Did you ever see small trains running about in a store window? Did you parents ever lay some track around your Christmas tree?

These are called **Displays**. You can play with them a little, by changing the speed of the train or switching the order of the cars around; but displays are intended for watching, not playing.

Have you ever visited a friend and seen a stack of sealed boxes containing small train cars? Perhaps they even had some shelves on which trains of 4 or 5 coupled cars were placed?

These are called **Collections**. On very rare occasions they might be used as a temporary display on someones track layout; but they are intended only for possessing, not playing.

Have you ever been to a museum and seen a miniature track layout? Perhaps you had a chance to visit a club where hobbyists were in the process of building one of these miniature worlds?

These are called **Models**. If the owners feel they can trust you, you may be allowed to operate these trains in a manner dictated by the owner; but they are strictly "hands-off", "no touching". Models are intended for admiring the creators craftsmanship, not playing.

There are books about Displaying, Collecting, and Modeling, but almost nothing about playing with trains, also known as railroad "Operating". This pamphlet will hopefully correct this oversight, by explaining how to select and play with miniature trains; but in a way that will keep them in good order, so they can provide many hours of enjoyment.

What exactly is a train?

That is a very good question, as many people have never seen a train in real life. A train is a part of the transportation system, like a cargo ship, airplane, or commercial truck. Train cars are boxes and cans that can hold cargoes of goods or passengers. Train cars have wheels which run on metal tracks. The tracks reduce the friction at the wheels, allowing heavy loads to be moved. A locomotive pulls these cars to their destinations. A locomotive is like a "big-rig" truck cab, while the train cars are like the trucks trailers. The word "train" normally refers to a set of coupled cars, rather than an individual car, but even coupled cars are not a train until they are assigned a number in a train schedule (timetable).

A railroad consists of the trains, tracks, bridges, buildings, and any other property the company owns in order to move cargo from one place to another. To give meaning to your play, your miniature railroad should also represent a transportation system. Although it should take its cues from full sized railroads, and you should try to operate it as if it was a real railroad, there is no reason why your miniature railroad has to accurately represent anything that existed in real life.

One way to play with your trains would be to create a real working transportation system. You could, for example, lay track from one side of the room to the other. Then you could make a train of open top cars, load the cars with golf balls, and transport the balls to the other side of the room, where they can be unloaded into your golf bag. Real working transportation systems like I just described provide limited play options however, which is why with few exceptions (such as to move bar drinks) miniature railroads rarely are built to transport full-sized objects.

On the other hand, loading, moving, and unloading fake cargo can provide a lot of play value. Later I will talk about the function of different cars, but for now just examine a train car that looks interesting. Imagine what kind of goods it could carry, then think how you would build a portion of your miniature railroad with an origin and/or destination that can be serviced using that car. This car does not have to exist in real life, as long as you can make a sensible case for its existence. Although you can have a lot of fun playing with cars and accessories that load, move, and unload imaginary cargo, it's even more fun when the cars and/or accessories can physically load, carry, or unload real miniature cargo.

<u>Choosing the miniatures</u>

Although over the years miniature trains have come in many sizes (scales), the most common ones you would find in a hobby stores today are 2-rail track trains in sizes N, HO, and G, and 3-rail track trains in size O. N and HO sized trains are marketed for modelers, and not intended to withstand more than occasional handling. Because of this, and their tiny size, they do not make good candidates for play.

G size trains are quite durable, as they were originally designed to be run out doors. Originally they were marketed to be used mostly as displays, but the manufacturers soon began marketing them for modelers. Although fun to play with, their large size can be problematic if used indoors. As modelers don't usually load or unload toy cargo, there are also few operating accessories available. Finally, although the track with their two rails looks more like the tracks used for real trains, 2-rail track poses electrical problems that are not an issue with 3-rail track.

3-rail O size trains were designed from the beginning to be played with, and they hold up well to rough handling. They are large enough that they could be, and have been, used out of doors, but they are really intended to be used inside. Most cars are specially designed so that they can make very tight turns, which allows for interesting track layouts in smaller spaces. Because they run on 3-rails rather than two, electrical connections are very simple. Most important for play purposes, many of the cars are "action" cars, designed to carry and/or unload physical toy cargo. There have also been many operating accessories manufactured, that will load or unload toy cargo carried by these cars.

The remainder of this pamphlet will be focused on O scale, 3-rail railroading. Note though that because O scale trains have been made for decades, some incompatibilities have arisen that make some choices better suited for play then others. The first issue is coupler incompatibility. It is smart to choose only cars with the modern Lionel style couplers. Although the couplers that can be opened automatically offer more flexibility, they are not a requirement, as it is perfectly acceptable to uncouple cars using your hand. To uncouple by hand, cup the top of the car over the wheels closest to the mated coupler in the palm of your hand, so that your finger tips are touching the wheels. Now lift the wheels slightly off the track until the coupler is raised above its mate. Roll the car down the track on its other set of wheels enough to part the couplers, and then lower the lifted wheels back onto the track.

Another consideration is choosing cars that are built full-scale (1:48) or "foreshortened" (sometimes called O27). The advantage of the shorter cars is that they take less room and can turn tighter corners, but they still look similar to their prototypes and can carry most of the longer cars cargo. They are also often cheaper to purchase than their full-scale siblings, and often more durable as well. Try to avoid mixing shortened and full-sized cars of the same car type, such as long and short passenger cars, as they look odd when coupled together. Accessories allow a little more size flexibility, but make a real effort to keep the scale variance no larger than 1:43 or smaller than 1:50. Be aware that Plasticville brand buildings sold as O-scale are actually built to a tiny S-scale 1:64, but equipped with oversized 1:48 scale doors. Always avoid the automatic gateman accessory, as it is actually sized for G-scale.

Track is another compatibility issue, as different styles don't easily connect together. The common O27 "tubular" track from Lionel / Marx brands is also the least desirable (O "tubular" is superior). An ideal choice is the Atlas brand track (GarGraves / RCS brands are a good second choice), as trains run well on this style of track, and Atlas offers numerous specialty crossovers and turnouts (switches).

Developing a Theme

Since we want to play with the trains, rather than just show them off in a moving display, we need to give consideration to the playing field. We only have so much room, so we need to use it sensibly. Our train cars must be doing something, whether hauling cargo (such as with freight and passenger cars) or providing services (such as with search light or fire fighting cars).

Deciding on a theme allows us to create a compact area in which cars and accessories can sensibly integrate together. Some real life examples where this occurs are urban light industry districts, cargo transfer ports, end-of-the-line passenger terminals, and railroad equipment servicing facilities. A fantasy example could be a government experimental testing area (complete with missile launchers, radar antennas, and atomic wonders). Initially assuming your playing field to be physically located in an urban fringe area, will probably open the broadest selection of logical theme choices, especially since many of the available cars and accessories are styled on those found in the "manufacturing belt".

Keep in mind that apparently incompatible themes are sometimes found together in real life. For example, a commuter passenger platform might be located in the midst of a cargo transfer port. A small dairy farm might also host a small oil well, and be located near a locomotive watering facility. But whatever theme you choose it must be justifiable. You might find coal in the middle of the desert, but you certainly wouldn't find a major shipyard in Death Valley.

If you have the space, you can increase your fun by building more than one theme. Just keep drastically differing themes somehow visually separated, so as to prevent jarring contrasts. You just don't find the Appalachian mountains next to the Pacific ocean. The simplest way to separate two themes is with a fascia board or some obscuring building fronts. If you have slightly more space, you can create a short transition section, such as by installing large bridge over a ravine.

To maximize play value, don't spend too much effort in getting train cars with the same railroad name, or which come from the same real life geographic area. Most real railroads interchange cars with each other, or occasionally even lease specialty equipment anyways, so it would be perfectly acceptable to just acquire cars that visually appeal to you. Do avoid cars with obvious "toy" labeling though, such as, for example, cars with pictures of superheroes on them, or that say Merry Christmas. Fictional names like "Lionel Lines" or "K-Line" are justifiable however, as their labeling is similar to that found on real life railroad and industry rolling stock. Don't worry about color, as most 3-rail trains will be of a color that was never used in real life, and besides, you can assume all your cars have fresh paint.

Try very hard to have all your train cars marked with different numbers however (cars marked with the same number can be used if they have different railroad names, and/or are completely different car types). If you have no choice but to own two duplicate cars, you could use hobbyist number decals to add on an extra digit to differentiate the two cars. In real life all train cars have different identification numbers for tracking and routing purposes, and if your train cars are also so labeled (O scale lettering is easily readable), you can, and should, play at routing your cars too.

Choices in rolling stock

We now know that we are going to build a railroad that moves toy cargo. We also know that we are going to create a justifiable setting for our trains to move about in. So now we need to acquire the trains and accessories we are going to use.

Selecting rolling stock and supporting structures can be a fun pursuit in itself. To begin, we will need at least one locomotive and one car. A good place to begin is a hobby shop that specializes in trains. Here you will typically find both new and pre-owned cars. If they don't have what are looking for in the store, they can probably order it for you from a catalog.

Locomotives are one of the pricier purchases, and there are several choices that must be made. I recommend that your first locomotive be a Switching engine (a locomotive with foot boards) rather than a Road engine, as their versatility makes them suitable for far more railroading scenarios. I also recommend that your first locomotive be a Diesel engine rather than a Steam engine. Steam engines are burdened with the need to have tenders, and as they also often lack couplers on their front end, switching becomes much more difficult. Steam has a little more play value than diesel, in that they need to be constantly filled with coal and water and have their ashes dumped. But on the other hand, these facilities take up a lot of room, whereas a diesel fuel pump can be installed just about anywhere.

Another, and rather critical decision you must make, is how the 3-rail locomotive is powered. Once you have chosen a method, it is difficult and expensive to change over to a different method. In the past, the most common method of powering a locomotive was with an A.C. transformer.   Nowadays, digital command and control has become more popular. I suggest that you delay your purchase of a locomotive until after you have purchased some of your cars, purchased some accessories/scenery, and temporarily laid some track. This is because while in the initial stages of building your layout you may discover you prefer a different theme or way of playing than you had in mind originally, and you won't be stuck with an expensive locomotive that is no longer suitable. Also, the money saved by holding off on buying an expensive locomotive can be used towards immediately purchasing a higher priced car or accessory, which might give you greater long term play value than if you had compromised for their less expensive counterpart.

Now lets examine the various types of cars, and the accessories that support them.

* Gondolas and Hoppers

Gondolas have one of the highest play values, and they are also one of the least expensive of the cars that you can purchase. A gondola looks a lot like a shoebox on wheels. They are low sided cars that are used to carry loose bulk materials. Gondola loads have to be either lifted out or shoveled out.

Hoppers are a special type of gondola that can unload pourable loads themselves. Hoppers with low sides usually dump from the side, while hoppers with high sides usually dump from the bottom.   Some high sided hoppers are equipped with covers to keep their contents dry.   1970's/80's/90's vintage Lionel side dump hoppers are often animated so that they can actually dump their toy loads.

Some toy gondola loads that have been offered over the years include:

Empty reels for electrical cable
        (Note - you can wrap them with your own wire to make them "full").
Covers for rolls of sheet metal
        (Note - you can make your own sheet metal rolls out of aluminum foil).
Canisters for powdered cement.
Culvert pipes.
Oil drums.
Wooden barrels.
Scrap metal.

Some toy loads used in both gondolas and hoppers include:

Artificial coal.
Gravel.

Some associated animated accessories that have been offered over the years include:

Oil drum loader.
Wooden barrel loader.
Scrap metal loading/unloading magnetic crane.
Artificial coal loader.
Artificial coal unloading bin.
Culvert pipe loading/unloading crane.

<u>* Flat cars</u>

Flat cars are the most basic of all train cars, being essentially just a table top on wheels. Typically they are used to transport long goods such as logs, or very bulky loads such as farming equipment. Flat cars have often been supplemented with stakes on their sides to keep loads from rolling off, or walls down the middle to allow loads to be stacked extra high. Some flat cars even have a depressed center section to accommodate very tall loads, or an upper deck for stacking automobiles. A special animated flat car is commonly available that will side dump a load of toy round logs, pipes, or helium tanks.

Some toy flat car loads that have been offered over the years include:

Round logs.
Drain pipes.
Helium tanks.
Railroad rails.
Girders.
Lumber.
Missiles.
Radioactive waste containers.
Transformers.
Caterpillar-tracked vehicles.
Inter-modal containers.
Railroad wheels.
Piggy-back trailers.
Automobiles.

Some associated animated accessories that have been offered over the years include:

Round log loader.
Round log unloading bin.
Inter-modal loading/unloading machine.

<u>* Box cars, Stock cars, and Reefers</u>

Box cars (including "baggage" cars, which are just box cars styled to match passenger cars) look like boxes on wheels with sliding side doors. When the doors are closed, their contents are protected from the elements. Furniture and smaller goods are some of the items typically carried, although box cars with double doors can carry very large items such as rolls of printing press paper and exotic sports cars. It is not uncommon for box cars to carry a less than full load. "Express" cars are box cars upgraded to run at high speeds, and are often privately owned by overnight package shipping companies (such as REA). A special "exploding" ammunition carrying box car is intended as a target for missile launchers.

Stock cars are box cars that have ventilated sides, so that animals can be transported. Because smaller animals and birds do not need as much headroom as cows and horses, some stock cars are lined with shelving for cages, or have an upper deck, for better space utilization. Animals in stock cars must be fed, watered, and rested if the trip lasts too long, and stock cars must be cleaned out after every trip.

Reefers are box cars with added insulation. Older reefers have a compartment for ice blocks, which must be restocked. Newer reefers have refrigeration machinery, which must be refueled using a special diesel fuel. Often a contracted mobile servicing company will be hired to resupply both types of cars. Reefers are used to transport foods that must be kept cool, such as meat, fruit, vegetables, eggs, and cans of milk from small farmers. Remember that reefers do not have to be cooled, so they can be used as ventilated cars, or even pressed into service as lesser internal capacity box cars.

Due to their perishable contents, loaded stock cars and reefers are usually assigned fast locomotives. Because they are closed, the loads carried in these cars must usually be imagined. However, several special animated cars have been built that will load or unload their contents:

Bags (for animated box car)
Horses (for animated stock car)
Cattle (for animated stock car)
Ice blocks (for animated reefer)
Milk cans (for animated reefer)

All the animated cars also have associated animated accessories, with the exception of the bags which can unload anywhere (but bags must be loaded into the car manually):

Horse loading/unloading corral.
Cattle loading/unloading pen.
Ice block loading ramp (blocks must be unloaded from the car manually).
Milk can unloading platform (cans must be loaded into the car manually).

A special animated accessory is available that will swing a Mail Bag towards a mail car, baggage car, or caboose (that you must first have fitted with a small magnet). The mail bag hangs there until the train is stopped somewhere where the bag can be removed. Real railroads usually put these mail pickups at rural stations, which the train would slowly pass through so the bag could be hooked (this is to avoid stopping the train for one bag, as locomotives burn a lot of fuel when starting from a stop).

* Tank cars and Vat cars

Tank cars look like cans on wheels, and are used to hold liquids. Loads include heating oil, diesel, gasoline, chemicals, pressurized liquified gas, bulk milk, vegetable oil, and top secret biological ooze. Contents are poured in and out through pipes. Tank cars are built to specific loads, so for example, you would never see a non-insulated tank car used to carry milk. Some tank cars can have their tank body subdivided in to two or three sections, with each section having its own valve dome. Subdivided tank cars are used when you need to transport quantities too large to be practically stored in individual drums, but too small to fill up a full size tank car (you don't want small quantities sloshing around).

Vat cars are cars with large tubs that hold solids immersed in a liquid. Bulk pickles are a typical load. Contents could be scooped out, but instead are usually emptied out through a large diameter drain. Although they don't look like vat cars, the fantasy "aquarium" cars intended to transport live fish, are in effect vat cars.

Tank car loads must be imagined. However there is one associated animated accessory where the floating lid of a bunker oil storage tank slowly raises or lowers, to simulate oil loading or unloading.

<u>* Passenger cars</u>

Passenger cars come in three major types. Coaches, the most common type, are filled with chairs. Sleepers are like hotel rooms, equipped with Murphy beds and a nearby porter. Diners are like restaurants, equipped with a staff space, storage areas, scullery, kitchen, and passenger dining tables.

Passenger cars sometimes combine features into one car, such as dedicating half of a coach to carrying express packages. A special car, called an observation car, is intended to ride on the rear of the passenger train, in order to give the passengers a special rear view. It is fairly common for observation cars to include a snack bar. Streamlined passenger cars are sometimes equipped with domes, which give special views from the middle of the train. They are sometimes also equipped with snack bars.

Coaches must be regularly cleaned, to remove dirt and trash, and to refresh the cars toilet. The water holding tank must also be refilled. Although these chores are often done in the "coach yard" (once unloaded, cars are usually moved out of the station to free up station platforms for other trains), these chores are simple enough that they *could* be performed on a rural station platform during a layover.

Sleepers must be cleaned at the end of their runs. This includes not only refilling the large water holding tank and removing the dirt and trash, but refreshing each compartments toilet and changing out all the bedsheets and towels. Although these chores are usually performed at a special laundry (Pullman) building, especially if the cars are privately owned (in the past, the Pullman company owned and staffed most of them), these chores could instead be performed right on a station platform during a long layover (linens would be transferred to a laundry in the station, or to a linen company truck).

Diners are difficult to maintain, because of their high cleanliness and food preparation needs. Besides having large water holding tanks for cooking and dish washing, they also have a large liquid propane gas tank, which is used for both cooking fires and for operating the refrigerators when the electricity from the locomotive is disconnected. Along with the normal dirt, trash, and toilet refresh issues, diners generate substantial food garbage. Table linens will also need to be cleaned, and any damaged tableware replaced. Fresh food and drink, including refrigerated and frozen items, must also be regularly resupplied. These chores are normally performed over at a special diner supply (commissary) building, which contains a pantry and walk-in refrigerator.

Passenger car consists often change, with cars added or removed as passenger loads dictate. An example is a baggage car that might be added so seasonal skiers could carry their equipment. Cars may be added or removed at any point in the trains run. For example, for efficient dining car usage, diners can be switched between different trains mid-route (passengers preferring to dine, rather than eat at the snack bar, will have the opportunity to lunch on one train, and supper on the other).

Special passenger trains will sometimes be created and routed on the layout. These include a train for a political candidate and his press agents, a train assembled for a sporting event, or a railroad property inspection train. Privately owned passenger equipment such as circus trains, dinner trains, or business cars might also make requests to operate over the railroad or park at a siding.

Passenger car loads must be imagined. However there is one associated animated accessory where the people on the station platform can be hidden or revealed, simulating passenger loading and unloading.

* Service cars

Service cars are cars that perform work other than just transportation. One example is the Railway Post Office (RPO). When mailmen still hand sorted mail, an efficient way to speed mail delivery was to load a RPO with unsorted mail destined for a city down the tracks. Mailmen then rode inside the RPO, and finished the final mail sorting while the car sped down the track.

The most common service car is the Caboose. A caboose is a small rolling office for the train conductor. (Always remember that a conductor is the captain of a train. The engineer is just a member of his crew). They were common in the past, when the work days were longer and the train cars less reliable, but now they are rarely encountered on anything but the longest distance trains. Although often placed at the rear of a train (so the conductor could constantly look forward to see if there were problems with his train cars), they don't have to be if an end of train marker is hung from some other car on the rear of the train. However, as many toy 3-rail cabooses were built with only one coupler, the end of the train is where most will end up by default. Because they are now rarely used, and to save both layout space and purchasing money, I suggest that you initially avoid acquiring a caboose.

Work trains are trains built of cars needed to support a railroad repair crew. Some real life service cars are equipped with snowplows, cranes, generators, sources of light, and a bunkhouse for the workers. Work trains that go on emergency calls also bring along cars carrying spare parts, such as new rails and replacement train car wheels. Fantasy service cars may be equipped with extension ladders and fire fighting hoses.

Government trains are fantasy trains with a cold war flavor. Some of their service cars fire missiles, launch helicopters, float targets, and are equipped with radars. Government convoy trains carrying biological hazards and radioactive waste containers, or coin-mint ready copper and nickel ingots, will be given special priority as they move across your layout (often traveling with a "security" team), as will your fantasy living loads, such as municipal zoo/aquarium animal transfers.

Some animated accessories for service trains have included "exploding" target buildings for missile cars, and "burning" buildings in need of rescue by fire fighting cars.

Scenery

Although there have been several beautiful "Hi-Rail" O-scale 3-rail models built, a focus on Operating means we do not have to worry about being model craftsmen, and can be spartan with our decorating.

Smart placement of scenery can be of much benefit to your railroad. Careful placement of buildings can, for example, block views, giving you the impression that your railroad space is larger than it is. False front buildings are great in this role. Bridges can also be used as both a view block, and/or as a place for forcing tracks to form an operational bottleneck. An open top girder bridge can even look correct if it is just sitting right on the ground (sometimes done to transverse culverts or weak ground).

Scenery can go a huge way to increasing play value, especially when used for destinations. The false front buildings are again of use here, as loading docks can be easily implied with just a doored wall. Trompe l'oeils, forced perspective, and other optical stage tricks can also be employed. You can even use scenery to imply that additional portions of a destination lie behind the viewers themselves.

And don't overlook the play value of adding non-train vehicles. Trucks can be rolled around to make deliveries or pickups from an industry serviced by a train car. They can also be physically loaded and unloaded. Work vehicles, such as forklifts or bulldozers, could move loads from one area of an industry to another area of that same industry serviced by a train car. Train cars could be parked to await the arrival of a truck, ship, or airplane. Automobiles and other vehicles could be rolled on and off of train cars directly.

Scenery can also go a long way to increasing ambiance. For example, dairy cows standing in a farmers field, a microwave tower on telephone company property, or a rotating beacon beside a landing strip. Lighting is one of the bigger ambiance setters. There are a lot of illuminated cars, structures, and lighting fixtures available, and your railroad takes on a whole new dimension when you dim your room lights, and you use the lighting within your layout to simulate operating at twilight or after dark.

Some scenery you would only think of as ambiance, can actually interact with the working railroad. A bus depot, if located across from a passenger station, might have its schedules matched to the arrival and departure of trains. Don't forget that besides passengers, the baggage compartments of these buses often also carry express packages for transfer. Although most automobile gas stations get their fuel from tanker trucks, there is no reason why a gas station built beside a railroad track couldn't receive its fuel directly from a railroad tank car.

The beauty of building a railroad as separate modules, is that each module lends itself to being a stand-alone diorama. Although your industry will not change, and the cars servicing it will remain the same, changing the scenery around the industry will completely change the feel. Make it look as if its in the wide open West, the cramped East, in the city, out in the country, or anywhere else you have the creative urge to simulate. And because you can spread the modules apart (with spartan filler modules in between), you don't need to worry about the scenery being congruent between modules. One thing you *should never* do however, is change the *era* between modules! Pick a time frame for the background scenery, and keep it the same. Don't have, for example, modern autos parked at one passenger station, and horses and buggies parked at another (even the Amish use modernized buggies). A relatively contemporary era (even a fantasy contemporary era where, for example, steam locomotives still ride the rails) will usually be your best choice, as an older building can be justifiably incorporated into the contemporary diorama as a survivor.

<u>Track and Benchwork</u>

Although track could be laid out on the floor, it has been shown that a layout works best when the top of the rails are raised to just below your pectorals when standing. This allows you to comfortably reach over the rails to access your trains and scenery, yet when you sit on a stool, the track falls close to eye level, giving you the feeling of almost being a part of the scene. Also for reasons of access, you should try and avoid having track farther than about 30 inches from your body whenever possible.

You could build a one-piece wooden latticework to mount all the track on, but a better solution is to build the benchwork as connectable modules. An interior door from a building material recycler is a practical module foundation. These doors are light, extremely inexpensive, and being only 30 inches wide by 80 inches long, easy to transport in a station wagon, pickup, or large SUV. Use the door as a tabletop, and attach flanges and water (or electrical conduit) pipe to make adjustable removable legs.

Don't attach the track directly to the tabletop, because moving trains will make too much noise, as the tabletop will act like a drum head. To reduce sound, cover the tabletop with high-traffic carpeting. As a side benefit, if you accidentally knock a train car on its side, the carpeting will help cushion the fall. Thinner carpeting, perhaps around 1/8th inch thick, makes a good play surface, because small wheels roll and scenery doesn't tilt. Avoid a solid color carpet, and use instead one that has a washed-out mix of slightly differing colors. A lighter gray tinged carpet induces a feeling of pavement. A lighter auburn tinged carpet induces a feeling of natural ground, and matches well with almost all scenery elements.

Although real railroads lay their tracks on a raised gravel roadbed, 3-rail track usually works better without it. Many track side accessories, especially animated accessories, were never intended for use with roadbed, and will have height alignment issues if a raised roadbed is used. If you still feel you absolutely must simulate the look of roadbed, even though you are mounting the track directly on carpeting, you could always lay a strip of gravel colored construction paper under the tracks.

When laying track, make sure there is sufficient clearance in places where you intend to manually uncouple cars, so that you can get your hand in without knocking things over. Don't forget that much of the cargo carried by your cars will also have to be loaded and unloaded using a "five-fingered crane".

To prevent sideswiping, have a safety margin of not less than 4 inches between two parallel tangent track centers, or 2 inches between a tangent track center and a structures protrusions. Increase this distance when curves are involved. Overhead clearance needs to be at least 5 inches above a track top, but there are few needs for the overhead clearance to be higher than 15 inches. Railroads sometimes use a device called a "tattletale", which is a bar from which short ropes are suspended, at the approach to tunnels or low bridges. If the top of a car touches a rope, the conductor gets a visual indication that the car is too tall to fit under the approaching obstruction (a gimmick also used with some fantasy cattle cars to cause a protruding giraffe head to "duck").

Because train lengths should be limited so as to best utilize available space, and because even real life railroads are faced with length limits that cause them to break long trains into separate sections that closely follow each other convoy style; passing sidings need not exceed 73 ½ inches. Stub sidings however must never be less than 13 ½ inches long (or nothing will fit in them). End stub sidings with bumpers if possible.

<u>Layout Planning</u>

Although play is our ultimate goal, we are at the same time trying to recreate a miniature railroad influenced by real North American railroads. One issue we cannot avoid is that we are restricted in the space we have to build in. This means that we must be selective in what and how we model. Due to the higher than prototypical traffic levels generated by model railroads, a layout should normally be built using double-track main lines. Local control of switches is also suggested.

The simplest design of all is to model a section of Main Line track, with staging areas on each end. This could go so far as to be a completely accurate reproduction of the real world, with accurate trains scheduled to pass through at accurate times. This quickly gets a bit boring however, even if you spice it up with a section of passing track, or fantasy animated cars like aquariums or cops chasing hobos.

The excitement and long term interest only comes when you model an area that "feels railroady". This almost always means modeling the commercial areas, where cars interact with customers to transport freight and/or passengers. Although most modelers seem to gravitate towards modeling large switch yards and running freight trains, O-scale 3-rail trains are ideal for modeling passenger operations.

In their heyday, passenger operations were a ballet of ever changing action, and modeling a large passenger terminal will keep you engrossed for hours. Large passenger terminals are more than just a place to load and unload people. If the train cars are intended to travel in a particular manner, such as a rear facing observation car, the cars will have to be turned around for the outbound trip. There must also be a layover, to give workers time to clean the cars and fill water tanks. Pullmans, being rolling hotel rooms, face the same laundry/cleaning issues as hotels. Dining cars, being rolling restaurants, will have to be cut out of the train and moved to a special food (commissary) resupply building.

You must create a timetable listing regularly scheduled trains, but note that the number and types of cars you choose to assign to these trains will vary depending on each days estimated passenger traffic.

The dining car commissary needs to get regular deliveries from a reefer car, which brings in the perishable food used by the dining cars. Less frequently, a box car will make deliveries of dry goods and sundries the dining cars also need. Occasionally a tank car of liquid propane gas needs to arrive to refill the buildings storage tank, which holds the propane used to refill the dining cars. You could even roll a garbage truck over to the building now and then. Your diesel locomotive will also need to be refueled. This can be simulated with an animated track side fueling pump. The storage tank will need regular refill deliveries from a tank car carrying diesel fuel. To increase play, the train cars making deliveries can share the normal track, so they have to arrive, do their business, and get clear, between the regularly scheduled passenger train arrivals and departures.

If the passenger train carries express packages or mail, these cars must also be cut out and routed to their respective express or postal buildings (or to a station platform where carts can be loaded and unloaded, without blocking foot traffic, for movement to a holding area inside the station). Express could also be hand unloaded track side directly into waiting express company delivery trucks.

<u>Forwarding</u>

Freight train operations will either be a transfer service ("through freights"), whereby cars are moved completely across the railroad property between tracks connected to other railroad companies; or a local service, whereby the railroad delivers cars to destinations located beside their own property.

All train movements are conducted under a Train Schedule (sometimes called a Timetable), because a train only becomes a train when it is given a schedule number. Some freight trains are regularly scheduled (such as, for example, a daily unit train of coal to a power plant), while others are added on as "extras" when required (typical for "way freights"). Having a schedule gives your railroad more of a purpose, as it causes you to consider your actions, such as if your parked car will be blocking another train. Schedules do not have to by tied to a clock, but can (and initially probably should) be event based, so you can take your time playing with loading or unloading cargo, or shuffling cars around. All the other trains will just wait until you are finished, before they move to their next scheduled stop.

Railroads are in the business of making money, and that means keeping cars rolling. Moving trains is of particular difficulty, as you have to avoid blocking yourself in at job sites, avoid blocking scheduled train movements, and avoid crashing into any other moving train cars. To prevent crashes, all real life railroads install safety signals. I recommend always installing signals on your track layout, even if they are just non-functional scenery. This is because even nonworking signals will mark limit points behind which you can safely park cars. To maximize play value though, I encourage you to use real working signals that can be made to indicate either stop or go, particularly at crossing tracks. O-scale signals are large enough that a toy train operator can read their indications just like real engineers do.

Time is money for railroads, so in the interest of efficiency they have developed something known as a "classification yard", where they can presort cars for their destinations. Unlike real railroads, our toy trains rarely will consist of more than five or six cars, while even our longest trains are still very short by prototype standards. Therefore, we can entirely forgo modeling classification yards (recovering the space for other uses), as they will not speed switching chores by any statistically significant amount.

A runaround track will still be required, as we need some way to service facing point switches. However, as our total track length is so short, only one is necessary on the layout; and even that can be eliminated if we choose instead to run our trains around a staging loop to change their direction (loops are a great addition, as they allow you to easily change the direction of a passenger observation car or a snowplow). All model railroads should have a staging area (ideally connected to each layout end), which is a place where trains can be placed onto, or removed from, the modeled layout area.

The real fun with O-scale trains is that they are large enough to physically load and unload real cargo. This means that you will probably have lots of destinations scattered across the layout where cargo can be loaded/unloaded. In order to efficiency route cars to the right destinations on time, real railroads create "waybills" for their customers. Although you can invest in complex computerized waybill generating software, a simple system can be created using nothing more than cards. A company called *Micro-Mark* even offers blank ones for sale. Should you prefer to operate you layout in a more casual manner, you can use a routing system called a "switch list". With blank switch list in hand, walk around your layout looking at your industries. When you note an industry you want to service, mark on the sheet what car you want to assign for the job. After adding several entries, make up a train from the switch list.

Operations

Every railroad layout owner should write a Rule Book which explains what to do in common railroad situations (such as explaining train class priorities, explaining how trains may operate within a Yard, etc.). The purpose of this Rule Book is primarily to thwart accidents, and can be anything from a simple sentence ("Ask the layout owner for a decision."), to a detailed booklet based on one used by a prototype railroad. Note though that since we are playing with trains, rather than accurately modeling a real life railroad, we should simplify the Rule Book by reorganizing it in a more logical manner (we do not have to consider legacy rules), labeling these rules with our own numbering system, and including rules specific to running the model (such as, for example, what to do in an electrical failure).

No traffic should move (even if it is just a locomotive by itself) unless it is slowly operating within "Yard Limits", or operating on the main line as a listed Timetable train number. This of course means that you must have a Timetable, but you don't have to create one in advance. You can just add all trains as "Extras" to a blank Timetable, as the need to move traffic arises. You might also assign each main line train a First, Second, or Third class priority. This makes train meets more efficient, because lower class trains must by rule get out of the way of higher class trains, allowing the higher class trains to travel across the layout quicker (pleasing patrons, which earns the railroad more repeat business).

Although there can be up to a six man crew for each train (Conductor, Engineer, Brakeman, Flagman, Fireman, and List man), all trains must have at the minimum a Conductor, who is the sole person responsible for the train, and who is senior to all other crew members (Conductor, *not* Engineer, is the title of a model railroader operating a train by himself). Conductors ultimately report to a train Dispatcher, who is the person responsible for the movements of all main line trains in his district.

<u>APPENDIX</u>

Often the possibilities for train car loads, and industries using the loads, are not giving enough thought. Then there are the fantasy cargoes and destinations to consider. Here then are some ideas to get you thinking about what to play with on your own railroad layout:

A power company service yard is a simple destination for many of your train loads. The yard itself is just an open field with some parked power company vehicles as scenery. Reels of cable and an occasional transformer will be needed. Boxcars deliver insulators and other small items. Telegraph poles can be used as flat car loads, if you remove their base. Add a small piece of weed-grown track on the grounds (if you want, it does not even have to connect with the rest of your layouts track), and you can store a mobile generator car.

A stamping plant is a building that holds a big sheet metal press. Send gondolas with sheet metal covers. The tabs on the covers are where a crane would be hooked in real life. You can even make rolls of sheet metal to put under these covers from aluminum foil. The rolls are moved inside and unwrapped under the press, where items such as car fenders, computer cases, and all sorts of cans are then stamped out. The stamped out items are then loaded into boxcars for shipment.

A cement road, commercial building foundation, or dam under construction is where you can send a gondola of cement powder canisters. The tabs on the canisters are where a crane would be hooked in real life. A flatcar of lumber will be required to build the forms, and a tank car of water might be needed so the cement can be mixed. Scenery tip: bent-up paper clips make a good simulation of re-bar.

Fantasy military train cars have always been popular, so what better than a weapons proving ground as a location for them. The difference with this destination however is that the track layout becomes the focus. For missile launching cars to hit target cars, you need to have two tracks that cross like a "T", so that you can fire over the train and into the side of a target. Many cars can fire missiles sideways, so you should also have two separating parallel tracks opening to a large gap. Some accessories, like ammo dumps, are also targets, and some accessories can even fire missiles back at the target cars. Scouting helicopter launching cars will have to be tested, and radar antenna cars will need to watch all the activity. More missiles will have to be brought in on flatcars. You can also get some toy plastic tanks, and use them as a flatcar cargo to send to the proving ground. Boxcars of supplies will also need delivery, including the occasional reefer of perishables for the mess hall.

Some real life services can be placed anywhere. Place a tray for an artificial coal side dump hopper somewhere track side, and park a pickup truck next to it. The customer shovels the dumped coal into the pickup for sale to those few homes that still want to burn coal. Place a small ramp at the end of a stub siding. This is where flatcars can be end-loaded with the occasional vehicle or piggy-back trailer. Park a tanker truck next to the track. A tank car can stop here and transfer liquids to/from the truck.

Bakeries are a compact industry that will receive a lot of railroad deliveries. They require covered hoppers of various flours, milk tankers, dairy reefers filled with butter and eggs, and box cars of sugar sacks. A reefer full of miscellaneous boxes of supplements like bananas, strawberries, and chocolate might also be necessary. The baked goods get sent out to the community supermarkets in trucks.

A lumber yard is a good industry to wrap around a stub siding. Flat cars with lumber will need delivery, as will empty flat cars for stored lumber that needs be sent out to a job site. Lumber is often unloaded with a forklift, so you should either have a toy forklift or an animated forklift accessory in the scene. If you assume a sawmill on the premises, you could deliver round logs from a side dump flat car.   As most lumber yards have now evolved into builder supply depots, box cars will have to make regular restocking deliveries of builder supply hardware. Occasionally other types of cars will bring builder supplies such as gravel, drain pipes, wooden barrels, or even monument stone.

Small family farms, though becoming scarce, are a picturesque industry. Larger dairy farms will fill a milk tank car, but smaller dairy farms will only set out a few cans of milk for a milk reefer (the empties will need to be returned). Milk needs to move daily and quickly, so it is often put on a regularly scheduled express train. Chicken farms will fill ventilated reefers with eggs, and stock cars with mature live caged chickens. Cars of feed grain and box cars of empty egg crates will need to be delivered in exchange. Beef, pig, and horse farmers usually transport their animals to separated stock pens located on a railroad siding, where they wait for an appropriate stock car.

Grain farmers bring their product to explosion proof storage silos located on a railroad siding, for later filling in covered hoppers. Grain, vegetable, and cut-flower farms will need to receive cars of both seed and fertilizer. At harvest, vegetable, cut-flower, and fruit farms, will need packing boxes, so they can send their harvest out in reefers, for eventual delivery to refrigerated distribution warehouses. Although sometimes (such as with apples) only a ventilated reefer is needed (a ventilated reefer is an ice reefer that is NOT loaded with ice, but instead has the ice hatches propped open so air can circulate through the car), these farms often require a refrigerated reefer. A reefer icing/fueling station is usually located near these farms for just this purpose. Tankers with diesel fuel are needed to fill the station storage tank that fuels mechanical reefers; and unless the ice is made on-site, ice will have to be brought to the station storage room in a reefer, so ice bunkers in ice reefers can be filled.

Ports, including freshwater ports, are great destinations for concentrating train cars of bulk goods, as well as a place to locate several types of animated loading/unloading accessories. You could even paint a picture of a cargo ship on the background to give the area atmosphere. Ports are where cargo is transferred, so you could have some loads going out while at the same time different loads could be coming in. Hopper cars, especially those with artificial coal and iron ore, will need either loading or unloading. Gantry cranes will be moving shipping containers on and off of flatcars. Large items such as culvert pipes and automobiles will need to be shipped to foreign destinations. Reefers of perishables will need to be transferred, with local harvests going out, and exotics coming in. Heating oil is piped in and stored in large tanks for refueling ships, but tank cars are also filled there for delivery elsewhere.

Scrap yards are an industry that will keep you busy. Scrap yards take, store, and send scrap metal, so you can both deliver and remove the scrap from this one location. Place a track on one side of a magnetic crane, within range of the magnet. Place a small shallow non-metallic tray on the opposite side of the crane, also within range of the magnet. The object is to move metal scrap to and from the tray and a gondola. Place a dump truck near the tray, to suggest scrap arriving from elsewhere, and a small office shack nearby for the employees use. Additional play can be had by actually filling the dump truck with scrap metal, rolling it over to the tray, and dumping it out. When a gondola is full, move it away for a while. Later, you can move it back, pretending it to be a fresh load from elsewhere.

Although automobiles are constructed in giant factories, there are many specialty vehicles that are built in small local assembly plants. These include all types of combat vehicles, small boats or planes, farm machinery, and construction equipment. These plants take box cars of large parts and sub-assemblies in (some possibly from a casting plant or machine shop located elsewhere on your layout), and send finished vehicles out on flat cars.

Fantasy cars, especially animated ones, are popular with toy train manufacturers, as they are both colorful and humorous. Although they were originally intended just for watching by the toy train owner as they traveled around and around in circles, they can also be imagined to have destinations. A nuclear power plant will need to remove spent fuel rods. This then becomes a loading destination for your atomic waste flatcar, along with possibly a guarding AEC (Atomic Energy Commission) security car. In a similar manner, a sewage processing plant will need to remove their hazardous waste, and as such it could possibly be a loading destination for your liquid bio-waste tank car.

Although a fantasy fresh water aquarium car could perhaps be imagined to serve a fishing port and a fresh fish market, the various non-edible sea creature aquarium cars (filled with sharks, jellyfish, etc.) are harder to justify. Why not imagine an educational "Traveling National Aquarium"? You could couple three or so salt water aquarium cars together, perhaps pulling them with an antique steam locomotive. You could even put a caboose on the end of the train, over whose rear railing could be hung a sign reading: "Traveling National Aquarium". The train would be imagined as traveling from station to station across the country, spending a day or two in each town, giving free marine life viewing opportunities to adults and children.

In a similar manner, the various fantasy wild animal transport cars could be justified. Many county fairs have equestrian events, where horse cars load and unload participating horses. Imagine if zoos and circuses in their off-season placed some of their wild animals on loan. A train of these wild animal transport cars could drop these happy animals off at the fairgrounds as well, where viewing the wild animals would be a featured attraction. And not just animals. County fairs feature all kinds of mechanical marvels. Small boat and airplane vendors might have several of their latest craft delivered by train, so they can display them to potentially purchasing fair goers. Fairs could also be where, for public relations purposes, the Navy might display one of their mini-subs, or NASA display some of their old training space capsules.

Airfields are an important transfer point for priority mail and express cargo (especially perishable and live cargo). Many businesses engaged in "just-in-time" shipping also tend to cluster around airstrips, and light industries (machine shops and such) sometimes lease old unused hangers.