Glasgow Suburban Electrification

Yellow: Service begins 7 November 1960
Blue: Service begins during 1961
Glasgow Electric

The story of Scotland’s new Electric Railway

by George Blake
Out of a cutting above the River Clyde and into the sunshine there flashes a train at speed. Its coaches are painted the bright blue of the kingfisher, gay against the softer greens and browns of the fields, and its windows, almost unbroken in length, flash cheerfully. An old man on a chair at a cottage door on the hillside looks down to see that the three coaches ripping along so fast and so purposefully do so as by dark magic; vaguely he misses the smoke and steam, the glowing fires and heaped coals of the engines of his young manhood. At least, he has lived long enough to see the electric train come to Scotland.

Electrification of the British Railways suburban lines out of Glasgow is manifestly a point of major change in the history of passenger transport in Scotland. The hundreds of thousands of travellers enjoying the new services will come to realise that it is more than a mere change: that it is, in fact, a revolution.

When diesel-drawn trains were introduced a few years ago, first of all on the busy Edinburgh-Glasgow line, the public responded to the improvement with enthusiasm. It seemed wonderful that the old curses of smoke and smuts had disappeared. The sociability of the open corridor coaches was appreciated by the great majority of travellers. Busy men—and eager small boys—appreciated the fast acceleration out of stations. Miraculously, these new diesels seemed to break down the old-standing barriers between Scotland's two largest cities.

Now by far the largest city of Scotland is having its internal pressures relieved by trains of the most advanced design. Its countless commuters, to use the convenient American word, are to be passed to and from their city tasks by a service of electric trains that move like arrows on a frequency unheard of in the days of steam. The focal point of the new system is obviously Glasgow's Queen Street Station, and during the peak period the new, bright trains pass through it at the average rate of one every three minutes.

Obviously, a vast enterprise of this kind, covering in all some 150 miles of track or 71 route miles, has involved a large sum of money and a vast expenditure of engineering skill. It is one thing to run diesel-drawn trains over a railway line originally planned to take steam trains; the line requires no alteration. When a line is electrified, however, miracles of reconstruction have to be undertaken to bring about—deliberately to use the word again—a revolution both in terms of traction and passenger convenience.

There will be much to say later about these aspects of the railway electrification in and out of Glasgow. It is necessary to understand in the first place something of the historical background.

Rival railways

The traffic possibilities of the Glasgow industrial region were the rich prizes for which—sometimes bitterly, often wastefully—the three major railway companies in Scotland competed during the nineteenth century. Goods and mineral traffic apart, the drive of the rival concerns was for
shares of the then very profitable passenger trade. The successful men of the Clydeside business world started to build their homes far away from Glasgow, creating almost purely residential colonies in such pleasant places as Helensburgh, Kilmacolm, Troon, and so on. Many had their summer villas on the shores of the Firth of Clyde, and the labouring masses, in vast numbers, demanded their outings on that beautiful estuary and in the prime native product—the steamboat.

There was thus created in and around Glasgow a complex of railway lines, loops, joint lines and junctions as would terrify a modern planner. The drive towards the Clyde coast in particular produced such dramatic, nay fantastic, anomalies as that created in the Greenock-Gourock area. The old Caledonian company built its steamboat pier at Gourock, the Glasgow & South Western concern its rival establishment at Greenock, barely three miles away. But to get to these terminal points both companies were obliged to drive tunnels for miles through the hard igneous rock of the region, the tunnels criss-crossing over and under each other in a crazy pattern.

The rationalisation of the British railway system under Sir Eric Geddes in 1923 did something to clear up the confusion. In general, the new L.M.S. group took over the interests of both the Caledonian and Glasgow & South Western systems on the south side of the Clyde. The new L.N.E.R. group was given control of most of those on the north.

Even so, wasteful duplication and anomalies persisted. When the whole national system was put under State control in 1948 British Railways inherited a load of mischief of quite monumental weight. One has used the word ‘revolution’ in relation to the electrification of the suburban lines out of Glasgow; and so it is in terms of both engineering and of the comfort and convenience of passengers. It is also a revolution in the sense of being a heroic clearing up of a confusion.

Steamer terminal

Look now, however briefly, at the geographical background of the enterprise.

Roughly, four different impulses governed railway development out of Glasgow in the age of unbridled competition: (a) mineral traffic out of the coalfields and ironworks of the Lanarkshire hinterland towards Glasgow and the Clyde harbours; (b) the creation of suburban services to carry the workers in expanding communities to and from their homes; (c) service for the well-to-do in their more distant residential communities, and (d) the holiday service of all, rich and poor, through the Clyde coast ports.

The new electrification scheme solves many of the problems in one stroke, so fast and flexible is an electric system. Even in this first phase it vastly simplifies the overlaps inherent in the old dispensations. Ironically, it takes within its orbit, and fuses, two characteristic enterprises of companies that were rivals in the days of independence.

We are concerned here mainly with the electrification of the line that runs from Airdrie in Lanarkshire through Glasgow to Helensburgh on the Clyde coast. This is Phase I of the operation now completed. Phase II, to be completed within the year, covers that complex of suburban lines on the south side of Glasgow, so familiarly and affectionately known as the Cathcart Circle, with a spur leading out to the Kirkhill district of Lanarkshire and a longer extension to Neilston in the foothills of Renfrewshire. The map at the front shows the layout clearly.

Again there is historical interest in this union, though the two systems will not—immediately, at least—be connected. The Airdrie-Helensburgh line was originally laid out by the old North British Railway Company. The Cathcart Circle Railway and its expansions were enterprises of the Caledonian Railway Company. But another relic of Victorian confusion has survived on the north side of the Clyde. In the heat of nineteenth century competition the Caledonian concern sought to cut into North British territory by creating a parallel line to run through Dumbarton and, as the plan shows, reach Loch Lomond at Balloch Pier by a spur running northwards up the Vale of Leven. The gods may smile to see that the engineers of British Railways, planning their electrified route towards Helensburgh, made a switch off the original North British line...
near Bowling on to the original Caledonian line so as to bring an extra station, Dumbarton East, into the modern picture.

**Cathcart Circle**

Railway electrification is mainly of social significance. It is designed, that is, to provide a fast, clean and frequent service for passengers as distinct from goods. The operations on the suburban lines out of Glasgow were therefore aimed at increasingly important targets.

To reverse the order of precedence and take Phase II first: the Cathcart Circle has long served a wide range of residential areas on the south side of Glasgow. Since it was first constructed, and especially during the past thirty years, new housing has been pushed southwards out of the overcrowded city at breakneck speed. Some of the housing schemes of Glasgow Corporation in those parts have the dimensions of small towns, and private building has taken the suburban spread far over the municipal boundaries into the counties of Lanark and Renfrew. It is not unimportant that Hampden Park is on the Cathcart Line, so that the handling of the huge crowds flocking to International football matches and cup ties is enormously facilitated by the swift frequent service of the new trains.

**Industrial spurs**

To return to Phase I, Airdrie-Helensburgh through Glasgow: the plan shows its greater complexity.

It is plain enough sailing from Airdrie into Glasgow, Queen Street, apart from two short spurs running northwards to Springburn and south-eastwards to Bridgeton (Central) respectively. Both spurs serve mainly industrial districts, but the workers have to be carried to and from their jobs, and the purely domestic traffic towards Springburn is increasing as the new housing creeps up the hill. The Airdrie High Street section of this line used to be largely concerned with the mineral traffic out of Lanarkshire, but again the sprawling housing schemes have engulfed many acres of farming land in that direction, and the workers in the Glasgow factories and offices must be catered for precisely as workers have to be carried expeditiously out of the city to the industrial estates that have grown up in those eastern districts.

Westwards from Glasgow, Queen Street, the plan shows the complexity of the loop from Hyndland round by Jordanhill with a spur from Westerton running northwards to Milngavie from the main line. This is territory that must benefit vastly from the provision of electrified rail services. The Milngavie and Bearsden areas have grown immensely as residential places in recent years, and they are still growing rapidly. Hard by these agreeable towns the Corporation of Glasgow has set up at Drumchapel a housing scheme of gigantic proportions. Hereabouts, in fact, is a vast agglomeration of people in daily need of fast transport to places of work in both directions: most of the villa-dwellers into the City of Glasgow, thousands of such as typists and shop assistants in the same direction and thousands of workers from the great housing estates towards the industrial establishments that crowd thickly along the north bank of the Clyde.

Note that two stations hereabouts carry what are virtually trade names of world-wide repute—Singer and Clydebank. At Singer there is in fact a station for the benefit of workers exclusively. In the age of steam traction empty trains might lie here for hours on end, waiting for the emergent hordes. Electric traction now makes it possible, indeed imperative, for the workers' trains to maintain rapid services at shuttle speed. The name of Clydebank is synonymous with large ships; and between them the shipyard on the river's edge and the factory on the hill give employment to thousands of men and women in normal times.

On the short stretch of line between Glasgow, Queen Street, and Clydebank the complexity of the social and traffic factors is formidable. The topography of Clydeside has a character that is best described as knobbly. The hills fall steeply to the Clyde, with many buttresses of rock
blocking the obvious tracks of roads and railways along the riverside. These eccentricities of level presented the early railway engineers with enormous problems, and they were fortunate in having sufficient cheap labour to bore tunnels that would present intolerable financial problems today. The length of almost unbroken tunnel under the City of Glasgow alone is approximately 1 ½ miles; and on the main line, beyond Dumbarton from Dalreoch to not far short of Cardross, there is another stretch of tunnel nearly half-a-mile long. We shall shortly understand the massive nature of the problems these tunnels presented to the engineers of the electrification scheme.

Meanwhile, two new stations have been built within the city boundaries of Glasgow—Garscadden, built to tap the southern district of Knightswood, a suburb created by Glasgow Corporation after the First World War; and Hyndland, replacing an older station of the same name.

The social-industrial pattern prevails for miles westwards from Garscadden—heavy industry, housing schemes, oil installations, shipyards, docks—and none of it without interest for the traveller with an observant eye. About Kilpatrick, however, the scene seems to change, for hereabouts the train rushes into the open, as it were. The ship-channel of the Clyde is seen to widen, the fields of Renfrewshire green on the other side of the river. The great mass of Dumbarton Rock is dead ahead. At Bowling one looks down on the western terminal of the Forth and Clyde Canal, with all manner of strange craft moored in the basin. One may see a big ship come up towards the Glasgow docks, seeming gigantic in the narrow waterway, a fussy tug in attendance. If the day is clear, the jagged hills of Cowal above the outer Firth are seen to make a frieze of peaks against the western skyline.

Dumbarton is a sizable industrial town, its shipyards, engineering establishments, distillery and bonded warehouses offsetting the high historical interest of the Castle on the Rock. In terms of the newly electrified line towards Helensburgh it is important as a junction.

Here at Dalreoch, barely a mile west of Dumbarton (Central), a spur runs northwards up the Vale of Leven towards Balloch at the lower end of the fabled Loch Lomond. The Vale of Leven is a short but busy stretch between Britain's largest fresh-water lake and tidal salt water. Apart from its own old-established industries, it embraces a large industrial estate, in which a great American firm of watch and clockmakers has profitably settled down, providing good employment. The slopes of the glen are covered with modern housing schemes.

Finally, the spur reaches Balloch: the terminal point of the Loch Lomond steamer, the location of one of Glasgow's greater public parks, a yachting and motor-boat centre, well equipped with good hotels: a place on the edge of Highland country, the high mass of Ben Lomond a few miles across the water—in short, from the railwayman's point of view, a fruitful centre of holiday traffic, as heavy on any fine Sunday as during the appointed holiday periods.

Unique Helensburgh

From Dalreoch to Helensburgh the line runs close by the sea; and through the tunnel it passes, in fact, under the site of a castle much used by Robert the Bruce. Industry is left behind. This is farming country, mostly of the dairying sort. Just across the water the steam trains on the Gourock and Wemyss Bay coast lines are seen throwing their plumes of steam against the Renfrewshire foothills until that shore emerges into the long, smoky conurbation of Port Glasgow, Greenock and Gourock, busy shipyards on the edge of the tide all the way over there. The ship-channel of the Clyde enters the Firth proper; the aspect opens up, as it were. Great ships, waiting for the tide to carry them twenty-odd miles upstream to the Glasgow docks, are at anchor in the roadstead called the Tail of the Bank, a fine stretch of safe water between Greenock on the south and Helensburgh on the north.

Helensburgh is the western terminal of the electrification scheme in its first phase. Before it is reached, the swift train from Glasgow has touched at Cardross, a large village or townlet of purely residential...
character, but one which, by some error of navigation or deliberate deflection, had to take a hiding from the German bombers in 1941.

The station at Craigendoran, barely a mile short of the terminus, is important in its own right. It serves the large eastern section of residential Helensburgh. The pier is one important terminal of the Clyde river steamers, always attracting heavy loads of passengers during the summer months. At Craigendoran, moreover, the picturesque West Highland line branches off to run at high level towards Fort William. Since this line touches at stations serving residential settlements along the northern shore of the Gareloch, its diesel trains complete the pattern of accelerated services.

Helensburgh is a town to which the overstrained epithet ‘unique’ is truly applicable. It was laid out by Sir James Colquhoun of Luss in 1775 and named after his wife. The laird’s first intention was to attract what we would nowadays call light industry to this part of his estates, but instead it attracted people prosperous enough to move out of the thickening industrial areas and build themselves villas by the sea.

One would be hard put to it to think of another community in all Britain that is so compact of villas. But these are so arranged along wide streets, lined with flowering trees, so well protected by gardens and orchards, that it is a most desirable place in which to live: on the very edge of wild Highland country, with ‘its back to the wind and its face to the sun’ in the old Gaelic phrase. Helensburgh sends its meed of workers towards Glasgow and its offices and factories, but it is essentially the busy man of affairs who will benefit through the fast services out of this terminal.

The Inglis Report

The electrification of the complex railway system of Clydeside had been specifically recommended in the Inglis Report of 1951 on the traffic problems of the district. The realisation of the scheme, however, presented massive problems of engineering and finance.

Naturally, the engineers had been for years considering the elements they would have to face when the project came within the sphere of practical politics, but it was not until 1956 that they went into action to set out in detail the innumerable considerations the scheme involved. At the same time, the policy-makers and the legal experts had a myriad problems to solve before a case could be presented to the British Transport Commission, which alone could authorise the work to be started.

Any railway line is not a sort of right-of-way. It necessarily cuts across the boundaries and rights of several local authorities; it may conflict with the interests of the Post Office, for instance, and with the rights both of the public and of the private landowner. In the matter of bridges alone—when your plan involves the demolition or alteration of dozens carrying public roads or merely farm service roads across the track, you obviously face many possibilities of friction.

The first task was to come to terms with the Corporation of Glasgow, by far the largest local authority concerned, the city boundaries including the very nexus of the whole enterprise. British Railways were fortunate in settling with Glasgow without undue difficulty, and so it was with all the county and burghal authorities up and down the line. All parties, in short, recognised that the electrification scheme was to be of benefit to the area in general and their own bailiwicks in particular.

The case was presented to the British Transport Commission in 1956, and the necessary approval was duly given. The estimated cost of the project was to be £13½ millions. The first spadeful of earth was turned early in 1957.

One should reflect that that was a long time ago. The work of conversion from steam to electricity has taken the best part of four years. All of it had to be done with the minimum interruption of the ordinary steam services, with a minimum of inconvenience to the travelling public; much of it had to be done during week-ends. Bridges demolished or jacked up or built anew; stretches of track lowered; 200,000 tons of ballast to strengthen the track put into the job; a whole new system of
The guard controls the sliding doors
colour light signalling installed; miles and miles of overhead wires strung on portal or cantilever gantries—all this over and above the complex installations of electrical control and the building of new rolling stock. 'Revolution' is still the operative word.

**Lowering the track**

Just one feature of the work dramatically illustrates the vastness of the problems involved. The Ministry of Transport require that overhead wires, charged with thousands of volts, must have substantial clearance from the roofs of tunnels. It has been shown that the Airdrie–Helensburgh line in particular abounds in tunnels, all these constructed for steam-drawn traffic. How then to get the many inches of clearance required by the authorities? The only answer was to lower the track over considerable sections of the line: virtually uprooting the old rails, digging two or three feet down, and re-laying the rails in a new, sunken bed. We shall see later on how daunting were the problems thus presented to the electrical experts as well as to those responsible for the maintenance of the permanent way.

Mechanical devices of the most advanced kind were brought in to speed the work; but how they were to be applied in an orderly fashion was a question that could be answered only by intensive staff work. Obviously, the engineers, the electrical specialists and the signals experts were in a sense competitors for the freedom of the line; obviously their inevitable overlaps had to be phased with meticulous precision. Quiet week-ends allowed much work in different departments to go on simultaneously, but it was quite another matter to accommodate the pieces of the jigsaw during the relatively quiet hours of the working week, if only because the Glasgow area is peculiar in having four 'peak' periods instead of the two elsewhere, the regional habit being to go home for the midday meal.

As for a vast military operation, as for an exercise in logistics towards its own D-day, the Scottish Region of British Railways created an
operational staff. This group of specialists was housed in one building, so that there should be no waste of time in correspondence, so that one specialist could thrash out with another on the spot their inter-departmental difficulties.

The military analogy still holding good, the technical experts of the Scottish Region approached their own D-Day—or should it be E-Day?—according to a plan carefully thought out. When they could be assured of complete possession of one track at a time, the drill went like this:

1. An Auger Unit went in first to excavate cylindrical holes for the masts. When it had moved on to the next location,
2. The Steel Erection Unit followed, and the mast, supported by a temporary framework, was planted in the hole by the crane. This unit having followed the Auger Unit along the line, there immediately appeared
3. The Concreting Unit to place the mixed concrete about the foundations of the mast already positioned.

Altogether a neat and surprisingly speedy job, but still a massive undertaking over 114 track miles. When the task was completed, the erection of cross members or cantilevers, the installation of fittings, such as insulators, and the running out of the wires were tackled at separate times and as opportunity offered.

One example of highly organised attack on a special problem was the lowering of the track through the Finnieston Tunnel between Charing Cross and Partick Hill, 742 yards in length, to provide the headroom required by the Ministry of Transport. The job could be done only when the tracks were completely clear, and it was accomplished, in fact, during four week-end periods of 30 hours each in winter, when no timetabled services were running through the tunnel on Sundays.

First, a crane specially designed for track work entered the tunnel and proceeded to tear up the permanent way on the parallel track. Excavating machines loaded on special wagons followed, to be unloaded on the site: the whole scene like a film set in the light of bright electric lamps. The wagons withdrawn, a train of empty wagons entered the tunnel to

Boring for mast foundation
Building new station at Garscadden

Building new station at Hyndland

Servicing electrification telephone to Cathcart Control
load the spoil now being torn up by the excavating devices. When all that
was done and the track cleared, still another train went in with a load of
fresh ballast to form a new base for the permanent way. Finally, a track-
laying crane moved in to put down a new track on the fortified perma-
nent way.

Another stretch of tunnel, at Knightswood, presented its own special
problem. Here the line dips under the Forth and Clyde Canal, and when
the track was lowered water could no longer be cleared by the outfall
drain provided when the old tunnel was built. To deepen this drain
would have been an expensive job. This apparently trivial, but exasperat-
ing, problem was largely solved by the installation of an electric pump
at the level of the lowered track to raise accumulations of water to that
of the original outfall.

Every civil engineer engaged on special tasks of this kind up and down
those miles of line has his own story of his own special headache. A new
problem would always keep cropping up as, for instance, that of remov-
ing and simplifying a complex of junction rails at Bellgrove: a task that
occupied more week-ends than the planners liked to spare. Perhaps the
major operation on the route was the complete reconstruction of the
low level station at Glasgow, Queen Street.

This place was too long a grim Victorian relic. It was dark and dank,
water dripping endlessly from higher levels. Positioned between the
ends of two tunnels, it could never be kept quite clear of smoke. The
more impatient sort of traveller cursed it; the wits of the Glasgow even-
ing newspapers lived for generations on the bad joke it symbolised. But
to transform this abode of troglodytes into a pleasant place, fit to be the
principal station of a brand-new electrified railway system, was a major
undertaking.

The main feature of the old station was an island platform, towards
which, with two other narrow platforms on either side of it, the tracks out
of the tunnels converged. There were only two tracks within each tunnel,
to be sure, but there had to be four tracks through the dark station, and
this antique arrangement needed to be sorted out. The transformation
from those original four narrow platforms to two spacious platforms in
the new plan was a great task of reconstruction. It took six months, the
work done in four stages, during which the old tracks were transposed or
uplifted in careful relationship to the elimination of the old platform
faces and the construction of their handsome successors.

Those who never knew the old Queen Street Low Level station can
hardly envisage the extent of the transformation that has been con-
trived—infi nitely more space for the handling of passengers at peak
hours; more contentment for the passenger in bright lighting and tiling.
It is much for busy people hurrying home out of the city, or arriving to
go shopping, that the tortuous approaches to the old station have been
removed and replaced by easy, bright accesses from the streets leading
off the city centre.

The new station at Garscadden has been accounted for. But the new
station at Hyndland is not the one so long familiar to Glasgow suburban
travellers in the days of steam. That is closed; the new Hyndland station
is on the main line and, possessing like Garscadden an island platform,
Serves two well-populated suburban areas, while the old station and its
precincts have been developed as a maintenance depot for the new rolling
stock. Provision has also been made for the storage of stock at Helens-
burgh and Balloch, both terminals. Near Dumbarton, to accommodate
slow-moving goods traffic in and out of the Leven shipyard and other
works, a new loop had to be constructed to get the shunting trains off the
main track while the passenger trains streak past to keep their tight
schedules.

Bailey Bridges

The long tunnels of the old tracks, especially on the Airdrie Helens-
burgh section of the electrification scheme, presented the civil engineers
with their toughest problems. But let even a non-technical layman count
the number of bridges over the stretch of line he uses daily, and the total
will surprise him. Within the Glasgow City area alone, on both the north

---

Hyndland Maintenance Depot
and south sides of the Clyde, 165 bridges had to be dealt with in one way or another.

At any time, the lowering of the track to provide proper clearance for overhead cables is undesirable, and the bridges had to be treated harshly both in Phase I and Phase II of the operation. Local circumstances dictated that the track should be lowered under 38 of them, but 32 bridges were raised and 95, including 34 footbridges, were entirely reconstructed.

The techniques of procedure in this major operation were varied and occasionally dramatic. The heavy arches of a mass of masonry cannot be raised as a metal structure can. Thus, many of them were demolished with explosives, while in some cases it was possible to drop the arch by means of a beam pulled up by a crane on either side. In some cases, where road traffic had to be allowed to flow across and above the track, the engineers could rapidly bridge the gap with that invaluable creation of the Second World War—the Bailey Bridge.

A close look at any one of those bridges, brand new or merely reconstructed, should point to one special and important feature of any scheme of electrification. Gone is the open lattice-work of the old-type iron bridge. The parapets are high and virtually unscalable. For electricity flowing along overhead cables with a force of 25,000 volts—or even 6,250—is a lethal instrument, and there are still a lot of mischievous small boys and not a few adult fools in the world.

The factor of safety alone laid a heavy burden of responsibility on the engineers in all departments throughout those three-odd years of work on the scheme. Apart from the stringent but necessary requirements of the Ministry of Transport, apart from the natural concern of British Railways to protect themselves and their personnel, there cropped up here, there and everywhere some local question of safety raised by police or fire authorities. One odd little special problem was that of accustoming drivers and firemen brought up in steam to understand that they were working in a new element. A steam loco fireman will climb up on the coal in his tender to redistribute the load, and scores of them had to be taught to think in new terms, just as drivers had to be instructed how to handle the controls of an electric train, relatively simple though these are in fact.

Most of us approach electrical apparatus with discretion, so that the replacement of a household fuse can fill quite intelligent persons with alarm. The specialists who have spent years handling the installation over so many miles of the Glasgow suburban lines will maintain, and with justice, that the incredibly intricate complex of apparatus they have put into the job is perhaps the most advanced in the world in terms of safety alone. Even if electrical experts talk a language of their own, their technical terms pouring out as fast as electricity itself, the uninstructed layman can understand that their system, with its elaboration of checks and double-checks, its tight code of controls and signals and escape-routes, is as safe as a boy's miniature railway laid out on the playroom table.

Catheart Control

Power is drawn from the national grid at 25 kV; its handling thereafter is the business of British Railways' specialist staff. Their seat of authority is the Electrical Control Station, an agreeable building of the modern sort recently set up at Cathcart on the south side of Glasgow. From this point, both phases of the system will be fully controlled in all their complexity when the second comes into operation in 1961. It is already controlling all movements over the 52-mile stretch between Airdrie and Helensburgh, both towns a good many miles away.

The nexus of this building is a large, quiet chamber, finely lighted in both daylight and darkness. It is so remarkably silent one marvels that such a huge amount of power can be controlled through it. It is in an almost monastic atmosphere that two men, the Controller and his assistant, sit at a long desk, their eyes on a constellation of lights that flicker against a wide, high, concave screen in a material which looks
Assistant Control Room Operator selecting system voltage

High voltage switchgear
Cathcart—general view of control room

Switching on the power by remote control
like an expanse of modern flooring. (Examined closely, the mimic diagram is seen to be a mosaic of tiles, each exactly one inch square, which can be removed and replaced if some extra warning light is required). The vast screen shows in large scale every convolution of the widespread system. Clusters of pin-point lights—steady or winking or failing utterly—immediately inform the Controller of a failure or, so much better, that all is well along the lines. The technically minded may care to know that the mechanism of this panel is not properly described by that popular word ‘electronic’. It is more closely analogous to the working of the automatic telephone exchange.

Thus this Control Station sits remotely in power, alert to initiate such switching of power as is required to govern the movements of dozens of electric trains running over many miles of track. It does not take many men to keep this command post going—but the Controller and his assistant and a man to attend to the switchboard are on duty night and day, while a skilled equipment mechanic is always at hand behind the scenes. This is, as it were, a brain extraordinarily sensitive to disorders within the system it governs.

The safety factor

It has already been stressed that, thanks to the innumerable tunnels and bridges along these stretches of railway track by the Clyde, the standard voltage of 25 kV must be reduced to 6.25 kV at intervals to meet the safety requirements of the Ministry of Transport by providing overhead clearance at different levels. Now, you cannot slam an electric train out of one track of high voltage into one of relatively low voltage any more prudently than you can drop from top to bottom gear in a racing car at high speed. Within an electrical system the change-down, so to call it, is contrived on what are called neutral sections: that is, sections over which the train must pass on its own momentum, and without the aid of power, as it moves from one extreme of voltage to another.

It is unlikely to happen in practice, but it is conceivable that through inexperience or an error of distance judgment any driver could have his train stopped over one of these stretches of dead line, though they run up to 270 feet in length. So what happens then? The answer is simple. All along the line at quarter-mile intervals there is a telephone in immediate contact with Central Control at Cathcart; there is naturally one at every neutral section. Thus, if a driver somehow fails to carry the neutral section, he hops out of his cab and explains his predicament; and the safeguards come into effect immediately.

That is a simple, but striking, illustration of the degree of control exerted from Cathcart, the Controller's attention always on the factor of safety. The electrical specialist can enumerate a score of devices designed to render the system foolproof—the main power cables carried in covered concrete troughing; the complex of sub-station and feeder station, each with its automatic safeguards; the 93 miles of conductor on the northern line alone to return power to the grid, and so on.

The main 25 kV power cables can either be of the gas-filled or oil-filled type. The gas is sent out from bottles under pressure and the oil from small tanks in order to maintain satisfactory insulation.

Again the bald figures relating to the purely electrical aspects of the scheme are massive. The route mileage of 51-plus involved the equipment of 113½ miles of single track. Overhead masts to the number of 3,462 had to be put up and their foundations firmly established. Booms for the heavy portal-type supports numbered 736. Wiring for the overhead equipment ran to 131 miles. The return conductor cables cover 93 miles in length.

It might seem to those who are apprehensive of electric power that so much of it is under the hand of the average driver, in trains capable of high speeds. They may rest comforted. For one thing, the Airdrie–Helensburgh line is curved along 63 per cent of its length—a fact which largely accounts for the great number of masts, portals and booms involved in the construction. In fact, the driver cannot go berserk effectively, for if he does, there are automatic devices that make it impossible for him to blind along happily. He is himself controlled. In the
dreadful event of sudden illness or collapse that ominously named device ‘the dead man’s handle’ comes into operation. This is quite a simple affair. As in the good old-fashioned tramway-car, the driver’s chief instrument is a key moving round a series of studs, each dictating its own average rate of speed. This key must be held down by the human hand at a pressure of 8 lb, and should confusion or faintness weaken the grip, the spring lifts to break the circuit, and the train stops.

52 track miles

Along the 52-odd miles of track between Airdrie and Helensburgh there used to be 56 signal boxes. There are now only 28. Those boxes, tolerably ugly buildings in red brick, controlled old-style semaphore signals on tall masts. These masts, to the number of some 300, have gone with the wind. All signalling on the Glasgow suburban lines has, like the traction, been electrified in a high degree of automation and with an almost agonised concern for the factor of safety.

Signalling on the traditional steam system was wasteful of manpower in that any one box controlled relatively small sections of the track, and that mainly by the sounds of bells and telephones. The modern electrical system provides for the operator in the box seeing, through gleaming lights on a plan of the sector he controls, precisely the position of every train he has to handle. He does not need to hear the clunk of clumsy levers and watch for the lofty semaphores to rise or fall within his sphere of influence. It is all before his eyes on the illuminated panel. Any signalman, especially in one of the larger boxes, can easily handle traffic that may never come near his station. He can work confidently and lucidly by the tell-tale lights—signals, points at junctions and all the rest of it. His outlook on the progress of traffic along the line is wider than anything possible under the old dispensation.

First: it must be emphasised again that the electrification of these Scottish lines was a Combined Staffs job. The Civil, Electrical and Signalling engineers looked at the complex of problems together, though each in the light of his own responsibility. Thus, when this General Staff came round to the specific problem of signals, the experts in that department worked closely in with their opposite numbers in the other groups. For example, when it came to the siting of signal boxes—eliminating a couple of antiques here, putting in a completely new installation there—a joint panel examined each position from every angle.

No signal box is ever in the position that the layman would think the obvious choice. That choice is governed by a diversity of factors—curves, tunnels, gradients, junctions, and so on. The emphasis is always on the factor of safety, on making impossible the appearance on the line of that phenomenon celebrated in the American song, the Runaway Train. The system of coloured signal lights, allied to elaborate checks and the Automatic Warning System now being standardised throughout British Railways, reduce the possibility of mishap to near the point of disappearance.

Automatic signalling

We have glanced at the new-style signalman in his cabin, a battery of coloured lights on the panel showing him exactly the position of every train within his section, even if they are flowing at the rate of one every two or three minutes in a slow, inner section or at one in four or five minutes in a fast, outer section. His task is to keep the traffic flowing evenly where the working of automatic signalling will not do so. This applies particularly at junctions or in cases in which trains tend to follow each other closely. In the larger signal boxes he no longer depends on the old, conventional ringing of bells, for he has the automatic pattern of operations in his region before his eyes. He has always at his elbow a battery of telephones through which he can ring up, or be rung up by, his neighbour on either side.

It is of interest that signalmen of the old school took to the new technique like ducks to water, appreciating at once the lucidity of the
modern system, appreciating above all the visual command of the track granted them by the lights on the plot of the track before their eyes.

Such old-style signal cabins as have been retained would hardly be recognised by the signalmen of a generation past. The great bank of heavy levers that used to gleam behind the front windows has been moved back and set in the opposite direction under the panel with the glinting lights. The signalman of the electrical era does not need to look out on the track; he looks instead on its picture within the frame before him. The levers are for the handling of points only. They are powered for ease of handling. In several cases, where points far from the box are concerned, electric motors near the points facilitate the shift.

The gear controlling any one of those new signal boxes has the complexity of that of a busy telephone exchange. To the uninstructed eye it looks as if literally miles of insulated wire feed the appropriate impulses to the selective devices. In fact, in the great new signal box outside Glasgow Central station, which must govern movements over main lines as well as those on the Cathcart Circle electrification, and believed to be the largest in the world, the length of wiring installed runs up to some 400 miles.

Staff amenities

The passenger on the Airdrie-Helensburgh main line will observe two new power signal boxes—if he can recognise these elegant modern buildings as such. These have been built at Dumbarton East and at Hyndland within Glasgow. One dislikes to use the word ‘box’ of those two-storeyed buildings. Apart from the complex of delicate machinery on the ground floor, they include mess and toilet rooms for the staff and the maintenance men who are always on call. The signalman on duty operates in a chamber as spacious as a sitting room in a large villa.

The chief mechanical point about both these new control points is that they are wholly powered. There are no points levers to be pulled; the operator has only his buttons and switches to care for, and electricity does the rest. He spans and controls a very much longer section of track and its diversions than would be possible from an old-type cabin, however cunningly adapted to the new system. These two are, as it were, master cabins: so refined in design that the fluorescent lights on the roof may be dimmed when conditions of light outside tend to blur the signalman’s clear view of his moving rings of colour; so neatly laid out that the man on duty may, in a recess behind the panel, brew up a cup of tea or even fry a sausage while the clicks from the console tell his acutely-trained ear what is happening within his section.

As the train-driver sees it, the new signalling system marks another phase of revolution. All gone are the old semaphores on their tall masts. He is now guided on his way by lights.

The removal of the semaphore system was a mere physical necessity. Apart from their inherent clumsiness, these old sky signs, so to call them, cannot be seen through the complex of overhead cables, gantries and catenaries of an electrical system. The new signals, set low and near the driver’s eye-level, are in general like those used at a busy street crossing—the familiar red, amber and green. But they are set deeply within hoods to counteract the influence of bright sunshine and they are reckoned to penetrate fog effectively. Many of them are of what is called the four-aspect type: that is, there are two ambers, one below the red, one below the green and this kind of signalling allows for higher speeds within crowded areas of the track.

Associated with colour-light signalling is the Automatic Warning System which gives the driver both oral and visual warning of the state of the signals concerned.

Subtle techniques

All this implies automation in a fantastic degree of complexity and finesse. Inevitably, Signals must work in close association with Traction. Traction takes in most of the electrical power required and, through its
Working on motor-coach underframe
...swift service to handle the crowds

The driver's cabin
 transformers, reduces it to the much lower voltage required by Signals. But Signals must break down that intake into the variety of voltages required for their operations in several fields so that the more important signal boxes have their own transformers. The signalling system is subtle. It has to be much concerned with interference; its directors, for instance, are adjured by the G.P.O. to abate interference with T.V. reception as far as possible. Like Traction, it must have regard for leakages, and it must use the return cable that takes up the excess discharge of the motive power. It must run its own telephone system.

The co-ordination of all the factors that make up an efficient electrical traction system involves subtleties of technique beyond the lay understanding. This unprofessional sketch of the system may at least suggest that, as between the oversight of all matters affecting power from the Cathcart Control Station and the more intimate control of sectional movements through the signalling system, the web of safety is as tightly knit as the brain of man could contrive.

The observant traveller may notice one somewhat unusual feature of the signalling system—the fact that the signals beyond any platform are placed well ahead of its end. This was done with an eye to the future. The normal through-the-day train consists of three coaches. Rush hour and excursion trains run to six coaches. If traffic demands prove to be heavy enough, we may see nine-coach trains with a total seating accommodation for 708 passengers. Thus the signals have been thrust forward to allow for extensions of the existing platforms. The planning is all for a potentially brilliant future.

**Time reductions**

It is well that the average passenger should understand what is done within any railway system for his safety and convenience, but he (and she, indeed!) is most immediately concerned with the two factors of speed and comfort.

Along Phase I of the Glasgow Suburban Electrification scheme, along the northern bank of the Clyde, a large increase of speeds is assured. During the 'off' periods of the day the trains will naturally run on the local basis, picking up at as many points as possible, but even so a 'slow' electric train will on the average improve on the performance of the 'slow' steam train by 10 minutes in the hour, so rapid is the acceleration out of stations and so high the speeds along suitable stretches of the track. The fast trains for peak-hour service show dramatic reductions in journey time. During the age of steam, a fast run from Helensburgh to Glasgow or vice versa with a large load of commuters took some 43 minutes at the best. The electric train takes 30–35 minutes.

**Scottish built**

The provision of rolling stock is an engineering function, and the coaches used on the electric lines out of Glasgow were designed by the British Railways engineers and built at Linwood near Paisley. The design is unique in that the driver's cabin is glass-fronted and so sloped backwards that passengers can see ahead as well as around: a blessed relief from the claustrophobia of the old-fashioned 'compartment'. The glass windows, wide and high, give an unbroken view outwards, for the seating is so arranged that their frames coincide with the division between each pair of double seats. There is plenty of light, and in those broad coaches—a trifle broader in Scotland than those on the English lines—there is the feeling of roominess as well. The average three-coach train carries 236 seated passengers in comfort, with ample seating and leg room. The doors, controlled by the guard, are automatically opened and closed.

There is no distinction of classes, but there is a pleasant variety in the interior decoration. The upholstery is in moquette, but in two quite different moods, so to speak. The dominant fabric is striped horizontally, giving the general effect of a light, gay beige, but at least one coach in
Overhead power

Wiring train

Feeder and switching structure at Milngavie Junction

At Dalmuir Park Station
Cathcart Control Station

Cathcart Sub-Feeder Station under construction
Westerton Sub-Feeder Station
most trains is upholstered in a deep but warm green. And what traveller of experience would dare to argue that such a choice is without its importance?

The boldest decision of all, however, was to give this new rolling stock an emphatic, bright colour that confers on the trains a special regional distinction. This paintwork is of bold royal blue, a gay hue that has also its historical interest in being the colour used on the steam engines of the old Caledonian Railway. There is no mistaking an electric train in or out of Glasgow, whether it is clearing a long suburban tunnel or cruising at speed through the green fields of Dunbartonshire.

Finally, the line had to have its symbol, a sign to emphasise its status as a public utility. Such a sign has to be simple and easily recognisable. And so the symbol of the interlocked chevrons in blue and yellow came into being.

Any design of the kind need not have a literal meaning, but those chevrons do possess a sort of heraldic meaning. The yellow chevron is the pantograph—that is the spring-hinged instrument on the top of the motor coaches through which the current is brought down from the overhead wires to the motors; the blue chevron can stand for the converging banks of the River Clyde.
Railway miracle

Thus and thus has railway electrification come to Scotland. Phase I, comprising the tracks on the north side of the Clyde, is in being; Phase II, covering the important suburban lines on the south side, will be operational in 1961. The layman who uses the services, and enjoys their speed, cleanliness and comfort, may ponder the massive nature of the operation, the vast amount of theoretical knowledge and highly skilled craftsmanship that have been put into its completion. For this was not a job of mere conversion, not an obvious improvement like substituting diesels for steam locomotives. *It was in fact the virtual demolition of an obsolescent system and the creation of a new one over its ruins.* Over those four years of intensive work a miracle has been wrought, a revolution successfully achieved.

British Railways have had to endure harsh criticisms of the faults they inherited. Those of us who live and work in the area may decently salute them for having so drastically thrust the shards of their inheritance aside and provided a service that ministers so efficiently to the acceleration of business in the very heart of industrial Scotland.