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The friends you make in the hobby will even be there to help chase the winter blues away. The thermometer read 18°F on Christmas Eve in 1998 as friends gathered to run live steam on Tom Bowdler's upstate New York railroad. From left, Dave Graley (standing), Jim Strong, Tom Bowdler, and myself. *Ruth Strong*

I've literally grown up with the hobby, and have watched it progress from its infancy to where it is today. Since that time, I've moved around the country: college in Colorado, then to upstate New York, and back to Colorado, laying tracks in backyards all along the way, learning a lot about what makes building a railroad in one part of the country a whole lot different than building one in another part. That's the neat thing about this hobby—you never stop learning. There is always some new road to travel, some new aspect of it that will catch your fancy.

Along the way, I've had the privilege of sharing my thoughts through my Garden Railways Basics column in the pages of *Garden Railways* magazine. I write that column based on the premise that there are many aspects of this hobby, and even those who are old hands at one aspect may be complete neophytes in another. Whenever we start down a new road, we're all beginners along that path. So whether this is the first time you've ever heard of model trains running outdoors, or if you've been at this a while, I hope you'll find some fresh perspectives in these pages that will encourage you to try your hand at something unfamiliar.

The idea of this book

When I started out in this hobby, there was no book from which to draw ideas. The hobby was very much in its infancy. In the figurative sense, we did write the book on how to build a garden railroad. Now, 30-some-odd years later, I've taken that literally. Yet it would be foolhardy for anyone to take this one reference as gospel. I would hate for anyone to adapt any idea I've expressed in this book at the expense of ideas expressed by others. It's only through sharing ideas—bouncing techniques off each other to see what works and what doesn't—that I've been able to learn what I've learned. And I'll never learn it all. There's always some frontier, some new technique that stays just an arm's reach away tempting me to explore.

That's the magic of this hobby—no matter how long you've been in it, or how much you've accomplished, there's always some avenue left to travel, some new skill to develop.

My intent is to give you a frame of reference from which to start asking questions about where you want this hobby to take you. I don't ever want to write the definitive guide to anything. That takes the fun out of it. Garden railroading, like many pursuits, is a journey. It's something personal, and something different for each and every one of us. This book is a foundation upon which to start your journey.

My goal is to give you food for thought, to get the wheels in your brain turning. I want you to seek out others' experiences along the way because that's much of the fun. There's no way I would enjoy this hobby near as much as I do were it not for the friends I've made and the things I've learned from them.

In my "real" job in television news, there's a cliché line that goes "Tonight, we have more questions than answers." I hate hearing that when a reporter says it. But in this context, that's precisely the sense I want you to walk away with. For every one thing you learn, I hope you formulate two new questions you didn't think to ask before. If you do that, I've done my job. I've started

A dry rock garden might be an ideal setting for a railroad.

the first step—getting trains running outside. Everything else will come in time, and getting them running outside is really simple. Remember the loop of track you have set up in your living room? Pick it up and move it to the backyard. (Disassemble it first—it goes through the door easier.)

Where should I move it?

It doesn't matter, really. Find a place where you think you may want to build the railroad and put the track there. Hook the power up to the train, grab a chair and a cool beverage, and sit back. If you don't like it where it is, pick the track up and move it again. Run the track through the trees, under bushes, along the deck, or just out in the middle of the yard. If you can, borrow some extra track from fellow hobbyists in your area. This will allow you greater latitude in your experimentation. My dad's Woodland Railway started with just a few feet of track running between two trees in the woods. He saw that and said, "This is where it's going." There's something magical about getting the trains outside in the open. They become real, not toys. Sometimes the mere act of bringing the trains outside can ignite the imagination. Once they start moving around, you're well on your way.

Well on my way to where?

Again, don't worry. You're headed in the right direction. Garden railroads evolve over time (and thyme evolves over garden railroads). As you watch your train running among the petunias, you will doubtless start to see a vast railroad empire running over the yard. Your heart will beat faster. Your adrenaline will increase. Guess what, though—now it's time to apply the brakes. It's okay to have a vision of what you think your railroad may look like years down the road. Just don't try to do it all in one step. Great railroads don't spring up overnight. They take planning, or you will just wind up frustrated.

I often tell the story of a gentleman in our club (who shall remain safely anonymous) who was so gung ho about getting into this hobby that he filled his swimming pool with dirt and immediately laid a lot of track on top of the dirt. He had a very nice railroad for about three weeks, and then the dirt started to settle. Things stopped running as the entire railroad started to slide downhill toward what used to be the deep end of the pool. Frustrated, he ripped the entire thing out, sold the whole lot, and was never seen in the club again. This is especially important to remember in these modern times of instant gratification. Anything worth doing is worth doing right, and doing it right means taking things slowly.

That doesn't mean not moving at all. Perhaps the biggest mistake beginners make is spending so much time planning that they never get out to enjoy what they've planned. All these considerations can be dealt with in time, but you can't figure out what you like without trying it first. Think of this hobby as a buffet. There are a lot of different choices. Grab your plate and sample a little of each. Then go back for the dishes that you liked the best. The key is to step up to the bar in the first place. Get the trains outside and off of the living room floor. Yes, this means you may have to vacuum the rug now. Sorry 'bout that.

So sit back, grab a cold drink, and enjoy the train running on the circle of track. While you're doing that, read through the rest of this book. All those concepts I said not to worry about right now will be explained, and you can begin to shape your vision for the grand railroad empire in your backyard.

The warm afternoon sun greets a long freight as it rolls through Marysville on Paul Burch's Sierra Cascade & Pacific outside of Tacoma. Standard gauge railroads such as the Southern Pacific ran long freights and also served small industries such as those in Marysville. Paul's consistent use of 1:29 scale equipment and buildings, along with proportional rail and ties on well-manicured roadbed, gives the scene a realistic feel. *Paul Burch*

In contrast to most standard gauge railroads, many narrow gauge lines had tracks that were less well manicured. The Tuscarora Railroad is no exception. Tuscarora Valley No. 5 pulls a short, daily passenger train out of Shade Gap. The slightly overgrown and unkempt vegetation gives the look of a railroad that is making just enough money to keep operating, without a lot of frills.

Me? I'm a fan of late 1890s and early 1900s narrow gauge steam, particularly eastern narrow gauge. Chances are good that there's something from your past that draws you to your particular interest in trains. As you progress through the hobby, you'll likely focus your railroad around those interests. Maintaining that focus becomes a lot simpler once you grasp some of the basic principles of the prototypes for our trains.

Standard vs. narrow gauge

When discussing the prototypes of the trains we run in the garden, the terms *standard gauge* and *narrow gauge* frequently enter the discussion. The word *gauge* relates specifically to the distance between the rails, but the concepts of standard gauge and narrow gauge have a far greater bearing on our railroads than just that distance. In the prototype (full-size) world, standard gauge railroading and narrow gauge railroading are two entirely different concepts.

Standard gauge

The word *standard* implies that it is a universally accepted norm. How did that standard come to be? Why that and not something else? In the formative years of railroading, there was no standard. Each railroad chose a distance between the rails based on what was thought adequate for its needs. The general theory was that the wider the gauge, the more stable the trains would be. There were railroads with gauges as wide as 7'. At first, with each railroad being an isolated system, these different gauges didn't present any problems. Since there was no interchange of equipment between railroads, compatibility wasn't an issue.

It wasn't until railroads began to connect with each other to form networks that the distance between the rails became an issue. It was labor intensive to transfer the freight from a car of one gauge to one of another on the next system. So in order to reduce those costs, railroads decided to come to some kind of consensus on how far apart the rails would be for their networks. There was never a law mandating a particular distance—it was primarily based on local cooperation. In the United States, most northern railroads adopted a gauge of 4' 8½" as their standard. Railroads in the south built to 5' gauge.

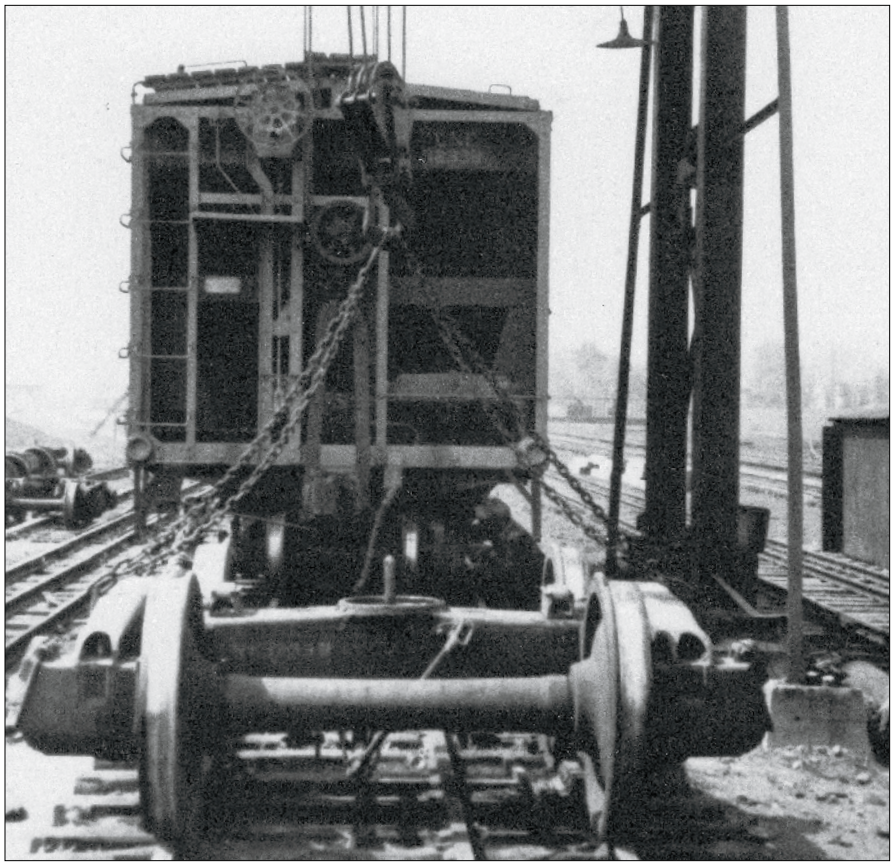
During the Civil War, this difference proved to be quite a headache for both sides when it came to getting supplies to their respective troops. When the war ended, the southern railroads regauged to the narrower 4' 8½" gauge, and standard gauge in the country was defined. Had the South won, it's conceivable that we could still have two standards in

North America, or the North might even have regauged to 5'.

Why 4' 8½"? That's a difficult question to answer, and one that is fraught with fanciful stories and romantic notions. The truth is most likely quite mundane. As railroad technology developed, primarily in the northern United States and Britain, early cars were adapted from horse-drawn carriages of the day. The builders simply replaced the wood wheels with flanged, iron wheels out of convenience. In many cases, the wheels ended up 4' 8½" apart, and the practice was born. Other countries either used different carts or had particular needs that predicated wider or narrower equipment. How arbitrary is this distance? Fewer than two-thirds of the world's railways are built to this gauge. "Standard" gauges, depending on where you are, run anywhere from 3' to 5' 6".

There was a belief in early railroading that railroad equipment became unstable when its width exceeded twice that of the gauge. This width is called *loading gauge*. It dictates how far from the track things like bridges, tunnels, signs, and station platforms have to be so that a passing train won't hit them. With a gauge of 4' 8½", that meant a loading gauge of around 9' 6". Early U.S. car builders rounded this to 10', and standard gauge railroad equipment has stayed right around that mark ever since. Some large locomotives hit the 11' mark, but that was the exception. (The loading gauge in Europe isn't as wide as it is in North America, so the equipment there tends to be a bit smaller in overall size, even though the track gauge is the same.)

When most of us think of standard gauge railroading, we envision large, powerful locomotives, long trains, and broad, sweeping curves. Branch lines that feed the major routes operate with shorter trains and smaller, lighter locomotives. These are often overlooked in terms of model railroading, but they are every bit as important in moving freight and passengers from one place to another. Standard gauge industrial or logging railroads also tend to lack the glamour of the Class 1 main lines but are often very well suited to the garden environment.



The East Broad Top Railroad remained viable into the 1950s, partly due to its practice of retrucking standard gauge cars with narrow gauge trucks so standard gauge cars could operate on the EBT. This was accomplished by a large overhead crane. This cement hopper, being positioned on the narrow gauge trucks (standard gauge truck in the foreground) was one of many that moved over the EBT during the construction of the Pennsylvania Turnpike. *Kevin Strong collection*

Tuscarora Timber Co. No. 4 rumbles across Trout Run with a short freight in tow. Sticking to one scale does not necessarily mean buying only one scale. The hopper and stock car in this photo are manufactured to 1:24 scale and the locomotive to 1:20.3. However, since early narrow gauge freight equipment was noticeably smaller than that built in the later years, the smaller scale models work well for the smaller prototypes when measured in 1:20.3.

Figure 7: Power supply

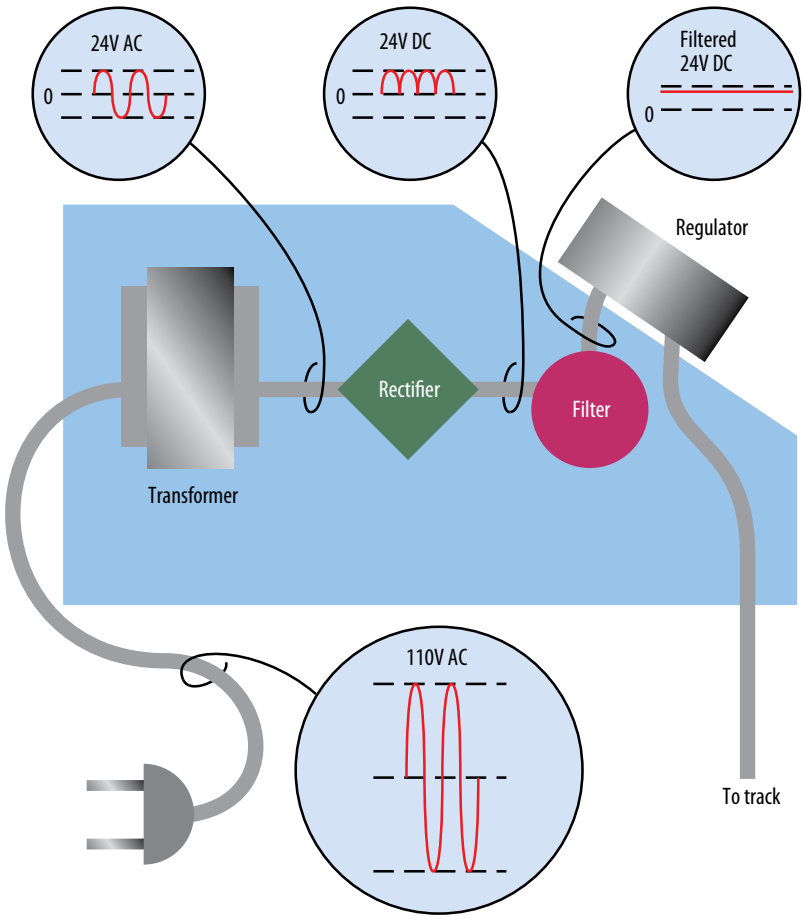
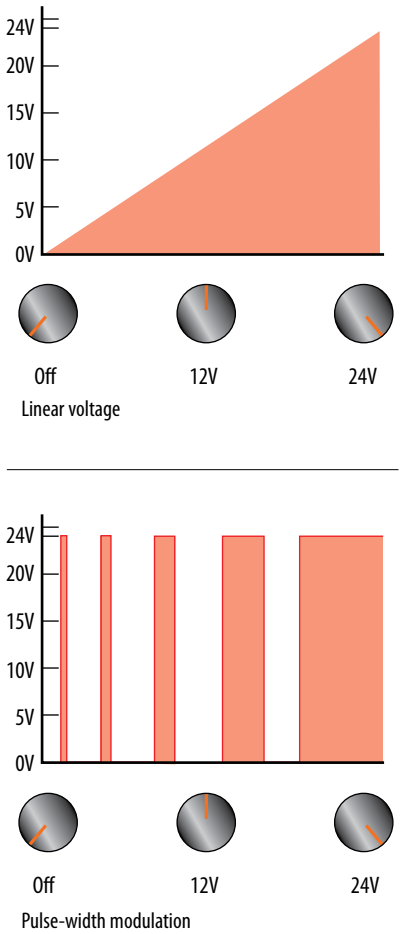


Figure 8: Sending power to the motor



Delivering power

The amount of power available for the train is perhaps the most important feature to consider, but how that power is delivered is also important. There are two ways that power supplies send power to the motors (see **Figure 8**). The simplest method is a constant, or linear, voltage. This method changes the speed of the motor by raising and lowering the voltage going to the motor. The advantage of this method is that the motor runs smoothly and stays cooler. The disadvantage is that your slow-speed control is not as good because, generally speaking, lower voltage means less current, hence a weaker magnetic field. There's more of a chance the train will stall.

To respond to this, manufacturers started designing throttles with pulse-width modulation. This method uses short bursts of maximum voltage. The speed is regulated by the time between pulses. The theory being that the short bursts of power create the strongest magnetic field, thus giving the motor the most power to start turning. However, by limiting the time this power is applied, the speed of the motor can be controlled. If there is no electricity flowing, there is no magnetic field to align the poles. The longer the time the power is applied compared to when it is off, the faster the motor will go. This method allows very slow-speed operation, but there may be an audible hum at low speeds as the voltage is quickly turned on and off.

Also, pulse-width modulation causes motors to run a bit hotter than those running with linear voltage, as the higher voltage and resulting current creates more heat. Typically, however, this is not a problem. Most of the locomotives in our scales are robust enough to safely dissipate any heat buildup. You may come across some incompatibilities or idiosyncrasies with certain sound systems when using this form of control. Check with the manufacturer if you're not sure.

If you envision a large railroad with many trains running, you will likely want the largest, most powerful supply on the market. If you are modeling a small industrial line, the large power supply will certainly be up to the task, but you could probably scale back a bit, opting for a cheaper, simpler model instead. Use your best judgment, but always err on the side of larger capacity. In general, our trains draw about as much power as a home computer, so we're not going to create any power shortages by running triple-headed diesel lash-ups. If you keep these basic principles in mind, you shouldn't have any trouble, except keeping the rails clean. That problem, I'm afraid, has no easy answers.

Yes, you can, but there's a lot more to a garden railroad than just track on the ground. There are a number of things you need to seriously sit down and think about before you start tearing up the sod. These aren't necessarily train-related thoughts but an analysis of your lifestyle and how the trains play into that. There are also some things that you can't control, such as the weather.

Design considerations

Let's face it—if you live in the desert, the chances of your re-creating a lush eastern landscape are pretty slim. Climate is perhaps the single most influential element on your railroad. The only way to change your climate is to relocate. Of course, climate doesn't only affect the plants you put on your railroad. Temperature and environment take their toll on the track, roadbed, and structures as well. If you live in a moist climate, you have a unique set of challenges to deal with. Cold climates present their own problems. Dry, desert conditions may be great for leaving things outdoors, but the heat will adversely affect the railroad in different ways. A good litmus test for how climate will affect the railroad is to look at your house. What do you have to do to maintain it through the seasons? Chances are that what you have to do for your house will be echoed in the garden.

Perhaps the next most influential force is your family. A garden railroad will impact every family member, whether they take an active role in its construction or not. Their needs and interests must be considered. If you have small children, it might be best to locate the railroad in an area that doesn't see much action. That way, it will be safe from soccer balls, bikes, and other things that go bump. And what about the activities of your significant other? If you enjoy entertaining, design the railroad to accommodate social functions, either by tucking it out of the way or integrating it into the social landscape. The railway can be a great conversation piece.

Of course, the space available also plays a role in determining how achievable your grand vision is. If you don't have a large yard, or if you have to restrict the size of your railroad for any of the previously mentioned reasons, then perhaps you should tailor the type of railroad you ultimately build to suit the limited space. Consider a small industrial railroad instead of a large mainline operation. Or think of ways to scale down your vision to its basic elements to fit the space.

Too much space can also be a problem. If you have lots of yard to deal with, the desire to go big can be very strong. Railroads have a tendency to fill available space. If there's a lot to start with, make sure you have a strong hold on the reins. Large railroads take an inordinate amount of time to maintain.

Regardless of how much space you have, your railroad will become an important, if not the most important, landscape feature of your yard. Put it where it can be enjoyed from both outside and inside the house. Because the railroad is a focal point, it will draw attention wherever it can be seen. If you have a favorite room in the house, set the railroad so it can be seen from the comfortable indoors. Family rooms and dining rooms often have large picture windows that can serve as nice frames for the railroad.

The downside of a garden railroad drawing attention to itself is that the attention it draws may not be what you want it to receive. Security is an important aspect of constructing a railroad. No matter how much or how little we invest in this hobby, you hate to see someone come in and take it away.

Roger Caiazza's Leatherstocking Line follows the natural slope of his backyard in Syracuse, N.Y. While less expensive to build, ground-level lines are more prone to accidental damage. If you have kids or large dogs, consider elevating your line a little.

An elevated railroad offers protection from foreign objects, while providing opportunities for points of interest such as trestles. Here, the brick walkway ties the railroad into the surrounding area yet provides a border that allows the railroad to stand out.

East Broad Top No. 3 passes by a spur where empty hoppers have been set out. The crew of No. 3 will pick these cars up and take them back to the mines where they'll be filled with coal.

The mild winter sun helps warm the Tuscarora Railroad crew as they pick up an empty hopper at Neelyton. The boxcar at the depot is also on the pick-up list, as TRR No. 10 makes its way west to Blacklog, where the cars will be dropped off and left for the East Broad Top crews to pick up.

Industries need not take up much space on the railroad. The boxcar sits in front of a simple loading platform (inspired by the one in Mount Union shown on page 51), while a hopper sits on a small coal trestle in the background.

A passenger train arrives at Blacklog depot, where an empty flatcar waits. A simple scene like this gives your railroad a sense of purpose. Passengers waiting for the next train and freight waiting to be loaded are things that, in small spaces, bring life to a railroad.

having to ram two cars together at warp speed, and you want them to uncouple with the touch of a lever or something like that. If you're always having to get down and fiddle with a coupler to get it to couple or uncouple, the fun quickly fades from the experience.

Keeping it simple

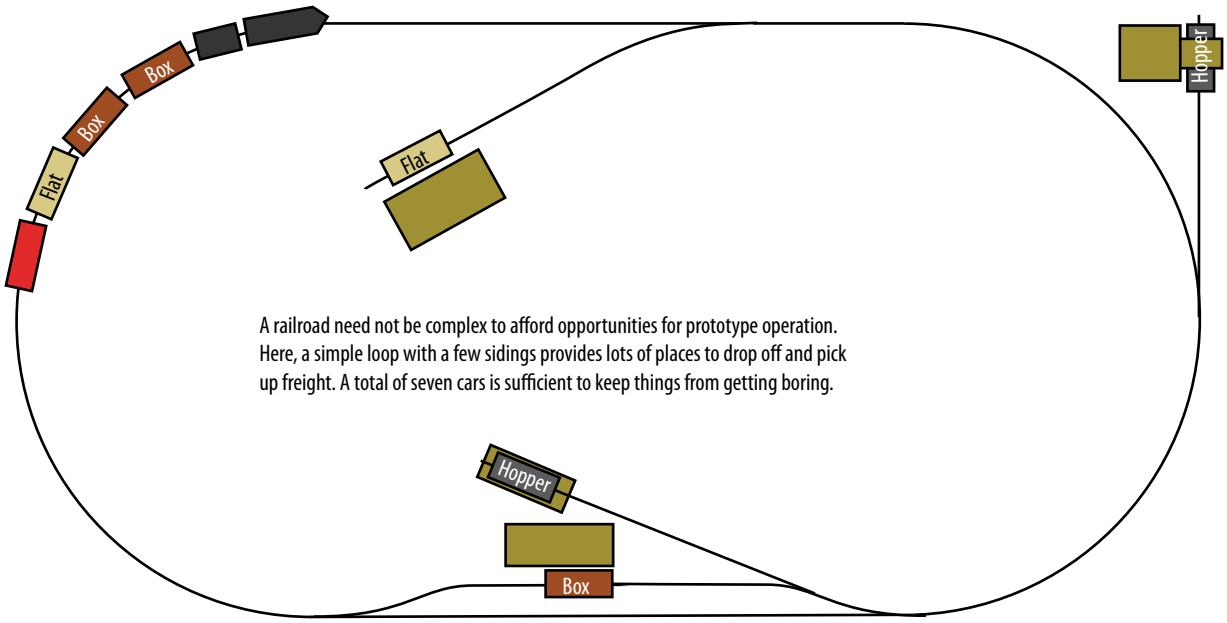
Okay, so how do you go about operating a railroad without all that fancy paperwork, dispatchers, and stuff? In most cases, garden railroads aren't set up as large railroads operated with multiple engineers. Some of us (myself included) can only run one locomotive at a time on the railroad. That's a good thing! It means we can keep things simple. At the simplest level, you operate your trains prototypically when you stop to drop off a car at a siding (see **Figure 2**). You don't need a waybill or anything to tell you to do that; you just stop when the mood strikes, set out a car or pick one up, and continue on your way. If all you have is one or two industries or sidings on your railroad, that's really all you need.

Perhaps one of the simplest methods I've used for prototype operations features colored tabs (see **Figure 3**). Along the line, each location has a designated color, and you start by setting cars on various sidings around the railroad. Each car gets a tab with one of the colors used on the railroad, and your job is to then deliver each car to the location having the same color tab. Once the cars are all moved to their appropriate locations, the tabs are flipped over and the process repeats. (The colors on the reverse side of tab are most likely not the same place the car came from originally.) I've seen variations of this where there's a code within each color for a specific type of car, but often it's as simple as knowing coal cars get spotted under the coal tipple and boxcars get spotted in front of the freight depot.

If you don't have colored tabs handy, reach into your change jar for a handful of pennies, nickels, dimes, quarters, half-dollars, and dollars (or some loonies and toonies if you live in Canada or near the border).

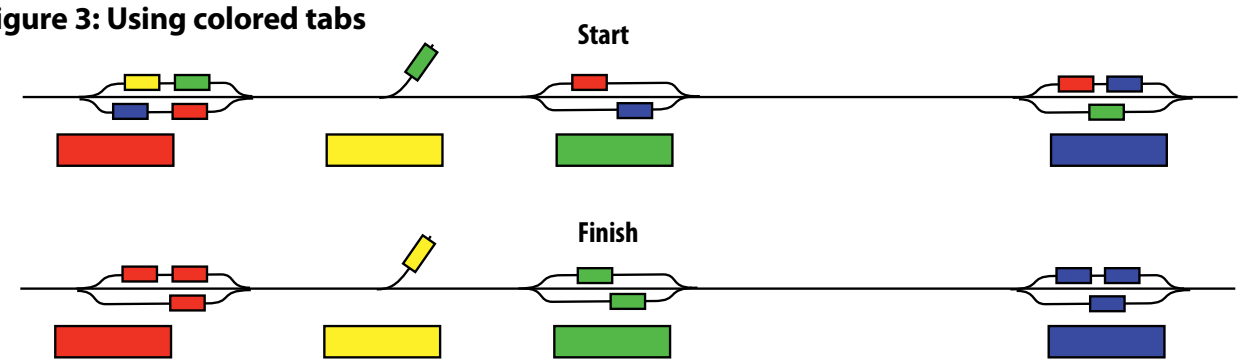
At its basic level, the colored-tab system is somewhat limited in terms of

Figure 2: Simple operations



A railroad need not be complex to afford opportunities for prototype operation. Here, a simple loop with a few sidings provides lots of places to drop off and pick up freight. A total of seven cars is sufficient to keep things from getting boring.

Figure 3: Using colored tabs



Colored tabs are probably the easiest way to simulate freight movements. Cars are randomly assigned colored tabs that correspond to colors associated with various stops along the railroad (top). The task is to get all the colored cars to their appropriate locations (bottom).

replicating prototype operations as it's more a random method of determining where cars go. The cars—whatever type they are—go wherever the colors tell you to send them, without a whole lot of consideration as to prototypical traffic flows. Empty hopper cars may be sent to a coal trestle in the next town (fat lot of good it would do them, since it's empty) instead of back to the mine to get refilled and then sent to the coal trestle later.

For my railroad, I created a spreadsheet that shows each type of car and lists potential destinations for the car (see chart on page 54). I set out a week of moves, for example, having a flatcar start out at a lumber-loading siding, moved next day to the woodshop, and then return empty to the lumber siding the next day or alternatively moved to the interchange for use elsewhere on the (non-modeled) part of the railroad. Not all cars move every day, as loads may take longer to unload. (Hoppers on coal trestles, for instance, move once every four or five days.) I then set tabs on the cars based on this spreadsheet as opposed to the random determination.

Other operational options include running a timetable with a passenger train and weaving your freight operations around that. I used to do this on my dad's railroad by setting a small railcar out along the main line to run up and down and then started working the daily freight. I'd have to keep an eye on where the railcar was before heading out on the main line to move the freight to the next town. If it was nearby, I waited until it passed. You could do similar things with through freight trains, such as coal drags or intermodal trains, that wouldn't serve any of the industries you're modeling but would be common over the rails. The trick in all of these examples is to do your switching so that you don't delay the other trains.

Three types of track are available in the garden. Sectional track (left) is perhaps the easiest to use. Flextrack (center) offers flexibility in planning and track design. Handlaid track (right) offers the highest level of realism, but it also requires the most planning and work.

Rails come in different sizes. Code 332 (left) is the standard size rail for commercially available sectional track. Code 250 rail (middle) is a common size for flextrack and handlaid track. Code 197 (right) is a good scale height for rail, but it may be too small for reliable use outdoors by inexperienced modelers.

Sectional track

The first choice we have in the track department is whether to use sectional track or flextrack. As the name implies, sectional track comes in sections, or preformed pieces. We can choose from a curve radius as small as 2' to as much as 15'. The radius of a curve is the distance from the midline of the track—halfway between the rails—to the center of the circle of which it is a part. The diameter of the curve is the distance across the complete circle—mathematically, twice the radius. When buying sectional track, be careful not to confuse the two measurements. A mild warning—manufacturers use both measurements almost interchangeably, so be sure you're clear on which measurement you're looking at when purchasing track. Straight track also comes in an variety of lengths.

The greatest advantage to sectional track is its predictability. By that, I mean it's easy to draw up a plan using sectional track, as you know what radii of curves and what lengths of straight track you have to work with. Plans drawn for sectional track translate easily from paper to the garden. You can make out a grocery list of the sections you need, head down to the local hobby shop, and buy everything to build your railroad.

At the same time, the predictability of sectional track is also its greatest disadvantage. While it's true there are ever-increasing choices for sectional track, if you're particular about a given brand of track because of the rail material or the shape of the ties (some are narrow gauge while others are standard gauge) then you may be somewhat limited to those particular product lines. Another limitation is that sectional track is predominantly available only in code 332. (More on code in a bit.) If you're after a smaller, more prototypical looking rail, then your choice of sectional track is pretty limited, if you're going to be able to find any at all.

Flextrack

Even though the selection of track sections has increased, it's likely that you may want more flexibility in planning your garden railroad. That's where the benefits of flextrack come into play. *Flex* is the key word. You can bend flextrack to fit whatever radius you need and can infinitely vary that radius to fit the lines of the garden. But that is not where the flexible options end. With flextrack, you have more choices of which rail size you can use, as well as the size and spacing of the ties on the plastic strips into which you place the rail. You also have a wider choice of rail material than with sectional track, since you're choosing the rail material independently from the ties.

There is no real cost difference between sectional track and flextrack, given the same rail and tie materials. Cheaper materials can lower your cost per foot, but in the garden, price shouldn't be the only consideration. There are many other considerations that come into play. Laying flextrack requires a bit more planning and work to install, but the visual end result can be worth it.

Handlaid track

A third option is handlaying the track. You have the same benefit of the choice of rail materials that you have with flextrack, and you can cut your ties to suit your needs. For the beginning garden railroader, however, I recommend sticking to either flextrack or sectional track, as they're both considerably quicker and easier to install. Remember, you can always go back later and relay your track.

Rail size

Let's talk about the different rail sizes and materials available for use in the garden. Rail size is measured in codes. Code is nothing more than the height of the rail in thousandths of an inch. Code 250 rail is 250 thousandths, or ¼" high. Most commercially available sectional track is code 332. The reasons for using the smaller rail are largely aesthetic. Code 332 rail is generally held to be too large to be prototypical. A smaller rail size looks more realistic in the garden.

The trade-off is that the smaller rail is not as strong when compared to rail of the same material but in a larger size. (Stronger rail materials in smaller sizes may be stronger than weaker rail materials in larger sizes.) Don't let that scare you from using the smaller rail, though. If the track is on a firm foundation, it's going to stand up to a fair deal of punishment. I frequently have young children walking on my code 250 track—albeit against my wishes, but kids will be kids—and it holds up very well. Even the code 250 aluminum

A rail bender is used to pre-curve rail for flextrack.

A dual-rail bender comes in very handy for bending rail that's already assembled onto tie strips. This one, by Train-Li, also has levels on it for checking the geometry of track that's already on the ground.

rail I used on my old railroad in New York withstood the occasional misstep and snagged garden hose without any ill effects.

Rail material

In a garden setting, the choice of rail material has more impact on performance than size. The typical choices for rail material are brass, nickel silver, aluminum, steel, and stainless steel. Brass is the most common material. It's easy to work with, easy to solder, and the material of choice for most sectional track. Stainless steel is becoming increasingly popular for sectional track. It requires little cleaning, but it is more difficult to cut and work with for custom trackwork. Nickel silver is similar in properties to brass and has the advantage of a more realistic color. Many say you don't need to clean nickel-silver track as often as brass, but my experience with nickel silver in the indoor scales shows that there is no real difference.

Steel rail has really fallen out of favor largely due to the fact that it rusts, often quickly to the point of non-usability. Perhaps in dry climates it can be an option, but there are better choices.

Aluminum rail is the cheapest of all available materials. Price, however, is largely its only advantage. It's the weakest of all the metals, so it's more prone to bending and kinking. It's easy to cut and shape, though. Aluminum is also an inconsistent conductor of electricity. It's supposed to be the most conductive metal, but trouble arises in getting the electrons to flow due to oxidation between rail sections. You can't easily solder wires to it, so any electrical connections have to be mechanical, made with either aluminum or stainless steel fasteners. Brass, copper, and other common metals have an electrolytic reaction with aluminum, the result being that both metals corrode and the connection breaks. I recommend using aluminum only if you're planning on building a live steam or battery-powered railroad. If you're going to run track power, I'd recommend the added expense of either brass, nickel-silver, or stainless steel rail.

Bending track

If you opt for flextrack, the first thing you'll need is a rail bender. Most track manufacturers offer them as part of their line. A rail bender is the best way to get smooth, even curves, especially when you want to bend smaller radii. Rail benders come in two types. There are benders that work on single lengths of rail, which you would then string onto the tie strips (or onto handlaid ties). With dual-rail benders, you assemble the track first and then bend the track to suit, both rails at once. You don't need to bend the curves to the exact radius, as you will be able to finesse them when you actually set the track down in the garden.

Fastening track

Whether you use flextrack or sectional track, you will need a way of fastening the track together to maintain electrical continuity throughout (if you're using track power). If you think you can safely rely solely on the rail joiners that come with the track, there may be trouble down the line.

There are three basic ways to make sure the track connections are good and solid. The first is to solder each joint together, ensuring a good electrical connection. While this method provides almost bulletproof electrical continuity, it has its drawbacks. First, there's the heat element. You'll need either a very large soldering iron or a small torch to heat the rail enough for the solder to flow. This will likely melt nearby ties if you're not careful. Second, it's pretty permanent. You'll have to unsolder things if you want to make changes. Also, you'll have to allow for expansion and contraction by using an unsoldered joint every so often. (These joints should have a jumper wire soldered across them.)

Another popular method is using rail clamps. These replace the rail joiners and clamp the rails together. This isn't a cheap method, but they can be removed easily to accommodate future expansion. You can find rail clamps that allow you to clamp together two different rail sizes. With insulated rail clamps, you can create

Glossary

Garden railroading has its own lingo, and knowing it allows you to better communicate and understand the advice you get from others before venturing too far into the backyard. This glossary features some of the more basic terms you will encounter on your journey outdoors.

Alternating current (AC): This is a form of electrical power in which the current goes first one direction and then the other. Household electricity is 120 volts AC. This type of power is fine for operating lightbulbs and some garden-railroad accessories (after the voltage is reduced to a manageable and safe level), but it is not intended for powering trains. See **Transformer**.

Ballast: Material put down around the track to provide support and allow drainage. In garden railway circles, this is usually in the form of crusher fines or other small stone.

Command Control (also DCC): A means of control by which multiple locomotives can be controlled independently from the same controller on the same track. DCC is a universal form of command control that allows different manufacturers' products to be compatible with one another. Other manufacturers offer *proprietary* controls that which work only within that particular system.

Control panel: A central location where all the controls for the railroad are located. Often a graphic representation of the railroad on the panel shows locations of turnouts and sidings with electrical switches for turning power to particular sections of the railroad on and off. If there is a fixed throttle for the railroad, it is usually located here as well.

Coupler: A device used to connect the cars in a train.

Crossing: Where two tracks cross one another, or where a road crosses the track.

The engineer keeps a sharp eye out as he winds around the curved trestle on Jim Strong's Woodland Railway. A trestle is often the focal point of a garden railroad, and it's worth the time and effort to build one. They are not, however, indestructible as can be seen by the broken cross brace at the bottom.

Current: The flow of electrons through a wire or rail that provides power for electrical devices.

Curve radius: A measure of how tight a curve is. While many of our trains are designed to operate around a 2' radius, it's advisable to use the widest possible radius that will fit the available space. The radius of a curve is measured from the center of the circle to the centerline of the track. *Curve diameter* is twice the radius. In large scale, curves are often expressed as one or the other, so it's important to know which measurement you're using to get the correct curve.

Cut (or cutting): A slice through a hill or mountain through which a railroad runs. Rock cuts give a landscape a sense of drama and depth.

Direct current (DC): A form of electrical power in which the current flows only in one direction. This can come either from batteries or from AC power that has been rectified and filtered.