatic operation, and he was sure that they were right in doing that.

Finally Mr. Jewell finished up his written paper by saying that the automatic half barrier was an urgent necessity where it was required operationally. That was so, of course, especially on lines such as the Trent Valley which were being completely resignalled with automatic signalling. But a proper balance must be struck between crossings to be provided with automatic half barriers to meet railway needs, either operational or economic, and those to meet highway needs by improving the traffic flow on busy roads. They were at present working on that problem at the Ministry.

**Mr. H. L. F. Tuff** said that on the Eastern Region they had something like a thousand public road crossings of which about 95 per cent. still had gates. It would therefore seem reasonable that for quite a long time they were going to be very preoccupied with barriers.

Mr. Jewell's collation of the principles governing the provision of barriers was, therefore, very timely because the change from the methods which they had been accustomed to for some time was inevitable, although not without its difficultes.

In Section 2.1. of the paper there was a point of interest ; it referred to a question of human behaviour, and Mr. Jewell had put it fairly without any bias one way or the other. It concerned the behaviour of an individual on a crossing, and it was suggested that he was in greater danger if he were on his own. He felt that that was not so. An individual on his own was more likely to take notice of what was going on around him, whereas if he was with a crowd he was liable to go with the crowd with a measure of confidence which could be very misplaced.

They had manually controlled barriers now in the Eastern Region at several locations, and those were undoubtedly, from the Signal Engineer's point of view, a considerable advance on the heavy gates which they replace. The old gates were intended, he thought, to constitute a virtually impassable barrier to road traffic in the days when they were first introduced. That, of course, had now gone and the light and more easily worked barrier was acceptable to stop the road traffic.

The author mentioned that the speed of operation of manned barriers and gates was not vastly different, but just the same he thought it was right to say that experience had shown that there was an advantage to road traffic with barriers because of the fact that they could be operated very much more easily by the signalman, who could take advantage of breaks in rail traffic.

Regarding the question of the control of automatic barriers,—the situations in which they were frequently placed were very often on lesser used lines, and in fact on lines which are becoming used even less with the cuts in traffic, and which might carry light vehicles. Both factors tended to decrease the probability of instantaneous shunting of the track circuits.

Mr. Jewell mentioned that a treadle was frequently employed at the entering end of the track circuit to cut the feed immediately and so give instantaneous shunting. They had had occasions where they deemed it desirable to put a treadle at the leaving end as well, preventing the track circuit from clearing until the treadle had been depressed. That was done in the absence, at that time of a more sophisticated form of track circuit, but he thought—particularly in view of the stress which both Mr. Jewell and Colonel McMullen put on the absolute necessity for ensuring infallable operation of the barriers—that a special type of track circuit was desirable in the great majority, if not all cases.

Mr. Jewell dealt very fully with the difficulties encountered when signals were located within the controlling area. Their experiences had shown that the controls could become surprisingly complicated in cases where signals existed in the area covered by the controlling track circuits.

Finally he asked Mr. Jewell a question from the illustration shown of the Italian half barrier which, from what he could make out, was electrically operated. Could he say, if there were hydraulic equipments in use in European installations or were we pioneers in that field?

**Mr. D. S. Jewell** replying said that Mr. Tuff had challenged a statement of his which was that if the road user was alone he would be more liable to make a mis-

take ; on the other hand if there were fewer people there would be less distraction. That was a philosophical argument but he thought the whole point was that they had to make the crossing so clear that the road user must know where he was. He thought this was the lesson to be drawn from it. These, he was afraid, were rather philosophical arguments, but, to repeat his point, the crossing had got to be made so clear that whether there was a lot of traffic or whether there was virtually no traffic the road user must know exactly what he had got to do. He thought the other important point was that procedure had got to be as far as possible the same, whether it was at Wick or whether it was at Lands End. In fact it would ultimately have to be the same throughout Western Europe. From the slides, the impression he had gained was that throughout Europe most of the installations were already very much the same.

He would agree with Mr. Tuff on the manned barriers. The speed of operation was not vastly different, but obviously it was very much easier for the signalman if one could justify power operation.

There must, however, be some variation and they must try and get a manned barrier which could still be operated by wheel or lever from the box relatively lightly if it was balanced, and thus save the cost of power operation. He thought there were one or two installations in this country where they already had direct mechanical operation. There was a slight difficulty, perhaps, for if one operated a thing mechanically one did not perhaps always get an exact timing, but that was something he thought they had to develop.

He had taken very much to heart what Colonel McMullen said about reliability So far—nothing too drastic had happened. They always had two arrows in their quiver—lights and booms!

The auto half barrier was an extraordinarily demanding and exacting bit of equipment, but as Mr. Tuff had quite rightly said, no matter how good your equipment is it was of little use if one could not rely on the track circuits. Here they were demanding possibly even higher reliability of track circuits than they had ever had. They had always liked the absolute, but there they had to demand almost the infinite ; and, although most of the track circuits had coacting treadles, there was always the difficulty about the track picking up subsequently. He would agree whole heartedly that they must develop better and more sophisticated methods of detecting whether the train was within the controlling distance.

In controlled areas it is going to be difficult to fit in crossings but he did not think that was beyond the wit of their profession. It was going to be difficult, and he would again stress the point that if they had those special controls they must keep to the principle of automatic operation. The exception was the case that Colonel McMullen had mentioned and even then the cycle did not commence until at least the station, or the train staff said that they were ready. They must retain that precaution against wasting time. As soon as they started wasting time they would not get brisk operation ; they would have people getting impatient, and they would be sure to do something silly, and the whole whing would be brought into disrepute.

Were they pioneers in hydraulics? No. The S.N.C.F. had over 300 automatic half-barriers equipped with hydraulic transmission, but so far as he was aware the British development had taken place independently. He would say also that there were a number of foreign contacts who had been quite interested to find out more about what they had been able to do so far.

**Mr. M. E. Leach** said he thought they would all agree that Mr. Jewell, both in the written Paper and in his lecture that evening, had give them a refreshingly up-to-date look at a very old problem of railway operation—the level crossing. He thought it was food for thought that in Great Britain the working of level crossings was still governed in principle by an Act of Parliament passed in 1846. That was a very prudent piece of Victorian legislation passed to safeguard the rights of the user of the public highway in the days when the railway was an unknown quantity. At the time that it was passed that legislation was well founded, and the system of protection which evolved from it had stood the test of time.

Safety at crossings worked by gatekeepers was, however, largely dependent on the integrity of the gatekeeper, and

nowadays it was becoming increasingly difficult to obtain reliable men for those simple but responsible duties. Furthermore, the cost of providing attendants at crossings had risen enormously and in many cases was out of all proportion to the work done. Again, the great increase in the number and speed of road vehicles had brought about conditions which were never envisaged at the time the railways were constructed. The delays to road traffic, which were inherent in the present form of crossing protection, were probably of little account in the mid-19th century, but the story was vastly different under modern traffic conditions. It was those difficulties which had given rise to the need for a new appraisal of level crossing protection and had led inevitably to the introduction of automatic working.

He went on to say that many of his points had already been covered either by Mr. Jewell's comments or by previous speakers but there were one or two details, however, which had not been raised. One aspect of automatic working of level crossings was the problem of the control of cattle which from time to time were moved along our public roads. He thought it was right to say that on the Continent cattle were infrequently driven out on to the public roads, but in Great Britain, at least in some rural districts, there was quite a considerable movement of cattle by road from grazing fields to milking sheds and back. Invariably, that was raised as an objection to automatic half barriers when meetings were held with Local Authorities to decide whether sites were suitable for that form of protection or not. At one particular crossing on the Western Region, special accommodation works, in the shape of pens to contain the herds of cattle which were taken across a particular crossing at certain times of the day had been provided. Whilst that was an extreme case, it was indicative of the thoroughness with which the problems associated with the introduction of the new techniques were considered, and the background for a code of practice was established.

On the question of the design of the British Railways standard half barrier, the point was made in Mr. Jewell's Paper that the profile which was outlined by the Industrial Design Consultant and the British Railways Board Director of Industrial Design was something of which they could be justly proud. Whilst the design had been the subject of criticism from some quarters, he was of the opinion that the distinctive flag silhouette did exactly what was required of it by being both outstanding and easily recognisable by road users for what it was, while at the same time projecting the image of a modern railway at the very place where the railway was in contrast with the rival form of transport.

One small final point which he had never been able to understand : on page 114 of the Paper, in the top right hand paragraph, it was stated that there should have been an overlap between the 2 red flashing lights so that any failure in the flashing mechanism could not result in no light being shown. Could Mr. Jewell comment, please, on the philosophy behind that particular requirement? In other words, how did an overlap between the 2 lights overcome the possibility of a failure of the flashing mechanism?

**Mr. D. S. Jewell** answering the last point first said that a flashing mechanism involved movement and, although it might be taking things to the extreme, it appeared that with an overlap, whatever movement takes place, and whatever position either of the two portions of the mechanism take up, there must always be a contact and therefore a light. No doubt they would move with the time as Mr. Leach had rightly said, and perhaps devise something else, but he would not have thought, in fact, that the overlap was a technical embarassment.

Mr. Leach had supported him in saying that the British Railways design was pleasing and outstanding, and gave a chance for the railway to project its image on the road user. Of course they not only wanted an industrial design for the half barrier ; they very nearly needed a standard road and standard fencing, and standard roads for at least 200 yards from the crossing. The whole image could quite easily be spoilt as the crossing must go into a plan and Nature and the hedges on either side were not always amenable to planning.

He would now like to be somewhat argumentative. Mr. Leach had taken them back into Victorian times. Mr. Jewell had

a faint suspicion that because they were talking about 1845, the principles must be out of date. That need not be so. The principles, whether they were written in 1845 or by Aristotle, would still be correct if the principles were correct originally. He knew that he had been guilty of using the words " New Look " and he thought that could be misleading. They did not necessarily need a new look ; perhaps they only needed to brush up what was under the surface.

**Mr. A. W. Damon** said that he would like to add his appreciation to Mr. Jewell for producing the paper for them. It was absolutely on time and it stimulated some of them, like himself, who perhaps seldom had anything to say, to go to the platform and make a few remarks. He was sorry that Mr. Leach had got in before him on the subject of the image to the public, because although perhaps they could not put a very great price on that it did indeed seem that perhaps belatedly, but nevertheless just in time, they were producing smart locomotives, electric trains and so on, and were at last getting rid, in some places, of gates and oil lamps. He would have thought the matter of image to the public, who might be induced to use our trains sometimes, was very important.

Now one thing Mr. Jewell has said which attracted his attention particularly was that at a crossing there must be road traffic discipline and traffic must stop—he may not have said " immediately " but he was sure he meant it—when it was required to. Mr. Damon's personal opinion was that the flashing lights did not often do that. He believed he knew why. They had not adopted the standard road signal which everybody knew and nearly everybody was used to. He did suggest that there were many motorists, and others, who did not know what a pair of flashing red lights meant, even now. There were quite a lot of other flashing lights of various colours which motorists came across, which as far as he knew had no warning implication. He felt there were a lot of people who had not read the Highway Code, and who certainly did not know the implication of these two flashing red lights. During the last 12 months he had carried out what he thought was an interesting experiment with three motorists who were in his home one evening. All were experienced motorists and Mr. Damon had asked them what they would do if they were confronted suddenly, along the road, with flashing red lights like that ; and not one of those three people had answered him correctly or quickly. One point he would like to make. Colonel McMullen had stressed the vital importance of reliability of this equipment. He thought it was worth remembering that whenever that was said it did automatically imply first-class maintenance, which to him meant first-class men on the job. Some crossings were in rather remote parts and once again they found themselves with equipment which perhaps required a special effort from the staff who had to look after it.

**Mr. H. J. Guthrie** said that he rarely had the opportunity of attending a meeting of the Institution in London. Since reading his first paper in 1936, his average attendance was about once in every ten years and therefore it gave him great pleasure to be there again and to meet so many old friends. He thought they could call it a signal occasion.

It was somewhat of a coincidence that the last paper he attended was Mr. Loosemore's paper on level crossing protection in 1954. In that paper the use of automatic half barriers on British Railways was unheard of, although the paper described at length the application of automatic half barriers in other countries. However, Colonel McMullen speaking at the meeting, mentioned that the British Transport Commission at that time was seeking legislation for the adoption of barriers as a substitution for level crossing gates, and now eleven years later they were having a paper on modern level crossing protection, which dealt only with the application of automatic half barriers on British Railways as being modern accepted practice. Time marched on!

He congratulated the author on his paper which had been most interesting and he was looking forward to the remainder of the discussion to bring out other matters. He had noticed that all the illustrations in the advance paper were located east of London and it was a pity that the author did not look westward a bit, perhaps to broaden his views, because in Ireland they also had quite a number of automatic half barriers. They had not

erected them just to keep up with the " Jones " next door, but as an urgent need to reduce their operating costs in the section of railways expenditure. 6 or 7 of them had been working for several years, 2 or 3 more were authorised awaiting materials and others were on their way.

Two exceptional installations had taken place on new trunk roads with unlimited motor speeds, and each one of them had barriers 20 feet long, which they considered the desirable maximum, and which coincided fairly closely with Mr. Jewell's mention of 18 feet long as being the maximum.

The other half barrier installation on a trunk road was asked for at an angle of 10 degrees with the railway. The County Engineer was very anxious to get that very acute angle crossing which the railway people for various reasons could not agree to ; but the final limit was agreed at 20 degrees and that, over single track railway, meant that the half barriers were 150 feet apart, which gave them quite a problem in handicapping the train to give the pedestrian a sporting chance of clearing the line after the barriers had come down! So far they had been lucky.

At the high speed crossings that had been mentioned by other speakers, they had had to put three warning signs to road users : a sort of count down, " You are coming to a crossing "—" this is it " sort of thing and all the crossings, and the two particular ones on the high speed roads, including the very acute 20 degree crossing had worked exceptionally well, so much so that the good news was spreading around. A number of the County Engineers in Ireland were taken to see the latter one and now they were urging them, in fact they were *paying*, for new road crossings using half barriers.

Of their half barrier installations, half of them were on double line and half were on single line, and they were the usual electrical-mechanical type, and in general conformed to the British Ministry of Transport requirements. There were one or two exceptions however that they had found expedient. They now always put the right hand pair of red lights on the approach side of the crossing ; that is approaching the crossing there is on the left hand side of the road, the half barrier with its pair of flashing lights, and on the right hand side of the road the other pair of flashing lights, which with the two lights on the barrier form a barrage of flashing red lights.

Also the bells. They made the bells ring continuously so long as the barriers were down. The idea behind that was to scare any cattle that might be in the vicinity. They did occasionally get cattle grazing on the side of the road.

Clause 7, para. 1 in the paper mentioned problems of wind in the lowered position, but their biggest problem had been the breaking off of the barrier arms in the upright position under gale conditions. All the barriers in the south and west of Ireland had been blown off at a least once, breaking at the fracture block because of the high winds coming in from the Atlantic ; But the fracture blocks had now been stiffened up, and he thought they had cured the trouble.

Referring to clause 3, para. 1 ; he had read into that clause either some wistful or wishful thinking on the part of the author, that on crossings with small traffic moments the use of automatically operated lights only without half barriers would be reasonable and safe protection. He wanted confirmation on that point bearing in mind rural conditions, which applied so much on the Irish railways. The management and officials of C.I.E., were convinced that flashing lights were the only safe solution for unimportant level crossings and the logical application of automatic protection—so much so that his board had submitted official proposals to the Government on that basis, and it was hoped that in due course such installations would come to pass. The Irish Government sent a mission which included representatives of the Ministry of Transport, the Dept. of Local Government (the roads department) and the railways, to Holland and Belgium, and they were very impressed with the " lights only " installation that they had. They urged that the cost of the automatic half barrier installations could be economically justified in Ireland only in a relatively few cases, while the cost of " lights only," say half, would be economically justified over a considerable number of their crossings. The application of such an arrangement was not new. There were literally hundreds

of such cases on the Continent with very good safety records.

They could actually claim that they had one level crossing controlled by standard road traffic lights, not automatic, but operated from an adjoining signal cabin ; but the fact was there was one crossing with standard road traffic signals protecting it. With reference to some other speakers' remarks, he thought that some international road authority, similar to the U.I.C. for railways, recommended that where automatic half barriers or automatic crossings were in the vicinity of a town, where standard road signals were in use, that the lights at those crossings should also be standard road signals.

While speaking of the economic application of automatic protection, he would be very interested to know from Mr. Jewell if the electro-hydraulic application of those barriers offer any financial advantage over straight electro-mechanical installations.

**Mr. D. S. Jewell** replying to the last two contributions said that the question of flashing lights was important because they were the first part of the warning. There was certainly some difficulty. He thought that probably most of them who were motorists would agree that, forgetting all about automatic half barriers, in those situations in the middle of the country where there were road traffic lights they were a sheer and utter menace, simply because the background in open country was so light that they very nearly needed a searchlight full in their face to stop them. That was the difficulty. The lights which they supply to the Ministry's specification were very much more powerful than the standard road signal, but they thought they would try and develop the stopping power of the red flashing lights even further.

Whether motorists knew their Highway Code or not was again a difficulty but if the red signal was powerful enough, backed by the boom, he thought motorists would respond. In fact the proof of the pudding had been in the eating. They had not had serious trouble on that score so far.

Reliability and maintenance was most important, especially as it was, as he had said, an extremely difficult and heavy bit of apparatus. They expected it to fall like a signal relay. He hoped in their design they had provided something on which the maintenance had been reduced to a minimum. They had tried to aim at producing something which, if it went wrong, could be put right in a very short space of time. But that was a new venture, and they must proceed deliberately and carefully. After all they were only now at the end of the third year from the inception of the prototype. It was going to take time to get the ' bugs ' out. They must keep up the reliability, and as Colonel McMullen said there was money in it ; they must not skimp too much.

Now to come to the electro-hydraulic operation : Mr. Guthrie had asked what were its financial benefits. Mr. Jewell continued : " Let us put the finance on one side. Let us decide what principle of operation we want. We want something which will go up and stay up, and when it is up we want it held in such a fashion that as soon as that track relay is operated there will be no hesitation whatsoever in the barrier coming down, whether it is blowing a 100 mile an hour gale or not." It seemed to him that the hydraulic transmission offered the very simple and satisfactory solution of simply locking the hydraulic circuit once the barrier had been pumped up. He knew they had had some troubles, but he felt sure they could be overcome.

They then had the hydraulic lock. The hydraulic system also allowed the half barrier to be accurately timed on its descent. Other systems of transmission he thought were not so flexible nor had quite such a reserve. It would need quite a considerable hydraulic leakage for the time of descent to be catastrophically altered. Barriers should not go wrong ; unfortunately they did. If they had got a hydraulic transmission they had a fair chance of pumping it up and down by hand, and once they had pumped it up it stayed there. Their prototype in Marylebone goods yard was pumped up and left for a week and it never moved. Against that, one could think in terms of mechanical bolts, but he did not like them as they could get left in. It was no more expensive and he suggested to Mr. Guthrie that the hydraulic transmission had very clear technical advantages.

Mr. Guthrie had also referred to red lights only ; that would save some money, but it would not save more than 25 per

cent., because one would still have to provide the track circuits and other controls. That system was allowed by the Ministry requirements and he thought he was right in saying that they had no installation in use although they had a number in mind. They would save money, but would they save all that amount? In their case, as they had those difficulties with road authorities, they could only accept exceptional cases on very lightly used railways, probably where the train virtually came to a stand and operated the lights itself; otherwise they must keep the half barrier as a physical backing until that type of crossing had been more widely accepted.

Mr. Guthrie had referred to para. 7.1 of the paper. Mr. Jewell had recorded that the experiments which Mr. Webster kindly did in the full size wind tunnel, with a half barrier 10 ft. long, virtually full size, were tests primarily to ensure that they had sufficient gravity loading to bring the barrier down, with a gale blowing end on. So far they had not had a case where the barrier had been broken by a side wind, and they had covered that in the stressing. He wanted to know whether Mr. Guthrie was talking about a single boom half barrier because he would agree that theirs was virtually a triangle. Although that increased the weight and the moment of inertia it was right from the point of view of stability until they had had more experience.

**Mr. J. Howe** said that he had not any intention of saying anything; but one or two complimentary remarks had been made about the industrial designer's contribution to the exercise, and he felt that perhaps he might say a word or two about that.

The industrial designer did not aim to dress up the engineers' job; that was the last thing he wanted, and the last thing that he did, if he was a serious industrial designer. What they tried to do was to make the engineering express all the quality and all the skill that had been put into it. He had seen quite a lot of machines in his time, and he had been told, "This is a first-class machine, it is really excellent" yet when he looked at it, it looked like a heap of old iron. It was very difficult for him to believe that such a machine was really as good as it was made out to be. So a real design, an integrated design, was where the industrial designer made his contribution, as one of the team with the engineers. On the particular job under discussion they had a first-class team, and he would like to think that they worked well together and produced the barrier which, as Mr. Jewell had said, was even now in its infancy. They would go a long way further in making it even better. It was mentioned, he was not sure whether by Mr. Jewell or one of the other speakers, that from an amenity point of view it was a good thing to have a barrier which was good looking as well as efficient. But it could be spoilt by all the paraphernalia which went around it, and every one of their trial installations were cluttered up with bits of old fencing and badly-sited signs. These things had got to be done well if the whole scheme was going to be a unity. Perhaps from there he might go on a little further, and mention the attitude to line-side equipment generally. They had got now some very fine motorways which are excellent examples of landscape architecture, with splendid bridges. Great care had been taken to get them right. But in his opinion, the railway lineside was still regarded as a dump, and on any train journey the visual impression was quite appalling. He would like to put in a brief plea for more consideration to be given to the things that had to be accommodated on the railway lineside.

Finally many people had talked about flashing lights; could he say just one word? He hated flashing lights on the barriers. They were not *flashing* lights, they were *blinking* lights. They were not insistent at all; they lazily went on and off; they did not arrest one in any way. If they were going to have flashing lights then lights had got to flash, and really attract one's attention. Personally he still thought that the road traffic lights would be better on a barrier than flashing lights.

**Mr. L. W. H. Lowther** said that personally he was rather against half barriers all the way round. For years railways had been trying to get away from semaphore signals. They had all recognised the great superiority of the colour-light signal. Now what had they done with the half barrier? They had taken the semaphore arm off the post and brought it down to road

level, and they had mixed it up with an optical signal. The half barrier would never stop a motorist if he was going to drive through. He was not too sure of some of the details of Mr. Jewell's barrier which he had illustrated so well that evening. He could not gather from the illustration whether it had a knock-out feature, or whether it would be liable to be pushed across the track if anything hit it. He would like Mr. Jewell's comment on that. Lastly he was rather disturbed by Mr. Jewell's casting a doubt on the track circuit. A good many years ago, more than he would really like to think, he put in some track circuits on 47½ lb. rail, with a 6-ton axle load, and after one or two tests he never had any qualms whatever about the operation of those track circuits. He would be grateful if Mr. Jewell could say something about why he was now doubting the validity of the track circuit.

**Mr. D. S. Jewell,** replying said that they were dealing with a climate that was not all that dry, so he thought they were bound to expect some film on the rail. They were also dealing with a country which was beginning to have longer and longer holidays. He supposed the worst gap could be from the Thursday before Good Friday until Easter Tuesday. All these were difficulties. They had undertaken to provide automatic apparatus, which perhaps after four days without traffic would come down ' just like that ' for the first train. This he thought was a demand of a very high order and they had difficulty ; they had got to accept it. Maybe it was the weather, maybe their axle loads were too heavy. He did not know.

He did not think they could do away with the half barrier or arm. He would not be at all surprised if even the road signallers did not at some time or another find they had got to put the arm on as well as the lights.

He must apologise to the meeting that he really had not done all he might have done ; and that was also apologising to Mr. Guthrie for looking always to the east and not to the west. He had of course said nothing about American practice. He would think they were by far the most experienced and largest users of that type of equipment and that they would back him in saying that, although they had lights they usually added a gate because users did not otherwise obey the lights. He was sorry he did not put any examples of American practice into the paper.

**Mr. Adamson,** a visitor from Australia, said that he had got to come to the defence of his own country, Queensland, particularly as far as flashing lights were concerned and also to make a short comment about booms. The 20 feet boom seemed to be a winner that night. He must not boast about that, but they had booms 25, 26 feet long and had found them work quite successfully without any trouble at all. Their biggest trouble originally was the failing of the boom to drop in high winds, and they eventually overcame that by having narrower sections. They had a boom similar to the British shape and 26 feet presented no trouble at all.

Flashing lights ; they had a lot of installations with flashing lights, mainly because it was cheaper. They got a fixed amount of money each year to spend on level crossing protection, and if they could provide more protection, protect more crossings with that money, then they thought they had done a better job. They did not believe in sacrificing safety for the sake of expense, and they had a fixed rule as to whether they install flashing lights or half barriers. When they came to the problem of that protection, about 13 or 14 years ago, when they first started the installations, they could not see that the barrier would do any good whatsoever in bringing the traffic to a stop at the commencement of the flashing lights. Any driver who failed to see the flashing lights certainly would not see the barrier, and if he hit the barrier it would not stop him anyway. So they decided that such a feature did not add any form of protection at all, providing the visual flashing lights were in a prominent place and could be seen.

But the problem came of traffic waiting at a crossing, and of the first train passing the crossing and the traffic moving off behind the first train as they did do. They ignored the lights, and so moved into the path of a second train. So they decided the barrier should be effective as far as stopping the traffic moving off again. Consequently they now installed flashing lights on single lines or anywhere, so that

there was no possible thought of a second train hitting the crossing after the passing of the first train. Anywhere there was a possibility of that they provided half barriers ; and although the barrier would not stop a car it would prevent a car moving off into the path of another train using the crossing, and that became their deciding factor as to whether they installed flashing lights or half barriers. As to the cost of a half barrier installation, they could install flashing lights on a single line for £1,800 (Aust.). The cost of a half boom installation, or half boom as they called it, was about £7,000 ; but this was on a dual line usually, or perhaps 3 or 4 lines, which meant more track circuits. There was quite a saving, and they could install about 4 or 5 sets of flashing lights for the cost of one set of half barriers.

Another point he would like to ask Mr. Jewell : he was very interested in his remarks about the manned barrier, stating that there was very little saving in time and practically no saving to the railway. It was this type of installation that they found gave them the biggest saving as far as the road traffic was concerned, and also an economic saving as far as the railway was concerned. Where they replaced gates operated through a cabin signal box by a wheel which was interlocked with the signals, they replaced this with automatic half barriers for main line running only. This was worked in conjunction with the main-line signals, the signals being set for the through road, and the train would operate the barriers automatically from the normal position of an automatic barrier. This, of course, meant that the road did not have to be closed before the signals were pulled off. It meant that the train did not operate the barriers until it was much closer to the road, and it was an obvious time-saving to the roadway. In the box they also provided a control lever, and this lever was interlocked with all other signals reading across the road. Any reshunt moves, or any moves other than main-line moves then required the same working as with the gates. The signalman lowered the barriers and when they had been proved lowered he remove the signals and the train moves could proceed. The saving to the road user was obvious ; the saving to the railway was that, as long as they had automatic working for the main line moves they could then switch the box out at weekends and at night when traffic on the line was light. They switched the box out ; the signalman could be done away with, and he did not need to be maintained 24 hours a day, 7 days a week. He had to be on duty only when there were any shunting moves, or any abnormal moves when he was required by the railway—not to operate the road only. So they found quite a considerable saving.

It had been very interesting in Britain to see the development of half-booms. They had been installing them for about 13 or 14 years, and they had gone through all the phases that British Railways were going through at the moment. They had had the outcries by the public, and they had got over that, and now, of course, the public was demanding more installations to save time.

Another thing he had noticed with British barriers : when they decided to provide the barrier for the second train coming they had to decide what they were going to do if the second train struck in as the barriers were rising, lifting up for the first train. There were two alternatives. They could either drop them straight away, or they could complete the upward movement and drop them, as he believed was done in Great Britain, and they found that there was always confusion on the crossing when the barriers went up and started to come down straight away ; if this movement was continued up to the full vertical position, and then dropped again, of course, one got a reduced margin between the time the barriers reached the horizontal and the time that the train hit the crossing. They found that that was the very time at which they did not want the reduced margin. That was the time when the traffic was just starting to move, and with a slight bit of confusion with a reduced margin they did not have any time at all. So they detected that the second train must be at least 20 seconds away from striking their control tracks ; and if the barriers could not go to a vertical position for 20 seconds they did not allow them to lift at all. If they went up for less than 20 seconds it only meant that one or perhaps two cars would get through. It was risky so they decided that it would have to be vertical for 20 seconds, or not at all. He would like to

hear Mr. Jewell's comments on that, and more about his manned crossings, if possible.

**Mr. D. S. Jewell** replying said he found Mr. Adamson's comments extremely interesting. Obviously he had much experience in this field. So far as the manned barriers are concerned, that was, providing and working barriers adjacent to a signal box automatically for the through movements, they had given some consideration to this. They had not yet satisfied themselves that it would pay them as a Railway. They had it in mind, but at the moment they had other cases, where in fact they would have three shifts to save, and they had carried on with those. They had not fallen for the attraction of working crossings automatically from signal boxes because this normally benefitted the road. This would probably come when they widened the basis on which automatic working was provided.

Confusion might arise if a second train cut in just as the barriers began to rise, as there was a very short time in which the road crossings was open, and then it closed immediately : this was of course covered in the Ministry Requirements. It would appear that Mr. Adamson provided additional track circuits for the extra safety margin. He thought they would have to look at this again : from what had been said tonight, money did enter into this, but there was safety as well. He thought it was fair to say however, that their arrangements only worked because they were willing to accept a fair waiting time of the order of nearly 10 seconds for a single train. So, in fact, there was quite a lot of waiting time available to reduce under the worst ' second train ' conditions.

Mr. Adamson's relative cost figures of 7 units, and 1.8 units for doing away with the half booms were most interesting. He did not think their figures would be quite of the same order.

Mr. Adamson had also suggested that he could have booms 25-26 feet long. What, in fact, were Mr. Adamson's operating times? This was the deciding factor, although he thought he would agree that if they went much over 20 feet, they had an awkward boom. It could not be made any stiffer, and he would think they could not get a barrier which was over 30 feet long. It would be interesting for Mr. Adamson to tell them what his operating times were, because this was obviously one of the determining factors.

He thought it was of interest that the British boom operating times were about the fastest in Europe. The Dutch one was, he thought at least 10 seconds, if not 13 seconds, against their maximum of 8.

**Major Stacey** said that a level crossing was a level crossing whatever the status or type of the road, and whoever owned and operated the railway line concerned. All the discussions so far had been about level crossings on public roads, but it has been emphasised that the arrangements at all level crossings with barriers should be the same, because the people who use them were the public as road users.

There were many level crossings not on public roads but used by the public. He referred of course, to those on what, in a general sense, were called industrial estates. There were people who used the crossings because they were employed on those estates, and those who had occasion to visit such places, and use the level crossings. The owners of those industrial estates tended to invent their own forms of barriers, and lights and so forth. As far as he knew there was no statutory requirement that they should conform to any particular arrangement. Coming back to the point that was mentioned before, the person who had to interpret the lights, barriers or whatever there were, was the member of the public, who was a road user whatever road he was using and whoever's railway it was. He suggested that if crossing equipment was going to be as foolproof as possible, there was a need for some statutory provision that anybody who erected lights or barriers of any sort on a road which was used by the public, but which might not be a public highway, should conform to the self-same requirements of the Ministry of Transport. He did not know that there was anything requiring that today. The man who got into trouble if he misread or made a mistake was the road user generally ; he was much more vulnerable than the driver who was usually the first man on the railway side to be involved. That seemed to him to be the great weakness. There might be a lorry driver regularly visiting an industrial site getting used to some 'do-it-yourself ' light and barrier arrangement.

Then on a public road when he is 100 miles away he suddenly, and for the first time, encounters what might be termed the standard arrangement and imagines it is something different, and not what he had been used to. He thought the comments about flashing lights and the standard road traffic lights were relevant there, because if a road user was in legal trouble, but held a driving licence, he could not say that he did not know what a road traffic light was. He had signed a declaration that he had read the highway code. He could not get out of its legally, but he could well say he had never signed any sort of declaration, or anything about *flashing* red lights. When he goes to Joe Buggins' works where there were 20 or 30 level crossings they had red lights but not flashing lights.

He wondered if Mr. Jewell would care to comment. If the method described was going to be as foolproof as possible throughout the country there should be regulations which governed everybody who was concerned with installing arrangements at level crossings.

**Mr. D. S. Jewell** in reply said that Major Stacey had raised some interesting points. The legal side was somewhat of a jungle which had to be sorted out, in association with the job of providing this modern type of crossing protection. But he thought they could rest assured that British Railways were bound to be consulted before any such equipment was provided; because the railway was involved, and they certainly would not accept other than apparatus which they felt they could approve if they had a similar case.

The road user in the Works knew that he was in a Works. Obviously it was going to be very difficult to persuade all the steel works and industrial plants to put up standard barriers. A barrier was still a barrier. He thought the important part would be that they accentuated the profile because the speed was higher, and one was not likely to get that in an industrial works. In any case he would have thought an industrial works, unless they were absolutely sure that their traffic could not stop or back up, would be foolish to provide automatic operation. What would automatic operation give them—only saving in staff. It would not save time, he would think. Whilst dealing with shunts and the like there could be no through movements.

**Mr. A. W. Woodbridge** said that to him the paper seemed a very simple description of what went on behind the scenes. The equipment, its controls, and the arguments with the various people was one of the most complex things that man had invented and in sponsoring it jointly Colonel McMullen and his colleagues, British Railways had launched themselves into a maze of trouble.

He would like to add to the discussion by complimenting Mr. Jewell, Mr. Cardani and his staff, Colonels McMullen and Reed, and of course the Industrial Designers, in producing what he thought was a uniform, simple, streamlined job of work.

Now of course they were very conscious that they had launched out into a new piece of equipment; and most new pieces of equipment did give a ' spot of bother '. Therefore they had rammed home to themselves, and it was rammed home to them all the time, that reliability was the prime factor in this outfit. Mr. Lowther mentioned the track circuit problem. He was not sure if Mr. Jewell had really emphasised the difficulty with a track circuit. One could not have a bobbing track circuit; one could not have 'Monday morning ' troubles, or ' Tuesday morning ' troubles. The barrier must work under all circumstances exactly the same way and completely reliably. In their designs they had endeavoured to produce something which eventually would require very little if any maintenance. They had built into it some ideas which were perhaps a little novel. But they were there; they were accepted and they were working. So with that he would conclude his comments, and compliment his staff and the staff of the Western Region, and indeed all those who were working together to make a perfect system.

**The President, Mr. J. P. Coley** in concluding the meeting said he felt sure that Mr. Jewell could feel highly rewarded by the discussion that his paper had stimulated.

He had given them an extremely comprehensive paper. He gave them a very interesting and well illustrated resumé of that paper and he had dealt in a most competent manner with the discussion. They owed him a debt of gratitude. A vote of thanks was passed with acclamation.

# Provincial Meeting of the Institution of Railway Signal Engineers

*held at*

*Crewe*

*Tuesday, December 14th, 1965*

The Vice President (Mr. H. W. HADAWAY) in the chair

At this meeting Mr. D. S. Jewell read his paper " Modern Level Crossing Protection." Following the reading of the Paper, the Chairman invited questions or comments.

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## DISCUSSION

**Mr. H. Taylor** opening the discussion said that there were a number of questions he would like to put to Mr. Jewell, some of them original and some that had been put to him by members of the staff following the installation of a set of B.R.B. barriers at Balderton.

Firstly, he wondered if they were doing sufficient to educate the elected members of the Local Authorities, who in some districts had been showing so much opposition to the installation of half barriers.

Secondly, he said that the level crossing to be controlled by half barriers at Lichfield was a skew crossing, similar to one of the examples illustrated in the lecture ; and it was obvious that there would be complaints from railway drivers, in as much that they would be able to see the red flashing lights as they approached the crossing. It might be necessary to screen the red signals to prevent this happening. He asked if any similar installations had necessitated such screening being provided, and also what form that should take.

**Mr. D. S. Jewell** replied that although he might take a fair share of the responsibility he was not the designer. The design was done by a team and they remained a team. He did not think the team had done too badly, as it was only three years since the first inception of the design.

The question of education was very important. There were films for the instruction of school children ; pamphlets had been produced for the use of local residents, and the Operating Department provided someone on the site for at least a month, until the Ministry had inspected the crossing.

With regard to the question of getting the Local Authorities on their side, he suggested that the most important authority was the Highway Authority. The procedure was thus : In the first place, the case papers are sent to the Railway Inspectorate and they, with the Divisional Road Engineer etc. have a meeting on site to decide whether it is a reasonable case. Obviously there was going to be opposition ; but the main public body concerned was the Highway Authority.

There was no easy way out of opposition, except perhaps to drop the case which was proving too difficult. It seemed they were bound to win after the first fifty to a hundred had been installed ; then he expected there would be requests flooding in for barriers to be provided here, there and everywhere.

In the case of Lichfield it might have been financial difficulties, but they had got to keep battling on. That depended on the railway service as well as the Local Authorities. If they could not provide barriers that were reliable, they would never get anywhere.

In July, 1964, they had 11 barriers. That had increased to 18 by the end of

that year, and at the time of the meeting they had about 45 in use. They had just sustained the first accident, and it was not their fault. If anything happened on any crossing, there was obviously the danger of it reacting on all other crossings in use, or projected.

In answer to Mr. Taylor's second question, Mr. Jewell said they had made no allowance for screening the red flashing lights ; but it was obvious that they must not be seen by the train drivers. On other administrations they deliberately used the sight of the red flashing lights to indicate to the driver that the crossing was working, but that was not necessary on British Railways.

**Mr. H. W. Hadaway (Vice President)** asked if any consideration had been given for the provision of an emergency plunger, similar to that used for emergency fire service calls, to be used should a vehicle stall on the crossing, or a pedestrian collapse. Were there any grounds for not using such a device?

**Mr. D. S. Jewell** said that the answer seemed to be simple ; when the Ministry said they did not required anything, that was good enough for him. If they did provide signals on the railway, it would cost another £2,000 and a train could have passed their protection in any case.

**Mr. W. E. Mollart** asked if any special provisions were made on these half barriers where there was a third or fourth rail involved, such as Southport, with the electrified rail in the middle.

**Mr. D. S. Jewell** replied that no special provisions were made on the third or fourth rail electrification system. There were in fact something like twenty barrier installations in use now on such lines. It just meant that the conductor rail was cut short.

**Mr. W. E. Mollart** continuing said that in some places the gates were provided with wire mesh to prevent animals from straying on to the crossing. Was there any device at barrier crossings to prevent animals getting on the railway.

**Mr. D. S. Jewell** said that they provided cattle grids, but no more. On one of the very first crossings in use, there were all sorts of complaints, " this is dangerous " etc ; but further down the railway there was already a perfectly open footpath crossing. They could not cover everything ; they had got to try and progress.

**Mr. G. I. Foster** asked if Mr. Jewell could comment regarding the overall design, which he thought they would all agree looked very attractive, and did present a very unique sort of profile. On the other hand, when one started with the final shape first and then designed inwards, one did tend to finish up with a more expensive job. He wondered whether the expense was worth it.

Secondly, some means had been provided of operating barriers manually ; but he wondered whether the method of operation proposed was going to be adequate in case of emergency. If a barrier came down and caught a vehicle which had only one man on it, that man ought to have some means of pushing the barrier up clear of the vehicle, and holding it up with a catch. He asked if they had any experience yet of that eventuality?

Mr. Foster had had some experience with barriers and flashing lights on a swing bridge on a main road to Hull, and it had taken three attempts to commission the installation, due to barriers being damaged by drivers driving in streams of traffic, failing to observe the flashing signals and having the barriers descend on their vehicles. Did they make special arrangements with the local police to cover enforcement in the early days?

**Mr. D. S. Jewell** in reply took up first the point relative to the design. He thought the impression had been given that the cost had been increased by the procedure adopted. He would refute that. The designer was given the overall size, and that was filled up almost completely. He would also say that he thought their price was as good as anybody's.

It was not very easy to push a barrier up, by hand, particularly through the final approach to the vertical ; but emergency operation by the hand pump was ideal. Once raised, the hydraulics then locked the barrier up, and one avoided the use of chains and mechanical bolts. The hydraulic operation seemed to him to have proved itself. The locking up was absolute ; there was nothing to jam. The timing of the descent was invariable. If one tried to do that electrically, there was dependence on the integrity of the circuit.

**Mr. Berry** said that they had been talking about educating the people not to zig-zag round the crossing. He was thinking about a failure. He thought there were notice boards to say there was a telephone ; but there was nothing on the barrier to tell the public where the telephone was, or any instructions how to use it.

Apart from this, taking the telephone operation itself, if the handset was not replaced correctly, the microphone battery ran down until such time as the telephone was used again and replaced correctly. As those telephones were not used frequently, that might be some time, and the next person to use the 'phone might find it out of order because the microphone battery had by that time run flat,—especially as the maintenance carried out on that equipment was fortnightly. Even the M.O.T. Railways Inspecting Officer failed to replace it correctly when he tested the telephone! When one took the receiver off, and used it, and then returned it, it had to be replaced against a strong spring clip. They knew about it, but the public did not.

**Mr. D. S. Jewell** said he thought there should be a block on the telephone door which knocked the handset back into position. He would not have thought that faulty replacement was catastrophic, as it only failed to cut off the microphone battery.

**Mr. Berry** added that there was a block on the door, but it did not force it back.

**Mr. D. S. Jewell** replied that such was the case if there was a public telephone ; but they did not provide a public telephone in all cases, only if there was a regular cattle user. There was a telephone sign on the front of the door. After all, if there was a public telephone, the signalman was not entitled to tell the public to cross the double white line.

**Mr. Berry** asked how they were going to educate a motorist not to cross a double white line ; he was not going to wait there for ever. There should be some instructions on the barrier.

**Mr. D. S. Jewell** said they had not got a telephone in all cases. There was a double white line, and the road user should know not to cross it.

**Mr. H. W. Hadaway** said that it seemed there were two standards for the safety of people. When on the railway there must be safety at all times, but once on the highway, a high degree of risk was accepted. Absolute safety could not reasonably be obtained at a crossing, and he felt that a balanced view of the degree of risk should be permitted.

**Mr. D. S. Jewell** considered that a road was rather different, because the flow and the danger were obvious. It was different on the railway. When a train approached, it came at a fast speed, out of the blue.

**Mr. H. W. Hadaway** commented that when it came to comparing degrees of safety, it should not be forgotten that deaths occurred at a continental-type level crossing only a short time ago.

**Mr. Roscoe** said he had listened to what Mr. Jewell had said with a great deal of interest ; but there was a point with regard to the road surface at level crossings. This should be in a better condition than that of the adjoining road. He had difficulty in specifying a standard ; although he had spent a great deal working with many and various types of material, he had yet to find one that was very satisfactory. Perhaps Mr. Jewell had some suggestion to make. He would also like to ask what happened to the barriers with single line working.

**Mr. D. S. Jewell** answered that when single line working was in force the barriers had to be manned. One other thing had come out ; if there was a platelayers trolley to run, the signalman's instructions showed that the crossing should be manned ; but there appeared nothing to warn platelayers that there were restrictions to trolley working. From their point of view, he hoped that platelayers had been instructed not to use trolleys anywhere near half barriers.

With regard to road surface, it would be appreciated they had to make it no worse than before, so that there was reasonable protection against cars colliding or slipping. There was no standard crossing.

The cost of these crossings was between £5,000 and £6,000 ; the special equipment amounted to only about 20 per cent. of that, and something like 25 per cent. was spent on alterations to the road, white lines and verges, and those could be rather heavy.

It had also been suggested that in some places where the crossing was adjacent to the signalbox, the half barriers should be automatically worked for through trains, so that the crossing was closed for a minimum of time. If that was wanted, someone would have to pay British Railways to provide it.

**Mr. K. E. Hodgson** said he would like Mr. Jewell to comment on his remarks about speed restrictions being virtually lifted.

**Mr. D. S. Jewell** said that when the Requirements first came out in 1962 they were not allowed to consider automatic half barriers unless the speed rail was below 60 m.p.h. The Requirements were re-issued in September 1963 and now read : " Speed of trains themselves will not be the limiting factor, provided that the difference in time between the fastest and slowest train reaching the crossing is not more than 40 seconds."

Where there was a minimum waiting time of, say, 6 seconds, the slowest train had to appear within a waiting time of 46 seconds. Where the maximum speed of trains was high, the slowest trains might exceed this maximum waiting time. These slowest trains had therefore to be identified by measuring that their speed was below a certain limit, in which case the barrier cycle was delayed until the train was closer to the crossing. This was known as speed discriminating, which was also necessary if there was a stop signal in the vicinity of the crossing from which trains might be re-starting.

**Mr. K. E. Hodgson** asked what arrangements were made for temporary speed restrictions, when speed discrimination equipment had been provided in the installation.

**Mr. D. S. Jewell** replied that such an adjustment had not been worked out. After one of the first barriers was brought into use there was a permanent way slack adjacent to it, and the speed discrimination would have been useful.

**Mr. F. W. Young** said that the task of installing half barriers was that of the Signal Engineers, but the propositions to employ them involved all departments.

Talking in broad terms on the subject it could be said they were all anxious to see more automatic half barriers installed at suitable locations ; but it seemed that whenever progressive measures of this sort were proposed, everyone became very conservative. He felt sure that when the 200, or so, barriers now under consideration had been put into service, they would find an increasing demand, if not a queue for their installation.

He subscribed to Mr. Hadaway's philosophy. There was undoubtedly a tendency to demand safety measures on a roadway crossing a railway far in excess of the safety factors normally applying on the roads. The need to achieve a reasonable standard of safety was not denied, nor could they ignore the fact that the railway authority had a direct responsibility where a road crossed the railway. But there were limits to protection, in economic and practical terms.

It was to be hoped that the successful application of automatic half barriers did not divert the appropriate authorities from necessity to provide bridges over the railway in certain cases.

It was agreed they had to proceed gradually with the application of half barriers, and that intensive local publicity was essential, if only to reduce the criticisms levelled, as in the recent case in Yorkshire, whenever a half barrier installation was brought into use. Much reference was made to practice on the Continent. They were criticised on the one hand for not making progress towards barriers as on the Continent, and on the other hand for reducing the standard of safety if level crossing gates were replaced by automatic half barriers. It was so often the case on the Continent that barriers were provided at crossings previously unfenced, and they were therefore able to go forward more rapidly.

In conclusion, might he ask Mr. Jewell if the new barriers had built-in reflectors. That was not apparent on the slides.

**Mr. D. S. Jewell** replied that with regard to reflectors, there was a strip of scotch light on the front and back of the half barrier, and the Ministry had demanded that the notices " In Emergency " and " Another Train is Coming " be reflectorised. They had two flashing lights at the top, and along the barrier they had another three. Finally, they had a reflector strip down the middle.

He thought they would do just over 100

crossings next year. It was going to be quite a job for all of them ; but by 1967 he hoped it would be easier.

With regard to occupation and accommodation crossings, these were where the mishaps were occurring, and unfortunately it would appear that the Board was in no position to do anything, as it had no legal obligation. He hoped that could be thrashed out. They had in fact, an indicator panel with lights ; but unfortunately they were tied up in the legal sense and no-one could advise the Board to spend money.

**Mr. J. S. S. Davis** said that the danger to road traffic from rail traffic had been fully considered ; but there was also what he thought was a more serious matter, namely the danger to rail traffic from road traffic which had crashed the barrier, or which had come to a stand on the railway.

During the I.R.S.E. Convention in Italy, this year, members had been privileged to see a signalling complex at Livorno. That was a centralised traffic control system which had three crossings in the area of control, and the Italians were scanning those three crossings from the signal Control Centre with television cameras. The crossing had to be scanned before the signals were cleared. The technical press had from time to time suggested also that radar might be used in the control of remote level crossings, to establish that the road was clear above rail level before signals were cleared for the pasage of the train.

Would the author tell them if any development on either of those lines was contemplated by the British Railways Board and if so, what direction was this likely to take.

**Mr. D. S. Jewell** replied that they had embarked on their own experiments for the operation of crossings using television. He thought there was an example somewhere near Carlisle. That was to cover the case where the automatic half barrier was not suitable.

It was true that the 10-ton vehicle could be just as damaging to the train as *vice-versa*. They had nothing in mind to meet that, except good fortune, and the fact that the driver would have some advance view of the crossing. It was all very well talking about radar ; but where was its value if the road vehicle demolished part of the radar equipment, so that the presence of an obstruction could not be transmitted? He did not see, so far as automatic barriers were concerned, that they were justified in worrying about the stalled road vehicle, particularly as the crossing was free to be used up to only a short time before the train reached the crossing.

He would like to add that although he had shown many Continental slides, those administrations were still feeling their way. The U.I.C. had carried out an investigation into safety of all forms of crossings, and had satisfied everybody that automatic half barriers were certainly as safe as those they had replaced. The S.N.C.F. had the most ; they had about 2,500. The Dutch had more experience, and they worked with traffic movements of 2 million, that is much more rail and road traffic.

**Mr. H. W. Hadaway (Vice President)** said that the time had gone very quickly, and unless anyone had any further point they wished to make, he would like to say what an interesting evening they had enjoyed with Mr. Jewell's presentation of his paper. The paper had been a masterly effort in putting over this new subject, particularly in the quite informal wording Mr. Jewell had employed in his replies to the questions. Might he also, on behalf of the Institution, thank the London Midland Region, Mr. Brentnall, Mr. Davis, Mr. Taylor and all concerned, for the excellent facilities they had provided for the occasion.

**Mr. F. W. Young** added that although he was no longer in the Chief Signal and Telecommunication Engineer's Department, but speaking nevertheless as a Member of the Institution, he would like to express on behalf of all the Provincial Members present and their many visitors, their appreciation to the Council for permitting the meeting to be held in Crewe. He also thanked Mr. Hadaway, on everyone's behalf, for presiding so admirably over the meeting.