NOTE

This handbook is provided as a service to members. It was originally published in 1984, and some details, such as sources of supply, may be out of date. Similarly, it does not reflect advances in the hobby since that time. Please be aware of these limitations.

However, the vast majority of the content is still relevant today, and the handbook is recommended reading for anyone considering venturing into the garden.

Gauge 'O' Guild Handbook No 6

Garden Railways

in all scales

Edited by
Martin Bloxsom

Front cover

SUMMER IDYLL. GNR C12 4-4-2T approaches Crewchester Junction on Jack Ray's Crewchester, line built on a baseboard, with scenery on the board and shrubs around it to complete the scene. A 0-6-0ST in blue, of private owner origin, awaits its next shunting turn. Photo: Jack Ray.

Contents

Introduction

This is the Gauge 0 Guild's sixth handbook, and one which we hope will be attractive to all outdoor addicts and potential garden railway enthusiasts, no matter which gauge they favour. So, whether you model in Z, N, TT, 00, EM, 0, 1 or any other gauge, including the now popular narrow gauges, you will find much of use to you in these pages.

The book is intended as a handbook and, as such deliberately avoids a conversational or personal style — after all there are eleven contributors! The royal 'we' where it is used implies the experience and advice of several practitioners. This is important, for in the great outdoors there are many ways of doing things well. Where a possible course is ill-advised we have said so.

Our success will be judged when you take our book into the garden for help as you go along, having read it in outline — so why not put it with your toolbox? Obviously, we cannot cover everything, so the bibliography and list of model press articles should provide you with further information we have not had the space to do justice to. Besides finding out how others do it, it is pleasant research when it's raining in the depths of winter!

Many of our readers will perhaps jokingly think that the 'British Climate' which is often 'Weather', as distinct from reliable climates, may nullify attempts at successful garden railwaying. This is not true, and even an electrically operated line, if properly built and maintained, can often put on a session at short notice after rain for visitors or the owner's own pleasure. On a fine day nothing is more pleasant, especially when fortified by refreshments (of any sort!). The methods and products herein described, with fair construction and maintenance, should last for many years. As people move house more often than in former years this should be borne in mind when starting. Don't be over-ambitious — a country branchline rather than Clapham Junction is a more realistic aim. (We have suggested how to make your line moveable if need be!). You can make it large — but you'll need a club of helpers if you do. Your Editor is lucky in this respect, he has young people — of all ages — to help him. Perhaps the ideal is Jack Ray's latest version of Crewchester which can be operated by one man, or by five. Plan carefully, then, before you begin.

If consideration is shown by the initial enthusiast an outdoor railway in a pleasing garden setting can be a family hobby for all to enjoy. Experience would suggest that fanaticism at the outset by the one who wants the line in the first place will create hostility, just as much as if you wanted to build a line in what spare space there is in the house. If you have children who like to play in the garden the line needs to be robustly constructed — there is little point in sticking your best junction signals where the goalposts at their 'Wembley' stand!

If you create a garden line with care, you, your family, friends and visiting enthusiasts will enjoy if. I can only quote Ray Tustin's wise advice given in 1949, and still true now *(a). . .smart little line will make them realise that the person with a garden railway is a person with a hobby really worth having.*

Martin Bloxsom,
Gilmorton,
Leicestershire.
March 1984.

Contributors

The Guild and readers owe a debt to the following authors, who have contributed directly to all the chapters. Most are well-known and need little introduction from us. Much has appeared from them in print — two of them are the authors of standard texts. Their total garden railway experience is probably over 150 years! So thank you, in alphabetic order, to

Eddie Bray, LNWR Loughborough Branch
John Chamney, LMS Mainline
Deryck Featherstone, LNER Wingham Branch
Pat Honey, GWR Black Park line
Phil Johnson, LNER/LMS, North Charnian line
Don Neale, LMS Kirtley Branch
Jack Ray, LMS/LNER Crewchester line
George Reffin, SR/GWR branch line
Ray Tustin, SR branch line
Barrie Walls, LNER Wallsea Branch
The Editor, LNER/LMS Holt Branch

It is worth noting that Eddie Bray has built an attractive line in just three years of spare time, a lesson of hope for all those contemplating such an enterprise, whatever the gauge.

We also wish to thank John Constable of The Nursery of Miniatures, Ilton, Somerset, for much help with the chapter on garden scenery; Mr S C Pritchard of Peco Ltd., Seaton, Devon, for much useful information on Peco track and other products; Ken Sheale, Guild Technical Officer, for electrical information for garden lines; R M Shirley for information on planning permission controls, together with the Editors of our national model railway magazines for articles quoted and previous Handbook reviews. I would also like to thank Brian Burchell, famous for his 00 Gauge outdoor line, who has given freely of his considerable experience in the smaller scales; Ken Longbottom for help and advice over a long time; Mr J B Young of the Ruberoid Co. Ltd. for advice on mastics and their use out-of-doors.

Your editor owes a special debt of gratitude to Mrs J Tyler for her typing skills, and to his family for their fortitude in putting up with his frequent absences enjoying other peoples' lines, all with the aim of supposedly putting this together! As always, Roy Jackson's printing expertise is a godsend when preparing the whole package for publication. The Guild's Publications Sub-Committee have guided the whole project with tact and patience for one of our most ambitious projects to date.

ARTHURIAN MAGNIFICENCE! SR No 453, "King Arthur" at George Reffin's outdoor station. The lovely buildings, lamps, fencing, signals and vehicles are all packed away in a few minutes to leave bare platforms and track when running ceases. Note the effective rock "back drop" with its mixture of evergreens and deciduous plants. Photo: B. Monaghan.

Chapter One

Why Out-of-doors?

The answer will probably be because there is no room in the house! You may find, too, that once-spare rooms for railways are later commandered for a growing family, demands for teenagers to have rooms of their own, and other reasons. Alternatives are the roof-space — hot in summer and cold in winter unless well-insulated. You may want a line outside for summer months and the use of another inside. Additionally, you may have a small gauge and scale indoors and larger ones out-of-doors, a pleasurable mix. For those who don't, there's plenty to do indoors in the winter in the way of construction and maintenance of stock, anyway. Spring, Summer and Autumn you'll probably be very busy outside. Put this way, it adds up to the desirability and lure of going out into the garden, where you can have real scenery and a real challenge from the climate, which is more like the prototype than the idealised indoors will ever be.

Climate and Scenery

To expand a little more on these points, the much maligned British Climate is not totally unsuitable to such railwaying. In Inverness there is a fine Gauge 1 garden line, which is integrated into the garden at ground level, and is electrically powered. It does not seem to suffer from being so far north, where it can be quite wet, too. There is no reason why this should not work in the smaller gauges provided that the railway is properly built, regularly run and carefully maintained. For those living in warmer climes, outside the British Isles, the problems may well be caused by heat, expansion, and pests such as termites!

Scenery can mean creating a miniature landscape which lives and grows because it is the real thing and has an identity of its own. This looks most effective where there are ground-level lines literally landscaped into the garden environment. Even a line on baseboards can be effectively landscaped, provided that you plan this with care so that, even if it is sailing three feet above the ground, it won't look like that! It has the advantage that you won't need to bend down or lie down to see the trains dashing past.

Problems including Security

You will encounter problems, but don't let them kill your enthusiasm. Most of us have met them, and the person hitherto ploughing a lone furrow can rest assured that his or her problems are not unique. In these pages we shall deal with those of planning, siting, building and operating your railway. There are others we can deal with now. Of these, one may be your own family, not so much their attitudes — our introduction tells us about that — but the physical presence of small children or boisterous pets. Animal life can be detrimental to model railways, so build with this in mind. Short of them chasing trains and knocking the models about with disastrous consequences, your line should stand up to their attentions when traffic is not running. Wild creatures may cause problems but again these are usually of a minor, temporary and repairable nature.

Security these days may be another matter. Your stock should be well-secured when not in use and locked away. It should be insured if it approaches any value. The Gauge 'O' Guild runs an excellent scheme for its members which covers stock, electrics, even the track and 'outside works'. Planned by an insurance expert who is also in the hobby, it is preferable to most house and contents policies which may not cover you so well. It is worth thinking about this.

Plan your own security. A rear garden site, surrounded by a fence or hedge of sufficient height to deter unwelcome eyes, is a good idea. Cultivating friendships with your neighbours will help in this sphere, and a collective security so developed is quite reassuring when you go on holiday. It may also dispel their doubts as to your intentions once you start digging mysterious holes up and down the garden for your railway foundations! You might even initiate them into the hobby.

Scales and Gauges

A glance at the national model magazines and other books published in the recent past on this subject, will show that just about every gauge from N to 1, and bigger, has worked with success outside. This means that you can go ahead, whatever your scale and gauge. As indoors, it was once true to say that the bigger the scale or gauge, the greater the cost would be. Unquestionable in the past, it may not be true now, in the light of narrow gauge developments in recent years, where you can build your own stock cheaply and power it by batteries, as Don Rowlands and others have done. Space requirements for narrow gauge, even using a large scale, may be less, say for LGB on Gauge 1 track, than for a big 0 or 00 gauge line in 7mm or 4mm respectively; again, think what you intend to do before you begin.

Some scales appear in coarse and fine varieties, particularly 0 and 00, and a note on these seems appropriate. For years people claimed that coarse scale in Gauge 0 was just about the only way to do it in the garden, but many finescale railways exist in that gauge today, so how has it been done? Basically, by greater care in foundation construction, track laying, and the use of compensation on the chassis of *all* vehicles on the line (it seems to work better than springing) by several well-known modellers. In 0 Gauge, Ken Longbottom uses and recommends a flange-depth of at least 1.5mm, which will keep the stock on the rails quite satisfactorily in conjunction with compensation. The width of wheels can be normal fine scale (in the 3.5mm to 3.73mm range) — after all wheel width doesn't keep things on the track, it is the accurate back-to-back measurement of the wheels and flange depths, and careful pointwork engineering which do the trick. The ultra-fine scale work of the EM, Protofour and Scalefour Societies show this to be true for 4mm and, given what is said of 0 Gauge above, then these smaller scales should work outside, too. However, the temperature changes (in Britain) tend to be greater than inside the house, so track-laying on firm foundations is vital. Lines at ground level may present more problems than the baseboard types, where marine ply or absestos-like materials can be used. (The latter needs care and safety precautions to avoid health hazards when being worked). Some clever folk get round it by building a type of ground-level baseboard and then putting the garden around it (see our next chapter). All this means that ground level lines in 4mm are quite popular, using normal commercial standards, components and rolling stock, as Bryan Burchell and Don Jones have splendidly proved. Commercially available products in N Gauge 2mm scale have over-scale flanges which should help them out-of-doors, but the true 2mm scale model may present problems, not least that of adequate weight to prevent it from blowing over!

The advent of scale appearance track by Peco and others helps tremendously, as does its flexibility when laying. Tight radius curves with flexible track will cause problems as it will pull too-tight to gauge, whereas in reality it would be slightly over-gauge. But, then, we go outside to avoid the tight radii of indoors.

The larger scales, such as Gauges 1 and 0, tend to present less problems all-round; but small ones can and do work excellently out-of-doors. Why not have a go? For '0' Gauge the 0 Gauge Guild *Handbook* No 2, on 'Standards' should help you a lot. Whatever your scale and gauge, adopt one accepted set of dimensions and then stick to them.

Images old and new

One great advantage of the hobby is that you do what you like. For example your railway can be an outdoor version of one of those incredibly accurate models of a GWR branch line which produce a social and historical picture of the 1920's in a railway setting. Alternatively, you can go free-lance narrow-gauge and have just as much enjoyment for probably less bother. Many of us are somewhere in between. A model of a preserved line, of course, allows you to mix time periods without appearing incongruous to critical eyes. A modern image line, often neglected outside, has the benefit of relative simplicity in this post-Beeching age in the U.K., whether in a very plain track layout or in its signalling. Most gauges can offer ready-to-run commercial items and kits, too. Narrow gauge, besides its own charm, is bigger in relation to the track in the

larger scales, and is ideal for all the family; it can provide simple, efficient, steam-powered locomotives without resorting to expensive, high-class, miniature engineering for those who lack skills, tools or the money. Out-of-doors, too, a railway mixing several gauges is perfectly possible, although mixing scales would look rather weird! A narrow gauge line usually acts as a feeder to a standard gauge line, but a more unusual model would be the reverse of this.

Ambition, the time factor and enjoyment

Whatever type of layout you produce, make sure that your head rules your ambitious heart, otherwise your hopes may be dashed under a labour paralleling that of Hercules! If you wish to build an extensive line then much time will be needed in making it and maintaining it, too. You will probably need helpers. John Hart and Jack Ray did this, and your Editor still does, with young aides who provide a fine club atmosphere, but it could be that you never complete it; even a simple garden railway may well be a long-term project as it is. If your work is likely to force moves of residence then simplicity is desirable. It may be possible to make a movable, modular outdoor system, as chapter 3 shows.

Maintenance, rather than the initial building, may be your main problem. Be clear that maintenance is not just needed by the outside railway and its surrounding scenery, but by its constructional features, such as baseboards, bridges, station platforms and the like. Then add to this rolling stock, signals, point operation – everything needs attention. Jack Ray changed his famous Gauge '0' Crewchester line, which had intensive clockwork operation, to a simpler two-rail line, where he can operate sections on his own, out-and-back, or bring in several other sections when up to five other operators are present. It is done by using plug-in controllers, and thus opening sections of the line as required. On his own he can shunt indoors in inclement weather or operate outside on a fine day. This seems an excellent approach.

Jack Ray's adaptability is worth noting. A doyen of the Gauge '0' scene, he learnt the newer 'electric art' by visiting other's lines to see how to do it! Such visits are well-worth it as it is. In time, and given progress, others may wish to visit you. In the Gauge '0' Guild, this is the 'done-thing'; its merits are obvious. Many Guild local groups will help here. Others do the same in their societies, and Don Jones runs a pleasant informal network association from his home, embracing several gauges, aimed at an interchange of ideas. Operators in one gauge should visit not only railways in their gauge, but other gauges and scales too. In the winter, many '0' Gauge Guild members view excellent slideshows created by Jack Ray; with 40 programmes, half of them on outdoor lines, more again can be learned from an armchair!

So, you have by now placed yourself in a branch of the railway hobby with enormous scope – unparalleled, garden addicts would say. Not only is it a healthy, outdoor hobby, but it can be pursued inside in winter too, in the close season. Given the potential here outlined, there is great enjoyment to be had. We trust that the following practical chapters will aid you in pursuit of this admirable goal.

Chapter Two

Plans and Planning

This chapter deals with planning your line in the garden, siting and other basic requirements, together with planning permission from your local authority as it applies in the UK.

Layout plans and planning

Your own garden's size will determine the length of line and its basic shape. If you are fortunate enough to acquire a garden when buying a newly-built house, then it is possible for you to create a garden and model railway together. It will mean a lot of hard labour, particularly if you find the garden in the state normally left by the builders! It may be worth it if you stay in that residence long enough. Most of us inherit an existing garden, which you may adapt over time to your requirements.

Track Plans

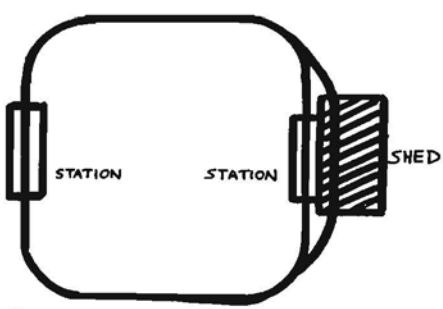
You may wish to portray an actual prototype line, or one from your imagination. Whatever the scale or gauge, remember that the bigger it is the more time it will take to plan, build, run and maintain. It will probably need more operators, too. A continuous layout may seem ideal, particularly if you want to sit in the middle and watch the trains go round. A line that is out-and-back may help the single operator, and if combined with a continuous circuit can give the best of two worlds. If you mix electric and steam power it would serve both. For steam, a continuous line is ideal; essential some would say.

An 'end-to-end' line can be fun, with possibly both termini housed in the same shed, alongside each other. This will suit one operator, or two, with possibly an extra station outside which can be brought into use as required for extra operators if they become available. Alternatively, you can have separate termini in separate sheds. Here trains go somewhere and disappear. One terminus could be just a storage magazine without scenery – really an indoor 'fiddle-yard' if you wish. It would save on scenic work indoors, too. However, separate termini allow you to put in phones and block instruments to add to the delightful illusion of railwaying. Extra stations for more operators may be added too. Basic plans are shown in *Diagram 1.*

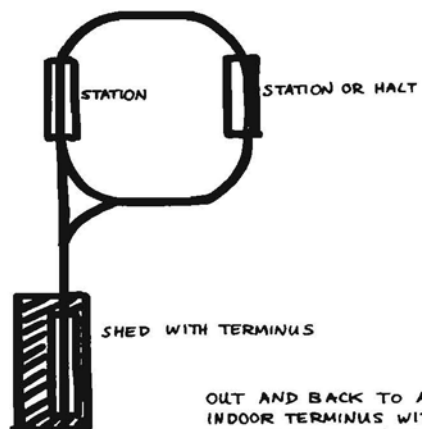
All this said, you can build a layout which incorporates all these ideas, as on Jack Ray's new Crewchester (see Press Articles appendix, and *Crewchester the Phoenix* MRC 1982).

Diagram 1

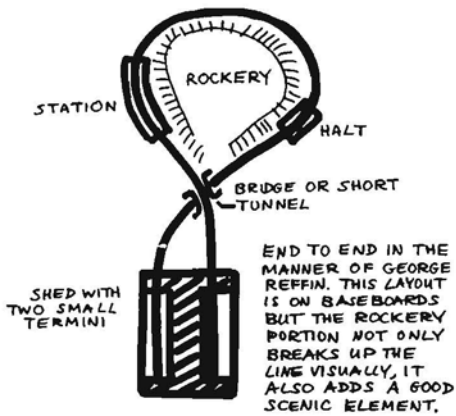
Some Garden Railway Plans

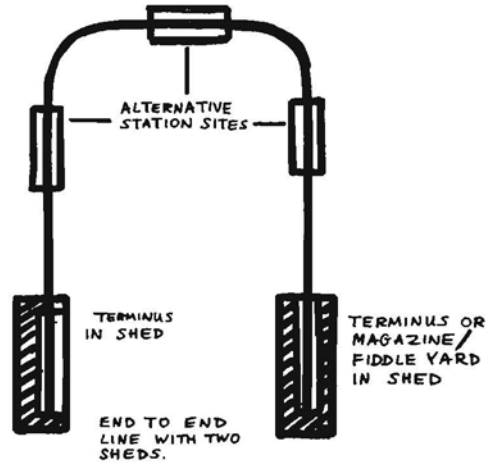


CONTINUOUS LINE WITH LOOP FOR SHED IS IDEAL FOR LIVE STEAM RUNNING.



OUT AND BACK TO AN INDOOR TERMINUS WITH CONTINUOUS RUNNING FACILITY INCORPORATED.





ALL STATIONS SHOWN IN ALL THE PLANS ARE, OF COURSE, OPTIONAL. EXTRA OPERATORS CAN BE USED FOR THE OUTSIDE STATIONS AS THE NEED ARISES

Levels and Curves

Levels and curves are important, and outside, at least, the greater room should mean that gradients are kept easy, and curves to the greatest maximum possible. *Table 1* gives basic recommendations for all scales, and motive power. It is designed for standard gauge main lines. Narrow gaugers may do as they please, but here again it depends upon the motive power to some extent, not to mention the weight of locomotives and rolling stock, and their free-running properties. Even a mountainous line of the NG variety may have straights between reverse curves; a standard gauge main line certainly will. Don't build a line and then flog your motive power mercilessly to get it to haul reasonable length trains at reasonable speeds.

Table 1
Gradients, Curves, and Motive Power

Maximum desirable Gradient
(All Gauges)

Clockwork	1/80 to 1/100
Potboiler Steam	1/70 to 1/90
High Pressure Steam	1/60 to 1/80
Battery Power	1/80 to 1/100
Electric	1/50 to 1/60

This is for straight stretches. Gradients should be eased if many curves exist.

Minimum desirable Curve Radius

Main Line	Gauge 1	0	00/H0	N
Clockwork	15ft	8ft	—	—
Potboiler Steam	10ft	6ft	—	—
High Pressure Steam	10ft	6ft	—	—
Battery power	10ft	6ft	—	—
Electric	10ft	6ft	3ft	2ft

This is for level track. Increase on gradients. Super-elevate if high speeds are required.

From Table 1 it will be fairly obvious that clockwork, pot-boiler steam and battery powered locos suffer most on sharp curves and adverse gradients. Battery power may suffer less if weighted over the traction wheels. Normal electric power, assuming clean track, suffers the least problems, but even then we don't recommend you building a severe incline into the middle of a long run on a set of reverse curves! On the other hand, a steep harbour line, modelled on Folkestone Harbour for example, or to a quarry, can provide plenty of operational interest.

The late Bill Stocks' Heatherfield Light Railway had unusual inclines which fascinated operators and viewers alike. It might be better to make it a branch feature, rather than literally the centrepiece. Variations add interest, but if overdone for gradients and curves may be frustrating and time-consuming to correct.

Heights and Garden Position

Positioning of the line may determine this as well as your garden's physical geography. A line may be either in the flower garden and rockery, a typical pattern, which suggests a ground level line, or on an outdoor baseboard, up to three feet or more off terra firma, another typical system. Some layouts manage to marry both types.

If you choose the first option, of siting the line by the lawn amid the herbaceous borders, build it near to the lawn or path, so that it can be reached easily, let alone constructed easily. It will avoid damage to plantlife, too. A rockery adds dramatic terrain. Don Neale's line shows just how well this can be done. An 'inherited' rockery may be adapted. One especially created to fit the line like a glove is better. (Details on construction appear in the next chapter). Unless your line is in a tall rockery or the garden slopes considerably you will view your trains from above, besides making maintenance and reaching the stock back-breaking. Pits for operators to stand in will get over this, where these are required. The main advantage, of course, is the natural landscape for your railway.

You may prefer to use baseboards instead. Here you don't have to bend down much, or you can sit and watch trains as you wish at a comfortable level. If the baseboard is wide enough and strongly constructed, scenery can be built onto it. Alternatively, a rockery may be built at the rear on the ground. You may compromise and fuse the two. In '0' Gauge a width of 4in (10cm) will take one track, so a baseboard width of 18in (45cm) will provide room for a single track line and scenic effects. 24in (60cm) will do for double track. Stations etc, will mean using a greater width. If scenery is not important then 8in (20cm) for single track, 12in (30cm) for double track will provide basic lineside room in 0 Gauge, and pro rata in other scales. A baseboard much over 36in (90cm) will cause problems in reaching small things at the back of it. With access from both sides – not always possible in a garden – you can easily go up to 60in (150cm) for adults. Of course, at this width the line is all rather obtrusive, even an eyesore to some, and really only of use if you are planning a large station with all its facilities. All track and other features need to be accessible, especially such items as point motors, both on or under the baseboard.

Find out where the intended route is in sun or shade, so that you can plan accordingly if it is at ground level. This may mean solid foundations, i.e. embankment or viaduct, in a shady area, with a more open structure on the sunny side of the garden, particularly if you are keen on flowers and shrubs. A railway can be put on a grassed embankment, as long as it is firmly held in. Cutting around it would be by a Flymo or similar machine, but that would put grass over the track which, in the small scales, or fine scale '0', could be a nuisance.

The costs of all this need to be borne in mind – single track is cheaper and provides an illusion of greater distance. A baseboard structure in reasonable timber can be expensive, more than a ground level line, rockery included or not. Maintenance might be more expensive also.

Sheds and Buildings

General Points

A shed or outbuilding is a necessity for storing stock and to put it in should it rain heavily. For a continuous run and/or steam power a shed on a loop line is a good idea. For other forms of propulsion the shed is best at an end of the line, near to the house where it can be seen. The larger scales will need a bigger shed, particularly if a mainline or important branch is modelled. Small branch lines and narrow gauge railways tend to be less demanding in this respect. Remember, a six coach train and locomotive will be around 10 feet long in O gauge, suggesting

a shed at least 14 feet long to take it and some simple track work at a terminus. A simple, short branch terminus, with 3 coach train and a tank engine will occupy 6 feet or less, so saving space. If you model far back in time note that trains were generally shorter, as were the locos, yet a passenger train can have a lovely variety of 4 and 6 wheel coaches.

Planning permission in the UK.

If you wish to build permanent accommodation for all or part of your garden railway there are two basic questions to be asked over Planning Permission and/or Building Regulations approval.

Firstly, will the accommodation be in the form of an extension to the house or secondly, will it take the form of a free-standing building in the garden?

If the former, Building Regulations approval will be necessary. Planning Permission will be necessary if (a) the extension projects beyond the forwardmost part of any wall in the original dwelling which fronts onto a highway, (b) the highest part of the roof of the original dwelling house is exceeded, (c) any part of the extension exceeds 4 metres in height within 2 metres of the boundary of the property, unless it is an alteration to the roof or a dormer window (d) the extension, either on its own or with other extensions (including garages sited within 5 metres of the dwelling), exceeds 70 cubic metres or 15% of the cubic capacity of the original dwelling up to a maximum of 115 cubic metres, (in the case of terraced dwellings i.e. of 3 or more dwellings within conservation areas, the maximum permitted volume is 50 cubic metres or 10% of the cubic capacity up to the same maximum of 115 metres), (e) the ground area covered by the buildings exceeds 50% of the site area of the property excluding the ground area of the original dwelling house.

If going for the latter option – a free standing building in the garden – for planning purposes a model railway room is generally regarded as being consequent to the enjoyment of the property (unless it is for club purposes) and Planning Permission will not be required unless (a) the building is erected between the house and the highway, (b) the height exceeds 4 metres at the ridge or 3 metres in the case of a flat roof or (c) the building covers more than 50% of the curtilage area excluding the area of the original dwelling.

Building Regulations approval will only be needed if the building is less than 2 metres from the house, or if it is in excess of 30 square metres floor area.

By the way, don't forget that fees are now payable for Planning and Building Regulations applications.

It must be stressed that the above constitutes only a general guide, as at the end of 1983, and the interpretation of the regulations may vary between local authorities. You are advised to check with your local planning authority before embarking on constuction work. It could save you time and money in the long run.

Other buildings

If you wish, this leaves you with a free standing wooden shed, which even then should not exceed 30 square metres floor area. The average shed won't come anywhere near this, for example one 24 feet by 10 feet will fit into this with plenty to spare! Again, try not to exceed the volume limits previously stipulated. Many firms supply 'garden sheds' to basic designs of modular construction, whose door and window positions may be varied to suit your own requirements. Costs will vary as some are weatherboard lapped joints or, more expensively, tongue and grooved. Roofs are best nailed, stuck and felted. Floors are usually included. (In 1983, a 12 x 8 foot free standing shed locally costs £255, delivered and erected, excluding V.A.T. By comparison a good, handbuilt 'O' Gauge Pacific will cost at least £500.) Of course, you can pick such sheds up secondhand, which may save you many pounds. Whatever you do, you'll need a level site, and it will be best to put the shed on loose bricks, so get plenty of those in good condition. Once joined to the railway it won't move unless it is in a very exposed position.

Having obtained your wooden shed it can be lined with a modern insulation material to keep it warm. A fire proof or fire retardent material is best. Avoid fire-hazard products. You can

now line it with hardboard on the top, nailed or screwed to the frame supports which stand proud normally as inside framing. Your interior should be quite snug. Heating again demands safety given the nature of its material and construction. Electricity, although expensive, is probably safest if a modern fan/convector air-heater is used. A portable one which will switch off automatically if smothered in any way over its air-intake is excellent, particularly if it will also circulate cold air on hot summer days into the bargain.

Make sure that windows can be secured and latched from the inside. Wire or bars inside the window will act as a deterrent and is advised. Where the railway leaves the building a lockable hatch is a sine qua non. It can run up and down on interior sliders, its bottom cut out to fit snugly over the track. The supports can be covered in brickpaper to look like bridge abutments. Door locks in many sheds, even to house extensions, are often simple mortice ones. Put in a more sophisticated one. Two locks may deter vandals wanting to force an entry as it will take them more time to do it.

Inside whatever building you have, put the layout at a workable height to avoid undue stooping. This means that 2ft 6in is to be preferred to 1ft 6in. Width varies, too, but anything over 3ft and you'll be stretching to reach things at the back. Attempting to couple up a 3-link couplings at that distance is literally a cursed business! In a building with a brick base you can make an operating pit if necessary. If so, a sill round it by the door is needed, otherwise you'll have a bathing pool. Raise the door, then, at least one brickcourse. Your baseboard inside can be made in the usual way and fixed. Wood can be used. Dexion-type framing, with chipboard on it so it can be removed as one unit, has been used with success. If the layout is put down one side of the shed you will have room for other essential equipment, including storage space. Don't however put in heavy things like lathes without carefully working out what loads the floor will take. Even a very small lathe will create vibrations in a wooden floored structure.

Some folk have used greenhouses with brick bases but the huge temperature variations can wreak havoc with rolling stock. In our experience such structures should be avoided if possible. A lean-to greenhouse which has its south wall of solid brick, is insulated and has roofing felt on it is better, as Don Neale has found. In winter bring the stock indoors, unless you have a building permanently heated like the house. Left in it ferrous-based materials will ultimately rust, particularly steel wheels and carriages of steel with glass windows. Locomotives may well fare even worse.

Details about using mains electrical power in your building are outlined in the chapter on Power, but don't forget to put in enough sockets, and light it well, both for the layout and anything you might wish to get at during the hours of darkness.

Chapter Three

Foundations and Track

This is where the real work begins! Ideally, start in Autumn, little grows then or for several months ahead.

Levelling

Having planned your layout's configuration, position in the garden and its length, you should work out width, curve radii, heights and, if in a cutting, depths. This is fine in a level garden, but most slope or undulate. Avoid a switchback by levelling. A library can supply basic books on surveying, or you can do it yourself.

One method, without a theodolite, is to use an accurate telescopic gunsight on a tripod with an accurate spirit level strapped on top of it. Do this along the centre line of your trackbed and mark carefully with pegs. For a ground level line these peg tops should be at the surface level of the track to be laid, called the formation level. On a level line this is easy, using a long spirit level on a board with true parallel edges. Set the first peg to the level wanted and then at a set distance the second, knocking it in until the required level is obtained. Repeat as desired. For gradients Ray Tustin's simple method can be used, pegs being a standard distance apart, say every metre. For 1/100 the rise/fall will be 1cm, for example. On a rising gradient drive a nail horizontally in to your second post at the required height, 1cm from the top, and true the level board to dead level between this peg and the subsequent one each time. On a falling gradient use a 1cm thick wood fillet on top of the second and subsequent posts each time, truing as before. Grave undulations are avoided. How accurately you then build it of course, plus any natural subsidence, will account for any deviations from the norm.

A second method is to level using a water tube. This should be of rigid, transparent plastic, long enough to bridge your pegs/posts. It is held up against the posts and a sufficient length of the tube is left empty so that levels can be taken easily. It is accurate, too.

The above methods will work at ground level on a surface line or on a line raised on baseboards. With the latter the actual posts can be used as the levelling pegs, or if they are in pairs side by side, their centres, but they need to be put in with accuracy, particularly in the vertical plane.

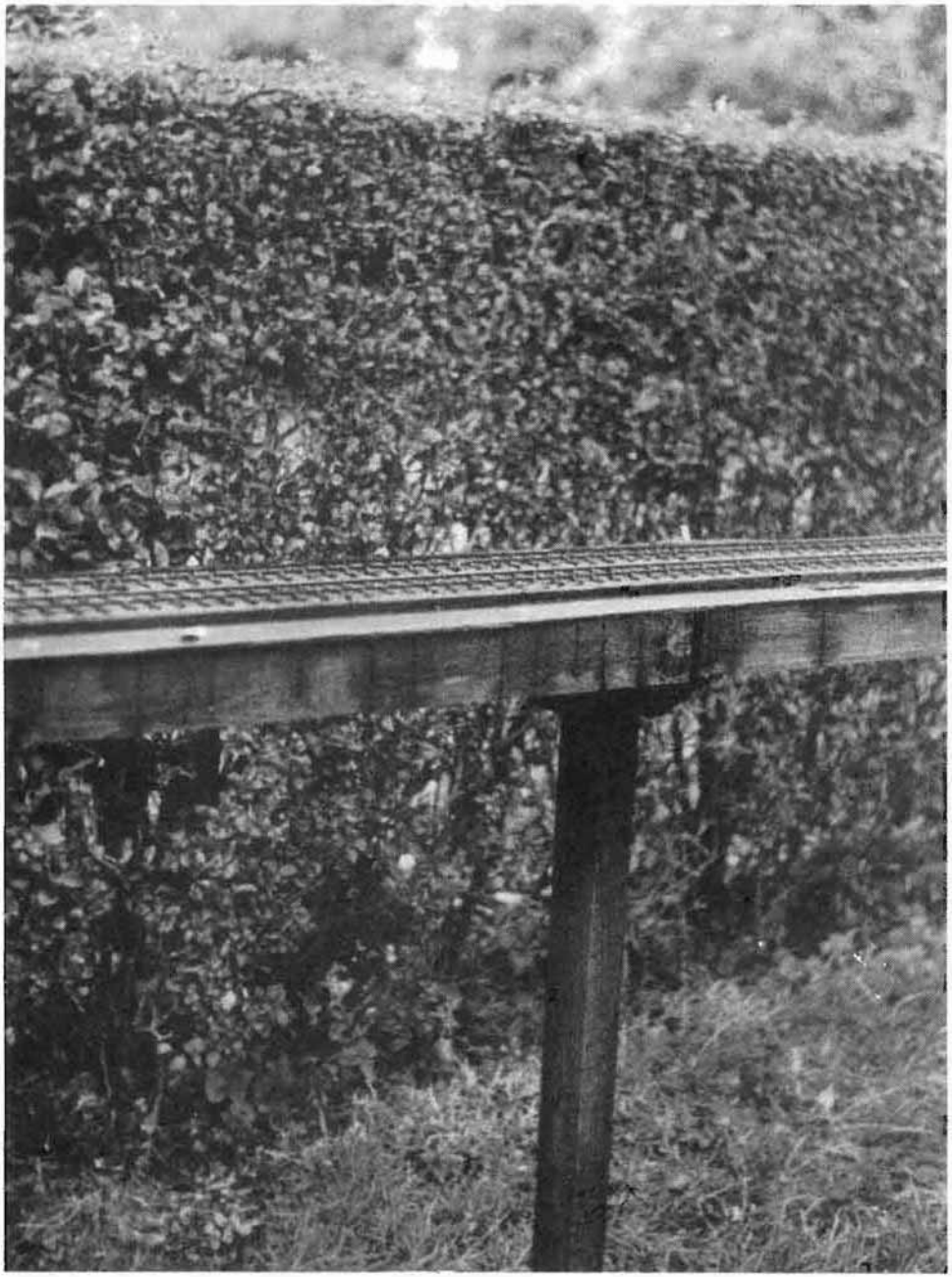
Foundations

If you get these right then a good line should result. There are several ways of doing this, whether for a baseboard type, or a ground level line. A layout may combine both. We have tried several ways and, doubtless, new methods will be developed, too. Ours do, however, stand up well and have stood the tests of time and weather. The two types are separately described to save you searching about in this long chapter.

Baseboard type

Unsightly though these can be, they involve less backbreaking toil. The ugliness can be disguised, too. This type can be of a temporary nature and also removable. At a height of three feet or so, you can view trains at eye-level, an advantage over the ground level line. As you get older, too, and your back stiffens, it is easier to get at and maintain.

Post and baseboard heights used tend to be between 15ins and 3 feet in '0' and larger scales, but lower heights have been used in "00' and 'N'. Widths will vary. Chapter 1 suggests some '0' gauge dimensions if you wish to put scenery on the baseboard. If you do, it will need to be strongly made to take weight, particularly if soil, stone and concrete are used. Curves can be marked out on a wooden template, which should have several marked on the centre line of the template if it is wide enough. It should bridge the disance between post supports if possible.



TIMBER BASEBOARD SUPPORTS by Deryck Featherstone. Oak Post into ground. Finescale Gauge '0' track on asbestos baseboard. Although narrow, room is left for signals, fencing, etc. In use 20 years when photographed! Photo: D. Featherstone.

Another template type can be accurately cut to track width. Metal *Tracksetta* types are commercially available in the smaller gauges to help you. (See *Table* 1, Chapter 2).

When putting in posts do try to avoid tree stumps – they sometimes take on new life! Tree roots such as weeping willow, silver birch and, worst of all, poplars, should be avoided. Don't plant such trees after you've built the line! Hardwoods can be very expensive, but oak posts will last and needn't be set in concrete. Coat all wood liberally, not just the wooden posts, in creosote before you begin. Leaving them to soak in an old tin bath for several weeks is best. You can put posts in concrete if you wish, but a core with bricks and stones in it will help. Ideally, even for a single line three feet off the ground, you'll need pointed posts, 4ft 6ins long, so at least one third of them are below ground level. Don't use softwoods, or poor posts, it isn't worth it. An angle iron stake can be fastened alongside the wooden post by bolts or screws if you wish to support the line should your wooden post rot. Your soil acidity will determine this, plus how well it is drained. Some clays are dreadful. Many of us use farmer's 3in square fence post stakes of oak. Drive it in with a heavy mallet, but use a block on top of the post to avoid damaging it. Broken bricks, stones, etc., will help consolidate it. A helper is desirable – two can do very well together what one person would find almost impossible. Rough sawn timber will do, it takes creosote better. Some lines have used telegraph pole posts – very substantial. See *Diagram* 2a and the photographs by Derek Featherstone of the posts which support a finescale '0' Gauge line of 30 summers standing.

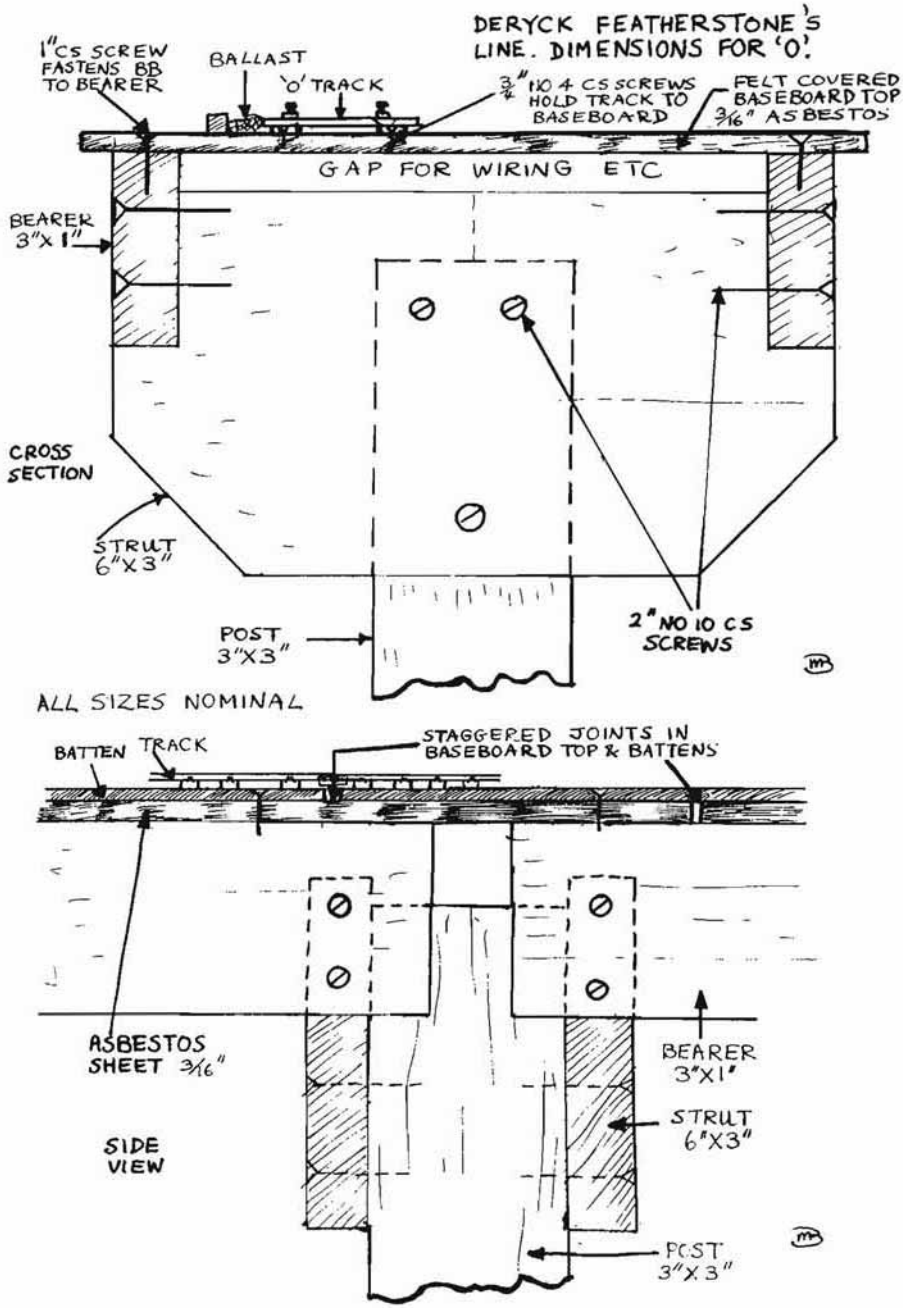
George Reffin uses posts fixed to a base plate, worth doing if you anticipate a move. If prefabricated it would be ideal. This system too is well made, and its main features are shown in *diagram* 2b. Barrie Walls uses a post system illustrated in *diagram* 2c, which is also removable and dismantleable, too. This rests on a (broken) paving slab. His pillars are 2in square legs from 24in to 30in high, and up to 12in across to take two '0' gauge tracks. At the top it is fixed to a steel plate to take the baseboard and its frame. The bottom has a short piece of old bed angle-iron screwed to it. This system, prefabricated again into sectional lengths of 6 to 8 feet, has the merit of being easily adjusted for height if necessary.

The distances at which you put your posts will vary. With telegraph poles it could be 6 feet. With 3in square timber not more than 4 feet is advised. In the small scales, and at a lower level, it may be possible to use timber at intervals of 3 feet too, provided that your framework to support the baseboard is strong,too. *Diagram* 2d explains other methods.

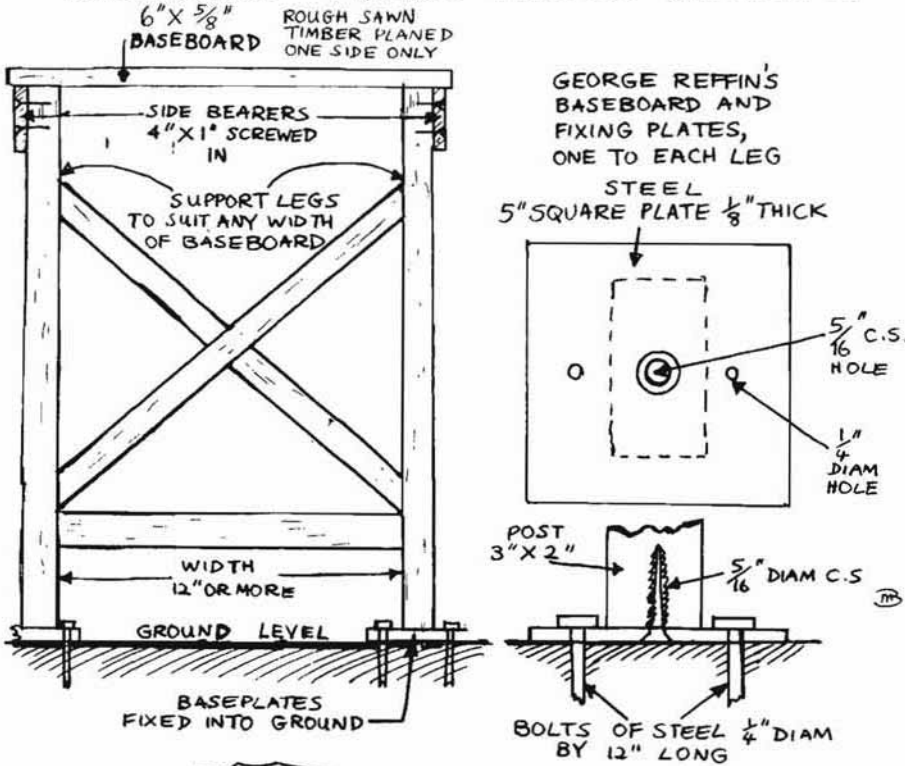
Another way is to build brick pillars. A source of the bricks is a demolition site, but pick clean ones of the same size. You can also get them from walls being knocked out for home extensions. At a low line level, say 15in, 9in square brick piers will do, with 3 courses below ground level and 4 to 5 above. These can be placed at 4-foot centres. For wide sections, such as stations, use 2 piers side by side up to 2 feet apart. Another way is to dig out 2 foot squares, 3 inches deep, along the centre line of your projected track, at 4 to 6 foot intervals. Fill the holes with cement, and while it is still wet put in two bricks on either side of the centre line. These should project above the cement which is flush to the ground. When these bases dry build up pillars in the normal way around the accurately placed pair of guide bricks. If the pillar height ends up a bit below the desired level it can be packed with old tiles and cement when the baseboard structure is in place, and capped-off to get the rain water to run off it. This would be for running lines only, not more than 8in wide on the baseboard, in '0'. Remember, the higher you go above the ground, the more you need to go below ground level with your foundations. Above all make your pillars vertical, so use proper ways to ensure this – a long spirit level with horizontal and vertical levelling is ideal, preferably with a set-square type attachment. You could build a dwarf brick wall, but it would be very expensive, and anyway it might look better with a stone facing. Another method, used with success is to cast your own concrete support posts. These would need to be reinforced. See *diagram* 2e for a simple one adapted from Ray Tustin's writings. Small concrete fence posts could be purchased instead.

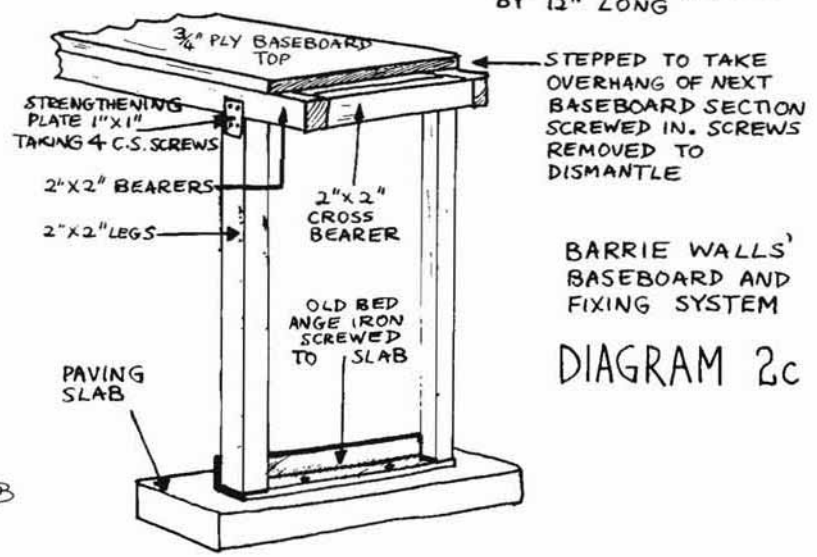
This brings us to the sub-frame to support your baseboard. It needs to be strong if weighty scenery is to be applied. On small scale affairs, just to take running tracks, you can apply sawn

BASEBOARD STRUCTURES DIAGRAM 2a



BASEBOARDS OF A REMOVABLE NATURE
BASEBOARD FIXING PLATES - DIAGRAM 2b

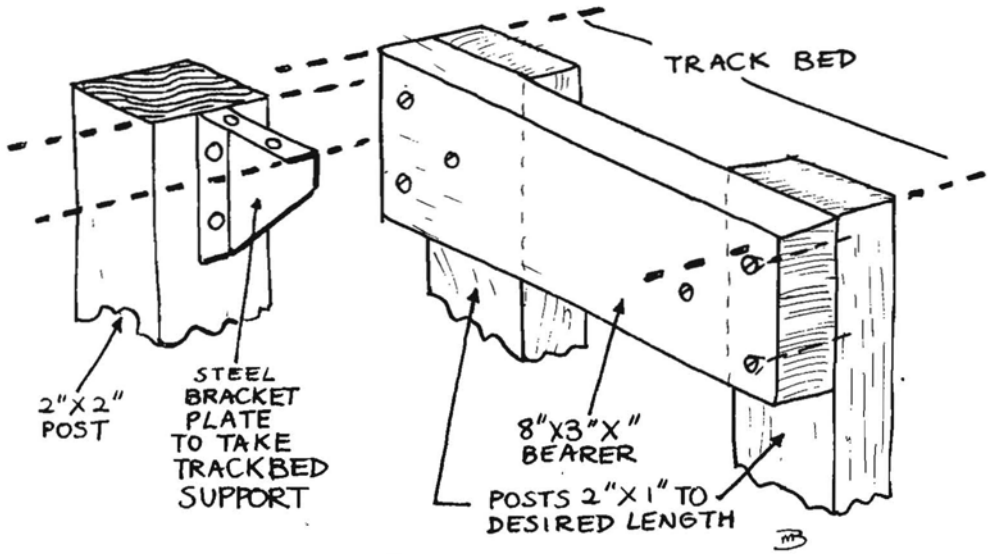


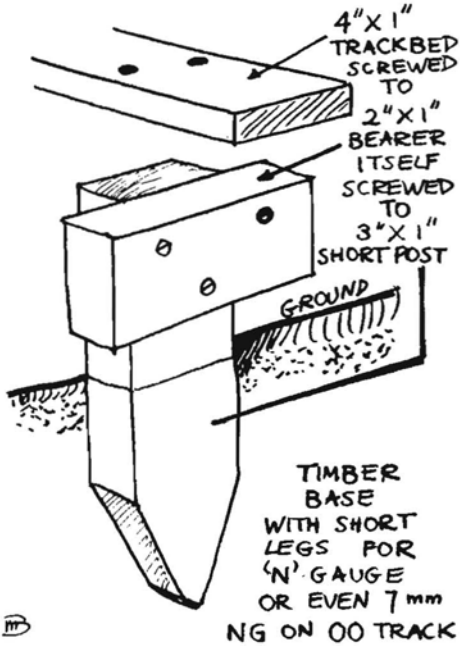


BARRIE WALLS' BASEBOARD AND FIXING SYSTEM

DIAGRAM 2c

BASEBOARD SUPPORTS DIAGRAM 2d
IN SMALLER GAUGES 00/HO/N etc.

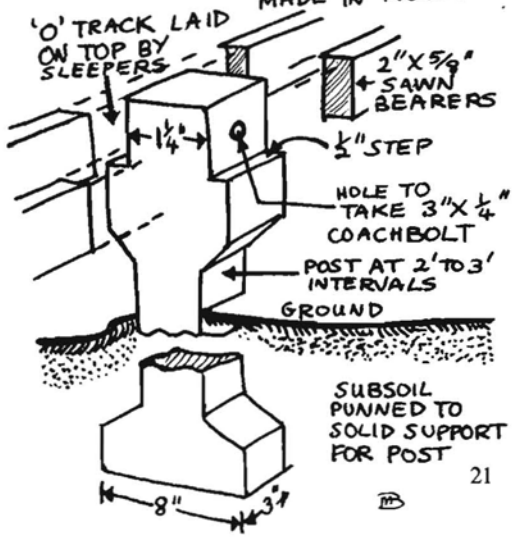




JOINTS BETWEEN 4"X1" BED MADE BY PLATES SCREWED BELOW TRACKBASE.

DIAGRAM 2e

PRE-CAST UPRIGHTS AS CAST FOR 'O' BY R. TUSTIN, SINGLE TRACK. HEIGHT TO SUIT THE LOCATION. POST REINFORCED & MADE IN MOULD



bearers 2in deep by 1in across, cross braced at intervals. For larger scales and weight deeper bearers will be needed, up to 4in by 1½in across. Jack Ray uses cross bearers from roof joists to his oak pillars, and longitudinally places 2in x 1½in timber on top to support this, with the same timber as cross bracing. On to this he puts planks longitudinally. These should be ⅝ to 1in thick for '0' Gauge. Finally, these are covered with roof felting with 1in x ¼in battens to secure it on the baseboard edge, the battens being 6ft long. This is not intended to be removable! The timber planks are often longitudinal but some people put them cross-ways, as does George Reffin. He uses 6in x ⅝in rough-sawn timber planed on one side only and screwed, with a ¼in gap between, to 4in x 1in side members screwed to the leg supports. Warping is avoided by the careful workmanship, choice of good timber and screws at 2in intervals. (See photos of the layout in this chapter). A really substantial bearing can be made from 12ft fencing rails, 3in x 1½in, available from sawmills, and fabricated into a base 12 feet long by 8in wide, using 5in lengths of the same timber at 3 feet intervals for cross bracing. This is in '0' Gauge, just for double track. In the smaller gauges less hefty work will do, based on similar principles.

This brings us to the top surface. Timber has already been mentioned. It should be good quality. If covered with felting it needn't be marine ply. If not covered it might be, but even the best quality ply has parted in our climate. Our experience suggests felting over is best if you can afford it. Alternatively, use Asbestos or Soffit Board. This has good and bad points. On the plus side it is easy to cut with a jigsaw type power cutter, or by scribing deeply with a tile cutter and breaking. ⅜in thick is best, but ¼in will do. Jagged edges can be rounded by a Surform tool. It will take paint, creosote and varnish equally well. Best of all it is stable and will not warp. Left to weather it will attract moss and lichen. The snags are there, though. Firstly, the older asbestos is a health hazard, the newer board less so. We recommend *proper* facial protection with a mask. Always work with it outside. If you wet it when cutting or drilling, dust is kept down a lot, too. Its other snag is that it needs to be well braced, so try not to drop heavy things onto it or they will go through! This is most likely during construction. It can be built in pre-fabricated sections though. The board comes in 8ft x 4ft sheets, and a kindly merchant might be persuaded to cut it into the sizes you want, so work out what can be done from such sheets and give the vendor a neat cutting plan. Soffit Board can be obtained in 8ft x 1ft lengths – ideal for straights in many gauges, or in multiple for use at stations.

Another system recommended by Mr Courtice over 30 years ago is mentioned in Ray Tustin's book, the boxed ballast system. This is for track runs and is not a strict baseboard. Built onto timber supports, it is a continuous trough-like box, up to 2in deep and as wide as you wish. Made of wood and thoroughly creosoted, it is filled with ballast, and the track is laid directly onto it. Anchoring is by wires from sleepers to the box edges on curves, and at intervals down the straights. Drainage holes are provided. Simple to maintain it gives quiet running, as does all ballasted track, but to creosote it periodically inside everything has to be removed.

Finally, an open timber structure may be used, with the track on battens laid along an open framework, rather like a timber trestle bridge. Its main advantage is airiness, and light gets to plants around it and below, but it requires a lot of planed fillets and timber. It also will need considerable quantities of preservative. Above 15in in height it will look less solid, too. Running over it would probably be quite noisy as ballasting is impossible.

A few other points need to be mentioned here in connection with the baseboard type of foundation. Drainage on such small areas is often no problem. The best thing to do is to build it, and wait for a good rainstorm to see if water stands on it! If it does, drain by holes drilled to take a plastic ½in diameter pipe, or a copper central heating pipe scrap offcut. Cover the hole with aluminium gauze or punctured copper foil to prevent clogging by ballast etc. The pipe should be several inches long to take water away, and not to direct it onto supporting uprights. (See also under Wooden Track, later).

We have mentioned screws. Don't use nails at all – they need knocking in, which knocks other things out of line. Coach bolts can be used for major work, as can steel screws. Always

grease before using and protect the heads with bitumen paint. Brass screws can be used and won't rust, but even they should be greased, to get them in easily. Oak doesn't like brass much, by the way. Use countersunk or domed screws as common sense directs.

Preservation should be by recommended preservatives such as creosote, Cuprinol, or bitumen paint as appropriate. On exposed areas it may be necessary to do it annually (in the autumn). A sheltered but not wet spot may need it far less. One of us has not creosoted some timber framing hidden from the weather since 1959 with no deleterious effects! But do inspect it regularly, at least yearly throughout.

You can disguise all this by plants grown in front if you wish. The higher your structure the bigger these will need to be. Privet, Box and Veronica have been used. Prickly privet keeps animals out very well, but takes time to grow. All these take cutting, in time when you would otherwise be running trains! However, they will cushion, even support, stock in the event of derailment. Another way is to build up a rockery in front of the base but not under or touching it, as Jack Ray and others have done. The late John Hart built an effective earth embankment up to his, but his supports were angle irons not wood, and we ask you not to use wood in direct contact with earth. Don't build right against a fence if you can avoid it, you may need to get at the back from time to time.

Finally, in this section, avoid fixing your line to fences and trellis work. People still persist in this, and get into print doing it! We don't like the idea at all – even in the smaller gauges. Fences often move. Modern birch-wove lap ones are often badly made and deteriorate fast. Also a flat fence with a large surface area is more likely to blow down in a gale – and will take your line with it! Last, if you adjoin another property, whose fence is it anyway? On many modern housing estates ownership is often rather vague.

Ground level type

This type certainly puts a model railway in the real scenic countryside, and will require some miniature civil engineering on your part to do this. With some toil and care it can be done, and once the plants are in and established it will look very pleasant.

Try not to route your railway near to troublesome trees, as already mentioned. Others to be added would include trees such as limes which secrete troublesome sticky substances, bad for track adhesion, worse for rolling-stock. Avoid shrubs which have sucker growth, too, and roses – prickly thorns don't aid track cleaning or maintenance! In an established garden check for dormant plants like bulb corms before you start, again for obvious reasons.

A railway on a rockery looks most appealing, and if it can avoid sudden changes of level with violent gradients in traversing the rest of the garden so much the better. A narrow gauge line, however, may look better for sharp gradients, curves and changes of direction – a miniature Festiniog, in fact.

To build a rockery is no light undertaking, requiring tons of rock and soil, much shovelling and physical labour if it is on a large scale. Even a small rockery is no light undertaking, but built from the start it will avoid damaging established plantlife and, above all, will put your line into a landscape planned by you. Try not to make the line straight, build in curves for effect. It can disappear momentarily behind bluffs, but avoid long, deep cuttings, as they will collect leaf debris and other detritus which adversely affects running, especially in the smaller gauges. (Tunnels are dealt with separately, in Chapter Five). When you've completed the rockery, plants can be planted, some way from the track especially if they take time to settle. Books on rockeries and plants for them should be consulted in the planning stage we need hardly add.

Having built your rockery and the track line, drainage should be thought of. Frankly, it will only present a problem if you have a heavy clay soil. If it is a problem, build soakaways every few feet, made to a foot or two below line formation level, and filled with clinker, stones or small tile and brick pieces. Often this can be avoided with a deep track bed support based on the methods of Ray Tustin, Don Neale, Bill Strickland and others, which have much in common. *Diagram* 3a, by Ray Tustin, shows the basics quite clearly, as applied to a line alongside a lawn. The tiles at the back can be dispensed with if there is a rockery behind the line

ROCKERY disguises Jack Ray's Crewchester Railway table-top line. Note how bushes break up the line of the railway. Baseboard virtually hidden. Photo: J.L. Ray.

TRACK LAYING COMPLETED on J.L. Ray's Crewchester line. Natural looking track in foreground with drainage gully and ½" Copper drain pipe shown. Batten at top retains soil for scenery. Photo: J.L. Ray.

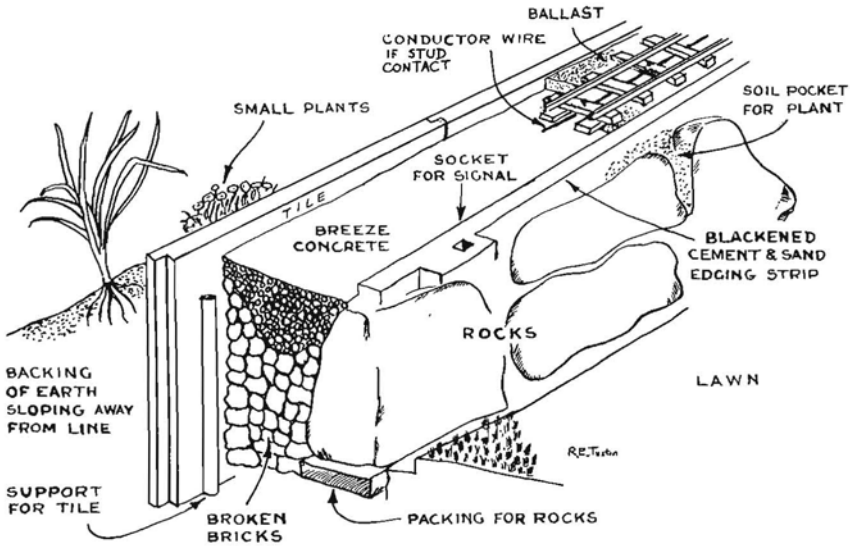


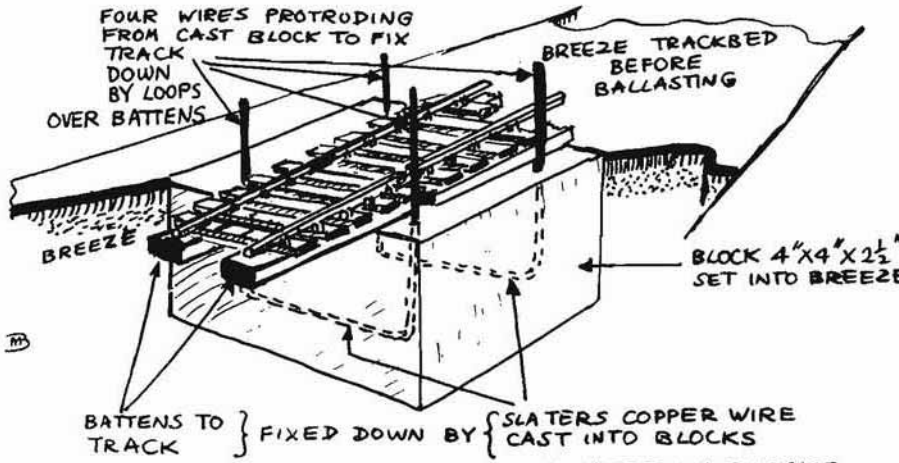
DIAGRAM 3a BREEZE FOUNDATIONS FOR A GARDEN GROUND LEVEL LINE

to keep the soil back with stone facings. The tiles should be modern locking ones by such firms as Marley or Redland.

To start, the ground if not heavy should be well punned to consolidate the soil, and the gravel and breeze laid above. In clay soil build the soakaways mentioned every 1½in to 2in, wriggling a crowbar around to make a hole up to 6in across and 1½in deep like an inverted cone. Fill as prescribed above, and then go ahead with your foundations, carefully laying the biggest stones first, then smaller ones. Ram to a solid mass up to 8in to 10in deep and a reasonably level one at that. Then add the breeze. It should be mixed in an old container of some sort, in proportions of 3 parts broken coke, sifted cinders etc., to 1 part portland cement, and not too runny. Use a builder's float to level it off. If track is not to be laid immediately and frosts are possible, cover it with loose ballast to at least 1in even depth to protect the breeze or it will break up. A cement strip ¾in x 1in along the edges can be built in to stop ballast wandering. This should be mixed 3:1 and darkened. Note from *diagram* 3a how to incorporate slots for signal posts at this stage. Signal guide wires from non-ferrous metals can be put in along this strip while wet too. You should plug signal holes now if they are not for use yet to prevent small rubbish or soil from getting in. Vertical breeze faces should be protected by a cement and sand mix at least ¼in to ½in thick to keep them weatherproof. Expansion joint fillets come from roofing felt offcuts every 4 feet or so in the cement.

One development to the above, suggested by Don Neale, is to put anchoring pre-cast blocks every 1½in or so to hold down battened track, and to enable it to be easily withdrawn. The blocks should be dimensioned about 4in square by 2½in depth for '0' Gauge, as per *diagram* 3b. Copper (tough Slaters) wire should be cast in the U shape shown to hold the track. Packing can again be by thin slivers of offcut roofing felt between track and concrete casting. In the smaller scales, such as 00 gauge, wooden hardwood strips ½in square are laid across the trackbed breeze every foot or so by Bryan Burchell for the same reason, and the track, plastic based Peco, is fixed through there. Importantly, to prevent dips or curling up at the ends of track where lengths join, these should meet on such blocks whether wood or concrete. Hardwood could be used in 0, of course, instead of small concrete castings. If wood is used liberally cover it with several coats of preservative before fixing into the wet breeze. *Diagram* 3c shows the Burchell method outlined above.

GROUND LEVEL LINE FIXING BLOCKS FOR GAUGE 'O' TRACK

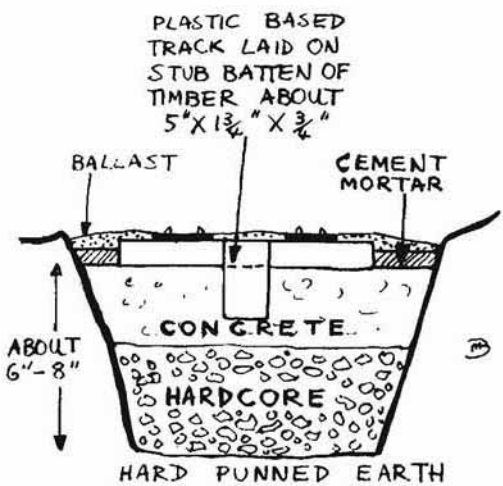


NOTE: TRACK LENGTH ENDS SHOULD MEET ON BLOCKS. BLOCKS SHOULD ALSO BE IN CENTRE OF YARD LENGTHS OF TRACK (DIMENSIONS FOR 'O' GAUGE).

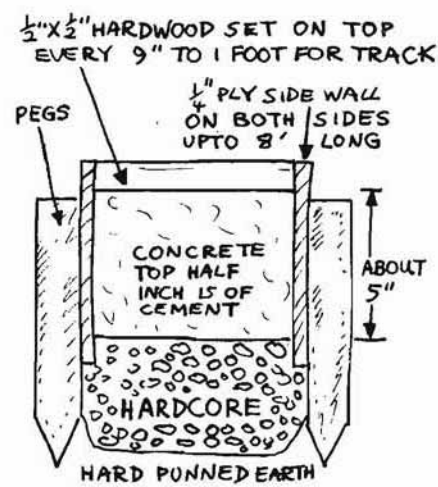
DON NEALE'S FIXING BLOCK SYSTEM DIAGRAM 3b

GROUND LEVEL TRACKBED FORMATION FOR THE SMALLER GAUGES

DERIVED FROM METHODS USED BY BRYAN BURCHELL et al.



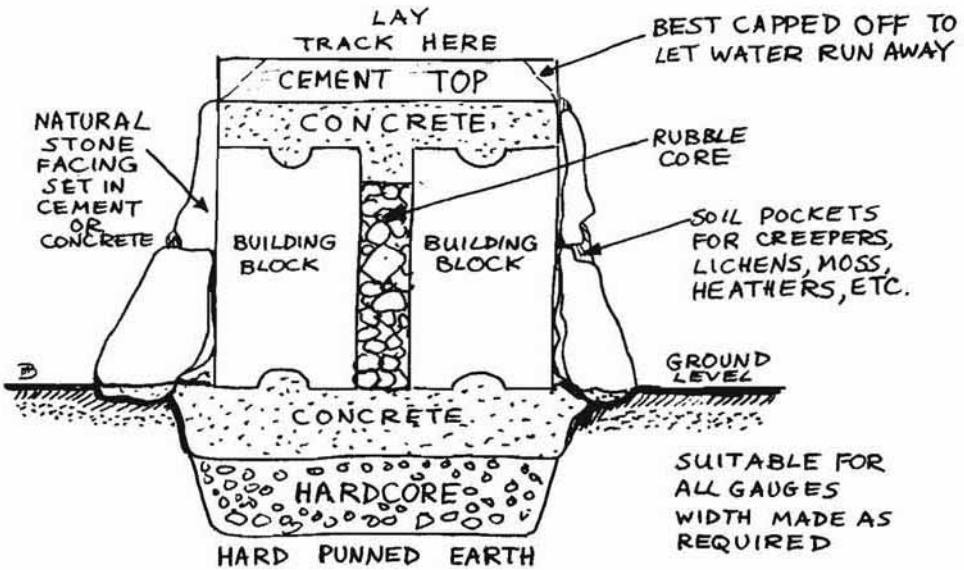
ABOVE SECTION LAID DIRECT ON SITE



CAST CONCRETE TRACK-BASE IN SHUTTERING LAID ON-SITE

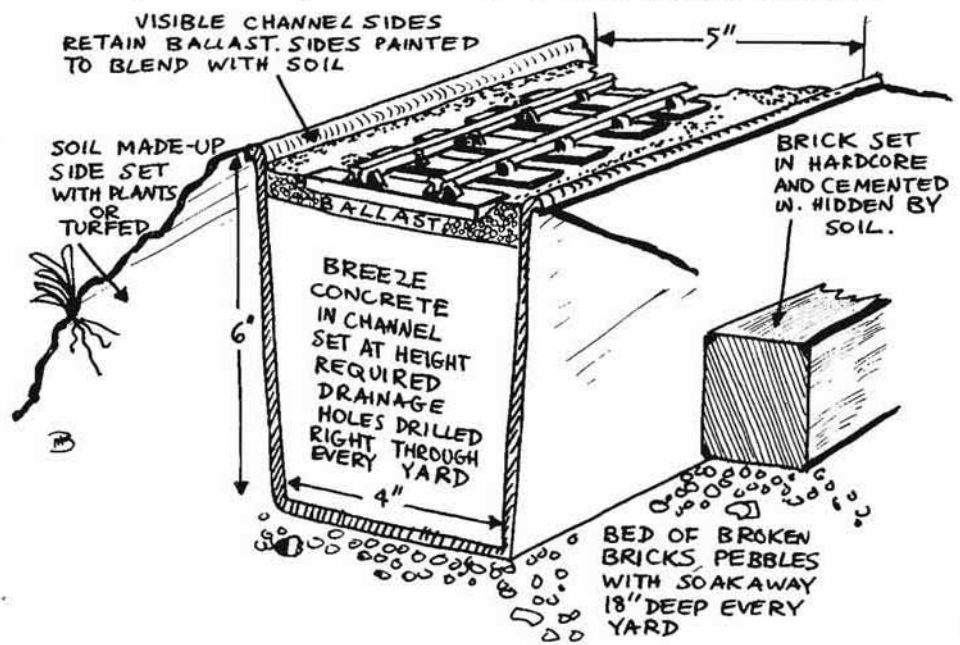
DIAGRAM 3c

RAISED CONCRETE TRACKBASE DIAGRAM 3d



FIBREGLASS CHANNEL TRACKBED DIAGRAM 3e

AS USED BY EDDIE BRAY FOR 'O' GAUGE FOR SINGLE TRACK, BUT ADAPTABLE FOR OTHER GAUGES



There are other methods of doing this. On good drained soil, concrete 3in deep can be used with drainage holes and wooden (hardwood) inserts about every foot, again to hold the track. This is put on top of well rammed subsoil to compact it. Cover again with ballast for protection. Now if this looks expensive in materials try cheaper ways. In the smaller gauges you'll need less, anyway. But, cheapness may mean it won't last as long. Both the author, Ray Tustin and Don Neale have garden lines of over 20 years standing each - certainly permanent.

The methods above are as for small walls, trenches, hardcore filling, breeze, and so on. Earth or rockery sides act as a shuttering and a secure hold. For embankments you build it up like a wall, rather like Ray Tustin's line in *diagram* 3a and as the photos of his line and E. Bray's in building show. Bryan Burchell's methods, shown in *diagram* 3c, are done by casting on-site between ¼in ply side panels, pegged in. These can be up to 8ft long, and quite flexible, for flowing curves. An effective self-explanatory system is shown in *diagram* 3d for '00' gauge. The cementing would need to be well done on top to avoid fragmentation over time. The stone facing would hide the unsightly grey building blocks. Having read this far, if concreting frightens you, then we once again recommend a trip to your local library. (Their patient staff should know you quite well by now!) A good general guide discovered by many of us is *Concrete around the House and Garden*, published by the Cement and Concrete Association. (This same body took excellent photos of Don Neale's magnificent line to illustrate his book published by Peco.)

GROUND LEVEL EMBANKMENT LINE in course of Construction in established garden to take double '0' gauge track. Hardcore in before cement lay of breeze on top. Note the natural stone walling, small conifers, etc. E.M. Bray's line. Photo: M. Bloxsom.

Two other methods might be mentioned. The first is to lay old railway sleepers on their sides, put a line on top and build soil up to it. Given the wood's strength and impregnation with preservative, such a simple line could last a long time. The small ad sections of farming magazines are a good source for such sleepers. A second method, used by Eddie Bray, is to buy scrap fibre-glass channel, which interlocks, from British Rail. (It was used for signalling cable, I think:— Ed.) This is up to 9ft long, and was laid directly into the garden (a level site) filled with core and gravel then ballast in that order from the bottom up, and the garden landscaped back right up to it. Drainage holes were put in every 18in or so. This should last. As it is light in colour, but will take creosote, the top parts can be disguised. It is ideal for single track '0' gauge. One problem would be availability, but if they can be found, such materials should be tried. Inverted they might do for tunnels, too! *Diagram* 3e illustrates Mr. Bray's method.

The final effect of all this is well shown in the photographs of a finished stretch of line. This brings us to the ground level building of bridges, ponds and tunnels which, as they are structures, will be dealt with in the next but one chapter. However, as they should be installed at the beginning, we advise you to consult the relevant parts of that chapter before track laying.

Track

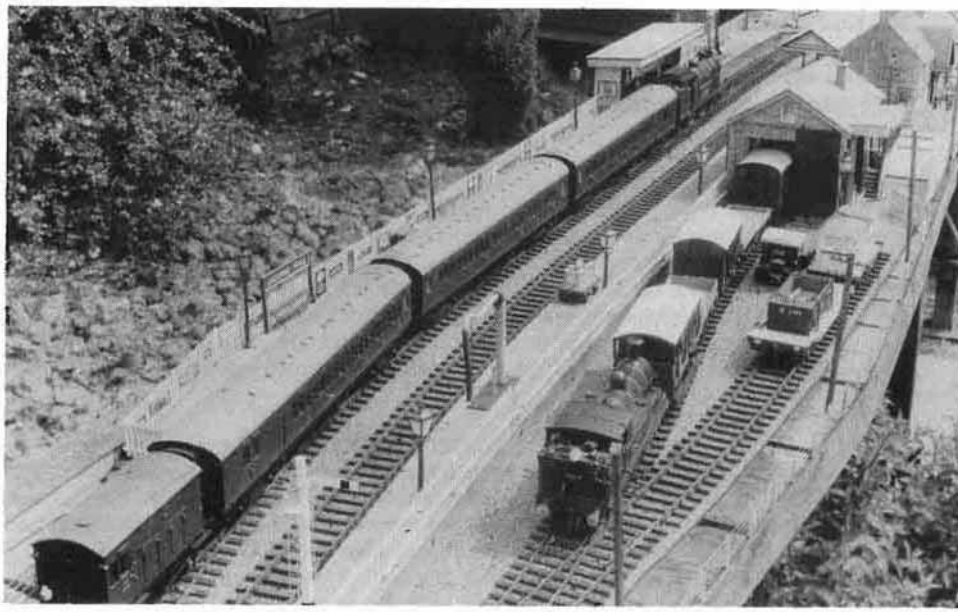
Track is of two main types, commercially supplied by well-known firms or handbuilt, usually at home. Some folk mix the two, often constructing their own pointwork. Most track these days is for two rail, now the norm in most gauges, although in Gauges 0 and 1 there is still quite a large following for Stud Contact, with Outside 3rd for SR enthusiasts, and Centre Third for vintage train enthusiasts, too. The electrical work involved is described in our next chapter, but it is worth noting that points for insulated track are more trouble to make, though not necessarily to lay. Stud Contact too can present problems. Studding work and its use appears in a later Chapter.

Commercial plastic-base track, copperclad track and paxolin track

Commercial track is 2 rail, and produced by firms such as Peco, Lima, Rivarossi and others in brass or nickel silver, which works well outside. Some firms produce steel track, but this is not recommended. Pre-war firms produced sheradised steel track used outside by such enthusiasts in '0' as the late Cyril Bremner-Smith. Our experience suggests modern steel track, even if sheradised, won't survive very long, so avoid it. It wouldn't be cheaper in the long run. This leaves you with nickel-silver and brass. There is little to choose between them. Brass does tend to pick up less verdigris. Track bases may be more of a problem. These are usually plastic. Peco produce such track in N, 00, 0 and 1, as well as narrow gauge for 16.5mm and 32mm, using less sleepers of a NG type for 00 and 0 track in so doing. Other firms' nickel-silver/brass is fine, too. Tenmille produce Gauge 1 and 0 track as do Märklin. LGB is brass track in Gauge 1 for NG, as LGB is scaled at 1:22½, a really large size for all to handle easily. In '0', besides Peco, Lima and Rivarossi also produce track with plastic bases. The bases make for flexibility — ideal for laying, but their wearing properties depend upon ballasting and how the fixing is done to some extent. We'll deal with this later on.

Laying flexible-based plastic commercial track is relatively easy. On a ground level line in the smaller gauges the value of blocks becomes apparent as a means of anchoring the track. Bryan Burchell lays his '00' track by pinning through the hardwood blocks, ensuring that the track lengths join on the blocks, so that both ends are firmly held down. Rail joiners, i.e. fishplates, should be nickel silver or brass, not steel, of course. For electric lines they should be bonded on every join. (See chapter on Power, following). The same basics would apply in 0 and 1 gauges, also. Remember that even on fairly generous curves — 6ft in 0, 3ft in 00, this plastic flexible track will narrow to gauge, so contradicting what happens in real practice. Therefore, always use an accurate track gauge. In 00, Bryan Burchell also puts his track on to a foam underlay. This usually lasts up to 3 years but, although this is not long by outdoor standards, it gives a

good soft ride. As it happens this foam is not normally recommended for outdoor use, so it's up to you. The pins used can be brass or steel. The former won't rust but may work free in severe frosts, the latter may rust — so grease them and drill pilot holes slightly under size to give them a start, and protect the heads with a sleeper coloured paint. In small gauges pinning is often down the centre. On curves you may wish to tack the sides, but don't upset any elevation necessary for high speed running. Alternatively, use small screws, steel greased ones. These allow for adjustment and tamping underneath if you require it.



RAISED TRACK BY GEORGE REFFIN. Background far right shows track baseboard resting at ground level on steel plate for layout removal if desired. Baseboard plants set ¼in apart. Peco track laid on mineralised roofing felt most effectively gives appearance of ballast. Stud Contact railway in '0' Gauge. Photo: Brian Monaghan.

The above paragraph applies equally well, if not more so, to track laying direct on to ply or wood, with or without a felt underly. You might wish to stick down mineralised roofing felt first. It looks fine in 0 Gauge, as pictures of George Reffin's line show, but might look overscale in 00, let alone N. It would give a smooth base, however. Screws can be used, but pins will cut up the felt less. George pins his Peco streamline track along the sleeper edges through the felt lay into the wood below, pins being driven in at a slight angle. Alterations to track formation or adjustments are done without trouble. After many years this method has been virtually trouble free (as has the lovely, faultless, running I've seen on George's line — Ed). With asbestos underneath use screws. Drill out and screw in. Evostick has been used to stick Peco to asbestos directly. We're not sure how long it will stay down.

Copperclad track, incorporating some plastic basework sleepers with copper cladding so that rail can be directly soldered on, has been used out of doors with good results. We recommend that if it is used sleepers, the clad and solder — where the chairs would be — is protected by

black bitumen or similar paint. Barrie Wall's outdoor section uses this with success on a wooden ply baseboard. Such track may not like ballast fixing by creosote and pitch though. We are not sure how well it will stand up to removal and to very severe winters if laid onto breeze at ground level. Some paint/oil mix would be desirable. The photo of Wallsea track out of doors gives an idea of copper clad track outside. Copperclad is available commercially made up, but Barrie's is homemade using Peco rail soldered on. Paxolin works well too, on Bill Strickland's '00' line.

We now arrive at wooden based track, some of which is made to order by firms such as Bonds, Charles Covey and others in Gauges '0' and '1'. Merlin even supply dual gauge track 32+45mm for N.G. The components for it, however, are readily available, so it is dealt with below.

Wooden based track and its construction

In the smaller scales as well as in 0 and 1 many hours have been spent on making track at home with trial and error, frustration and delight, to produce good and bad results. In 00, Bill Strickland's excellent book tells you most clearly what not to do. Being an engineer, and a persistent one at that, he finally hit on a workable system which has lasted well, using home-made sleepers cut from hard bakelite or paxolin, with rivets and clips for fixing good quality pre-war nickel-silver rail of 0.048in wide bullhead type, and later flat-bottom rail, which was easier work. The assembly was held in the track sleepers by 19 or 20 gauge brass pins. (See Bibliography.)

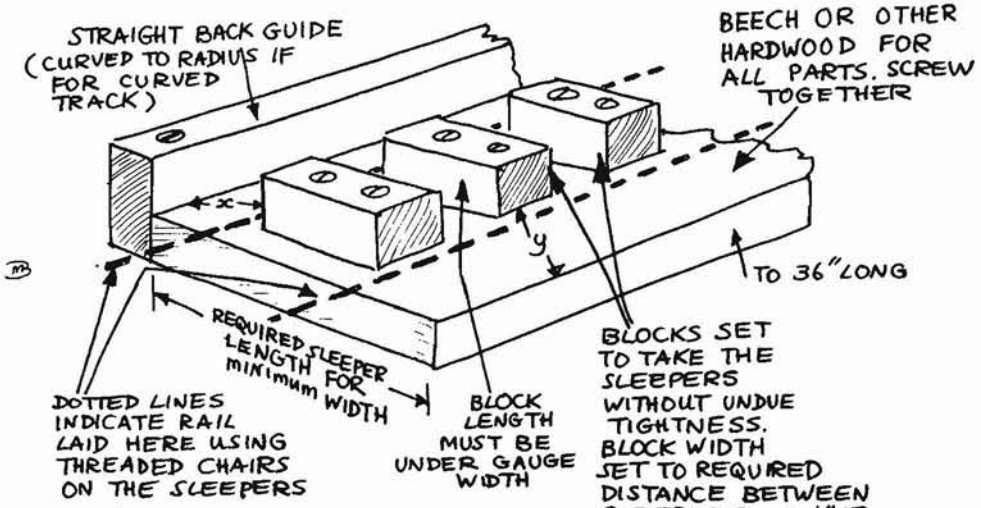
In the larger gauges track is often homemade, too. Straight track is usually made on a jig. For '0' with sleepers from 36 to 40 a yard where sleepers ⅜in or 5/16in width are used, or more if slightly narrower, say 50 if ¼in. Sleepers are usually about 2½in long in '0' Gauge. Materials for sleepers may be softwood or hardwood. The latter is now difficult to get. Western Red Cedar is ideal. Don Neale uses ¼in square sleepers, 2½in long. Deryck Featherstone uses obechi. Both use fine-scale CCW type slide on white metal chairs and rail, or Bonds similar rail (often sold for 00). For a coarser look in NG or '0' Gauge, 36 sleepers to the yard, 1 to the inch, looks well. Softwood may do, either bought in packs commercially, or cut to length, for sleepers. These tend to be ⅜in or 5/16inin across, by ¼in deep. If you lay without battens direct to a baseboard then the sleepers could be square in section, ballast hiding this when it is laid. Softwoods won't last as long as red cedar, also they tend to split easily. Avoid very soft or knotty sorts. Some are available impregnated with preservative. Even then we advise further soaking for as long as possible before use. Again, everything should be coated after use. Cedarwood oils tend to repel creosote — like coverings at first, so do it at least twice. Coatings should be over everything, rail, chairs, sleepers; the lot in fact. The chairs of white metal are quite fine, coatings almost certainly protect them. Some Guild members have had track chairs out for 30 years without deterioration. Rail should be brass or nickel-silver, with pins either brass or steel — a mixture might do, but if steel is used work preservative well in to protect the tops, or use coated pins.

Building such track is described for '0' gauge modellers in our *Handbook 2* in a chapter by Deryck Featherstone, so reading this is recommended, especially as it also deals with scales and track standards. Jig building is an excellent idea if you wish to build a lot of line. A straight jig is easy to construct for yard lengths of track and a good wood such as beech should be used for it, with the whole screwed together. Curved track can be built fixed to radius, again using jigs, or curved on site — easy if not battened or, if it is battened, by laying the battens first on site and then fixed to the battens by pins. Alternatively, fix battens on and cut those to get the right curvature. The curves should be accurately plotted out by pegs and markers on ground level lines, and drawn on when laying on a baseboard. A jig drawing is shown in *Diagram* 4a. If you

DIAGRAM 4a

TRACK MAKING JIG FOR WOODBASED TRACK

FOR GAUGE 'O' OR OTHER GAUGES BY ADAPTATION



(BATTENS CAN BE PUT ON AT START IF x AND y WILL TAKE THEM. ALTERNATIVELY COMPLETE TRACK WITHOUT BATTENS, TURN UPSIDE DOWN AND PIN TO SLEEPERS FROM UNDERSIDE OF BATTENS).

USE A TRACK-GAUGE AT ALL TIMES

TRACK SUPPORT & DRAINAGE ON A BASEBOARD

AS USED BY JACK RAY FOR GAUGE O

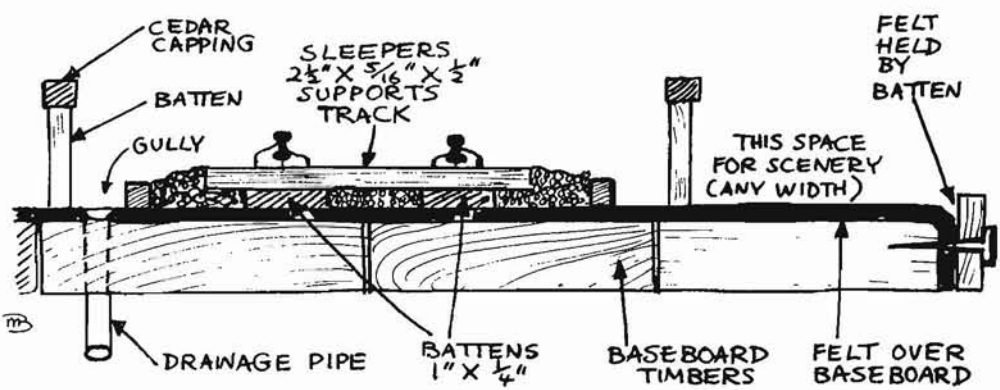


DIAGRAM 4b

(SEE ALSO DIAGRAM 2a FOR DERYCK FEATHERSTONE'S SYSTEM OF FIXING TO ASBESTOS 'BOARD)

wish to save on jigs for curved track, or templates, stick to a few radii only, and, as we noted before, use as big a radius as space will allow. You could use jigs for points, too, as some builders have, but an accurate blueprint is the best start. You can make up using standard sleeper lengths, per prototype, but most of us use long sleepers as it results in easier construction, greater strength and easier removal. Purists may frown on this, though. Laying on to sleepers may be "on site" or onto a blueprint (protected by a clear plastic film, preferably on a photostat). Methods of laying vary. The straightforward normal method is by laying the straight stock-rail, then the curved one. Next, inner rails which will require soldering after shaping, followed by point blades and wing rails. Finally, put in the check rails. For 2-rail this means cuts and isolations to avoid short circuits. A diagram for this by Jack Ray is found in Chapter 4 on Power. Your work should be accurate. Practice makes perfect, but get it right for bogie stock, six-wheel stock and for long rigid wheelbases such as eight-coupled, flanged wheels on locomotives. Complex pointwork such as double-slips (so called) is best avoided unless you are competent and wish to save space.

Battens may be fixed on or not as you wish. On a ground-level large scale line we would advise their use, as they do give strength and rigidity. They can be put on before laying. Cut as required beforehand for curves or changes in gradient. On board or asbestos many use battens. They help in laying, and when ballasted do "push" the track up from ground level, as packing of main line track does in real life. They can be made from wood ¼in in depth, and should be on straight track as long as the straight, and up to 1in across. On boards, etc, they can be laid first for curved track. You can, of course, on a baseboard do without and lay flexibly directly on to it as the late John Hart did. Using 5/16in square sleepers the depth and squareness of the sleepers was disguised by the ballast. Uneveness was eliminated by carefully packing the ballast before permanent fixing. With battened track lay first and ballast afterwards. Outside on loose ballast, often used on ground level lines, get the ballast as flat as possible and then lay and pack where needed. Super-elevation can be done quite easily this way, whereas with wired-down or screwed-down battens on a baseboard, wood fillets will be needed; don't use loose ballast on baseboards to do this or the chippings will get into all the wrong places!

Wood-based track may be permanently fixed by screwing through the battens, or if they are omitted, by screws at intervals through the sleepers into the baseboard. you can lay direct onto ballast as noted above on ground-level lines. On boards another method is to drill holes on either side of chosen sleepers and a U-shaped wire — coated copper — is put over the sleeper, and the ends twist tied together under the baseboard. This will firmly anchor the track, is easily removed and provides small drainage holes into the bargain. If you are worried about drainage, provide a gully alongside throughout as Jack Ray has done, as *diagram* 4b and the photographs of his line show. This should be fixed after ballasting. *Diagram* 4c shows Deryck Featherstone's methods for this with fine scale track.

Ballasting track

One simple method used by George Reffin is to use mineralised roofing felt cut into appropriate lengths and widths and stuck down onto the baseboard. It looks especially effective with finescale plastic track such as Peco, and avoids the messy use of fixatives which might damage the plastic track base.

On a ground level line ballast can be put down and the track laid on top directly. In this case, if well retained, it can be loose, with coarser granite underneath and more scale ballast put on the top. With a baseboard system we prefer to fix it. This can be by a hot mixture of creosote and pitch for weight and strength, 'boiled up' outside, well out of everyone's way, using a gas type can of the Camping Gaz or DIY variety. Pour on, wipe the rails clean and leave. It will set hard in a couple of weeks, but do protect it from rain and frost in the interim. A more

TRACKLAYING on felted baseboard. Battened track. Ballast being applied. Gauge '0' Crewchester Railway. Photo: J.L. Ray.

expensive method is to mix thick bitumen paint into the creosote, in proportions of 1:6. With this method many use edging from ¼in strip in 0 gauge. This can be avoided if you use undiluted bitumen paint along the edges, put on thickly with a very old brush! It will set hard and rarely chips loose. Now, this paragraph really pertains to wood-based track as you'll have guessed. What of plastic-based track?

For plastic-based track we suggest fixing ballast with slightly diluted adhesives of a waterproof type such as Unibond. Lay the track and then apply the ballast soaked in the stuff. When nearly dry you can clean it all up neatly. Peco use this on their own outdoor Gauge '0' track at Seaton in Devon, preferring not to use creosote or similar based preservatives on the track. A final touch for plastic track is to spray with one or two coats of clear polyurethane varnish as used for boats. Choose a still day and wipe the running rail surfaces afterwards.

The ballast itself will vary with the line and scales used. In N or 00 if you use real ballast, as

opposed to underlays of foam or mineralised roofing felt, tiny grit can be stuck down. It should be of good quality, and free from dust and shells as the latter will break up. In the larger scales chicken grit can be used, but it should be flint grit and also shell free, or it too will disintegrate rapidly. Such grit is best bought at a farmers' supplier in 1 cwt or metric equivalent bags. You'll probably need a couple of hundredweights for a relatively small line in '0' Gauge. More quantity will be needed if the track is battened and laid on boards than if it is unbattened. Fine granite chippings can be used. In '0' they really need to be ⅛in or less in diameter, and pro rata for other gauges. A friendly gravel quarry foreman might actually crush it right down for you, or you could use a stone crusher of the type used by some building and contracting firms.

Some other tips and hints on track and tracklaying

These are miscellaneous points we nearly forgot!

In putting down track onto baseboards, stagger track joins and baseboard joins. The two should not coincide or dog-legs in levels will result, if not immediately then after a time, for which the only cure is to relay the track. (I had to do it! Ed). Further, gradient changes should never coincide with track joins, either, whether on a baseboard or at ground level. Pointwork should never be on gradient changes at all.

Prototype principles should be followed, which means that facing points should be avoided on through running lines; use trailing ones. Trap points if used, such as Peco or wood-based, should steer derailed vehicles clear of the running line and also on the baseboard, not forcing them into an earthwards plunge; or into a nearby granite outcrop, if at ground level! Shunting necks should be 1½ times longer than the longest siding they serve. Put in engine release roads and sidings where needed — stations, large goods yards, etc. Goods sidings need vehicular access, adequate loading space, turning space for vehicles and so forth. Goods sheds require even more room. Clearances for large overhanging bogie vehicles, large locomotives with wide cylinder clearances, etc., should be made. Stick to the standard dimensions for your gauge and scale, if not you'll have problems running other peoples' locos on your line. Bill Strickland designed his layout to take normal 4mm, 00 models, or NG locos and trains on 00 16.5mm track. If you wish to mix it like this do the same.

Finally, a point on Coarse Scale in 0, or Finescale in 0, outdoors regarding track. Both work as we know, but coarse section rail and track tends to be tougher if it is trodden on. If, however, either type has paths for humans to cross it on the flat, then bed the track in well or, better still, build a bridge over it, however simple. People tend to use those rather than wander freely all over the place, especially visitors if politely told on arrival. One of those 'Cross the Line by the Bridge' facsimile notices comes in handy here! Plastic-based track is quite firm; its problem is sunlight which may make it go brittle.

Electrification, including Stud Contact, is dealt with in the next Chapter, on Power. Point operation is dealt with under that heading too, as signalling and pointwork, let alone electrical sectioning, should be intimately bound together.

Chapter Four

Power and Signalling

A motive power review

The garden line modeller has a variety of motive power to choose from, namely clockwork, steam, battery electric and, by far the most popular in most gauges, electric power drive, from low voltages transformed from the Mains supply. This is not a *Which* report on a best buy, all have their advantages and disadvantages, so you make the choice! We also point out the snags. One that it is best to mention here is mixing types. Clockwork, battery and electric will go together fine, although in 2-rail proper insulation of clockwork and battery would be needed unless you just leave the power off! In 3-rail — Stud, Outside 3rd (O3), Centre 3rd (C3), this would not arise. No, the main problem would be mixing steam and the rest. However, the term "steam" needs qualifying. pot-boiler or dribbler types using "wet" steam will cause the most problems, since they often leave oily water all over the place. High pressure steam will not, and it can be mixed fairly well with the other forms. Some high pressure locos use electrical control from the track as it is. If you get to the stage of inviting friends around to your electrically powered line to run live steam put the steam on last, it will 'top-the-bill' for all steam enthusiasts, anyway. Wipe all the track clean before running next time.

Clockwork

Today clockwork suffers from not being readily available to buy as no one makes the mechanisms — very costly as it would involve many separate production operations. Clockwork power is still supported by collectors, and meetings, swap-meets and sales will allow you to buy them. There are occasional folk around who repair them, too, failing which you'll need to do it yourself. Spare springs are not easy to get hold of either.

As a power source it has much to commend it, it needs no electricity, is always there ready to go, and the loco — like the prototype — carries its own independent power pack. In short, it is simple to operate and maintenance is straightforward. Mechanisms need greasing and oiling, and very occasionally, a dip in petrol to clean them thoroughly. In the past, and on many second-hand models, locos were not very controllable, nor did they run far. Some machines by Märklin and Walker-Fenn had a pre-set speed control which improved things a lot. Mechanisms of this sort now are difficult to obtain, even secondhand. However, in the late 50's and 1960's, Bob Lovell and the late Drew Donaldson, among others, pioneered changes to existing mechanisms by fitting new type governors, which brought down speeds to a controllable level and, with the development of 'frictionless' PTFE plastic bearings for rolling-stock axles, similarly dramatically increased the loads locomotives would haul, often by 300 to 400 per cent! Distances run increased, too, and were often doubled at the same time.

Clockwork may be for you then, but it dislikes gradients and sharp curves, including the threading of a path through many points. Running should be on the level, with a slight up gradient at the start and a dip at the end. Jack Ray's old *Crewchester* line did this when clockwork-powered and quite impressive it looked as an express rolled gently towards the bufferstops. Each locomotive's performance with a given load over a particular distance was carefully computed. Winding a certain number of turns for this adds to the fun. Locomotives need driving. End to end, perhaps out-and-back, would be a good clockwork line. Stopping from the track can be done by a ramp, but it wants a fairly gentle stop, not the sudden old Hornby-type which often gives you a massive pile up! Back in 1951 the late E.F. Carter produced a booklet on the control of clockwork locomotives by electrical means, published by Percival Marshall. Whether it all worked particularly well we've no idea. In the end electric power and control in the smaller gauges came to hold sway.

Changes in temperature will affect clockwork performance. Cold weather running is not

advised as the spring will be rather brittle and may snap.

As a system it will survive, if only for collectors or those of us who have the odd clockwork loco with which to re-live childhood memories.

Steam

Steam power in steam locomotives is the real thing, fascinating in the Vulcan-like atmosphere of real exhaust heat, exhaust smell, oil and water, coal and the steam inextricably combined. It isn't like it used to be in model form. Quite a lot of people seeing developments in the last twenty five years concerning boilers, firing, power and control have abandoned electric power and gone over to it. In the narrow gauge field it has come into its own. By using standard track such as '0', bigger boilers than the normal 7mm scale allows for can be put on, so scales such as 10mm, 16mm and bigger have come about for running on '0' as a result. Handling is easy. Expense needn't be too great either.

Basically, there are two types — pot-boilers, with external wick firing such as the Mamod system, or sophisticated high pressure steamers with control systems to match.

Pot boilers have the system of firing noted, often protected to prevent spillage, with a vaporising or spirit lamp. Cylinders may be oscillating, but the better models have fixed ones, and have valve gear such as that developed by the pioneer, Henry Greenley. Cylinders tend to be an exact fit with no packing. The lubrication is by displacement using steam down to the cylinders. Reversing is often by slip eccentric, the lever being in the cab. The Bassett-Lowke Mogul ran like this, as do its successors. Their performance can be improved as E.J. Cooke showed in the Gauge '0' Guild *Gazette* in a fine series of articles in 1976-7. Well worth looking up. Safety is taken care of by designing the lamp to go out just before water and fuel give out. A good pot-boiler can be cheap, fun to run and, with the help of parents, an ideal introduction for youngsters to live steam. Some small firms produce kits to improve the Mamod engines, NG on 0, (see your model railway magazines, particularly Merlin's *Live Steam Railway* — noted in our Bibliography). Readers will realise that pot boilers tend to be found in '0' and larger gauges.

In the case of high pressure steam, the locomotives are internally fired and work at pressures often around 80-100lb p.s.i. (pot boilers work between 15-40lb p.s.i.). These machines are even found in '00', although their small boilers give short runs. In '0' and the larger scales the length of run may be quite long and, apart from stops for water and fuel, could go on for hours under test conditions. More efficient tubed boilers mean that, with proper cylinders, packing and draughting, the locomotives can have great power — sometimes better than the prototypes modelled. Accurate models of the prototypes tend to be the norm, even in narrow gauge.

Fuelling is by paraffin or butane gas, with coal in use for Gauge 1 and above. The work of Mr. Cooke in '0' Gauge and by members of the Gauge 1 Association should be noted here. Once forced draughting by a motor to a chimney extension gets the machine ready for the off, away she goes.

Such models will need adequate water tanks, others for fuel, and pumps (usually axle-driven) to supply the boiler, lubricators, water and boiler pressure gauges. Proper hydraulic tests are needed on the boilers and so on before running under steam. In large scales boiler certificating and insurance is the norm — the latter often done by groups/societies for their members.

Control used to be a bugbear, being for the fleet of foot in the past! No longer. Now it can be by electrical impulses from the track or by radio control. Most ingenious it is, and quite a lot has been written, mostly in specialist society magazines — Gauge '0' Guild *Gazette*, Gauge 1 Association *Newsletter* or *Model Engineer* and *Engineering in Miniature*, more widely available. Electrical control can be by electro-magnetic systems used by Messrs. Birkbeck, Courtice and Harrison over 30 years ago. E.J. Cooke and others have developed a remote control system using electronic relays working through a 2 rail track electrification system, necessitating total wheel insulation. Apart from wet track it works well, and such locos. tend to be more water-tight as regards track spillage than pot-boilers. Radio Control is now a reality.

Kits exist for that and the locos they "drive". Barrett Engineering of Walsall produced a 10mm scale GWR Manor with radio control for about £900 in mid-1983, ready to run on Gauge 1 track, to give you an idea of costs. Kits are a lot cheaper, and often quite modest for narrow gauge. Merlin — see Bibliography — would help many a budding convert, along with many other small firms. Continental outline — European and N. American is not neglected, either by Aster for Gauge 1 models of standard gauge, or several firms in narrow gauge modelling. Note that many models are done in short or limited production runs.

Track tends to be wood-based in live steam, but plastic varieties would probably be satisfactory for high pressure steam if locos. can avoid 'dropping their fires', while passing over it. Accidents might cause problems if not reached sufficiently quickly!

The future for Steam Power, then, has never looked brighter in '0' and larger scales, it is a living nostalgia and seems to have come in with full size steam preservation in general.

A brief note at this point, before passing onto electric power forms, can be given on diesel power in Gauge 1 and large scales. Bob Symes-Schutzmann and others have produced diesels using hydraulic, mechanical and electrical transmission. You would need Gauge 1 at least to do this but, like steam, it's the real thing.

Battery

This is electrical power and may be supplying the track from large batteries or carried in batteries on the locomotives themselves. This latter type had a vogue when Tri-ang produced the Hymek in the mid-1960's. Novo now produce this in 'O' Gauge, including the popular Hymek and a narrow gauge-looking 4 wheel diesel. Recently Lima have produced their 'O' Gauge LMS 4F 0-6-0 in this form. They have been aimed at the junior end of model railwaying, but modellers have done many most interesting conversions to them for greater accuracy, or to make them into other locomotive types. They have the merit of cheapness. Their chassis have found their way into all sorts of conversions. Don Rowlands produced NG locos for a few pounds, from the Darjeeling Himalayan Railway to the Tralee & Dingle, to run on his garden NG 'O' line. With scratchbuilt lightweight rolling stock in plastic styrene sheet (plastic card) quite good loads could be hauled. All sorts of scrap plastic and bits and bobs can be utilised to do this. For standard gauge the Triang/Novo 4 wheel chassis can be disguised and put in tenders, the loco-end being free running with no power in it, rather like many OO 4mm scale proprietary models by Hornby and Mainline. The Lima 0-6-0 chassis can go into tank engines.

Like Clockwork, Battery power really needs gentle gradients, but you can run most of the year as long as the rails don't get wet. The main cost would be batteries in the event of excessive running. Dirty track would have less effect, too, in all probability, particularly if light loads are hauled. The battery system also allows the younger operators to have 'their' engines running with yours — so capturing their interest and ensuring the continuance of the hobby. Again it is for '0' and larger gauges. An all-battery NG line could be cheap and a lot of fun, and be quite well combined with steam for greater enjoyment.

Low-voltage electric drive (from mains via transformers)

This is used in all gauges from Z upwards, being near universal in 00 and H0, the most popular gauges today. 2-rail is near universal, too, in those gauges, with 3-rail systems being rare. In Gauges 0 and 1, 3-rail systems of centre-third, outside-third and stud-contact are used, and will be considered later. Most people choosing electric power in those scales go 2-rail today and often, in the case of '0', finescale. Quite a lot of the contributors to this book use 2-rail, the rest stud-contact. They both have advantages and disadvantages, but the future appears to be with 2-rail, mostly on account of realism. Overhead supply should be noted. It was used by the late Victor Harrison in Gauge 1, almost half-a-century ago outdoors. It is rare in 0 outside, but has been used. LGB use this system for NG and it looks well. In 00 it is used indoors, but outside is another matter and we do not know of long-lasting Märklin or Lima systems out of doors. (I now await postbags full of letters from readers saying they've been doing this for years! Ed). The main problem would be damage to posts and catenary wires by animals and man, let alone

the elements in winter.

2-rail, apart from appearance — its greatest virtue — is easy to install outside, and on plain track probably cheaper, especially if you make it yourself, as extra materials for 03 or studs and wire/copper strip are avoided. The old snag over point making can be got over relatively easily as regards rail insulation, and entirely if you buy proprietary plastic based track, which can be used outside, as long as the rails are not steel. Switching and frog insulation or live frogs are practical outside as this chapter shows further on. What are the snags? Few really, apart from having to insulate the track and all wheels to prevent shorts. Only if you want to convert from 3-rail to 2-rail will you think twice in '0' or '1' Gauge. The other snag is track circuiting which is not so simple as in 3-rail, and which requires magnets, a system like that marketed by Cockrobin Controls of Weston-Super-Mare, or the use of different current systems AC and DC on the track, which tends to put off the uninitiated — most people we fear!

Stud-contact is used largely in 0 and 1 outside for several reasons. It allows 3 rail-like running with more realism as only studs in the track centre are needed, sticking up like small pegs. These can be very unobtrusive (look at the photos of George Reffin's line in this book — did you notice them?). At track junctions i.e. points, they have to be taller to allow the skate pickup, a flat collector mounted "amid wheelships", to climb over rails which would otherwise both cause a short circuit and de-rail the loco. Track circuiting is easier, as noted, and bonding of the rails can be across as well as along a given piece of track, meaning greater realiability and probably less current voltage drop. The studs, too, as a pick-up-power source are less affected by steam powered locos than other systems of electrical pickup. It is less trouble than outside or centre-third track over complex junctions regarding electrical pickup. The snags are the extra work when making up the track for it, putting the studs in and wiring them up. It has never really been available commercially for outdoor use, although MSC models produce a skate collector for '0' Gauge, saving the rather fiddly making of them, another chore. (Don Neale's Peco book explains how to do this and is recommended. Most accurate skates are similarly modelled. To save space here see his description, *Railways in the Garden*, pp 40 to 43). See later in this section on electrifying track for more on this. When cleaning track you tend to catch fingers on the studs, but in operation they are virtually self-cleaning.

Centre-third is one of the oldest electrical supply systems and is used by collectors and 3-rail enthusiasts who fight shy of stud contact. Such C3 track is available second-hand, usually in Coarse Scale 0, or Gauge 1. To make it is 50% more expensive in rail alone and requires special chairs.

Outside third supply would be favoured by SR enthusiasts in Britain. If you modelled the London Underground 4-rail might be on! 03 is also used by some ex-LMS lines, and the now abandoned NER Newcastle system. Ironically, 03 and 4-rail are prototypical to railways along with Overhead supply. Stud Contact is derived from Tramway practice, not railway, and 2-rail has no proper prototype. In any case, bar electric prototypes, the whole electrical system most of us use in steam and diesel outline is a subterfuge! Nevertheless, we use it precisely because it gives cheap, realistic operation, indoors or outside.

Electrical power supply from mains to controllers

This handbook is designed to help you build a garden railway, but at this point we would advise that your connections to the mains be done by a qualified electrician and not by amateur hands. Where possible mains supplies should be kept in the house or its extension. If not get them properly brought out to your garden shed terminus. This should have full earth protection and sufficient power points for your needs. Your transformer can then be put next to them and protection arranged to prevent accidental damage. Never leave plugs connected into the mains when not in use, we would add. Additional power points in the garden should be fed from the transformer at low voltage.

If you do take mains power into the garden, shed or interior terminus, we urge you to fit an Earth Leakage Circuit Breaker, (ELCB) to the point of connection to the household mains. If

the connection is a permanent one in the UK your local Electricity Board will fit one to your distribution board.

If you use a flexible cable to plug into a household socket then a special version of an ELCB is available called a Power Breaker. This looks like an enlarged UK 13amp flat pin plug and incorporates the breaker in a moulded case. (In mid-1983 it cost £16.50). It is designed to ensure electrical safety to all portable equipment, especially when used in conditions where damp can occur — hedge trimmers, lawn mowers, your power tools, and this could apply to your transformer in a shed.

You can have a mains circuit put into your garden to cased water-proof socket boxes, into which you can plug transformers for station sections out there, but again, get a professional to do it. Alternatives of running out temporary mains cables are not be recommended if they're left out in inclement weather. Even on damp days when the sun has come out to make running possible we dislike the idea of running power lines that snake all over the grass to your control point. The safe alternative is a low voltage supply cable.

A low voltage supply cable is safer and effective. Its main problem is voltage drop over long lengths of cable. This can be quite a nuisance as outdoor trains tend to run at 12v to 24v D.C. The difficulty arises as it is necessary to have a large enough cable to supply adequate power without it becoming very expensive due to the diameter of the cable required. To run 30 feet to the layout would lead to a drop of 0.54 volts at 1amp where 0.75mm cable is used for a Gauge 0 loco drawing 0.5 to 0.75 amps at full power. This is on arrival at the track controller, not at the locomotive, which could be many feet away with further voltage drop ensuing en route. A loco drawing 3 amps (a heavy current consumer) would, using the distances and cable size and length above, lose 1.62 volts. If you used 1.5mm cable the drops would halve to 0.27 volts at 1 amp for a 0.5/0.75 amp loco, full power, and 0.81 volts for one drawing 3 amps. Now cable like this costs more the bigger it is so it will need costing carefully; a reliable electrical supplier can help you as to costs per metre. A 25 or 50 metre drum is far cheaper in the long run if you want a lot, a metre then costs 60% of what it would be purchased by the single metre. Also 1.5mm diameter cable costs about 2¼ times the price of 0.75mm cable. Always get good quality cable.

All this can be done by taking cable in and out each time on a reel or by laying it. Remember it is low voltage. Select a route from house mains to control point preferably at the side of a path. Dig a shallow trench 6in to 9in deep (minimum) and lay the cable inside a protective sheath and fill. PVC waste pipe from your local DIY shop makes a suitable sheath and provides quite strong conduit to prevent accidental damage by spades, etc. This is a semi-permanent connection, as its connection at the transformer end (into the mains from the transformer) should only be when you require it, as it will be at the controller end also. The cable used is not flexible for the connection laid above. Even with sheathing it would be little more than flexible cable taken in and out every time.

Transformer Rectifiers are sometimes built into controllers. For 00 it needs to produce 1 amp at 12v DC. For '0' Gauge that might do for small, light motors but you really need one to take 3 amps. Modern motors such as Bühler, Crailcrest, etc., take less current than older ones by Bonds for 0 gauge, so a line needs something to take the upper range of amperages if you mix different motors on your line, as most do. Some folk buy old transformers, but have these checked properly. Old ones tend to be single-insulated, so check that the earthing is in good condition, both the bonding inside the case and the earth connection to the plug via the power supply cable. A replacement source of good quality is a small output battery charger (as sold for cars). Well made to high standards, they have protective devices on both High and Low voltage sides. A 2- to 4-amp model should suffice for '0' and '1' Gauges.

Controllers and Track Supply

Controllers come in many forms, basic resistant mat ones to complex ones using electronic refinements to govern acceleration, braking and so on. Check whether they will do for outside use. Manufacturers are often most helpful over this. Some state that they are unsuitable for

outdoor use. (In practice they mean if it is to be left outside.) If your railway is run from a building housing the control gear in the dry all should be well, if you use the correct voltage recommended by the manufacturer, but check first. In '0' Gauge and smaller sizes 12v. DC is normal inside. Out of doors, it should suffice, provided that voltage drop is not too great — see further — and that the track is cleaned regularly, preferably before each running session. In '0', or above, 24 volts is recommended, because it will be less likely to suffer voltage drop of a sort which makes running poor outside. Most motors are not 24v, but you can run 12 volt motors on 24v in '0' provided that the controllers can cope to produce a realistic speed range (at low speeds especially), and — with the increased juice available — that you don't overlead the locos and burn out the motors. Care is needed, therefore. All this applies to any gauge or any current collection system. Some folk compromise and use 18 volts for 12 volt motors in the larger gauges. On a 1/55 bank the Editor uses 16 volts on it, with 12 volts elsewhere, to aid haulage uphill. If there are derailments switch off straight away to avoid damage. Don't overtax locos weighting over driving wheels or motor bogies might help more than just 'upping' the voltage to the track. Resistance in the track tends to stop full power reaching the motor, but to be safe we suggest a safety cut-out in case of overlead and derailments. A final point here, don't go above 24 volts for traction power. In smaller gauges run on 12 volts and clean the track. The finer motor windings in the small scales and some '0' Gauge mechanisms probably won't like too many volts and amps through them. It's best not to be called out from your control panel to see a steam outline model 'smoking' like the real thing!

Your Editor uses resistance mat H & M CU1 type controllers of 1 amp rating for '0' Gauge. These give good control and speed range to a variety of mechanisms. This may seem low for Gauge '0', but is probably because he has an end-to-end line with controls at each station. Trains run through, and so the controllers do not cut out because they operate for a minute or two, and don't have a chance to heat up. On a continuous line, with continual running they probably would not like it, and problems could result! On his Black Park line, Pat Honey uses 2 x 12v, 2½ amp transformers coupled together for each main line, a continuous circuit of 100 yards. Giving 15v output at 5 amps, this is fine for 12v. motors for his '0' Gauge use. Jack Ray has standardised on the fine-wound low-current consumption JH motor and has 12-16v DC ECM Compspeed Controllers, modified by the makers to give 2 amps. There is common earthing. These are switched-polarity controllers working from the same firm's transformers which will supply two controllers. George Reffin uses H & M controllers specially wound by the firm to deal with Bond's Motors. Many firms will supply for the larger gauges and modify their products. Visit other lines and look at adverts in the model press about this side of things. Transistorised control works well out-of-doors and developments are continual. Some electronics magazines have had articles on DIY construction, and doubtless those with the ability will build their own. This can often be done for about £5 whereas a purchased product could be six times as much, but do be sure you know what you are doing!

How you control your locos can be by cab control as does Don Neale, with an outdoor plug-in controller to follow the train around the garden, or by other systems such as split potential or single supply. We have used all three between us, and all work well. Outside it's probably best to keep things simple. You can interlock power supply, signals and sectioning, so that locos cannot over-run signals set against them so as to obviate rear-end collisions. If you do it will take a lot of time to set up and maintain. It would probably be better to do it on your indoor sections alone. A single track line with passing loop(s) and simple electronics can operate a hefty service as it is. Bear in mind, too, are you going to be on your own or not? In his new Crewchester line Jack Ray has a line with plug-in controllers for six sections. These can be plugged into two places, either at a strategic point in the section itself, i.e. a station area, when sufficient operators are present, or in the main garage control centre, so that one operator can control the system from the garage. The line's plan also provides point-to-point operation, out-and-back, or continuous, a clever combination of most ways of doing it. In all these systems the track is sectioned out.

The new systems by Hornby and others for multiple train control by chips in the loco should

work out-of-doors, too. At present these are rated to no higher than one amp only, so they would probably not suit the larger gauges. It would certainly eliminate much wiring. The only other objection is that you are limited to 16 locos or so for a layout, unless your loco yard has some basic wiring of sections in it to allow more locos to stand around. It's still early days with this, and for all of us it would be good to see a degree of compatibility between systems commercially available.

Having got your power to the track you will still lose volts on the longer than usual outdoor sections. This can be virtually eradicated by the following means. Firstly, all track must be properly bonded from rail to rail where they join. Don't rely on fishplates, notorious as 'voltage eaters' on a large scale. Bond by soldering coated copper wire (not bare wire — it will oxidise). 18-22 swg will do in '0'. In 3-rail you can additionally cross-bond so that both running rails are used to return current, unless you do track circuiting (which should be using a separate power supply insulated from traction supply and worked by non-insulated axles and wheels on all rolling stock back to indicator lights on a geographical control panel). Secondly, for long section lengths, put additional feeder cables connected at intervals along the track to help maintain the voltage. Barrie Walls feeds each yard length this way. For this application single core earthing wire cable is best and quite cheap. 1.5mm diameter cable is about 10p a metre (late 1983) and cheaper on drums obviously. A section of 100 feet will take up to 60 metres in feed, connections, etc. — solder it all thoroughly. Thirdly, clean the track — both rails for 2-rail, and for C3/03 power supply rails.

BASEBOARD OF ASBESTOS supported by framework, under which is situated a cupboard for electrical equipment. (It could do with its annual paint job). The supports of aluminimum above it and below the baseboard for the removable control panel based on diagram 5a are clearly seen. Photo: M. Bloxsom.

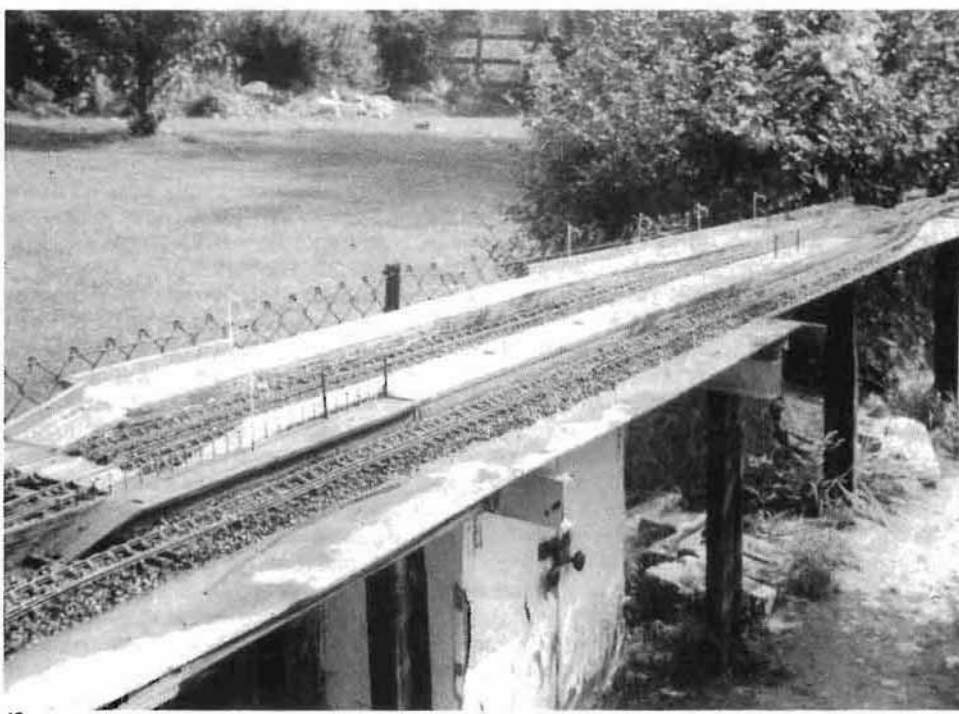
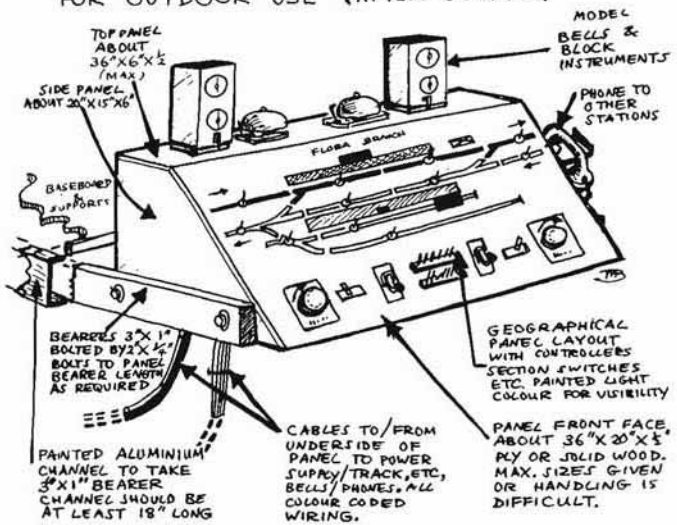


DIAGRAM **5a**

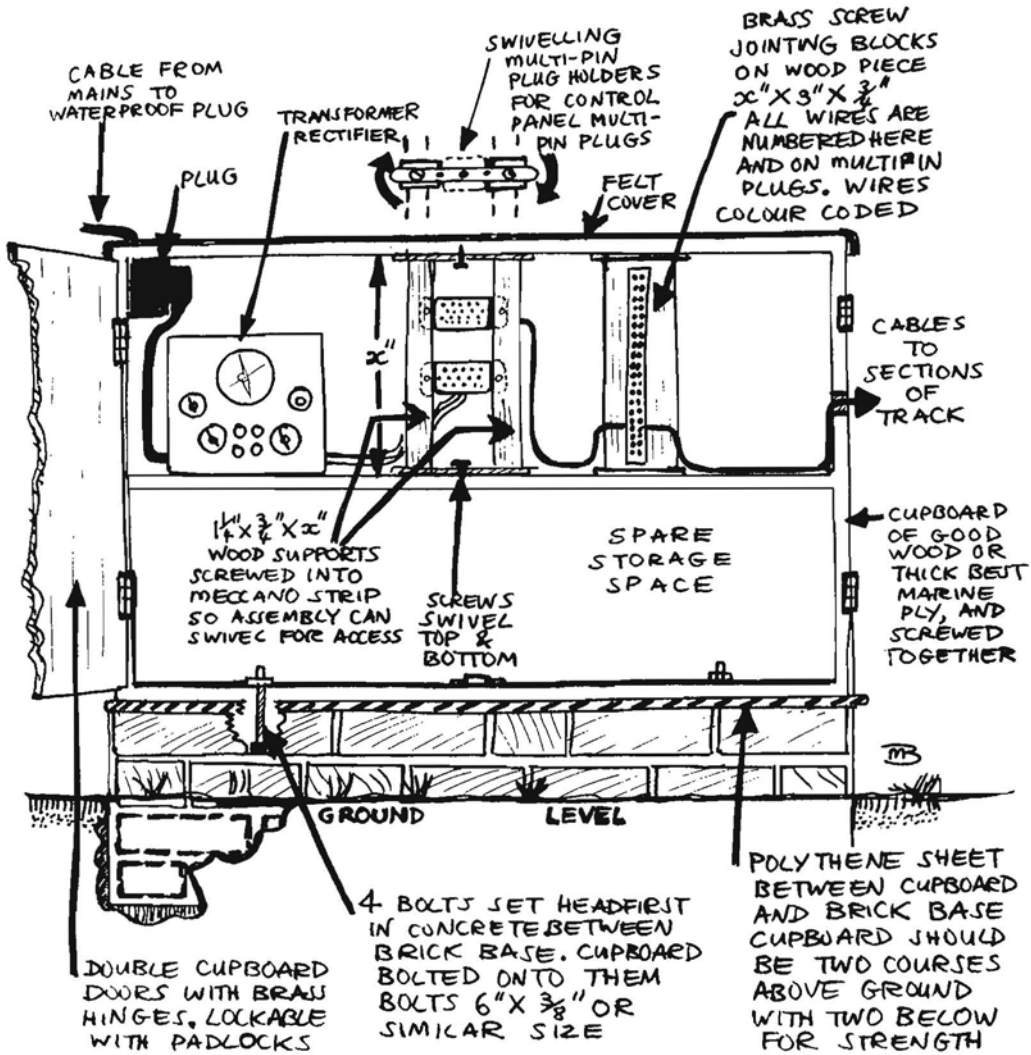
CONTROL PANEL ON SLIDING SUPPORTS
FOR OUTDOOR USE (AFTER J. HART).



NOTE: MAXIMUM DIMENSIONS GIVEN FOR EASE OF HANDLING. LOW VOLTAGE POWER ONLY IN & OUT. WIRING DONE UNDER MAIN PANEL WHICH, WITH AN UNDERFRAME BRACING, COULD BE HINGED IF DESIRED FOR EASE OF ACCESS. PANEL STORED INDOORS BETWEEN RUNNING SESSIONS AND NEVER LEFT OUT. FULL SIZE BLOCK INSTRUMENTS ARE BEST HOUSED SEPARATELY ON ACCOUNT OF THEIR SIZE AND WEIGHT.

For stud contact the studs are self-cleaning if you run regularly in reasonable weather. Cleaning at the start of a season may need emery paper, but with regular running track rubbers (Jack Ray's are made from bicycle brake blocks!) and flour grade paper should suffice. Excessive heavy cleaning will wear out the track rail surface over time if a very abrasive pad is used. Some folk use oil on the track, but we find that it gets all over the place, so avoid it. Ken Longbottom advocates protection by covering all track when not in use from rain and its content of man's industrial pollution. If this isn't possible, run as often as you can and clean as suggested above.

Controllers outside are fine on a removable panel, geographical or otherwise. The late John Hart had a fine large panel with controllers, telephone, bells and block instruments on it, which had wooden sliders of 3in x 1in sliding into painted aluminium channel under his baseboard at one station. A sketch of this type is included *(Diagram 5a)*. Well built it should last a lifetime. A photograph shows the cupboard into which one puts mains electric gear outside. This should be substantial, solid, and screwed as well as glued together. Put it under your baseboard, but off the ground by at least two brick courses which are used as foundations. The editor did this with a polythene sheet between cupboard bottom and concreting on the brick base to cut down damp. (Concrete is the usual 3:1 mix). The cupboard is bolted to the ground by 4 bolts 6in x ⅜in set into the concrete. The cupboard is thus removable if need be. Preserve it by either paint or creosote. Under a baseboard it misses the worst of the elements. *Diagram 5b* shows a typical interior. On a ground-level line a special box would need to be unobtrusively placed near to the desired control spot. A plastic cupboard, rather like those electricity boards used for house meters, set in a wall or on posts would be ideal, if you could get one like it. Control panels are taken indoors when not in use we need hardly point out.



NOTE: LOW VOLTAGE ELECTRICITY MAY BE SUPPLIED INSTEAD. IF MAINS TRANSFORMER/RECTIFIER USED IT SHOULD BE REMOVED IN WINTER (HENCE PLUG). ONLY ONE CABLE IS SHOWN LEAVING FOR TRACK ETC, OBVIOUSLY THERE WOULD BE MANY.

OUTDOOR ELECTRICAL EQUIPMENT CUPBOARD

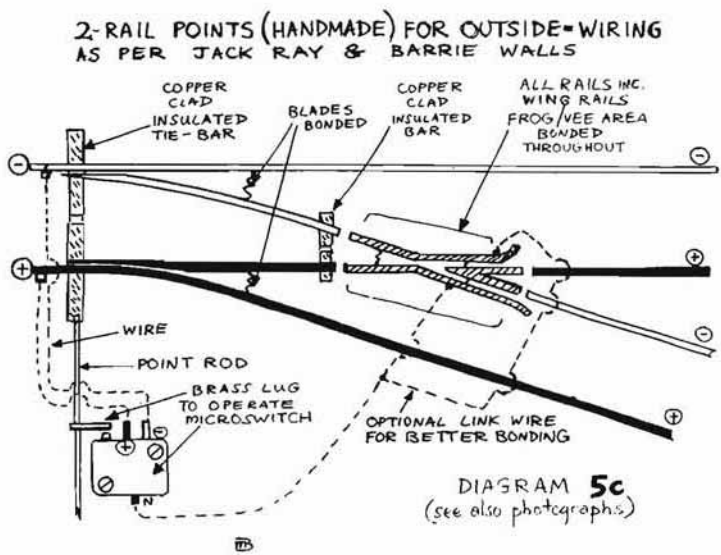
DIAGRAM 5b

Two-rail electric power including points

This is as for indoors, but bond the track. Sectioning is by insulating at fishplates. For plastic-based track the nylon joiners by Peco, for example, work just as well. On home made track it depends on the size of rail-height, given by Code of rail. For 80, 100 and 125 code rail joiners are available. For old type brass coarse rail you'll need to use insulated fishplates. A simple DIY way is to put insulating tape inside one which has been forced open a little, clip under the rails and use pliers to firm it home, but be careful not to split the tape. Test it thoroughly.

The main problem with outdoor two-rail is points and their working. Peco points for 2-rail should stand up to this, provided that their gear is well protected. On their own outdoor '0' gauge line they cover their motors with plastic which is used for Peco 'N' gauge wagon packs, and they assure us it is trouble free. A robust job can be done with other motors. Unfortunately, few are suitable for out-of-doors because they rust. H & M HM3's were good, but the Hornby takeover has ended their production. Shame! However, Sandown Electronic Engineering of Kempton Mill, Kempston, Bedford, produce a double solenoid motor, on printed circuit board, with a change-over switch to operate auxiliaries or to change frog polarity. It has provision to mount LED's also. It can have an add-on pack which provides an extra switch on it. Protected by a plastic cover it will operate points of a plastic based-type outdoors from '0' down to 'N' gauge. It will also operate one hefty '0' gauge handmade wood-based point, too. They could be an answer for many. (Price late 1983, £2.20 each).

For homemade points in two-rail *diagram 5c* shows how to do it for wood-based track on battens. Polarity control at the frogs is by micro switches (such as those sold by Whistons of Stockport). Copper-clad plastic stretchers are used, cut to give insulation, (denoted by insulated bar as the diagram). The frog is bonded as shown. The wiring is clearly shown. The micro switch can be point-operated, or from rodding. The switch should be well protected from the elements, either under a baseboard or by a little model p.w. hut. (See photographs in this chapter). On points made from copperclad rail such as those of Barrie Walls, illustrated, failure of the soldered joint at the vee crossing and wing rails has occurred. He feeds both vee and wing rails and uses micro switches to wire all points (indoors and out) in this manner. (See *diagram 5c*).



Stud Contact Track Electrification

Stud-contact has been introduced previously in this chapter. It gives better, almost two-rail appearance, with 3-rail running. For stud track the BRMSB developed standards back in the late 40's. These have been modified by some in the Gauge '0' Guild since, mostly over skate pick-up width, up from ½in to as high as ¾in. Many use the compromise of ⅝in. The length is normally 4in with the ends turned up slightly, a ⌣ shape. These dimensions will determine the positions of the studs on the track. Obviously studs must not be more than 3in apart or the skate will drop down. Width affects the placing of studs on points, and studs opposite each other on diverging tracks must be the same height or the skates could jam in between them.

Track laying can be a chore, but done properly maintenance is minimal unless the screws are damaged or wires broken. Number 3 Roundhead brass screws, with or without heads, can make the studs, but less obstrusive studs are made of brass pins or brads, with or without heads, put down onto the track (see photos of G. Reffin's layout). Their lengths will vary, but for coarse-scale battened track they will need to go below the sleepers by about 3/16in to ¼in in 0 Gauge. On straight track their height need be only ⅛in above sleeper level, so a minimum length of ¾in is desirable. They may be longer at pointwork, which is approached by gradually raising the six or so studs before crossing on an even gradient, so that at the rail crossing the heads are 1/16in to ⅛in above the rail height, and for a distance on either side of it, before descending down again to the next plain-track stretch. This is fine for homemade track of a wooden type laid on battens. On prefabricated track studding can be done on the workbench, whether plain or pointwork, bearing the above in mind. Drill holes every 2 or 3in, less on points, and fix the studs as required. Turn over, and solder tinned coated copper wire 18 to 22 swg, to each stud underside. It's best to twist the wire around each stud end at least twice, and leave enough wire to fix to the next piece of track. Apply paste flux and solder with a heavy iron — at least 100 watts is recommended. Multicore solder will do nicely by the way, and from a reel it's all rather easy. You can solder above track level but it is more noticeable, although easier to get at. On point-work, in order to avoid causing short circuits, keep the stud wire away from the running rails. You may need to put the studs off-centre to clear wheel treads and brakegear etc. To wire all this, the best route, (stud to stud) may not be the shortest. If you put the wire along studs above the sleepers and it is ballasted in or laid on bare boards, any cresosote or preservative will render the wire nearly invisible, especially as eyes will be inevitably drawn to the trains. On wood sleepers, battenless track, small studs may be used going 'up hill and down dale', i.e. from stud to stud. over the sleepers. For curved track leave enough wire in play between studs so you can curve the track on site.

Plastic sleepered, commercial track, such as Peco, can be studded. There are several ways of doing this. It partly depends upon your track foundations and the fact that plastic does not like soldering irons! Where plastic based track is laid direct to a baseboard George Reffin uses 1in studs, of a beheaded screw type, between sleepers, through the baseboard and joined beneath as outlined above. This way no hot irons get near the plastic. Alternatively, and time-consuming as well as wire-consuming, each stud is fed independently from a wire alongside the sleeper edge. This means more soldered joints which will be near to plastic sleepers. A simple heat sink near the iron should prevent undue casualties. A smaller iron may be better also.

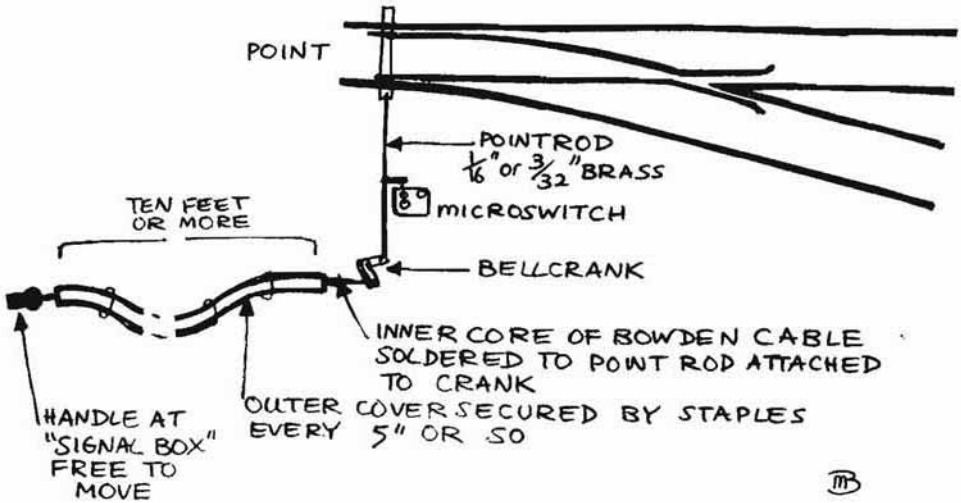
For ground level lines drill a 1/16in hole every 5 studs in Peco type track, and screw in ⅜in brass No. 2 roundhead screws until they are about ⅛in clear of the sleepers. The screws will tap themselves in through the plastic. Tinned copper tape is used for the conductor wire and deftly soldered to the screws with one touch to avoid damage to the plastic. A heat sink would be useful here to dissipate heat away from the sleepers. A bradawl through the tape will provide holes for the screws, and they should be pushed through before soldering. ½in screws would be needed for Peco type points because of the extra height needed to clear running rails. ½in brass screws should be used for wood-based finescale track.

As with all other methods, stud contact can be sectioned for your track control purposes easily.

The skates can be made parallelogram type as Done Neale shows, op cit, or as a plunger. Excellent articles on their making are also found in the Gauge '0' Guild *Gazette*, by Deryck Featherstone, for April and July 1975, before he changed to 2-rail, which is where we came in!

DIAGRAM 5d

POINT OPERATION OUTSIDE BY BOWDEN CABLE



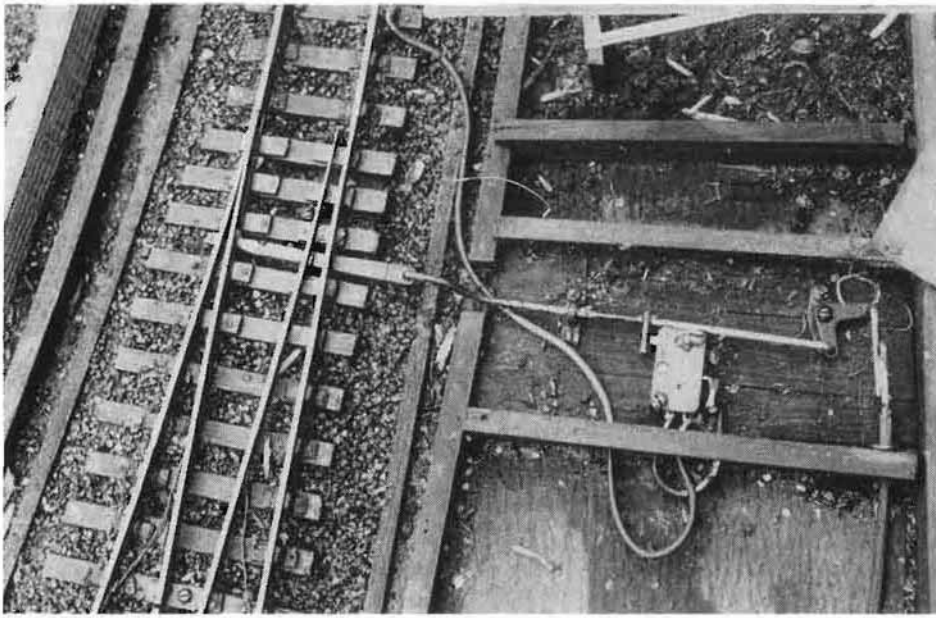
Point operation

Over short distances, up to 10 feet, points can be operated by rodding, but this may expand and contract a lot on hot days to render operation difficult, unless joints of a special bell crank variety are incorporated. One good method is to use Bowden cable. Cycle shops will sell you inner and outer matching cable packs. Grease the inner core before putting into the casing. Put in a short length of brass rodding from the point stretcher (carrying the blades) to a bell crank, if required. Solder the ends of the inner core Bowden cable to the rod. Staple down the cover to your 'signal box'. Leave the end of the cable free, fix a handle to it and it will always work, whether it expands or not. (See *diagram 5d*). This of course applies to any gauge or type of track.

Over longer distances use point motors, properly housed and protected in boxes, which are disguised as permanent way huts. A small box of wood, or plastic sheeting screwed and stuck together, will protect motors and micro switches. On wooden ones you could screw on a 10-gauge zinc roof with a swivel opening — the fixing screw at the corner — for easy access. Spray the works regularly with WD 40 to preserve them and ensure good contact, especially if they are non-wiping. For stud-contact and three-rail systems in general much of the above applies.

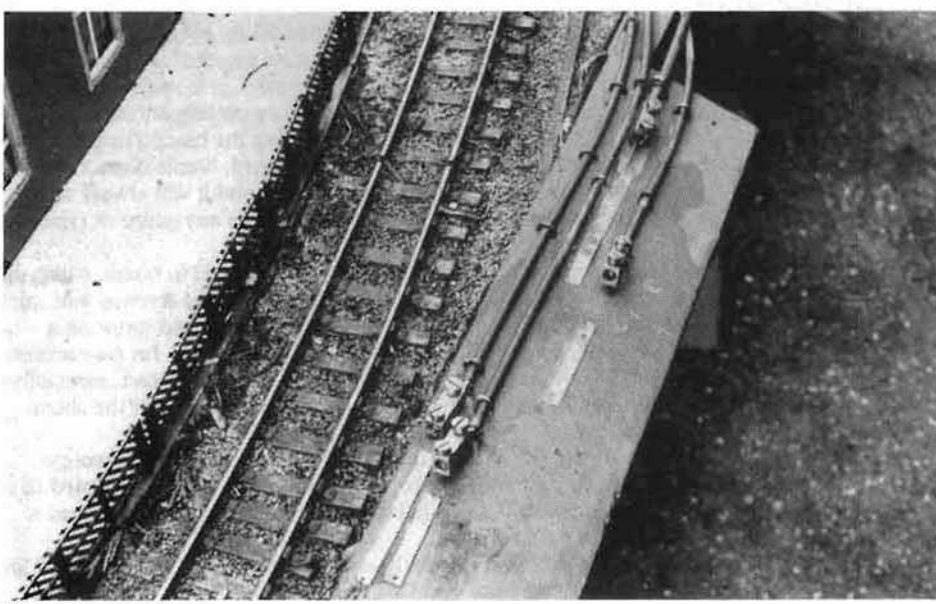
Voltages to points are often AC or DC, but the important thing is to use good quality switches which don't stick. These are usually flash contact types which need to be tested to see this doesn't happen otherwise point motor coils will burn out, as a heavy amperage load is created momentarily to operate the points.

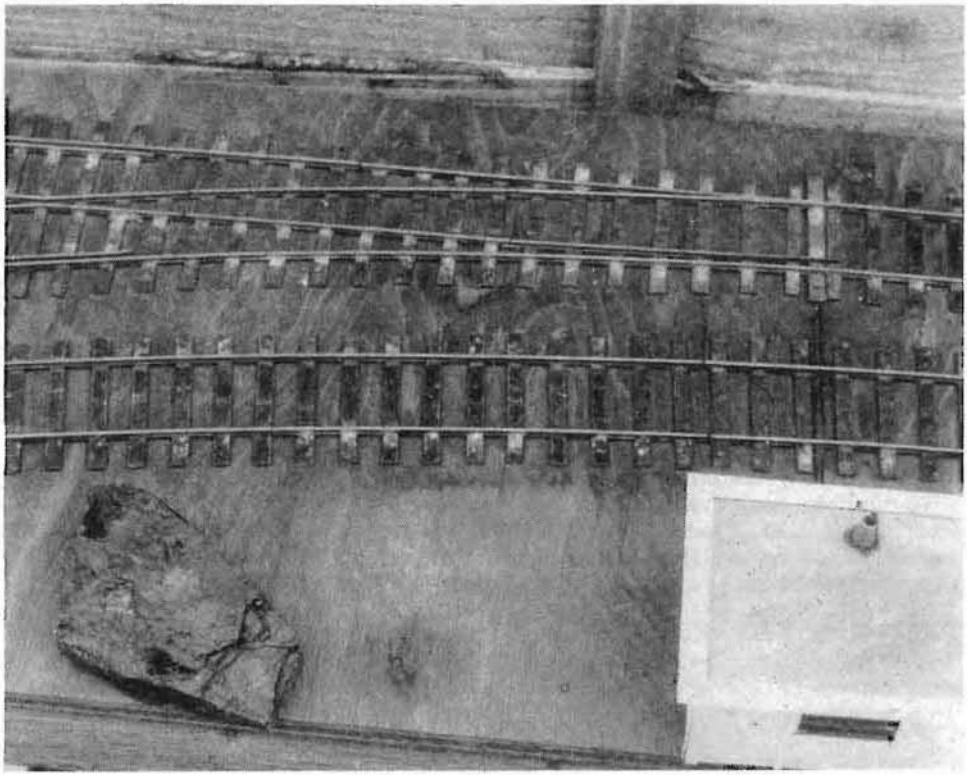
Points operated on site are quite satisfactory and the simplest of all for a garden model line. For narrow gauge operation this would be the norm, as it is in the prototype.



2 RAIL POINTWORK OUT OF DOORS showing wiring, microswitch and track bonding. Point operation by Bowden cable. Cover protection for switch removed for photograph, note hinged zinc cover, centre right above crank from cable. Photo: J.L. Ray.

BOWDEN CABLE OPERATION at control end, opposite end to pointwork photograph. Handles on end to be fixed. Note staples to hold cable onto baseboard Photo: J.L. Ray.





POINTWORK ON COPPERCLAD TRACK, Wallsea branch. Brass fixings to baseboard, just before annual creosoting. LNER P.W. Hut hides electrical point operating apparatus. Photo: B.C. Walls.

Electrical safety

Throughout this epistle on electrics we have tried to urge safety onto readers. If in doubt don't; this applies particularly to mains electrics. Don't fiddle about with live electrics switched on. Avoid wet and damp outside. If you follow the advice given here you should be all right, but don't take risks.

Finally, one point, it would be as well to install a fire extinguisher in your control shed by the door just in case. For electrical fires choose the right sort. A small extinguisher costs less than a decent ready-to-run coach in '00' gauge, a small price to pay, surely?

Signalling

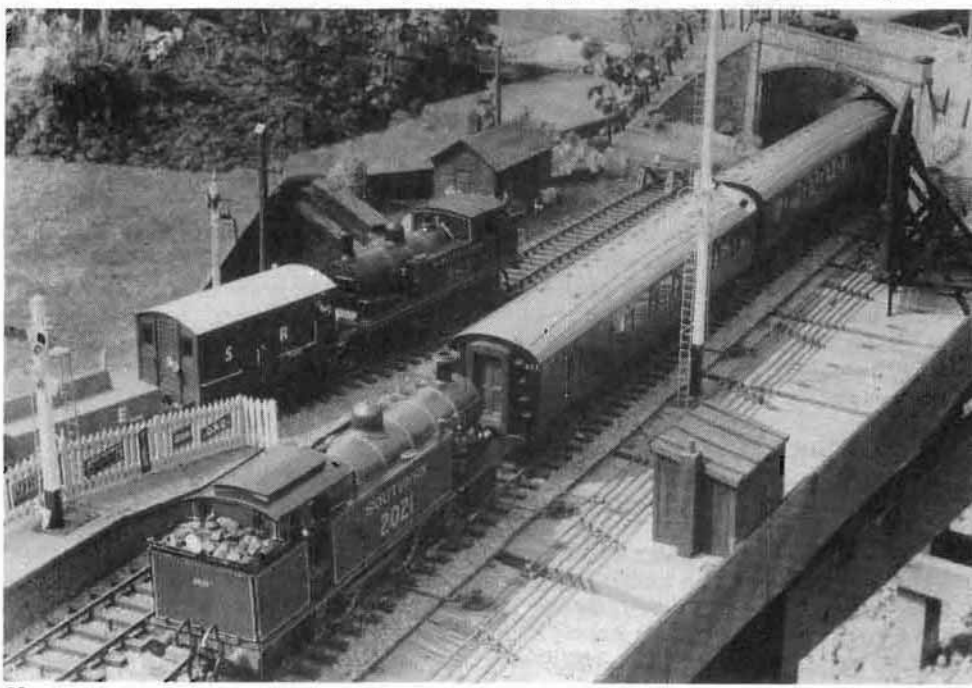
This is included here as it often entails electrical equipment. There is much material on this subject available regarding prototype size, installation, siting and so forth. Our own Gauge '0' Guild *Handbook No. 5* deals with this, and includes prototype information as well as articles on building 7mm scale signals, for indoor and outdoor use. It would be of interest to users in other scales. All this is for standard gauge. Narrow gauge lines often had very few signals, which means that you can cheerfully leave them out! This is often done on lines outside which do need them, usually because they are said to be fragile, or because the materials won't stand up to usage in the wild elements. This is not true, provided that elementary steps are taken to ensure strong protection and proper care of them.

Signal construction

Construction needs to be strong. Signals are best put on a base for easy removal. In the smaller scales many plastic and metal signals, as long as they are well painted, should stand up to being outdoors, although the plastic would go brittle if left exposed for many years. Coats of polyurethane clear spray should be tried to prolong their lives.

If you build your own signals the model forms of modern electric signals should present few problems. We would advise brass as it is strong, easily soldered and weatherproof. '0' Gaugers should refer to our fifth handbook at this point as it includes Alan Hepworth's article on how to do it! Again, modern tubular semaphore posts such as LMS and GWR types, still much in evidence on BR, should be fine in brass with brass or white metal parts. Derek Mundy provides etched brass kits in 7mm and 4mm scales which with care should be usable in gardens. He includes those fascinating lattice posts in his range. The SR enthusiast can use old rails for signal posts which are just as strong in model form as in prototype. Brass square section tubing will do for wooden post semaphore signals, and electric cables for lights, by wire or fibre optics, can be put inside if you wish. If you insist on using wood buy good quality wood and shape to the right shape; many posts tapered towards the top. Paint such posts well and use a clear spray on them, too (but watch the lens in case the colours are made too opaque by the spraying). We would recommend them being brought in at the end of each season even so, to preserve them. Bases should unscrew from your line, or the signals come out of sockets. George Reffin's beautiful SR and GWR signals are put up each time he runs. The co-acting wooden signal would grace any layout. (See photograph) There's no reason why you can't base yours on actual prototypes — much has appeared in print these last twenty years.

PERMANENT POINT RODDING following prototype practice on George Reffin's railway. Lever frame "hidden" neatly behind hoarding, top right. Signals, taken in and out as required, not connected to lever-frame, but work from bottom of post upwards. Photo: B. Monaghan.



At ground level you can fit shunt dollies (ground signals). Parts are available in most scales to make these. If metal they should be OK out-of-doors. Non-working ones in '0' Gauge can be suggested by using flat drawing pins, suitably cleaned and shaped, put into a wooden post and put on the layout after painting.

A Sykes banner repeater signal could be made in '0' Gauge or above. Ray Tustin did it 40 years ago, using an old watch case to do it, soldered onto a rail-built post as he models the SR. Pivoting the arm so that it all works should be possible. Route indicators are another prototype worth modelling, and given the micro-electric LEDs now available this is at least possible in '0' Gauge. John Hart had them on his layout some years ago.

There seems little point to us in guying all the signals up with wires, except perhaps in Gauge 1 or above. To be scale size the wire would need to be very thin, in which case it could not do the job properly!

Signal Operation

Signals may either be cosmetic — i.e. non-working, or fully working. If you wish to do the former we would suggest that you make the signal operational, to the extent that in semaphore types the arms are pivoted, the wires and guides put in along with weights down to the crank at the bottom of the post. You can then connect them up one day. Jack Ray and George Reffin have got to this stage. If you use colour lights they might as well be wired up, it's an easy business.

Making outdoor signals light up, semaphore or colour, is worth doing, and can be done as for inside, but use good quality plastic covered wire. As dusk draws on and you run in the evening twilight there is something reassuring — not to say magical — about such small twinkling lights as anyone who has seen it in model form will know.

Electrical operation is possible our of doors for semaphore signals. On a baseboard type layout the whole signal can be fixed to a plate, on the underside of which is the solenoid and other electrical apparatus, which will fit into a hole in the baseboard covered by the signal plate. Alternatively, the signal can be fixed to the baseboard and the electrical equipment put in boxes alongside, as with the points illustrated. Electrical wires should be kept clear of the ballast, and on a baseboard they should run below board level, and be clipped properly by Hyatt or other clips to the wood where they are accessible. Always leave extra wire of several inches at the signal end on a baseboard set up to facilitate easy removal of the 'works'. For ground level lines this is possible, too. Don't bury signal or other cable under the track, or worse under its foundations — as one article we saw advised — for how will you get at it? We need hardly add that all the different wires should be colour coded and of sufficient amperage for the jobs they are to do — track power, track circuiting, point or signal operation, telephones, etc.

Wire and rod operation is possible outside, and seems most appropriate to the larger scales but in 4mm scale the Ratio system could be adopted over small distances. Rodding might buckle in the heat, but the wiring should not. Over long distances you may need to provide intermediate cranks to take up the slack, or intermediate weights on a post for increasing the pull on a distant signal really distant from the box, or lever frame. Signal wires can be non-rustable florists wire or electrical fuse wire. Fishing line can be used, but use terylene rather than nylon which in our experience in use for this purpose outside was found to stretch more.

Rodding can be 1/16in brass brazing wire through suitable metal guides as in prototype practice for Gauges '0' and '1'. A threaded wire can be bought, which aids adjustment. Secondly, you can use a screw adjuster, or unsolder and resolder again at the forked end which is easier. Painted lever frames such as the GEM ones are fine outside.

Bowden cable can be used and should be employed as per Jack Ray's method above.

Both wires and rodding can be taken below track by tube. The wire and outer tube should be located before ballasting. Tubes can be plastic (old biro cases for example), or copper brass pipe — but keep them clear of electrics and any possible shorts.

Ray Tustin's book also shows pneumatic operation through pipes, rather like the ex-LSWR line out of Waterloo before it was modernised. ⅛in copper piping was used with cylinders at each end, lever frame and signal. With a close fit and probably not too great a distance it apparently worked well for Gauge 1, as long as the pistons in the cylinders were kept lubricated and so airtight. Plastic pipe might be used today, given copper's prohibitive cost.

Interlocking

Mention of this has been made. Apart from its construction, it will need maintenance whether mechanical or electrical. In both cases it should be housed in weatherproof places. Electrically speaking, if you know about circuiting, it should not take up too much space thanks to the latest electronic technology. The rest of us might do well to avoid it, particularly if we seek simplicity.

Telephones, block instruments and bells

These add tremendous fun to an end-to-end layout and if the operators are separated become a godsend; once you have them you wonder how you managed without! There was a time when the bells and block instruments could be got from real railways for very little. They are now collector's items and so not cheap, but an extended life on a model line is a good idea, especially if the instruments are from the railway company you model. If your budget is limited put in the bells. Various door bells and their pushes can be adapted, e.g. Friedland, Woolworths, but do get ones that sound right! The block instruments could be made, and diagrams to do this have been published. Triang-Hornby once produced quite serviceable ones but today they can be only got secondhand. Telephones can be a simple intercom of the keep-an-eye-on-baby variety, or you can sometimes purchase them secondhand from British Telecom or British Rail. Once installed you'll need to learn the appropriate bell (and phone ringing) codes for your company at the particular time you model.

Telegraph poles

These should 'garnish' the layout. Don't wire them up — it would all be too fragile. Plastic ones in kits are available for N to 0 Gauge, (the latter being Italieri kits for wargamers), and should weather nicely. You could scratchbuild them, of course.

Level Crossings

The traditional gated British level crossing would be a problem to build if the proper under-road operating gear were to be installed, particularly for outdoor use, as getting at it for maintenance would be a necessity, even if electrically operated. Hand-operated ones can be used. They could be scratchbuilt. In 0 or 1 gauge, Britains farm gates could be used with minimal adaptation, being strongly made in plastic. They can also be used for gated sidings.

Modern continental barrier crossings are available in gauges such as '0' and below. These tend to be electrically operated, and out of doors, with suitable protection to their apparatus, would make an interesting and worthwhile feature, especially if train operated as in reality. Ringing bells to warn road traffic could be operated via simple switching gear built into the barrier's operating mechanism, rather along the micro-switch lines proposed for point operation in 2-rail above.

Chapter Five

Buildings and Structures

We shall turn this chapter on its head by dealing first with the construction of the type of structures put in on a ground level line at the beginning, namely bridges, tunnels, ponds and platforms. For a baseboard line where construction may differ this will be also given under the same heading. Buildings will be covered in the last part.

Bridges and Viaducts

These come in almost 57 varieties! To simplify matters we shall deal with them in the order (i) removable and (ii) permanent. Construction, too, may vary with the type of layout foundation, those at ground level tending to be of the more permanent type. Basic types of construction will be included, ending with viaducts. Finally, we shall briefly review commercial bridges available.

Lifting Bridges

These are necessary on most layouts to allow access to other parts of the garden, other buildings, etc. Over paths the height at which they go is important in one respect — will they be tripped over or will they easily be seen? If the former they should be removed unless you are actually running trains. The latter, too, may be hazardous at night time. A simple one is made of good ½in to ¾in hardwood timber boards, dropping into suitable slots. If ply is used it should be best quality marine ply, well treated and suitably braced underneath by angle-iron for instance. If placed at a low level, decorative upper-works are best left out in case folk trip over them or tread on it.

Track must be firmly placed. In the case of homemade track it is best anchored down on brass plates, both on bridge and landward sides. These help alignment, and protect and strengthen the ends, always the most vulnerable spots. With coarse scale track in '0' it is possible to put locating side tags, bolted by 10 or 8 BA nuts, and bolts through the rails on the bridge, to help locate it on the abutments. Locating lugs or drop-in metal rods or bolts which fit into metal tube can help also. Their tops can be disguised. You will need four for each bridge, two at each end.

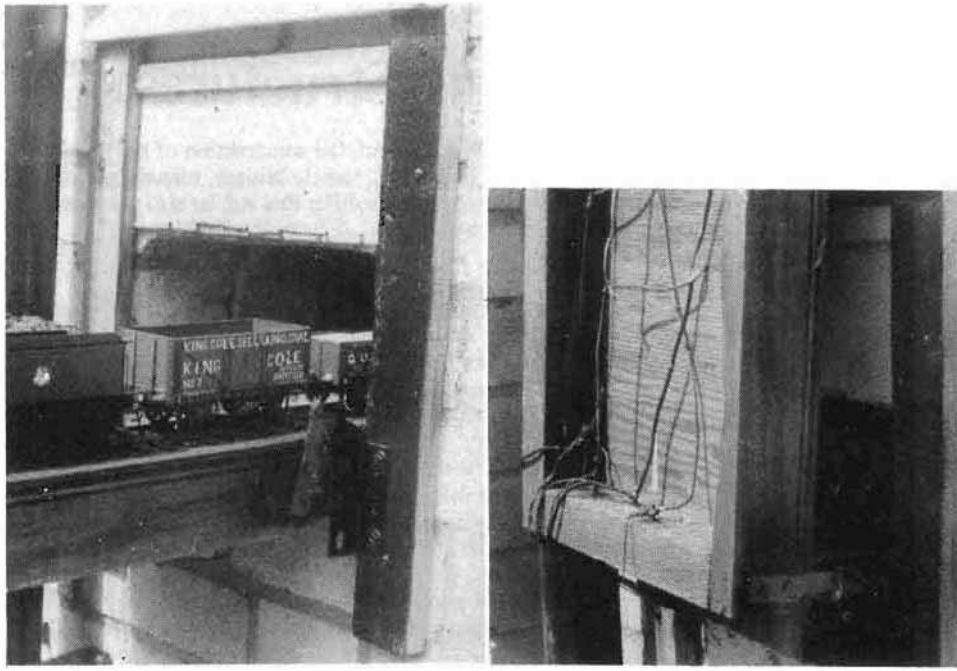
Abutments may be wood or concrete. Always sweep them clean between sessions. Bill Strickland urges small scale users to extend their track base well beyond the abutments on both sides to give adequate support. This is less true, probably, in '0' and upwards where things are larger and tend to be stronger.

With flexible track, such as Peco, cut it to span the gaps at each end of the bridge. Care with laying the approaches should ensure smooth fitting.

With both types of track remember to leave expansion gaps of at least 1/16 – ⅛in, according to rail size and gauge. Loose sliding fishplates/rail joiners should help alignment — but not too loose!

Bridges may appear to move with weather action but if good timber, properly preserved at regular intervals, is used, or the concrete is well done, movement in Britain, a temperate climate don't forget, should not be excessive. Over time packing may be needed. Bridges, of course, suffer least the less they are moved.

For bridges at 'trouser-top' height an upper structure of girders may help to protect stock inside passing over the bridge if someone actually catches it. There are many designs for this — plate girder types, or lattice particularly, look effective. These can be made from wood, metal such as brass angle (once found cheaply in curtain rail fitments), even tough plastic. Screw it all together properly, solder if appropriate. Use materials which will stand up to the weather. Don't over-complicate them, an overall effect is best. Coarse scale '0' gauge rail can be used as well as strip metal. Paint it all thoroughly to preserve the structure.



RAISED BRIDGE SECTION on the Wallsea branch, in open and closed positions. Note hinges showing between wagons of train passing over it. Flap shown raised, which should be locked when not in use. The raised view shows the underlying strength of the bridge's structure. Wiring temporary — to be tidied up! Photo: B.C. Walls.

For electric track bonds, current, etc., multi-pin plugs and sockets should be used with adequate flex. The part with the pins is best fixed to the bridge part, with a hook on the underside to hold it so it does not dangle when being moved. The pins are best protected by a plastic cover. Some firms supply such covers with the plugs. The socket is best covered in a little box for protection under the bridge approaches — it will be safer there. For a simple line old bayonet-type plugs and sockets will do, carrying just two pins. Being made of brass they won't rust.

Lifting bridges hinged at one end will work but when not in use must be securely held so as to prevent damage. Barrie Walls built one 3ft 6in long x 15in wide to take three Gauge '0' tracks. Old flattened cupboard door hinges were used with the pivot point 1in above rail level. Dexion angle anchors the board to the garage housing the internal part of his layout. The section just sits down onto the adjacent baseboard by placing Dexion angle either side of its location so that the flap sits snugly between. When up, it acts as a 'stop' when running is just going on inside the garage. The flap for security is also shown. (See our two photographs).

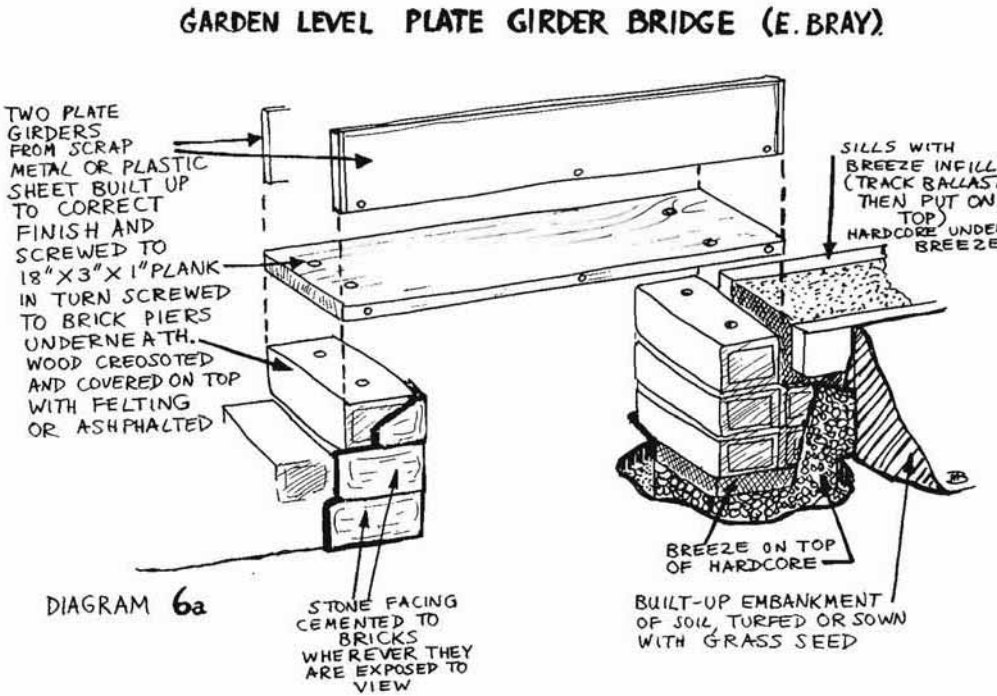
Horizontal opening bridges opening from one end need accurate construction, particularly if the structure rotates through a right angle. It is done a lot by model engineers on their tracks in 3½in Gauge and above, often to change tracks, etc., so look how they do it. We have seen it done by welding angle irons which on the outer, swinging end, are supported on a bogie where a wheel carries the weight. Ball-bearings would help with the load carrying here, but you'll need to follow good engineering practice.

Permanent Bridges

Construction here can be using materials described above to produce Warren trusses, bowstring bridges, plate girders, etc., whether underslung or over track. More ingenuity could produce 'tube-like' bridges, like those over the Menai Straits or the old Brunel one over the Wye near Chepstow, let alone the timber viaducts on brick piers in Devon and Cornwall. It's been done as articles in the magazines show. Don Neale's splendid line uses bowstring and Warren trusses over valleys and ponds. His Warren type are on concrete cast pillars, made as for viaducts, to be described later. Materials used are best quality stripwood ½in x ⅜in, with ¼in square strips for bracing and uprights. A jig was used to simplify accurate construction. Formica like material, easily drilled and tapped, provided the bridge deck. Excellent illustrations are used in Don's Peco book.

Whilst on designs, books on bridge engineering will help, as will the dimensioned drawings, easily altered for all gauges, in Greenly's classic 1924 book *Model Railways* — (See Bibliography). The HMRS, and other societies, have produced excellent drawings and photographs, so you can model these accurately too — the information is there.

A simple rail-over-road bridge by Eddie Bray is shown in *Diagram 6a*. It was actually built to allow the family tortoise garden access, which it soon found to be safer than being run down by a LNWR Lady of the Lake in full cry! (It was safer for the trains, too!) The bridge is a straightforward plate girder type of premier line practice. The construction is as per diagram. After three winters, one being really severe, it is firm and sure. (See also photograph).



BUILDING AN UNDERBRIDGE on E. Bray's LNWR garden line. The resemblance to what goes on in reality should be noted. Piers already stone-faced to hide bricks.
Photo: M.Bloxsom.

CONSTRUCTION OF BRIDGE OVER POND showing how welded angle-iron rests firmly on brick supports. Full details described in the text. Eddie Bray's pond bridge is single track.
Photo: M. Bloxsom.

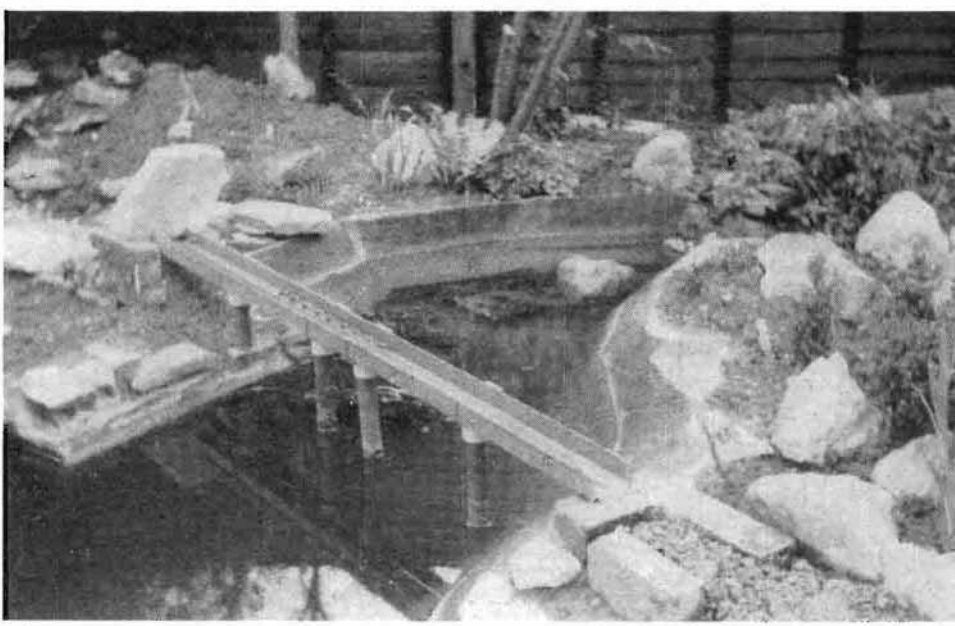
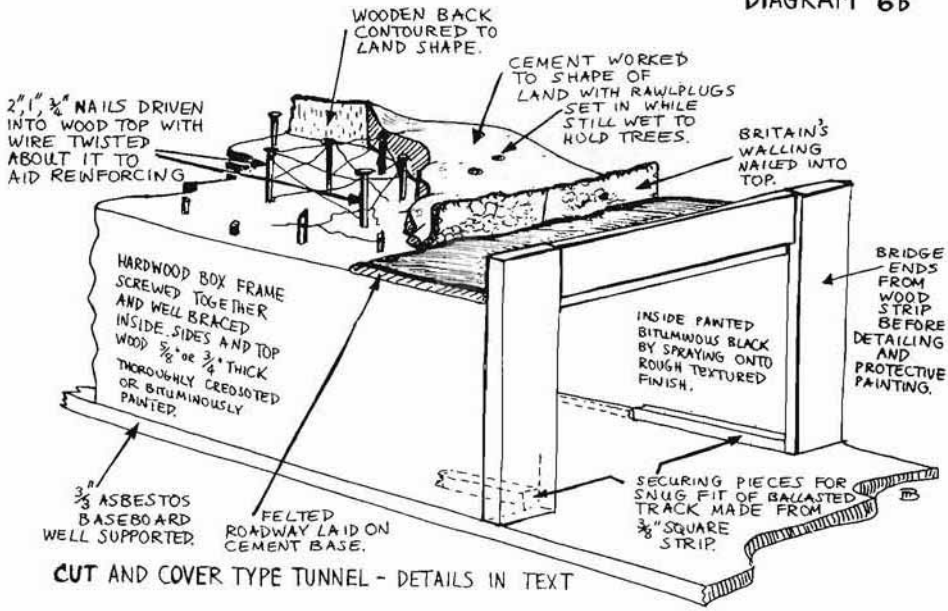


DIAGRAM 6b



CUT AND COVER TYPE TUNNEL - DETAILS IN TEXT

Over the pond on his garden line, as a focal point of delightful charm, Mr. Bray has built a simple bridge, some six feet long. It rests on normal brick and concrete abutments and is in fact removable if desired. Angle iron from an old bedstead is welded together. From this are suspended three piers of metal tubing, about 2½in in diameter, welded to the rest of the structure. These go down into the pond several inches and, with light and reflections playing onto the water, give the impression of being firmly on the pond bed but they merely hang to give an illusion of this! Plastic drinking cups are stuck to the tubing to give surface variety of pierwork, suitably painted. The ends of the bridge are ornate follies of the builder's own. These are an interpretation of Hardwicke's Euston entrance and of the end of the Menai Bridge. They are built of plastruct. The arch has grecian figures scraped off a plastic mock-Wedgwood flower pot. The pillars are filled plastic cake decorations for wedding cakes and the like. Photographic slideboxes provide the bases for the lions, which come from children's plaster moulds in red rubber. (See the photograph, taken before ornate ends were added).

Bridges for baseboard lines, over or under, can be made of heavy materials if the base will stand it, but wood and plastic can be used if it is desired to save weight. Good wood should be used. Overbridges can be used as a scenic break if desired. The Editor's method is shown in *Diagram 6b*. It is in fact a scale 120ft long, being really a short overbridge and tunnel, carrying a road and part of a field. It is made from an old hardwood drawer ¾in thick with end bridge supports of ¼in x 1in softwood, screwed, scribed and painted with paint, preservative and sand mixed; an effective brew. The flat top has a road made with roofing felt at one end. The wall is Britain's farm walling, with a reinforced cement 'concrete' field next to it. Whilst setting, rawl-plugs were put into the cement and when set firmly held Britain's trees screwed in and suitably painted by spray paints as was the field. The whole weighs over 30 lb and rests on strongly braced ⅜in asbestos, itself over a post support. The track ballast is held in by ¼in square battens inside. It is a snug fit and could be removed if required.

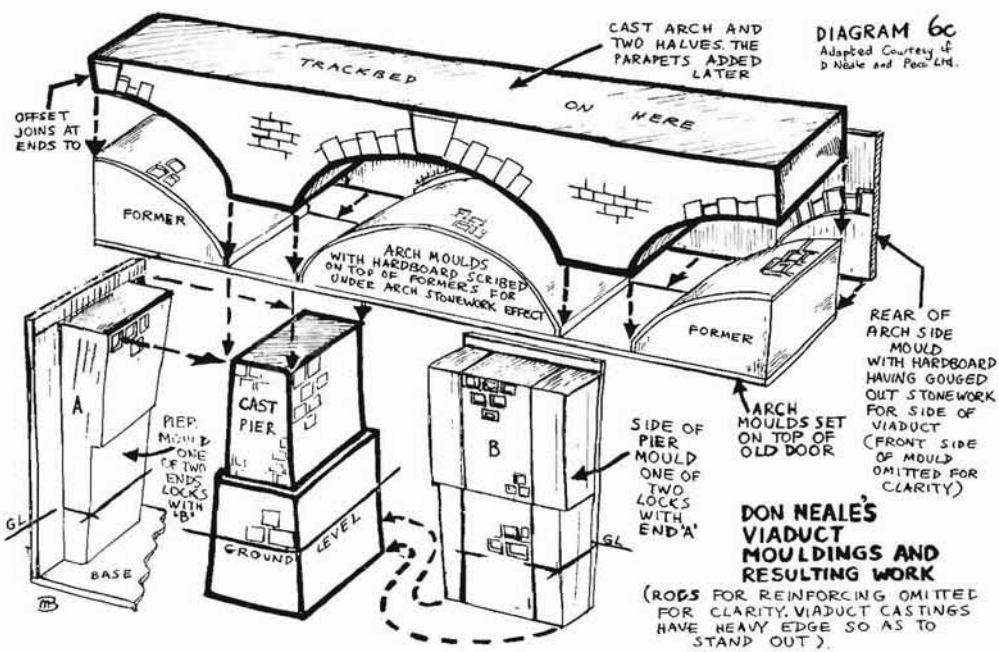
Peco make plastic bridge sides in '0', '00' and 'N', along with other firms which, suitably reinforced at the back and preserved with clear sprays, should last out-of-doors. Jack Ray uses scribed wood and very effective it is, particularly as he has a wide baseboard for full scenic effects to go with his bridges.

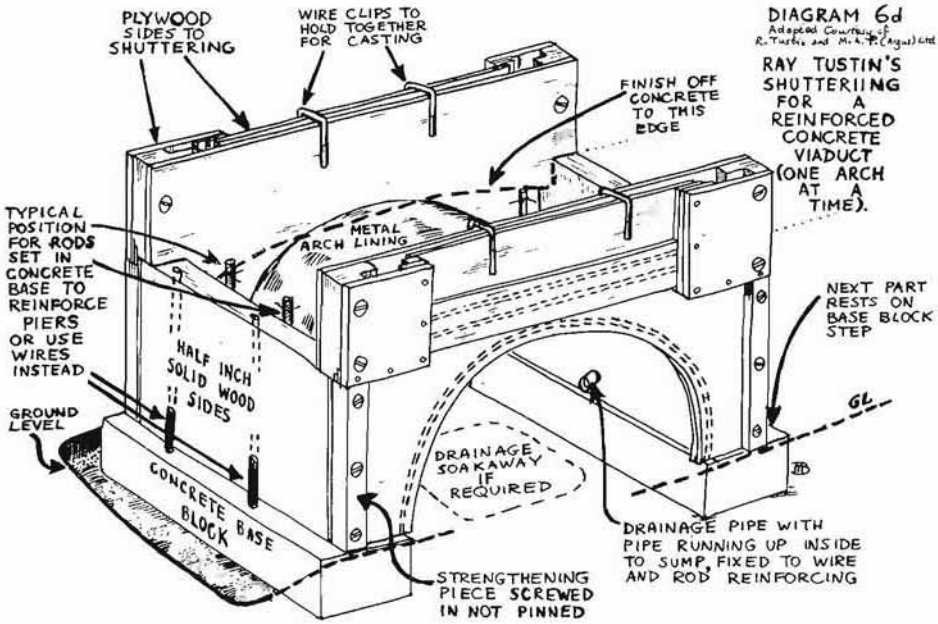
Reinforced concrete bridges and viaducts

These may be modelled on actual prototypes, straight or on a curve — the latter being more difficult. The methods used by our contributors Ray Tustin and Don Neale have stood the test of time and are outlined here. It will take time, and use up many hundredweights of cement, but the end result will probably be the *pièce de resistance* on your railway, scenically at any rate. A simpler wood method is described at the end.

On site first dig out a trench. In '0' or '1' Gauge, this should be about a foot deep and up to 18in wide to take double track (which type of viaduct will be stronger on account of its width). Next pun the ground to consolidate it. On bad clays soakaways should be provided, made as described in Chapter 3. Now, if a straight viaduct, put in a centre line using string. Next put in two pegs about a foot apart, knocked into the pre-determined height of the arch crown, which of course is the height of the embankment from which the line comes. Check all this with levelling equipment. For a curved viaduct you'll need to cut an accurate template on a firm, thick, unwarped plank, rather like we suggested from track jig templates. For the viaduct it will need to be on a plank several feet long. Don Neale's viaduct was on a 45ft radius curve, his template being drawn onto a seven foot plank.

Foundations now come next. Good bases for abutments are cast in coarse concrete, using greased shuttering. These bases should be 2 to 3in deep and ½ to 1in wider all round than your abutments will be. The coarse concrete can be six parts Thames ballast to one part cement, or three to one sand and cement. Into each abutment foundation rods are put for the piers. You can either cast pieces separately to aid prefrabrication of arch sections which fit on top, as did Don Neale, or you can copy Ray Tustin by casting complete arches and abutment piers in one, on site. If the latter method is used it may take longer, but might be better for a low arched structure which is not very long. Each method is described to save confusion. *Diagrams 6c and 6d* show the basics. Don Neale used piers cast in separate units, with the arches cast separately





and located on top. His reinforcing rods from galvanised wire 3/16in thick were put into the mould, projecting through holes in the base of it. The whole rested on the bases put in, the bottom 6in or more lying below ground level (where the trench dug out at the start was filled in). Stonework was scribed on the inside of the hardboard pinned in the mould. This was filled in situ. with 3:1 sand/cement mix, coloured black, the whole being filled, rammed and pushed to expel the air and fill the mould. You'll need to be patient to do this. Don't take off the cover mould until dry. Again, be patient or you'll ruin it and waste materials. Remember to grease the moulds inside each time you use them. Clean with a wirebrush quite carefully between times.

The arch was cast as one complete arch and two halves off-site on a flat old door. The inner sides were hardboard, again scribed inside to get the stone effect. The arches were formed by bending hardboard over formers nailed and cross braced together. Joins at arch centres were not on the centre line but offset by the keystones on the arch tops. When dry it was carried and placed in situ. This needs care in aligning, and Bondcrete and slurry cement were used to joint and fill to get it all level. This was done down at the pier bottom level, (out of sight when completed, of course). Parapet walls were added later. These have proved rather fragile and replacements are needed, largely due to the fact they're thin in section, although done by clamping the shuttering for them on to the viaduct. Last of all, holes were drilled for drainage in the arch crowns and covered with zinc covering perforated to let water through but not ballast. Holes to take rawlplugs for track battens were drilled, with track packing done by pieces of roofing felt, the ballast being packed loose on top. The result is quiet, smooth running and firm. Just how effective it all is can be seen in photographs in the articles he has had published, as well as the book with its splendid illustrations.

Ray Tustin's method is slightly different in that the whole unit, arch and piers, is cast at once, which means one at a time. The pier, of course, is really half a pier, which is completed when the next half is cast, backing onto the half already there. *Diagram 6d* shows the main points and the type of shuttering used by Ray. In this case the concrete supports could have the

reinforcing rods sticking up to arch crown level. To keep them apart they should have wire clips of the builder's type of ⋈ section — or your version of them. The shuttering is then carefully placed over this as a complete unit, horizontal rod and wire reinforcing fixed to existing reinforcing rods prior to fixing the drainage system.

In Ray's method a drainage pipe is used which empties into the under-arch space at a low point rather than the crown. This can use ¼ or ⅜in pipe bent to a suitable shape, the spout at the bottom protruding through a hole in the shuttering, so it will need to be fixed in before cement is poured in. At the top it should be wired in and protected by plugs to stop cement getting in. This pipe could descend from a sump on top of the piers made by putting a greased small block of wood in it, removed after cementing has set and covered by perforated zinc. Now pour in the cement, working it as before. All this done proceed as for Don Neale's method. Repeat for each arch. This method does not allow for scribing imitation stonework on it. Doubtless, this could be done. The late Ralph Clark used a rubber matting produced as doormats, which had a stonelike raised ribbing on it. Greased and applied inside the mould it produced an excellent effect on his Bishop's Castle Railway.

A cheaper method is to make piers of suitably scribed hardwood posts set in concrete. Once levels are checked, you can used scribed ply to build up a bridge, parapets and all. Alternatively, bricks could be used, but unless covered by cement they tend to look like bricks! For either of these a paint with a sandtex type finish could be employed to good effect on all these viaducts.

Commercial bridges and viaducts are available from several firms in various gauges and, as most are plastic, with care they should last outside quite well. In '0' Lionel produce a splendid 24in-long single-track lattice girder with plastic piers, as well as plate girders. Airfix bridges need little introduction from us, and Professor Harding has used them in '0' on his S & DJR line although they are intended for '00'. Hornby and foreign firms produce a whole variety of 00/H0 and N gauges. Adaptations for your own use are legion, even in other gauges to those intended. For example, a M & GNR footbridge for '0' could be built from an '00' Airfix girder bridge except for the steps and supports.

Besides plastic, some firms produce excellent structures like footbridges in etched brass. In '0' a LNWR one is produced by Modeller's World of Coventry. It should stand up to outdoor use.

Tunnels

Most books and articles state categorically that these are a nuisance out of doors, but folk do like them, often as a scenic break, so here goes!

Firstly, keep them fairly short. If not, lifting sections amidships, as it were, will be needed to get at any derailments, etc. Secondly, when not in use do block the entrances to prevent vermin getting in — especially at ground level. Thirdly, a straight one is easier to build and to get at!

On a ground level line they could be built using bricks to make a box-like structure on breeze foundations, with cast, wood-formed or plastic tunnel mouths and wing walls. Once completed the whole can be covered in earth. Track could be laid before the top is put on, or laid with prefabricated lengths afterwards, a tricky job. However, when looked through it will look wrong in section, so that you could use earthenware or plastic 6in pipe for '0' gauge, and other diameters for other gauges. The loading gauge inside nevertheless should be of generous proportions so as to get at things trapped in it. This could be masked by a nice tunnel portal cast in an intricate way to resemble the Gothic 19th century ones.

In '00' Bill Strickland used asbestos-lined flue pipe with a wood trackbase, and the bakelite trackbase fixed on top of that by screws on the end outside the tunnel to facilitate removal of the track.

On his baseboard-supported line, Jack Ray uses 10 gauge zinc bent on a former to shape, with a supporting wood-frame at the ends to which wooden built-up portals are added. Battens rung along the bottom to hold the walls straight on the baseboard. Curved tunelling can be

made by slitting the zinc, once shaped, up one side of the tunnel wall and gently bending it. This is possible only on a large radius curve of say 20 feet in '0'. To support scenery, bricks are built up around the 'tunnel tube' and a strong tin tray put over as a roof — the sort used for car sump oil collection. The whole is then covered with soil, landscaped and planted. This needs a strong baseboard which must carry this weight, as Jack's will. Something similar could be adopted in the smaller scales, demanding less weight, of course.

Ponds

These provide yet another focal point for a garden line. They can be made from concrete in a saucer shape, bought ready made in fibreglass to put into the ground, or laid in an appropriately shaped depression using tough polythene sheet. DIY books will show you how to do this. Planting, fish stock and water snails are covered too, in appropriate books, as is periodic cleaning out. Ambitious workers could have interconnected ponds at different levels with waterfalls. Water could be recirculated with pumps from lower to higher levels. A bridge over or in front of a miniature Niagara could be a real showpiece. If you put in fish remember that you may need to cover the pond with netting to keep out herons and their like! A bridge over water by Eddie Bray has been described already.

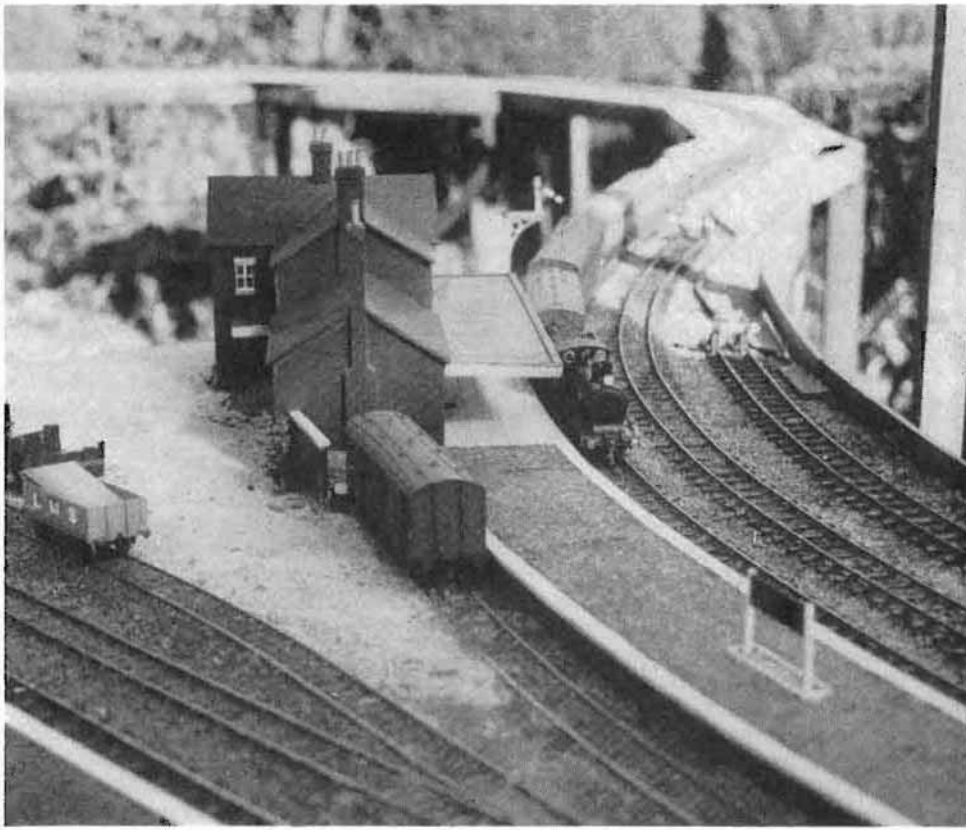
Platforms

These are not only for passengers — goods depots and cattledocks may be constructed in a similar manner. For a ground-level line they can be cast in situ. using concrete onto breeze foundations. In the larger gauges they could be reinforced for strength in the way noted for bridges and viaducts. A 3:1 sand/cement mix coloured to get a weathered look will do. Ramps are easily done by using a brickie's trowel. Holes for lamps, etc., should be cast in. Put in metal corner-plates on which to secure buildings before the cement sets.

With care wiring for lamps can be arranged. It might be advisable to put the main wiring behind the platforms rather than under them so you can get at it. Some commercial plastic/metals lamps would do, but you could make your own. Pat Honey makes his from brass tube which, suitably heated, will bend to form a swan neck. His are jig built, wired inside, being to 7mm scale. Where they enter the platforms — wooden ones — a snug fit is gained by using plastic sleeve cover from 13amp household cable. At the lamp end he uses a plastic sleeve with plastic type 'coolie-hats' for the shades. The wiring should be in parallel, not in series, or one blown bulb will put the rest out!

Platform edges can be suitably scribed, or edging laid in. Eddie Bray used plastic slabs stuck down with strong waterproof tile adhesive. An overhanging lip to the platform is difficult to cast in as it will be fragile. However, wooden strip can be fixed. While the cement is wet on the running line edge push rawlplugs in at regular intervals. When dry they should be held firm. Mark out the strip and, after drilling, screw in using countersunk, greased screws. Cover up the screw heads and apply a rough sandpaint finish.

The above can be used on baseboard supported lines but, as before, the board should be strong to take the weight. Wood is more normal there, however. Good knot-free wood will do, and a framework with cross bracing can be made, even fabricated off-site. The centre cross-bracing is drilled through for fixing screws direct into the baseboard. The platform can then be laid on top. If overhangs are wanted they should be wider than the supporting frame underneath. Separate ramp tops are made where appropriate. Instead of a wooden flat platform you can use asbestos on to a wooden framework, screwed in. Filler should be used to cover the screws, they being countersunk in, of course. The whole can be treated with textured paint of an appropriate colour. Much better is to put a felt top to the platform. Use good quality roofing felt. Cut a strip as long as the platform including the ramps, but slightly wider — at least 1in along the sides in '0'. Next, apply hot pitch — heated up away from the house! Cover immediately with felting and leave to dry, then trim with a very sharp craft knife dipped at times into paraffin to stop the blade clogging. Alternatively, use a mastic for cold use sold in



DERYCK FEATHERSTONE'S WINGHAM BRANCH STATION at Bedon, showing effective cover of baseboard by ballasting, etc. Buildings made of ply. Platform surfaces vary — note stone flags under awning and tarmac elsewhere, made from sand put on black paint. Ex. GER 2-4-0 on local train. Goods Yard is "readymix" concrete mixed with ash. Note effectively modelled dilapidated coal staithes. The whole protected by a light PVC sheeted roof. Buildings removed in winter. Photo: D. Featherstone.

tins such as that by the Ruberoid Co. for builders and DIY enthusiasts. Both methods should work well. When sticking use a heavy round bar (like a rolling pin) to flatten out any air bubbles. The work should be done on dry timber when there is no rain or any possibility of it over the next day or two. This saves painting the platform surface which will otherwise need it every year or so. Lastly, paint on the white edging using a good rule to scribe its course.

You can make proper wooden platforms from old sleepers on a wooden framework as in real practice. It could be pinned together or screwed. It might be best to remove it in the winter for storage. Old coarse scale sleepers and battens can be used provided that they are sound.

A large range of propriatory brands of platform are available in plastic. These could be used outside and have been by numerous workers in the smaller scales. Again, protect with clear sprays as required.

On the narrow gauge, platforms may be only roughly delineated and hardly raised at all, in which case you could do the same, but we would not advise you to use ash or unprotected breeze alone.

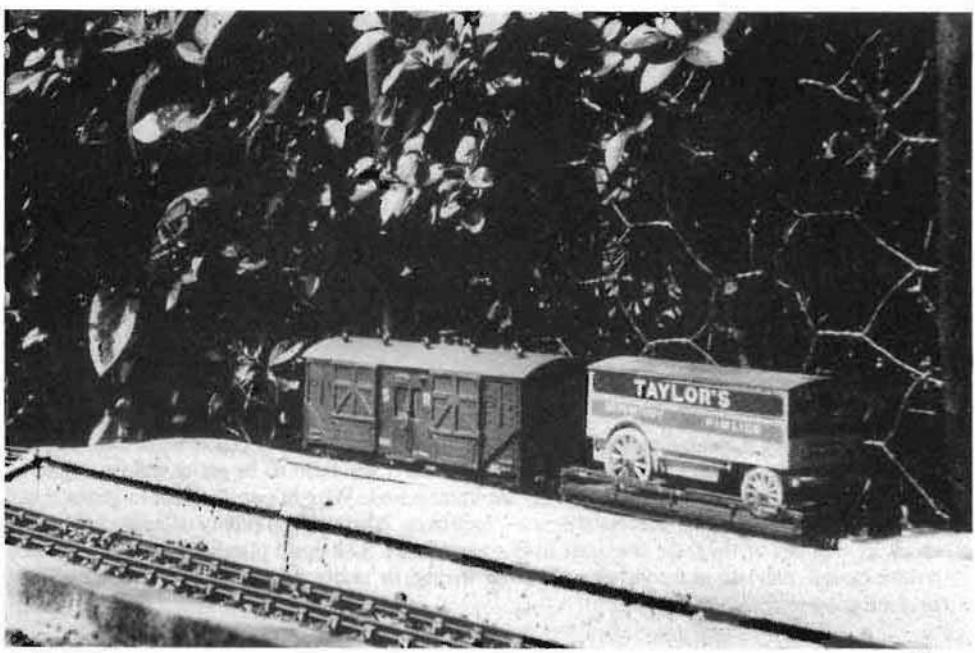
Buildings

You can make these by scratchbuilding, or can use kits and readymade ones. At the outset you must decide whether to leave them out between sessions when you will face the climatic onslaughts of nature, or whether to make them portable or not — in which case remember that they must be regularly handled, so putting them on a base, tailor-made for a particular location is worthwhile. This is especially so with fragile items such as signal box steps.

Buildings can be made of wood, which needs to be more than scale thickness. Use good quality wood. Old blind laths and old furniture may be a good source. Roofs can be aluminium sheet, suitably scribed, pinned and stuck on. Real glass can be used, suitably fixed inside the building. You could rebate special wood strips to do this. Well painted and clearly varnished they should manage the average summer left outside all the time.

Another source is hardboard, used inside out, i.e. showing the rough surface. This should be exterior grade, of course. Windows, etc., can be cut out, with stripwood used as interior framing. The texture of the board is bricklike for 7mm anyway. Roofs should be covered with felting stuck on. Chimneys can be from tubing, dowel, plastic tubes — old biro cases, or metal cast ones by firms such as Scalelink. Then put on an undercoat, maincoat, and finsh with at least two coast of polurethane varnish — four coats in all. Add window glazing using either glass or Slater's Plastiglaze. Doors can be plastic ones — Slaters kind, or scratchbuilt. Such buildings need only be brought in for the winter. Clean by the occasional sponging down with water.

PLATFORM AND LOADING DOCK on Ray Tustin's garden railway. Concrete sides with infilling as shown in foreground left of incomplete platform. Concrete edging to platform laid on top last of all. S.R. Carriage Truck and Prize Cattle Wagon in dock. Photo: R.E. Tustin.



We are not enamoured with the use of plys, even exterior grade marine. It will survive, if cuprinol treated, for platforms, but on buildings we find it will delaminate if left outside over a long time.

Plastic card, i.e. styrene sheet, can be used for buildings but we prefer these to be of the removable type. If left out they tend to go brittle in bright sunlight. In shaded areas they last longer. You should not paint them in gloss or enamel paints as it will make them blister under very hot conditions. This varies with the plastic, so a little experimentation may be in order here.

Commercially available plastic buildings, made up or in kit form, could therefore present problems if left out a long time and their careful placing and protection with clear sprays is desirable. There is an immense variety available so take your pick. This includes fencing and gates as well as buildings. In Gauge '1' there is the Britain's range plus continental firms' offerings. LGB do their own, which at 1:22½ scale is quite large! In '0' Gauge there isn't so much choice, but you can modify Britain's. Fittings in plastic such as fencing are produced by Slaters and others. Subbuteo produce paling fancing which is excellent in 7mm scale for platforms and modestly priced. Heljan produce an engine shed, but that might be better indoors. 00/H0 and N again have a huge range of available products from just about every make so go ahead. Bryan Burchell has used Airfix and Peco products outside with success, to name but two.

Cardboard can be used out-of-doors provided it is shellacked. Bring such buildings in when not in use. Flimsy steps in this material are best replaced by ones made-up from plastruct in 00/HO and 0 Gauge. This applies to kit or scratchbuilding. A clear spray helps protect them from a sudden shower. This is advisable if brickpaper is used.

Accessories and hints

A multitude of things is covered by this title. Many metal castings are used for water columns and the like. These can be left out if properly painted. Metal people should be brought in. Plastic people if left out will go brittle and disintegrate over time.

Simple station name boards can be made from plastic card using Slaters' alphabet letters, appropriate to the scale modelled, which are stuck on. In Gauge 0, the supporting columns can be made of old brass coarse scale rail stuck into the platform ends or through holes drilled in them. The nameboard should have a cap along the top to stop it sliding down the posts when in place. There are kits with cast and etched letters which will do in '00' as well.

Your own accessories can be scratchbuilt. Many make up or use proprietory buildings to hide point motors. Permanent way huts in wood or plastic have been used by us, but be guided by the limitations of your materials — and all of them do have limits! Use good, stout, framing for your buildings, inside where it won't show. Those of us in the larger scales tend not just to stick woods or plastics together but screw them, too. Use good quality paint suitable for the surface intended for it.

To end here, use plans or draw your own for any buildings you intend to make.

Lighting

This has been mentioned in connection with platforms. Buildings lit up do look attractive, and this is worth it for night or dusk running, as it is with signals. Use low voltages, 6 volts or 12 volts, particularly if modelling earlier periods when lights were often rather dim! Buildings should have plug connections for removal. Roofs, etc., will need to be get-at-able to replace bulbs if other than single storey buildings are illuminated. Wire in parallel, not in series. Use separate lighting circuits from transformers/rectifiers. Always keep plenty of spare bulbs in stock as supplies of these do fluctuate in our experience. Use good plastic-coated wire which, if colour coded, can run in a conduit with other wiring, or under the baseboard if held by Hiatt or similar commercial cable pins.

Chapter Six

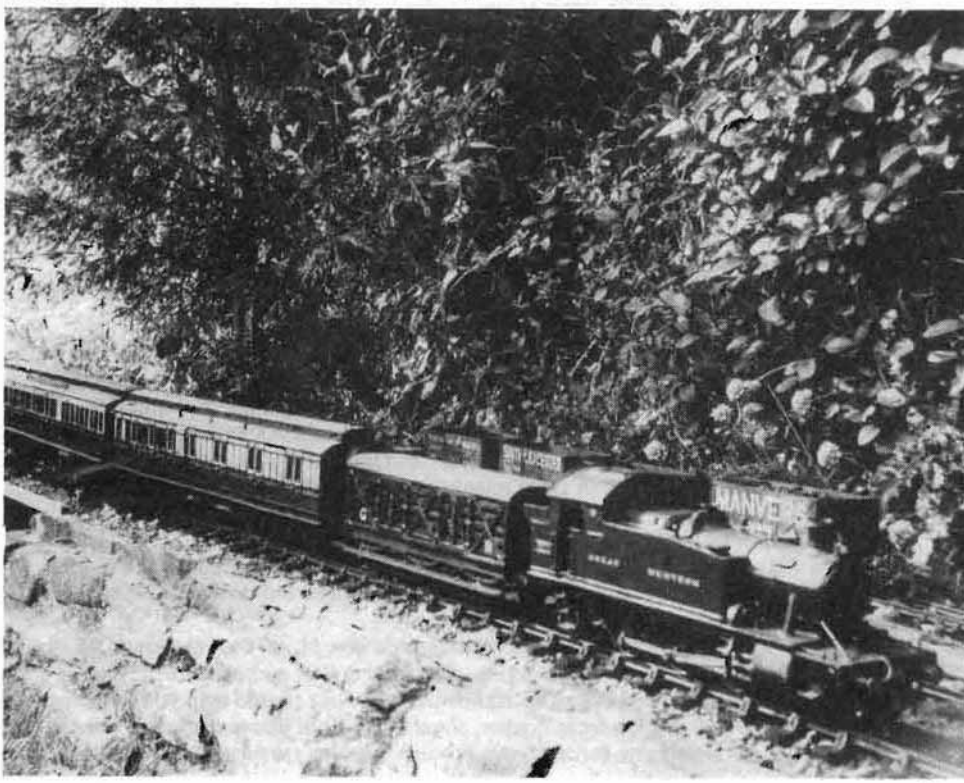
Garden Scenery

Garden Scenery may be modelled using artificial means, similar to those methods used indoors but of tougher materials, or modelled largely using nature's bounty of plants. The two can be mixed together, whether you model a baseboard line or a ground level one.

Concrete and plastic scenery on a baseboard

This can be modelled quite effectively. The late Ralph Clark's Bishop's Castle Railway had scenery on a very strong baseboard which consisted of reinforced concrete beautifully weathered to represent the scenery of the Welsh borders, complete with tunnels, cuttings and the edge of a village. His secret was not to overdo it — and to use effective weathering to which nature will add moss and other growth. Lichens and heathers were planted in nooks and crannies in the artificial scenery to good effect and softened the whole into a sleepy, mellow GWR branchline. Being a line raised above the ground on a baseboard, Ralph used a board, whether for single or double track, which was wide enough to take scenery and, being in '0' Gauge, 7mm scale, it was at least 2 feet wide at the narrowest.

SYLVAN SURROUNDINGS FOR GWR 2-6-2T No 5502 on a down passenger train. The line is about 10in above lawn level. Note the ease of access thereby gained. Photo: R.E. Tustin.



The reinforcing was done, as outlined in Chapter 5, on the Editor's line, for a bridge covered in concrete scenery. The reinforcing should follow the pattern shown there. This should allow for drainage if it is on a substantial scale. Rainwater run-off should be either off the baseboard direct, or into gullies by the track (as Jack Ray has done). Plastic plant trays can be set into the concrete, filled with peat and planted appropriately. The trays should be well drained with gravel in the bottom, or by pipes from sumps through the board. The board should be felted or be asbestos, well preserved with a bonding paint, before you start. We do not like the idea of putting plants into soil laid directly onto the baseboard — it must be held in and not be allowed to rot the supporting system. This also allows you to replace plants and keeps the soil where it should be — washouts onto the track are irritating to say the least. Filler can be used for repairs if the concrete cracks at all.

Plastic trees can be planted using the rawlplug method shown in Chapter 5. Again, they can be replaced easily if damaged or you grow tired of them. They can even be given seasonal sprays of paint to match nature! We do not recommend trees with metal trunks unless they are made of non-ferrous wire. They tend to be far more expensive than the ready made ones by Britain's, Faller and others. Don't forget to give them a clear spray to fix the paint and preserve them, in part from the effects of sunlight.

Rocks on an outdoor line can be suggested by plastics, too, if you wish to save weight. Pat Honey produced an excellent strata for a long cutting by using fibreglass sections (from Proops), such as is used for gas or electric fire imitation coal. This was laid end to end and screwed onto the baseboard. Suitably weathered and clear sprayed it is very effective. Doubtless other ideas will come to mind.

Goods yards and other lineside features can be laid on asbestos or felting by mixing sand (coarse variety) and laying it onto still wet paint or thin cement layers, which are useful to bring the land up to ballasted track that has been battened. Finish in appropriate colours. Real plants can be planted in the depressions and clefts of your 'concrete scenery'.

Real rocks can be used for cuttings, suitably arranged to show strata and cemented together to contain soil pockets, or larger soil areas, away from the track where it won't do your rolling stock any good at all. Don't use rocks liable to porosity or fracture as their breaking up will nullify your efforts over time to create permanent, trouble free, scenics.

As we noted in Chapter 3, you can disguise a baseboard quite effectively by creating rockeries or embankments. The photographs in this Handbook of baseboard layouts by Jack Ray and George Reffin show just what can be achieved.

Ground level line scenery — the preparations

Before you begin ascertain the type of soil you have — it may vary around your garden. Also remember that some plants grow better in light, airy areas and not others. Some do quite well in dark, shady spots. A neighbour, keener and better at gardening than you, may be a worthy consultant here. So may your local library, which should contain books on specific types of plants — evergreens, heathers, miniature trees, etc. and their probable suitability or not for your garden. Don't fall for a type of plant unsuited to your garden, which you'll only fully remedy by an importation of soil — heavy and expensive, plus fertilisers or their equivalent.

John Innes Compost No. 2, from garden shops, will help you create a good soil. Garden soil can be mixed with coarse sand and peat if necessary, but it should be weed free. For good growth 3in depth is a desirable minimum, but some small plants can do well on shallower soils on rockeries.

Stone, gravel, or pot chips may well help drainage and give plants rooting places. They also retain moisture, so if required put these in first, then your soil or compost. Some plants, especially the smaller ones, need this. The acknowledged books should help you. A home-matured compost, free you hope from disease, should help fit in plants and small trees. A carefully planned compost using garden waste products such as grass cuttings, dead leaves and flower heads, etc., is a good basis for your plants' successful growth later. Put this down in a

garden corner and see how things you wish to put in do there in experimental conditions.

Rocks and rockeries should be free from stones, well bedded in and not of easily friable material. Cementing may help to hold it if necessary. Soil, especially a loam from your compost, can be put into these nooks and crannies, and planted with the smaller bright covering plants which will clothe the rocks so beautifully and help the line mature.

Scale is desirable, and to this end you may wish to put in larger trees at the back, gradually working downwards to small plants near to your tracks. For this, large coniferous growths such as Cupressus Leylandi and Cupressus Lawsoniana should be back by the fence and away from the railway. They not only provide a good backcloth but also stop potential vandals from getting a look in! Close up, they drop bits which will derail stock in 7mm scale, or smaller, and these do also need a lot of clearing up. Later in this chapter we describe and list suitable plants including some miniature species. Most of those in the lists will survive winters. Remember that the odd 'large' conifer — it depends upon your railway scale — will not come amiss among the lesser plants, especially carpeting ones.

Try to get a blend of different colours. With care you can also have neighbouring plants which flower or look their best at different times of the year, so as to add interest when you're not running trains.

If you have a relatively straight line this can be broken up into a tableau effect by careful planting of taller trees and bushes. The photographs of Ray Tustin's line show this very well. It is complemented and placed in perspective by a pleasant lawn in front of it. This also lends space to the scale achieved. Once matured it will look really attractive.

Some things to Avoid

Weeds are an obvious problem. They must be rooted out if they set up near your line. Once many plants are established weeds will have less of a chance, so in the end most of your soil will be covered with plants. Invasive plants which might be acceptable elsewhere are to be avoided. A good garden dictionary should help you here. If drastic measures are needed then use a selective garden weed killer and put it on with care, don't spray it all over the place or your choice specimens which are wanted may die, too. It's best to get in onto virgin territory before the weeds do, as Bill Strickland points out in his *Chronicles*.

This picture sums up garden railwaying at its best. SR B4 Class 0-4-0T, No 100, on a short transfer freight on a ledge section in one of the tableau like scenes on R.E. Tustin's railway. The train has just emerged from a tunnel, hidden by foliage. Note the distant signal just before the Brake Van. Photo: R.E. Tustin

Trees should not be allowed near your line if they send up suckers or produce fruit likely to fall and damage track in the smaller gauges — as large cooking apples might do to plastic track in the smallest gauges. Pears are also out on this count. Out, too, go limes and similar trees which secrete sticky substances onto track, stock or anything else within reach. If you want these trees put them elsewhere. Many large and beautiful deciduous trees should be elsewhere — on account of the leaves they drop, which may derail trains. Put them out of harm's way. Roots from poplars and their kind were mentioned earlier in the handbook to stop you putting your line where they were likely to cause problems.

Shrubs or bushes with thorns on them are out, which means that rose trees belong to their own bed, and not your garden railway and beds adjoining it. Track cleaning by a rosebed would be hazardous to fingers!

Near to lawns, which can complement a line nicely, the gardener should use a grassbox. Avoid fussy little bits of grass difficult to get at near to your railway. Apart from it being awkward to look after, this may lead to neglect if you want to run your railway instead! Grass edging near to the track may cause problems, so it may be better to put the line on a higher level or away from the lawn altogether.

Animal life needs to be discouraged from running amok on your line. For example, don't plant Nepeta (Catmint) by your tracks — every cat we've met loves to gambol in the stuff. Your family pets should be encouraged to go elsewhere. Train them, too, in sanitary habits, especially large animals, if you can — enough said on that. A baseboard line scores over ground level on such points. Slugs, snails, ants, woodlice and their friends are best deterred by appropriate insecticides such as slug pellets, which do not harm humans or our pets.

Lastly, in this section, particularly if you run the garden and the railway, don't make the scenery too complicated, or you will need to spend too much time on that rather than the railway. If you have help, or others prefer to garden while you run the trains, come to amicable arrangements about which plants go where before the planting is even contemplated.

Some notes on plants and trees, and their care

Hardy varieties are really needed for your line, half-hardy ones may not survive so avoid using them in large numbers. Perennials will obviously save you a lot of bother, but to change the varieties annuals can be employed — everyone has their own favourites.

As a railway enthusiast and gardener, at least in part, you will realise that many plants are 'come by' if you visit friends' gardens and persuade them to give you a root or cutting. In return they will visit you and do the same. If, of course, your other outdoor railway friends encourage you to visit them the pleasure should be complete! Nurserymen are the other source particularly for harder to get items, which may be a little expensive anyway. John Constable specialises in these plants and trees for 10mm/⅜in scale (Gauge 1) and smaller scales, and will help fellow enthusiasts in the garden railway scene, especially if you mention this fact. (His address appears in the *Contributors* section — Ed.) His book will help you even more, and serious enthusiasts should study it, as obviously a chapter here won't contain enough detail for them. (See *Bibliography*). The catalogue he produces will be useful as an initial step (50p plus postage in December 1983).

Near to the tracks you will probably want cover plants which will bind well into the rocks and cuttings you have, as well as hanging nicely. These will include heathers such as Calluna Vulgaris, aubretia, alyssum, saxafrage, gypsophilia (but it will spread), frankenia, raoulia, sagina (not too hardy), mimulus (musk), minuartia imbricata, potstilla eriocapa and others. Their sizes vary from ½in to 2in, so think about your scale. Different coloured ericas and lings are ideal and are available in many varieties.

Larger plants include phlox, some pyrethrums (not all are hardy), iberis (candytuft), dianthus, thymus (thyme), and others. Thymus 'Doone Valley' can be made into a bush resembling golden privet. Other small bushes or shrubs include berberis, genista (a miniature gorse), rhododendron radicans — a lovely miniature, and many more, often of a more specialist nature. Veronica makes good bushes for the smaller scales.

Special trees include betula nana, salix, sorbus, syringa; all being deciduous. Evergreen conifers include abies, varieties of chamaecyparis, juniperus communis 'compressa', picea, thuja and, above two or three feet in height, some of the better known evergreens, which can have their tops taken out regularly and be shorne annually, rather like sheep, to keep their size down. Even then they should be a background feature, unless you are running a large-scale NG line through the equivalent of a Douglas Fir forest.

As mentioned above, planting should only be done after proper preparation. Plants obtained from a nurseryman should be unpacked straight away, watered and left in the shade outside. Plants received in winter are best kept in pots, well sheltered, and put out once Spring has properly arrived. Even then don't rush it. Put them into dryish soil which is well drained, then water. Don't plant in very hot weather, or when the sun is at its height on a really warm day. Wait, do it in early evening. Those grown in the sun stay tighter and smaller than if kept in the shade.

Care for many of these plants is not extensive, but be sensible. Watering should be done every day in hot, dry weather and not at all in winter. Again, as with planting, do it as evening draws on. Soils should be moist in spring and summer, but dryish in winter. Autumn rains normally take care of the other season!

You'll need to trim plants near to tracks or your line will look like a disused branch! Some plants, aubretia for instance, need regular trims. Use a good, strong pair of scissors for this.

Pruning over time is not a bad idea if your plants are to stay trim and shapely (rather like weight-watching, really!). It improves and encourages growth. Snip out crossing branches. It is best done after flowering where flowers are produced, but for many plants any time of the year is often satisfactory.

Liquid plant foods applied in the Spring should set your scenery nicely right for the summer. Remove dead leaves and rubbish before you start running — to avoid derailments and to make it all look neat. Where these accumulate in winter (your line's cuttings are the most obvious place), use a vacuum cleaner with its extension hose to do the removal. Choose a dry day and use a properly earthed cleaner and cable. The drum type cleaners used in industry or modified for household users are best for this work as the debris does not get near to the motor system, where anything vaguely liquid would cause problems!

Those who want to add countryside cottages, fences, gates, posts and rails, etc., can include all these. John Constable supplies them for Gauge 1. His miniature flagstones, tiles and ½in high flowerpot will go nicely in other scales. He also supplies cottage windows for those wanting to build their own 10mm scale houses. There's even a miniature spade. Several firms produce similar items in the small scales such as etched brass barbed wire — nasty stuff though it is in reality!

On visits to other lines — de rigeur, we suggest — take a notebook to note plants grown successfully and the methods used to achieve this. If it's written next to the details of a built-up loco kit you saw on the same line, you'll probably remember to do something about it. Trying to remember afterwards can be irritating and inaccurate. This 'disease' tends to worsen as one gets older!

In winter, look at those garden railways you know of on slides taken on visits so that you can learn more. The Gauge '0' Guild's slide collection depicts some magnificent layouts which can be viewed at leisure. A film about John Constable's miniatures is included in the English Tourist Board's *A Celebration of English Gardens*. It should be available on hire. A local model railway society might find it useful, not to say a change!

We hope that the 168 different trees, shrubs and plants listed here will grace your layout and produce a railway set in real scenery. Some are easy to obtain, others are of a more specialist nature and more expensive in consequence. Good planting!

Table 2
A List of Evergreen and Deciduous Trees

This is not exhaustive, but should give you plenty to work on

Name	Evergreen/ Deciduous	Height	Notes
Abies, balsamea hudsonia	E	Up to 2ft	
,, valsamea hudsonia			
Chamaecyparis, Adleyensis	E	Vary from 1ft to 2ft6in	Vast family with enormous varieties of colour shading and shapes
,, Elwoodi			
,, minima aurea			
,, ,, glanca			
,, obtusa caespitosa			
,, ,, ericoides			
,, ,, Kosterii			
,, obtu Nana			
,, ,, ,, gracilis			
,, ,, Pygmaea			
,, Orientalis aurea			
,, pisiferia filifera			
,, ,, ,, aurea			
,, ,, ,, nana			
,, ,, nana			
,, ,, ,, aureovariegata			
,, ,, ,, variegata			
,, plumosa aurea compressa			
,, ,, ,, Rogersi			
,, ,, compressa			
,, ,, squarrosa			
,, squarrosa intermedia			
,, ,, ,, minima			
,, sulphurea			
,, thyoides Adleyensis			
,, ,, ericoides			
Cryptomeria, japonica elegans	E	To 1ft 6in	Thick trunks. Often changes colour in winter
,, ,, ,, Bandai			
Sugi			
,, ,, ,, Jindai			
,, ,, Vilinoriniana			
Juniperus, communis compressa	E	To 2ft	Mininature Junipers for a formal look.
,, compressa depressa aurea			
,, prostrata var.			
Picea, abies mariana glauca	E	To 2ft	Very adaptable spherical heads
,, albertiana conica			
,, marlana Nana			
Thuja, occidentalis Rheingold	E	To 1ft 6in	
,, ,, globosa			
,, Rheingold			
,, orientalis rosedalis compacta			
Betula nana	D	To 1ft	

Name		Height	Notes
Salix, boydii (willows)	D	9in	
,, herbacea	D	3in	Dislikes frosts in
,, myrsinties	D	9in	some cases
,, retusa	D	9in	(Keep in pots)
,, hylematica	D	6in	
,, reticulata	D	3in	Hardy
Sorbus reducta	D	1ft	Like a Mountain Ash
Syringa, afghanica	D	1ft	Lilac like. Prune well
,, velutina (palibiniana)	D	1ft	Lilac fragrant. Prune well
Zelkova nivea	D	1ft	Elm like. Winter cover from frosts

Table derived from information by John Constable and Bill Strickland (op cit)

Table 3
A List of Shrubs and Plants

Name	Height	Type	Notes
Achillea, argentia	1in	Trails	Largish flowers
,, tomentosa	2in		
Aethionema	4in	Shrub	
Alyssum, montanum	4in		Colourful. Clipwell.
,, saxtile	6in		
Androsace, carnea	Up to 4in	Carpet	Small, colourful.
,, lanuginosa	across		
,, villosa			
Antennaria	1in	Carpet	Cover
Aquilegia	4in	Trails	Cover. Put away from tracks in small scales.
Aubretia	4in	Trails	(As for Aquilegia above)
Arenaria, balearica	Up to 4in	Carpet	White flowers. Spreads to give good embankment effect
,, ,, caespitoia	across		
,, montana			
Asperula, hirta	1in	Trails	Carpet effect
,, nitida			
,, suberosa			
Berberis Corallina Compacta	4in	Shrub	Evergreen, orange flowers
Calluna Vulgaris Foxii nana	3in	Heather	Can be made into hedge. Use peat.

Name	Height	Type	Notes
Campanula, avartica ,, avartica alba ,, pusilla ,, cochlearifolia ,, garganica ,, carpatica ,, stansfield ,, Warleyensis	3in to 6in	Bushy	Leaves large as are flowers for small scales. Keep away from track
Cotoneaster congestus nanus	4in	Shrub	Prune to get tree effect
Crassula, sarcocaulis	9in – 12in	Succulent Bush/Tree	Dislikes v. hard frosts. Likes sun. White blossom like appletree.
Dianthus, caesius ,, Little Jock ,, Freynii	3in 2in 2in	Carpet	Cover. Large leaves for small scales.
Erinus, alpinus ,, alpinus alba ,, Dr. Hanelle	2in 2in 2in		Tufty and neat.
Erodium, roseum	4in	Creeps	Keep away from tracks as will over run them.
Frankenia laevis	2in	Trails	Pink flowers on green carpet. Rock coverer. Use coarse sand to help drain when planted.
Geranium, dalmaticum ,, ,, alba ,, sanguineum ,, lancastriense	2in	Carpet	Cover, but roots spread. Could be problem to small scales.
Genista sagittalis pilosa minor	3in	Shrub	Gorse like flowers.
Gypsophilia, fratensis ,, repens ,, ,, rosea ,, Rosy Veil	1in to 3in	Trails	Neat. Not above tracks to trail down, put on rocks below.
Heather (Ericas) Erica, carnea George V ,, ,, Springwood ,, ,, ,, Pink ,, ,, Vivelli ,, cinerea atrosauginea ,, cinera Mrs. Dill ,, tetralix Con. Underwood ,, vagans Mrs. Maxwell ,, vulgaris – several varieties ,, Nana compacta	5in to 9in	Shrubs	Flowers vary as does colour. Leaf form varies. Can be O.K. near tracks
Helianthemum, Ben Nevis ,, ,, Vane Betty	5in or more	Trails	Not too near track. Good cover.

Name	Height	Type	Notes
Iberis, saxitalis	3in to 6in	Shrub	Neat. White Flowers.
,, sempervirens	4in		
Jasminium parkeri	6in	Shrub	True Jasmine. Prune. Plant with extra sharp sand. Protect from frosts.
Linaria alpina	4in	Trails	For walling, rock faces.
,, ,, rosea			
Mentha requienii	½in carpet spread		Mint like scent. Use as undergrowth, bank cover.
Minuartia imbricata	2in	Trails	Rosette flowers. Best for larger scales. Prune with scissors.
Phlox, Douglassi	2in to carpet	Trails	Spreads between other plants. Nice flowers.
,, ,, effusa			
,, G.G Wilson			
,, Rose Queen			
Potentilla eriocarpa	2in		Large yellow flowers. Grows well.
Primula, denticulata	2in to 5in	Carpet	Spreads. Put away from track to enjoy. Early flowering.
,, frondosa			
,, minima			
,, wanda			
Raoulia, australis	½in carpet		Minute flowers. Put in well drained soil. Not too hardy.
,, glabra			
Rhododendron radicans	6in	Shrub	Large purple flowers. Small leaves. Plant in peat.
Rubus articus	4in	Shrub	Miniature bramble. Plant away from track, especially in small scales.
Sagina glarba aurea	½in to 1in Carpet spread		Dense mat of golden evergreen. Clip well to stop creeping.
Santolina, incana	9in – 12in	Shrub	Neat Lavendar.
Saxafrage: –			
Aizoon:	½in to 1in	Carpet	Evergreens. Can be grown up to tracks but clip well at times
minutifolia,			
Cochlearis,			
lutea			
Rosea			
Kabschias:			
Apiculata			
Burseriana			
,, sulphùrea			
,, ,, erecta			
Jenkinsae			

Name	Height	Type	Notes
Aizodes atro rubens hypnoides carnival Peter Pan oppositifolia splendens	2in	Carpet	Mossy like. Clip well as can spread quickly.
Sedum, lydium ,, muralis ,, spathulifolium ,, ,, Capo Blanca ,, ,, purpurea ,, rosea ,, acre minor ,, anglicum (English)	to 6in		Can drape over rocks. Will grow on poor soil. Lydium is smallest and very pretty. Butterflies love them. Anglicum next smallest to lydium.
Sempervivium, arachnoideum ,, ,, Stansfeidii ,, hookeri ,, montanum			Succulents. Small types.
Sisyrinchium brachypus	4in		Iris like. Long leaves.
Thymus, azoricus ,, nitidus ,, ericafolius ,, serpyllum ,, ,, alba ,, ,, coccineus ,, ,, Annie Hall ,, ,, languginosus ,, ,, Pink Chintz ,, Bressingham Seedling ,, Doone Valley ,, transilvanicus	4in and above	Trails and covers	Great variety. Excellent cover. Tiny flower masses. Some are scented. Can be clipped with scissors.
Veronica Bidwelli ,, ,, lilacina bomdycina ,, rupestris nana	3in	Shrub	Small shrubs.

Table derived from information by John Constable and Bill Strickland (op cit)

Chapter Seven

Rolling Stock

An outdoor railway working in the true environment of real railways will present problems not always encountered indoors, and these should be borne in mind when making or buying locomotives and stock for your line. Often locos are expected to do much harder work on longer runs with probably lengthy gradients. They will encounter damp track and there is little doubt that hammerblow effect is greater than indoors. Both locomotives and stock need to be tougher in some respects in consequence. Handling, even falls, can be rougher, too. The weather can suddenly change and this should be noted if you get a sudden shower. Further, when they are left in store in your garden railway shed, dampness and temperature variations should be taken into account.

Locomotives

These notes refer to construction, particularly if you build your own from scratch or kits, or buy locomotives built to run outside.

We feel that frames should be substantial, and in Gauges 'O' and '1' at least 1/16in thick. Scale thickness etched frames, totally soldered together, we dislike. They may be too flimsy, could warp under hammerblow, and would need springing (almost certainly in the finer scales and standards of Protofour, Scalefour and Scaleseven). Further, they can't be unsoldered. We like to get at frames, motors, gearing and wheels without having to unsolder the assembly, which would ruin paintwork, too. We prefer steel or cast iron for loco. wheels. Force-fit wheels are out unless easily removable. We are not sure how plastic wheels with steel tyres will wear outside, particularly with hammerblow effect on wheels, etc. Wheels should be bushed or have proper moving hornblocks, etc.

Motors may be the older solid running types by Bonds, Leakey and others, or the more modern ones by MSC, Crailcrest, JH, MGS, Pittman, etc. Gears may be of usual types, but a double shaft motor will enable you to fit a flywheel, which will avoid stalling on dirty sections of track. Use a big motor in a big machine.

Pickup for 2-rail may need care as it can have problems with dirt. All-wheel pickup with insulated engine and tender couplings or bogies would probably be best. Sprung plungers may need maintenance. Stud Contact should give little trouble if properly fitted. Most important is the skate angle, an ideal of 30° being needed for good results. MSC produce one in 7mm scale, O Gauge commercially.

Body construction should be of firm materials such as brass and nickel silver. If plastic is used it should be well anchored to the frames etc, preferably by nuts and bolts. Weight is more easily added to metal locos as plastic bodies may distort. Lead or Wood's metal can be cast into plugs to fit into boilers. Flat lead sheet will fit in side tanks, either by glueing or temporarily by plasticene. Motors add to the weight. But it will probably be more necessary to have weight over or near the driving wheels. The standard dodge of weighting tender fronts to bear down on the drawbars of locos like 4-4-0's, which are sometimes difficult to weight, is worth the effort. Adhesion weight is vital.

Fine fittings can be added, particularly if you don't wish to handle the locos very much. Of course, if your loco catches plants, woody parts in particular, or sadly, has a drop off a baseboard such fine work will suffer more than robust, slightly overscale items. Even so cab detail, brakegear, etc, can be put on, provided that it is securely done. In 'O' and '1' and large scales of the NG variety, use screws or nuts and bolts wherever possible. These tend to be better than glues or soft solder. Modular construction methods all round are probably a sound bet.

Steam powered machines need to be properly, nay solidly, constructed, and the 'antics' in the construction of their electric powered cousins will amuse the true steam enthusiast! However, as

Chapter 4 shows in its brief survey, superb scale steam locomotives are quite common in all scales from OO/HO upwards.

Battery locomotives may be light rather than substantial, which would need lightweight stock, if battery consumption is not to rise rather a lot. Plastics may help here rather than hinder. Weight the chassis though, and try to use the batteries over the driving wheels to help you, rather than making them more dead weight to pull around.

In the smaller scales plastic bodies are used very much, particularly in ready-to-run models, so many may wish to use them if starting OO/HO or N in the garden. Again, weight well where you can. All metal wheels might be a good change if you can afford it. Take care to regularly check wear on gears – which are often nylon, and watch for dirty pickups, leads, etc. Flywheel motors may be a good bet from the outset. We are not altogether confident that plastic tender-powered locos will be man enough for long, continuous work out of doors. Weighting can be problematic with them as the engine 'dummies' just go around. Some of them have been criticised in the model press for lack of pull on test rigs indoors, so what of the great wide open spaces? Perhaps metal-bodied types are best, such as the old Hornby types produced by Wrenn besides their own models. Experienced operators such as Bryan Burchell like them for their lines. Don Jones, using diesel and electric locos particularly, tends to go for two power bogies – a simple, excellent idea, which backs up the view that outside you need the power.

Painting should be protected well, especially in view of potential problems from sudden rainfall or long storage in the shed. Varnish well to protect, particularly if you model dilapidated stock of minor railways. Weathering effects must be protected from real weathering out of doors!

Coaches

Much that has been written about locomotives applies here with regard to tough construction, paint finish, and so on.

Coaches may be constructed from wood, metal or plastic. All are suitable. In the case of wood use best quality, in the larger scales pin or screw as well as glue together. Varnish thoroughly over the paintwork. Windows may either be slid into rebates in a laminated skin, or stuck in. For Gauge O, our *Handbook 3* will help you with wood bodied stock, with two articles by G. Hemingway and G. Bigmore, long known as builders of fine stock for outdoor use.

Metal coaches last well, whether the older Exley types or newer ones by Westdale in aluminium, or the brass etched types by PC, DJB, Mallard, etc. Construct carefully and paint well. Protect the paint, especially as dampness from the odd shower can cause problems. Solder, if you can, the main body parts. If they need a repaint, thoroughly remove the old paint, clean up and repair, then degrease. Use a good primer. Bondaprimer may be used but don't lay it on thickly. Paint, varnish and reassemble.

Plastic coaches, whether RTR or from kits, seem quite happy outside in all scales and gauges. Just protect properly. Our experience suggests that some will go brittle if badly stored in the damp over time, so avoid that. Heat may buckle them if hot summers such as we had in the UK in 1976 and 1983 occur. The moral is clear. Plastic coaches may need weighting. If so, put it low down, but not so much that it would make the vehicle bow in the middle.

Wheels in coaches, and wagons for that matter, have brought out some controversy among Gauge 'O' and '1' users. This is on account of the propensity for some materials to pick up dirt which, if left on, will produce uneven running and could cause derailments, particularly with the finer wheel standards. In these larger scales our collective experience prefers steel, or iron, followed by hard brass. Dural, plastic or alloy wheels – like the old LMC ones – are the worst, and we would avoid them. However, users of smaller scales do seem to get away with plastic ones of the types fitted to RTR coaches and wagons. The best way probably is to clean the track before you run a session. It is far easier to clean track than wheels and far less time-consuming!

For good running we recommend good bearings and pinpoint axles. PTFE is excellent, giving excellent free-running properties, but you will almost need to brake vehicles as a result! For clockwork it has proved a boon, increasing the distances trains will run as well as weight pulled. This second point applies to other forms of traction power equally well. Pin point axles running in brass bearing cups by Slaters or Peco are recommended also, but don't oil too much. (PTFE won't need oil at all, in fact keep it well away). Try to avoid the old plain-ended axles running in white metal bogies in the larger scales, the drag is awful.

Couplings may be either automatic, as used by most commercial manufacturers, so that remote uncoupling is possible, or single – or three-link. With all these check that they don't misbehave on tight curves or even on undulating track so as to cause derailments. This is particularly true of 3-link ones with tight springs. In the larger gauges sprung buffers will help. If you run permanent rakes these can be permanently coupled, except at the outer ends, by simple bar and tag couplings designed to close-couple vehicles, but not so tightly that they derail on your sharpest curves and crossings. The hole to take the tag should not be too tight a fit.

The springing of axles on bogies or wheels on six-wheel and four-wheel stock is a mixed blessing out of doors as so often it is too hard, giving rough rides and derailments, or so soft as to be useless. If you can get away without it do so. Compensation may be better and can be used. Fitting sprung bogie mounting pins to the vehicle body is advised in the larger scales. Compensation is necessary if fine wheel standards are used. A Cleminson system may be used for 6-wheel stock. Four wheelers may need compensation also, unless of fairly short wheelbase and absolutely square and firm when stood on a piece of plate glass or metal. Frankly, if you are operating finescale 'O', or its equivalents in other gauges, a vehicle should be rebuilt until it is right, or endless trouble will ensue. Some plastic vehicles by Lima and Rivarossi in 'O' run beautifully round very tight curves despite wheels close to finescale, a tribute to Italian production methods in 'O'. Some British makers of 'O' gauge coach and wagon wheels should check them more carefully, as quite a number of us in O gauge find that their back-to-back measurements and concentricity have been appalling!

In OO/HO and N, stock is normally unsprung and in RTR form seems to run beautifully out-of-doors, provided that the track is well laid and clean. One sometimes comes to the conclusion that manufacturers for the mass market make better running vehicle wheels and bogies than the smaller specialist ones. Often the very simplicity of RTR stock is a merit worth noting.

Wagons

Virtually all we have said about coaches applies to wagons, so far as concerns construction, wheels, compensation and springing, squareness in the frame, couplings, free-running properties and painting, so we shall not repeat it yet again. Rather, we shall look at one or two features peculiar to wagons.

Being very often smaller than coaches, some problems are magnified with wagons. Lack of weight is one. Empty plastic wagons are often prone to winds scattering them like chaff as though some divine presence were capriciously playing trains, too! Cast vehicles, such as ABS in 'O', of course, won't do this, and if free-running should cause no problems. Plastic kits (Slaters come to mind) are often superb, but too light. Loads, if weighted a little, will help. You could put small lead weights between finely detailed underframes or put real loads in such as coal. The only snag with this is that it adds a lot of weight which might ultimately undo the adhesives which stick it all together. Real coal loads do look more realistic than dummy ones on slip-in loads. On an end-to-end line you can run full one way and empty back, collecting the coal in old family-size biscuit tins, so using it again and again, barring the odd spillage. It is spillage and weighting which usually puts people off though, so you make your choice!

Card cannot be used for model wagons outside. Wood, metal and plastic can be used very well if the elementary points noted above for coach construction are embodied in your construction work.

Preparation and storage

Before you start running, as you would indoors, check all stock for free running, correct wheel alignments back-to-back etc., couplings, fittings and so forth. Oiling and greasing needs care. For outdoor use we prefer grease for gears, not oil. In the larger gauges oil carefully and don't overdo it – it costs plenty. Very fine sewing machine oil tends to run off, so use a slightly more viscous variety – bicycle oil will do. Don't go too far. We dislike '3 in 1' – it tends to clog things up. It is much overrated as far as we can see. A small tin of car grease by Duckhams will last years. Always carefully cap it and your oil to prevent things getting into it, apart from the risk of spillage.

We deal with basic maintenance in the next chapter, but storage can be dealt with here. When running, which will probably be about April to October in Britain, during the light evenings when we gain an hour on Greenwich Mean Time, stock can be left in your shed or rail room. It should be properly secured. Never leave stock outside, even your grottiest wagon; it's not worth it as the climate will attack it, or your local vandal and visigoth population will go for it – they may be humans (unforgivable) or animals (your fault!).

In winter, when not running for long periods such as holidays, bring all your stock indoors, especially locomotives which have more parts in them which may seize up and go wrong, or rust. The security aspect is obvious. Stock will not like temperature changes, particularly the big drops in winter in an unheated shed. Wood and metal seem more prone to disaster than plastic stock so stored in winter. Check it all before putting it away. Boxes are best for this in a lockable cupboard in your house. Newspaper is still a good packing medium for the larger scales, and is cheap!

Label boxes with their contents. Put rakes of stock together and if in a set in particular sequence number them also. Storage in the smaller gauges is less of a space problem, but this commonsense care is true for all sizes. You might get away in OO/HO and N with putting plastic rolling stock in its boxes and leaving it in the shed in winter – there's little to rust or move. Even so, we would still advise you to bring your locomotives and powered railcars into the house.

Protection outside when running

If a downpour suddenly descends on your running session it is a good thing to get stock (and if need be buildings) under-cover quickly. The obvious place is your shed, so run it in before the rain comes. In case you are caught virtually unprepared each station out-of-doors should have a roll of thick plastic sheet capable of covering it and the trains passing through at the time. Thick sheet plastic as sold in garden centres or advertised in gardening magazines for cloches would seem ideal. Put wood battens at each end to aid rolling and unrolling. If it is at all windy then put weights along the course of this protective cover.

Deryck Featherstone has built a shelter over his station at Bedon, rather like a miniature car port, and it is there precisely to protect his trains. If you had a wall at the back of your layout station outside it might be possible to fix a kind of roller-blind in plastic sheeting onto it, so that it can be pulled over stock in the event of inclement weather.

Some folk happily run stock out in the wet. On a ground level line the splashing would not do engine mechanisms much good, especially in a steady downpour, even if plastic stock suffered relatively little. A few drops of rain can easily be wiped off any model's surface but running in really wet conditions is asking for trouble with most forms of traction, except possibly high-pressure live-steam.

Chapter Eight

Maintenance, Tools and Equipment

If you have read through the text this far it will have been apparent that we have laid great stress on making a substantial job of any garden railway construction task, from baseboards and viaducts to locomotives and signals. If it is well done then the need for maintenance, although obviously necessary, won't be so much as if you had constructed it all in a flippant, flimsy manner.

Maintenance need not be a chore, and if done regularly and carefully will pay dividends in good out door operation. If faults suddenly arise – a broken electric lead on a loco or a broken buffer we advocate withdrawal of the item concerned and a swift, proper repair. Outside, too, the maxim of promptitude applies if you find a broken bonding joint between the rails, for example. Repair it and then things will run as they should.

The late John Hart, who ran as reliable an outdoor railway as the Editor has ever seen, once said that regular running was the best maintenance of all. This is very true; it is quite amazing how things left for very long periods function badly when set going again. Model railways, indoors or out, are no exception to this rule. The first rule then, as far as maintenance goes, is to run it, and run *all* of it.

Other maintenance of the more usual kind is dealt with below. We deal first with the out-of-doors installations, then with electrics and locomotives, and then rolling stock. A comment on useful tools and equipment will conclude the narrative.

Outdoor maintenance – baseboard & garden levels

As your garden railway will to some extent be among the grass and flowers, the best time for maintenance will be in the Spring or Autumn when there is little or no growth. Choose a dry spell, especially for painting or applying preservatives like creosote.

Plan ahead if you can. Do the annual maintenance on a regular basis. The rhythm of the seasons is necessary to gardener and garden railwayman or woman alike. It's not a bad idea to walk your 'length' and spy out problems. Be systematic – i.e. baseboard only, then track only, then structures, etc., along the same route. If you can't do it then note it down in a little note book – one with a hole and string through it to hang up in your garden rail shed will help if your memory errs!

On a baseboard structure preservatives may not need to be applied every year, especially if it is well sheltered, but don't leave it too long. One to three year intervals are desirable. When using creosote or Cuprinol we urge you to use a brush and work it well in. Spraying this stuff looks nice, but it often gets where it should not, and only leaves a thin film where you do need it. The work will do you good. Don't get it onto plants – even the fumes from creosote can kill them. Other wood such as platforms or cupboards under your boards should be done at the same time. Concrete scenery can be filled or repointed, too, but cover it against frost.

Garden level lines should be checked for any concrete, stone or bricks coming loose. Re-cement properly, grouting as required. DIY books will show you how to do it. If there are cracks refill before winter rains get in, turn to ice, expand, and crack the surface even more. Do it when the affected area has dried out and protect against rain, frost or snow with a cover if necessary. Crumbling edges can be repointed, using vegetable black or other agents for colour if you wish. Fittings for signal posts, telegraph poles, and so on are best repaired at this time. Always keep breeze covered in frosty periods.

Track Maintenance

'Good track gives good running', sounds like an adaptation of Robert Frost's famous poem about walls and neighbours, but this truism needs to be stated. Check, then act over broken

chairs, bonding, split sleepers, lost pins that should be holding the chairs and track down, and any other track problem. Repair in the Spring before you start running. Clean if necessary, and resolder rail or bonding wires.

On plastic track check for brittleness setting in. Plastic track out-of-doors is best held at the edges of sleepers. Check for level, see that pins are in well, and replace even if just a head of a pin has come off. Held down by the edge, the track will hold to gauge better. It tends to narrow if fixed in the centre.

Wood-based track should be checked for warping by battens. Cut them and reballast. If the track rises up through frost action on the wood as pins come out, relay using a gauge. Brass pins come out but don't rust. Steel rust in and don't come out, so perhaps you could mix them. Make sure where lengths join that they don't form miniature peaks to derail your stock. Sleepers should be creosoted. Redwood cedar may need this less than softwoods, which should be tackled annually.

Copperclad track is given a black bitumen coat annually by Barrie Walls on his baseboard track outside to protect it.

For stud contact check every stud, and whether there are any split sleepers if the stud was clouted at some time or other. Replace and rewire as required.

Ballast, if fixed by Unibond for plastic track, or creosote, pitch and mastics for wood track, should be replaced if it has been chipped away. Loose ballast should be repacked, and the track realigned if need be. Loose ballast should periodically be taken up and re-claimed – washed out and then replaced. Once every two years or so should suffice. Avoid periods of frost for this. Keep the wet out for any job concerning ballasting. Cover if rain or frost is likely when sticking ballast down.

Outside Electrics

Always check mains wiring, low voltage to the track and section feeds annually. If a section goes dead check out and remedy. The system of wiring via jointing blocks, etc., in the outdoor cupboard boxes, should enable you to trace faults easily and make remedies or alterations straightforward. Where resoldering is needed make sure it is clean and neatly done.

Point and signal motors are all the better for a squeeze of WD 40, as will sliding contacts. This should be done in the running season and just before you stop running for the 'close season'. This maintenance will preserve and protect the electrics until you start operating again. Vaseline or grease can be used on point moving parts. Apply it in the Spring before commencing a new season, and test each point individually. In two-rail run a loco over to test frogs and switching. You should invest in a multi-meter type voltmeter for this – it will prove useful elsewhere on the layout where electrics need testing, and will pay for itself time and time again by saving frustration and bad language when the 'sparks' fail to work!

Garden Maintenance

This is essentially garden care, but remember to prune and cut bushes and trees, or cover plants as appropriate. A good clean up and prune before winter, when there's little growth, will save a lot in springtime. Moss, sometimes a nuisance, can be removed by creosote or parafin.

General cleanliness all-round is perhaps the best thing to aim for. Done regularly, maintenance is quite simple and brief.

Locomotives and rolling stock

If you run very little from autumn to spring, that period is ideal for maintenance indoors in comfort. Ideally, it should all be done before your stock goes back on the tracks for the coming season.

Repairs should be done first and any paint touching-up afterwards. Cleanliness, again, is all-important.

Dirt should be removed from all stock, not just its wheels, but from bodies, handrails,

glazing, in fact everything. To get rid of dirt use a proprietory cleaner sold in aerosols or, in the case of wheels, Carbontetrachloride or Servisol. The former whilst cheap is a health hazard and not easily available. Frankly, this is just as well, as its fumes produce similar effects to glue-sniffing. If you insist on using it, work in a really well-ventilated room (which in winter won't go down well). Never keep it in the house, as it gradually evaporates. When not in use keep it securely capped. See also under Wheels, below. This very necessary warning given, let us proceed to locomotives.

Locomotives

Electric mechanisms must periodically be examined for grit, dirt and general gunge. Clean the gear assembly thoroughly, removing any foreign agent – if not, any abrasive in it will affect meshing and subsequent performance. Re-grease, rather than oil, as the lubricant moves about less, but don't overdo it. Brush gear should be examined and brushes replaced if necessary. The springs for brushes and their holding clips should be cleaned and put back. Test the motor to see that they are working properly, after further checks and cleaning of the commutator end windings. Don't use abrasives for these, they are too delicate, and such use will possibly damage the motor. Lubricate the armature bearings sparingly. As mentioned before, we dislike 3 in 1, use another oil. A finer oil is best for the smaller gauges. Use a pipette type applicator if you have one. Peco Electrolube is a useful agent for much of this work.

Clockwork locomotives need similar cleaning and greasing, preferably before they are put away for storage. Test in the house, not outside on a cold day – the spring might snap.

Battery machines need little except on gearings, etc. Remove the batteries if you intend to store them for some time.

Advice on steam loco maintenance could fill a manual – in which case, consult it! But obvious things like complete boiler emptying should be done before prolonged periods 'on shed' or in 'the works'. You will need to check packing, lubrication, pumps (if axle-driven), valve settings, valve gear, dials and safety valves, the regulator and its attachments, etc, etc! Before proper running commences make safety checks as required (this could be required for insurance purposes), and have a test steam-up. Oil and grease properly before storing and running afresh.

Coaches and Wagons

Much the same applies to these as it does to locomotives; for their wheels it is the same set of procedures. Bogies should be checked for alignment and, if white metal, for any cracks, particularly in the larger scales. Seal them if you can, but if it looks bad either solder up with low-melt solder, or replace. Old bogie parts can be re-used – e.g. stretchers; the rest consigned to your model scrapyard, or dumped by your locomotive and carriage depots.

Wheels

The cleaning of wheels is vital for good, trouble-free running, whether on motive power, coaches or wagons. Wheel bearings should be examined at the same time. Do this before storing if you can.

For electric locos turn them upside down and run, using crocodile clips from a controller. Using a toothbrush soaked in paraffin, or a similar cleaning agent, press it on the tread of the wheels to soften any clinging dirt. If really stubborn dirt is encountered use a spatula-like edge to dig it off. This should be of a softer material than the wheel itself. Once the dirt is off the wheels should be cleaned up using a soft rag on the treads. For coaches and wagons remove the wheels (bogies with wheels in for coaches) and run them up and down your bench, using the same methods. Lubrication should be done with care; not overdone.

This work is aided by a cradle to hold your stock upside down. H & M produce a loco tester, and there are commercial cradles available for OO/HO and N. In 'O' and '1' you'll need to make your own. Obviously, it should take your largest items of stock. Make it strong, and line

it well where it will hold your piece by the edges. It should be capable of being clamped in a vice or onto your workbench surface. While suspended upside down you can also test the mechanism after cleaning, greasing and oiling it.

Some notes on tools and equipment

Tools

By now it will be self-evident to any DIY enthusiast that quite a lot of tools will be needed to make and maintain your garden version of God's Wonderful Railway (i.e Yours!) In fact the basic ones should include the following, in no particular order. You will probably acquire over time the more specialist ones.

Spade or shovels, planks (for templates, etc.), trowels, large and small spirit levels, good steel rules of a yard or metre length, retractable measuring tapes, string (as for marking out lines to plant vegetables), a crowbar for drainage holes, wooden mallet, hammers and assorted screwdrivers, etc. All these are for construction work.

You should have an electric drill. If not, get one with ½in chuck and hammer action. Ideally, it should have two speeds at least. Hand drills are useful. Drills should be assorted, and cased. There are different types for wood and masonry (if required). A good dodge is to use your countersink bits in a hand drill and the boring bits in the electric one, to save continual swopping about as you proceed. The electric drill must have a proper earthed flex capable of reaching everywhere on your projected layout. That on a roller is best. Given care it will last you for ever.

Get decent rail gauges for your line, preferably two of each type required. Keep safely in your toolbox in the same place.

A portable toolbox is necessary; one with an opening top and a set of trays is to be admired. It should have an easy closing top in case it rains. Keep things in it in the same places, especially items like chuck keys for electric drills, so easily misplaced.

Useful equipment

On the electrical side we have mentioned a Multimeter voltmeter – so useful for many tasks. A mains lead torch with cage to protect the bulb is excellent. Get one with a switch by the bulb, not at the plug end! A tough plastic one may be preferred to a metal one given how damp outdoors can be, even under baseboards.

A large fisherman's umbrella is recommended for outdoor work when it's drizzling – it can cover you and the work such as the track. An easily adjustable one is best, although not the cheapest.

A tin bath or its equivalent should be used to soak wood in creosote or other preservatives. Keep it away from plants, pets and children. Cover it up.

Three or four milk crates, up-ended and put together, can be used as a seat, with a foam pad on the top. Being light – plastic – they can be moved easily as you progress along a baseboard line. You can even hook them under your foot and deftly move them. (This is Pat Honey's claim. He doesn't seem any the worse for it! – Ed.)

Finally, and we hope that its use is never called for, may we re-iterate, buy a fire-extinguisher. It will give you peace of mind – and could, literally, be a life-saver.

Conclusion

This really is the terminus! If you have an established garden line, we trust that this epistle will help you. If about to embark on one we hope that it will aid your endeavours. Our collective experience has taught us a lot – perhaps we haven't agreed on some things, but they are far out-numbered by those views we hold in common.

We would urge you to read any article you can obtain on the hobby as practised out-of-doors in the garden. The books, in print, or not, are a must. In winter you can read them and, as they said in schools years ago, mark and inwardly digest them into the bargain.

Visit and look carefully at any layout you visit, and do visit them! Your editor, who has

prepared this whole handbook, has learned much from those who were cajoled into becoming contributors. Now that this task is over he can get back to the railwaying, especially all the construction and maintenance he promised to do, and has yet to complete! Perhaps this is, after all, a never-ending hobby activity, and a garden railway is for life – but not a life-sentence! We send the readers our best wishes for success in a truly fascinating leisure pursuit.

Bibliography

Books

The books below are especially recommended. Unfortunately, only three are in print. Surprisingly, they do not overlap as much as you might think.

R.E. Tustin	*Garden Railways* (1949) Percival Marshall	—
D. Neale	*Railways in the Garden* (1978) Peco	In Print
W.A.D. Strickland	*Chronicles of a Garden Railway* (1968) M.A.P.	—
M. Evans	*Outdoor Railways* (1974) M.A.P.	—
J. Constable	*Miniature Landscape Gardening* (1984) Lutterworth	In print

Other books of use include the following:—

H. Greenly	*Model Railways* (1926) Cassell	—
M.H. Binstead	*The Model Railway Hobby* (1948) Percival Marshall	—
D.A. Boreham	*Narrow Gauge Railway Modelling* (1978 2nd Ed.) M.A.P.	In print
E.F. Carter	*Stud Contact Electrification* (1949) Percival Marshall	—

Magazines

The major National Model Magazines all have articles on outdoor model lines. Their editors tell us that there would probably be more if contributors were more forthcoming! They include:—

Model Railways (formerly *Model Railway News*), *Model Railway Constructor, Railway Modeller, Continental Modeller, Scale Trains, Model Trains*, and *Practical Model Railways*, all available from newsagents and bookstalls easily. Of more specialist interest is *Live Steam Model Railways — for the Garden Railwayman*, not so widely available, but from Live Steam Model Rlys, 15, Bryn-y-Ddol, Welshpool, SY21 7TW. Despite its title, it has plenty for electrical and other non-steam operators. It appears to be quarterly, from Summer 1983.

Other specialist publications are from Societies such as the Gauge '0' Guild, Association of 7mm Narrow Gauge Modellers, The Association of 16mm Narrow Gauge Modellers, and in their journals.

Garden Railway Articles in the Model Railway press 1970-1983

The list of articles below concerns mostly 7mm modelling, or NG on 0 Gauge Track, together with other Gauges/Scales where appropriate. Space considerations dictate a limit as to how far back we go. Details come from the Press Digest in the Gauge '0' Guild *Gazette*, beginning in 1970. Back copies of the relevant magazines can often be bought cheaply at Train Sales, Meetings, etc. A good Club Library can help also. Some 90 articles are listed below.

Abbreviations

MRN	Model Railway News	2R	2 Rail Electric	S	Steam
MR	Model Railways	C3	Centre Third Electric	B	Battery
MRC	Model Railway Constructor	O3	Outside Third Electric	0	0 Gauge Track
PMR	Practical Model Railways	CW	Clockwork	NG	Narrow Gauge on
				FL	Freelance
				Owner named where known	
FS	Fine Scale	ST	Scale Trains	00	00 Gauge Track
CS	Coarse Scale	MT	Model Trains	1	Gauge 1 Track
ST	Stud Contact Electric	RM	Railway Modeller		

DBH & C Rly /0/CS/CW & S layout of V.M. Cutts	MRN 1/70
Staverton Lt Rly NG/FL on 0/CS/CW of C.T. Leak	MRN 2/70
Hampstead Moreton 0/CS/SC of M. Deane	RM 8/70
Branching Out at Crewchester 0/CS/CW of J. Ray	MRC 9/70
Experiences of Gauge 0 of G.Iliffe Stokes	MRC 11/70
Heworth Model Railway 0/CS/2R of D. Hutchinson	MRC 7/71
Bigston-Westbridge 0/FS/2R of G. Bigmore	RM 8/71
21 Years in the Garden 1/CS/S & CW of E.C. Griffith	RM 8/71
Ground Cover (for Outdoors) in 0 of R. Taylor	RM 8/71
Seeking Railway Atmosphere 0/FS/2R of K. Longbottom	MR 2/72 & 5/72
Crewchester bashes on 0/CS/CW of J. Ray	MRC 5/72
Manchester in the Garden 0/FS/2R of K. Longbottom	RM 8/72
Westbridge High Level 0/FS/2R of G. Bigmore	RM 8/72
Outside Again 0/CS/C3 of M. Hodges	MRC 10/72
Hawkesworth Lines 0/CS/SC of G. Reffin & R. Knight	MR 8/73
Tooslate Quarry NG/FL on 0/CS/B of R. Barton	RM 8/73
Round the Garden in 4mm Scale 00/2R of B. Burchell	RM 8/73
Raising the Pressure. Live Steam in the Garden of J. Wheldon	RM 8/73
Sandy River Logging Railroad of W. Strickland 00/NG/2R Photos	RM 8/73
Kirtley Rebuilt 0/CS/SC of D. Neale	RM 9/73
Crewchester Terminus 0/CS/CW of J. Ray	MRC 10/73
Thoughts before Deeds 0/CS/2R of J. Horton	MR 11/73
Back to the Thirties 0/FS/2R of K. Longbottom	MRC 6/74
Tracks for the Great Outdoors of J. Wheldon	RM 7/74
Border Counties Rly NG/FL on 0/S of J. Wheldon	RM 8/74
Cheltondale Branch 00/2R of G. Baker	RM 8/74
The Show Must Go On. Outdoor Public Running 0/CS/O3 by R. Mackie	MRC 11/74
Branchline in Northumberland 0/CS/SC of P. Johnson	MRC 6/75 & 7/75
M & SC Jt Rly, History of Layout 0/CS/O3 by R. Mackie	MRC 8/75
Trepolpen v Lt Rly NG/FL on 0/CW & B of Rev. P. Denny	RM 8/75
Maybank & Maycroft Story 0/CS/O3 & FS/2R of W. Banwell	MR 12/75
What's Up at Crewchester 0/CS/CW of J. Ray	MRC 6/76
Craven & Ravenstone 0/CS/SC & B of W. Clark	MRC 7/76 & 8/76
Getting into the Garden 0/CS/CW & B of R. Pound	RM 8/76
Heatherfield Lt Rly 0 with NG on 0/CS/CW & B of W. Stocks	RM 8/76
Trial by Exhibition Portable Layout In or Out 0/CS/SC of R. Ledger	RM 12/76
Wallsea 0/FS/2R of B. Walls	RM 1/77
Girder Bridge for 0 Outdoors using Airfix parts of Dr. G. Harding	RM 8/77
Guildford MES Portable Layout In or Out 0/FS & CS/2R & CS by G. Asplin	MRC 8/77
Twenty Years On 0/CS/O3 of R. Farrants	MRC 9/77
Cleaning Track Outdoors by Bill Strickland, 00 Gauge, NG	MR 2/78
Locos. of the Heatherfield Lt Rly NG/FL on 0 CS/CW/O3 of W. Stocks	MR 2/78
Live Steam NG on 0 in the Garden by D. Rowlands	RM 6/78
Blakehampton 0/FS/2R of M. Stanley	RM 8/78
Milkrun to Low Fennel NG/FL on 0/CS/B/S of D. Rowlands	MR 8/78
Terranden Lt Rly NR on 0 16mm/CS/S of S. Jones	MRC 8/78
Yeovil West 00/2R of R.J. Evans	RM 8/78
Laying Peco Streamline Out of Doors by V. Jackson	RM 12/78

Forgotten M & GNR Layout 0/FS/2R of J. Webster	MRC 1/79
Battery Diesels in the Garden (Lima) 0/CS/2R by M. Taylor	RM 1/79
Heatherfield Lt Rly Stock FL/NG on 0/CS/S/B of W. Stocks	MR 2/79
"Come into the Garden Maud" FL/NG on 0/CS/S/B of D. Rowlands	MR 4/79
Alderbrook Valley FL/NG on 0/CS/B/S of D. Rowlands	MR 8/79
Bishop's Castle Rly 0/CS/SC of R. Clark	MRC 8/79
Planning a Garden Rly in 00 by M. Cole	MRC 8/79
Pembury 0/CS/2R of P. Lock	RM 8/79
The Herbaceous Tracklayer FL/NG on 0/CS/S/B of D. Rowlands	MR 8/80
Craven to Ravenstone 0/CS/SC of B. Clarke	MR 8/80
Genesis of a Garden Railway 00/2R of G. Hobbs	RM 8/80
Cholmondely Viaduct (GWR) 0/FS/2R line D. Jennings & R. Markland	MRC 8/80
Diggle, Halebarns & Westport 0/FS/2R of K. Longbottom	MRC 11/80
Ballasting Trackwork	MT 11/80 & 2/81
End of the Line 0/FS/2R of M. Kelly	MR 4/81
Crewchester Unrepentant 0/CS/CW of J. Ray	MRC 2/81
Trepolpen Valley Lt Rly FL/NG on 0/10mm scale /CS/CW/B of Rev. P. Denny	MR 6/81
Garden Railways	MR 7/81
Operation Wallsea 0/FS/2R of B. Walls	MRC 7/81
Chronicle of the Heatherfield Lt Rly FL on 0/CS/CW/O3/B of B. Stocks	MR 7/81
A New Beginning (0 Out of doors) 0/FS/2R	RM 8/81
Narrow Gauge in the Big Outdoors 1/LGB on 1/S of B. Lamkin	MT 8/81
The Wingham Diary 0/FS/2R of D. Featherstone, Series of 8 Articles	MRC 10/81, 12/81, 3/82, 7/82, 10/82, 1/83, 4/83 & 8/83
Lirpa Loof Inc. FL/NG on 0/16mm scale /S	MT 4/82
Crewchester — The Phoenix 0/CS/2R of J. Ray	MRC 6/82 & 7/82
Avonside Garden Rly 00/2R	MR 8/82
The Princetown Branch FL/NG on 0/16mm & 10mm Scale/S	RM 8/82
The Daventry Garden Railway 00/2R of B. Burchell	RM 8/82
The Karslake Jt Rly, Memories of a pre-war line 0/CS	RM 8/82
Progress Report on a Garden Rly 00/2R of G. Hobbs	RM 8/82
Live Steam & Fun FL/NG/16mm Scale /S	MR 9/82
Clwyd & Dee Lt Rly FL/NG/16mm Scale /S	MR 10/82
Narrow Gauge Specifications for On 1¼, On 2¼, SM32	MT 3/83
Bigston 0/FS/2R layout of G. Bigmore	MR 6/83 & 7/83
Bigston Revisited 0/FS/2R of G. Bigmore	RM 8/83
Cransea & Hornbrook 0/FS/2R of S. Johnson & S. Atkinson	RM 8/83
Outdoor Lines 16mm NG on 0	MT 9/83
Building the little Yorkshire Rly 16mm NG on 0/S	MT 11/83
The Birches Bahn Light Rly 16mm NG on 0/S	MT 11/83
The Daventry Garden Railway 00/2R of B. Burchell	PMR 1/84

In the smaller scales it is worth looking up the articles in RM, by Bryan Burchell, on his 00/2R line in a small garden, in the 70's and 80's. Also those of Don Jones on his 00/2R line on a large scale, such as that in MT 8/81. For EM see N. Dyckhoff RM 8/67. For N Gauge, see Bert Groves RM 8/67 and 9/67.

Most of the 0 Gauge lines described are by Gauge '0' Guild members; we thank them for conveying their interest, methods and enthusiasms to a wide readership.