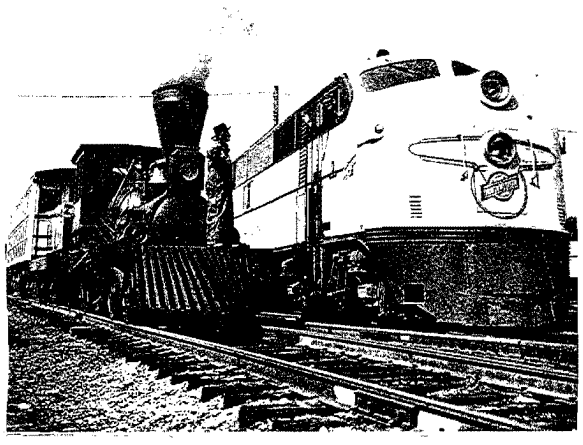
ART TO ZOO

News for Schools from the Smithsonian Institution, Office of Elementary and Secondary Education, Washington, D.C. 20560

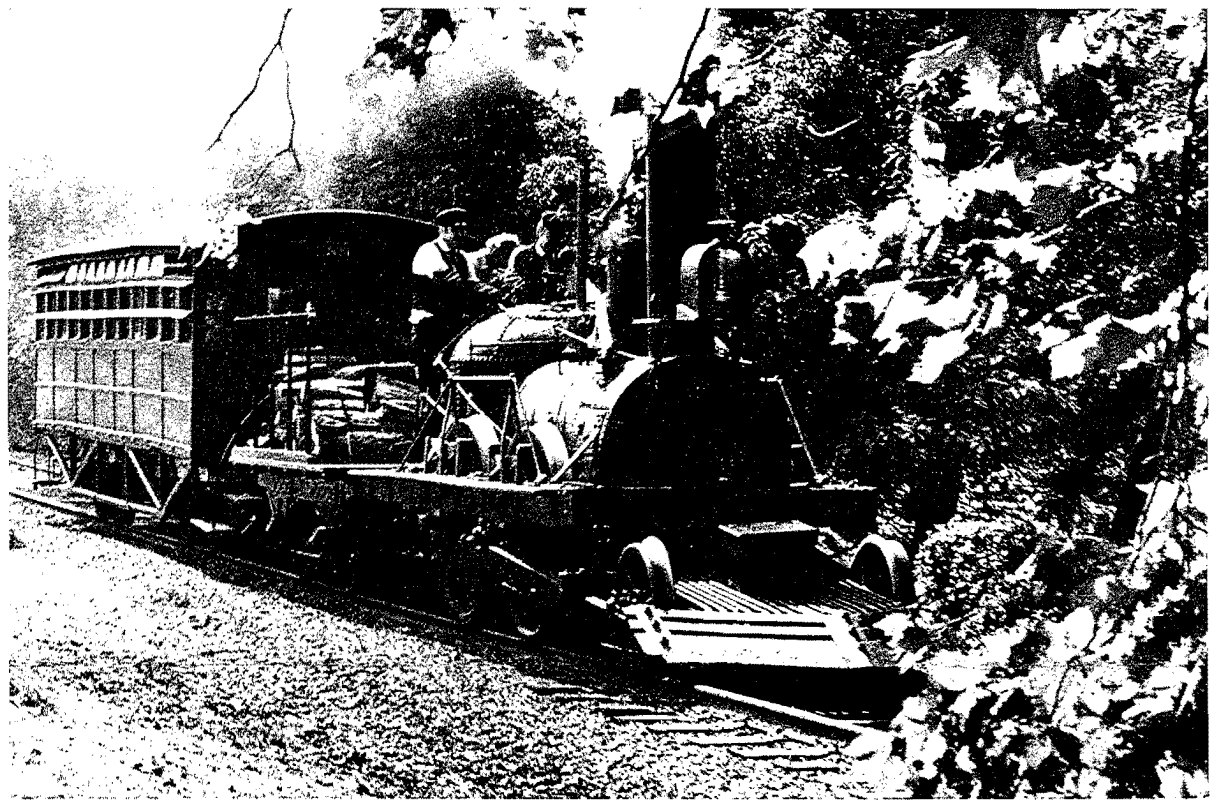
SEPTEMBER 1984

Trains and Railroads: From Wooden Track to Amtrak

As I watched the rails being taken up and hauled away, I thought—there goes over a hundred years of this town's history—for it was the railroad that opened up this area back in 1840 before Middletown was even a town. And it was the railroad that built *Middletown.**



The *Pioneer,* first engine to roll out of Chicago in 1848, stands alongside a C&NW diesel locomotive to contrast 100 years of railroad progress. (Photo credit: Chicago and Northwestern Railway Company.)



The "John Bull," running in 1981 on her 150th birthday, the oldest operable, self-powered vehicle of any kind in the world. (Photo credit: Smithsonian Institution Collection.)

Marvin Cohen, who wrote this, is not alone in recognizing the importance of the railroad to his town's history. Indeed, the westward expansion of America and the economic development of towns and cities all over the United States were closely tied to the advent and growth of the railroads in the 1800s and 1900s. Because of this importance and because of the natural fascination most children have with trains, the study of trains and railroading is an excellent way of sparking students' interest in American history from both local and national perspectives.

So here from the Smithsonian Institution, with the NATIONAL MUSEUM OF AMERICAN HISTORY'S RAILROAD HALL as a resource, are some ideas on how you might introduce the subject of trains and railroads to your students, especially in connection with a social studies unit on westward expansion.

Back in the Beginning

Our story begins in the mid-1400s in Europe, when horse-drawn carts with flanged wooden wheels (pictured in this issue of ART TO ZOO) first were used to transport coal and stone by wooden rail. Later, in the mid-1700s, iron rails and wheels began to replace the less durable wooden ones; and it soon became evident that horses could pull heavy loads of many kinds more easily over the rails than over the ground.

It Started in England . . .

Absolutely essential to the development of the railroads was the invention of a "self-propelled vehicle running on a railroad track, designed to pull railroad cars"—which is the *locomotive.*

The first true locomotive, called the "Penn-y-Darren," was built and operated in 1804 to pull cars to and from a mine in Wales by Richard Trevithick, an Englishman. In 1825, George Stephenson brought out his "Locomotion," the first locomotive to pull cars on a public-use, passenger-carrying railway. Then in 1829, Robert Stephenson (son of George) developed a faster and more powerful locomotive known as the "Rocket." The Rocket is often credited with really beginning the "Era of the Railroad."

. . . And Developed in America

By the end of the Revolutionary War, the westward movement was beginning in the United States and lands immediately west of the Alleghenies were being settled. Travel among the original thirteen colonies had been mostly by horseback, stagecoach, or coastal ship—but now with expansion of the country inland, Americans began to see the need for a more efficient means of transporting people and goods.

Within this context, American railroading got its start in 1825 when Colonel John Stevens of Hoboken, New Jersey, built a small demonstration locomotive and ran it on a circular track in his yard to prove that the idea of a steam engine operating on tracks was practical. Stevens's demonstration created much interest in the steam-powered locomotive, and soon other inventors were working on experimental models. A number of important developments resulted. For example . . .

- In 1829, Horatio Allen imported from England the "Stourbridge Lion," the first steam locomotive to be used in America.
- In 1830, Peter Cooper built his "Tom Thumb," the first American-built steam locomotive to run on a railway. Also in 1830, the "Best Friend of Charleston," the first American-built locomotive used for scheduled service, began operation in South Carolina.
- In 1831, the "De Witt Clinton," another early steam locomotive built in America, began service between Albany and Schenectady, New York. In addition, the Camden and Amboy Railroad began construction in New Jersey. The "John Bull," which now belongs to the Smithsonian, was this line's first locomotive.

During this early period of American railroading, some American entrepreneurs went to England to study railroad technology and to purchase early locomotives. However, it was soon discovered that the English locomotives could not run very well on the more roughly built, rapidly laid American tracks. For use in America, a more agile locomotive, which could handle track less carefully built, was needed.

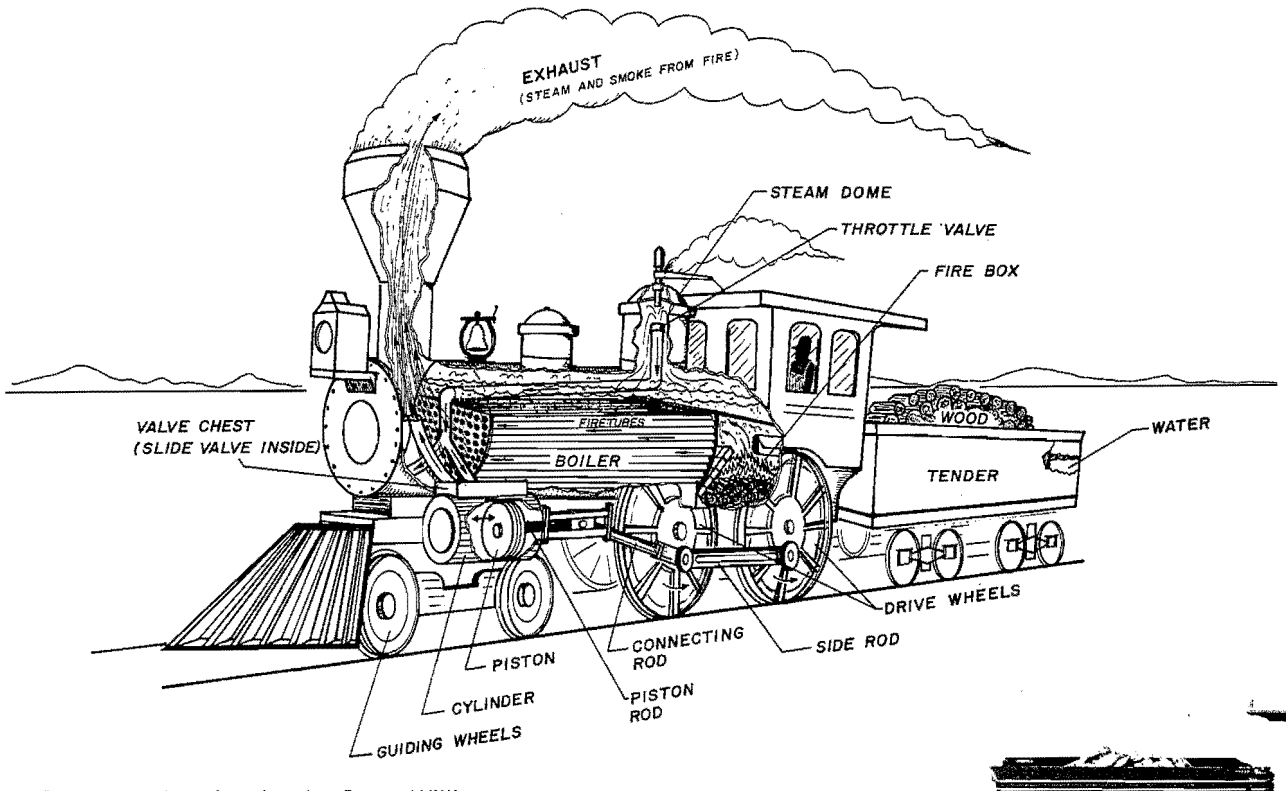
From the very beginning of English railroading, the emphasis had been on building a carefully constructed system of rights-of-way, with sturdily engineered tracks, to connect the cities and towns of a relatively small island nation. In America, however, the focus had been on laying down track as quickly as possible to cover vast distances. Speed of construction was the American forte, with durable but lightly built track. By the mid 1830s, many areas east of the Alleghenies were connected by a system of railroads.

The Rail Network Continues to Grow

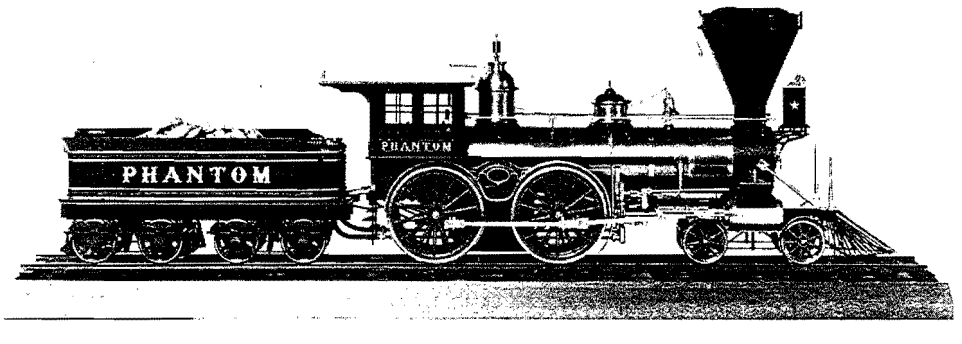
In less than twenty years, by the 1850s, lines were in service all along the Eastern seaboard, as well as between New York, Chicago, and the Great Lakes . . . Baltimore and Saint Louis . . . Richmond and Memphis . . . Chicago and the Gulf of Mexico. Most of these lines were physically linked together, since an unconnected line couldn't transfer its freight or carry travelers very far. But the railroad lines were built by many different railroad companies, each operating a particular segment and hoping to realize its own profits.

continued on page 3

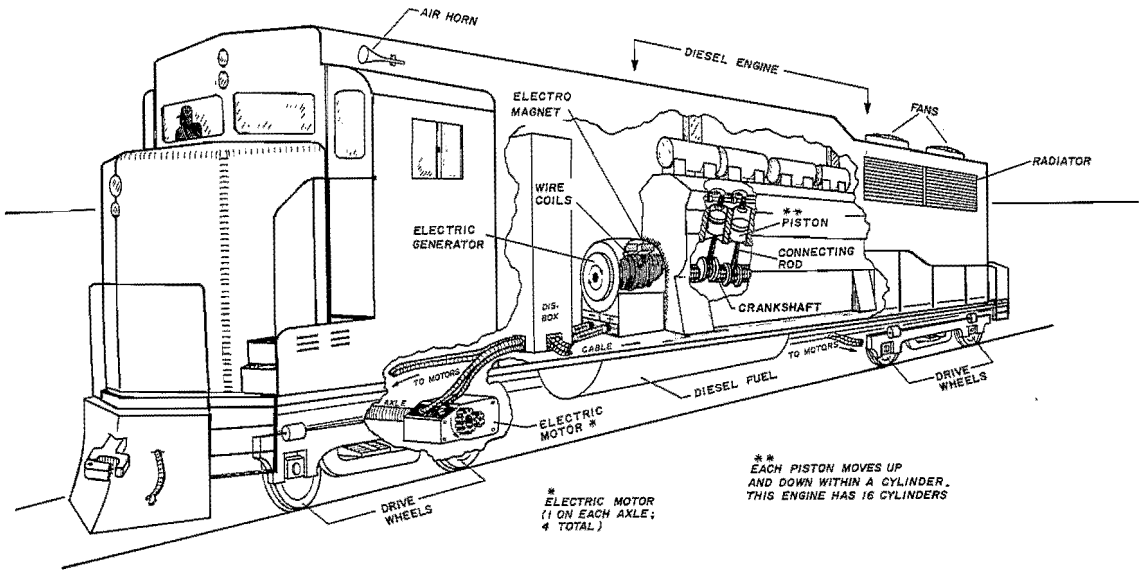
*Marvin Cohen, Editor, Steam Passenger Directory Service, Empire State Railway Museum, Inc., Middletown, New York.



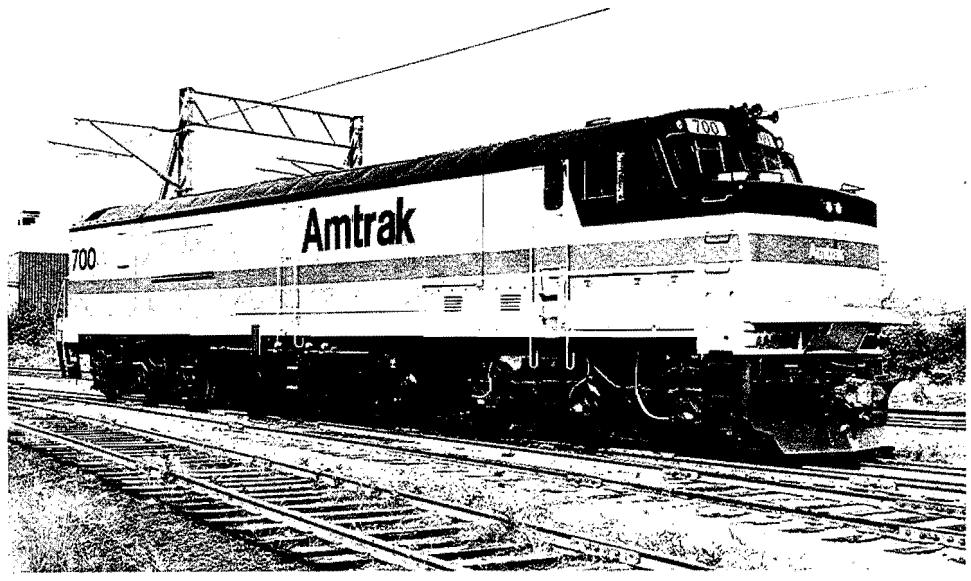
Steam engine drawing by Steve Williams.



A model of the "Phantom," built by Mason in 1857, is typical of the basic American-type locomotive design of the mid to late 1800s. (Photo credit: Smithsonian Institution Collection.)



Diesel engine drawing by Steve Williams.



Amtrak's P-30CH Diesel locomotives built by General Electric feature head-end power and a six axle, 3000-horsepower unit for use on medium-haul routes. (Photo credit: AMTRAK.)

The Steam Locomotive

A steam locomotive consists basically of a *firebox*, a *boiler* that generates steam, and machinery by which the steam under pressure pushes pistons to turn the *drive wheels*. This kind of locomotive operates as follows:

- Fuel (wood, coal, or oil) is burned in the *firebox*.
- Flame and hot gases from the firebox pass through hollow firetubes in the *boiler* causing the water surrounding the tubes to boil under pressure into steam.
- The steam under pressure is collected in the steam *dome*.
- The engineer opens the *throttle valve*, allowing steam to rush down a pipe to the *valve chests* (of which there are two, one located on either side of the locomotive). Inside each valve chest, a *slide valve* regulates the steam flow in and out of the *cylinder*. (Again, there are two *cylinders*, one on each side of the locomotive.) Inside the cylinder, the steam expands and pushes a *piston*. Part way through the piston's stroke, the slide valve shuts off the steam supply against the piston; the steam then expands on its own, pushing the piston further. At the end of the stroke, the slide valve opens a port through which the spent steam exhausts. The cycle is repeated, with the piston being pushed back and forth. Steam pushes the piston in *both* directions, every stroke. The movement of the two pistons turns the *drive wheels* which are connected to the pistons by the *piston rods*, the *connecting rods*, and the *side rods*. As the exhaust steam is released from the cylinders, still under some pressure, it is directed up the smokestack, creating a suction at the front end of the firetubes, drawing the hot gases from the firebox, thereby creating the needed draft on the fire.

The Diesel-Electric Locomotive

The diesel-electric locomotive has three essential working components: a *diesel engine*, an *electric generator*, and several *electric motors*. This kind of locomotive is, in effect, a self-contained power plant. The engine drives a generator, producing electricity that is used to power the electric motors, of which there is one on each driving axle. A brief explanation of the function of each part follows:

The Diesel Engine. The *diesel engine* converts fuel into mechanical energy to turn the generator. Each of the 12 to 20 *cylinders* in the diesel engine contains a *piston* attached to the *crankshaft* by a *connecting rod*. Air enters the cylinder while the piston is moving down. When the piston moves up, the air in the cylinder is compressed, which causes it to become very hot. At the top of the piston stroke, diesel fuel is sprayed by an *injector* into the hot air and the fuel instantly ignites. The rapid combustion creates very high pressure which forces the piston back down, turning the crankshaft by means of the connecting rod. Each cylinder in the engine fires individually, in sequence, causing the crankshaft to turn continuously.

The Electric Generator. The engine's crankshaft is connected directly to the *electric generator*, where electric energy is produced.

The Electric Motors. The electric energy produced in the generator flows through wires to the *electric motors*. (There is an electric motor on each driving axle.) The electric motors convert the electric energy back to mechanical energy to turn the axle and thereby the *drive wheels*.

Thus, in the diesel-electric locomotive, it is the compact electric motors, and not the big diesel engine, that actually propel the locomotive.

Note to Teachers: The illustrations on this page may be used with an opaque projector, to help *you* explain how each type of locomotive operates . . . or as the visual for *student* committee reports.

Lesson Plan

Step 1: Down by the Station—Planning an On Site Visit

To enable first-hand observation, your lesson should if at all possible include a visit to a nearby railroad station. To obtain information about procedures to follow and useful persons to contact in planning such a field trip, you might contact the public affairs department of the railroad line serving your area . . . check the yellow pages of your telephone book . . . or refer to the annotated bibliography of railroad resources included in this issue of ART TO ZOO.

In planning your visit, you will first need to find out what kinds of services are available at the site. Are guided tours offered? For what grade levels? Will a railroad employee who is knowledgeable about the history both of the railroad and of your community be available to give the tour? And if not, can you find such a person on your own, through your local library or historical society?

Retired railroad employees, many of whom are railroad and train "buffs," are often happy to volunteer their services to school groups . . . and some individual railroad lines, including AMTRAK, will make special arrangements for school groups if given advance notice. In addition, excursion and scenic railroads usually offer special rates and programs for schools. (See the 1984 Steam Passenger Service Directory—included in our bibliography under Special Resources—for a list of these facilities in the United States and Canada.)

If there is no railroad station in operation within reasonable distance of your school, you might consider visiting a freight depot instead—since freight is, and always has been, the most important business of the railroads. Certainly the historical correlation between the growth of the railroads and the growth of the nation can be seen through the study of freight as well as of passenger trains. Because a freight yard can be a dangerous place for children, arrangements for a supervised visit must be made with the freight yard ahead of time, and your group must be closely chaperoned. Under these circumstances, you can then simply adapt our lesson plan to suit your needs.

Step 2: Preparing Your Students

To prepare your students for their railroad station or freight yard visit, encourage them to share *in class discussion* their own experiences with trains or railroads. Some of the children may actually have ridden on a steam excursion railway or a modern diesel-powered locomotive. Others may frequently pass a railroad yard or have occasion to see trains running through town. Others may have read books or seen television specials on the subject.

Once this discussion has been completed, armed with pencil, pad, and camera (if desired), your students will be ready to go . . .

Step 3: The Visit Itself

First thing at the station, direct the children's attention to an arriving, departing, or waiting railroad train. Have them look at the train's engine, or *locomotive*, so as to find the *headlight* and the *fuel container* and to notice where the engine is *coupled* (linked) to the cars it pulls. The children should also be able to locate, painted on the side of the train, an identifying *name* and *number.*

Then have them carefully observe the *cars* that the engine is pulling. What kind are they: *passenger* or *freight?* If freight, what *types of freight* does this train seem to be carrying? How can you tell? If passenger, *how many* cars are there, and judging from the number of seats, about how many passengers does each car hold? Also, by looking through the train's windows, the children may be able to see if there's a separate dining car, sleeping car, or lounge. Finally, have the youngsters notice how the *flanged wheels* of the train fit the rails of the track so as to keep the train on its course.

Then move the class *inside* the station house to continue their observation and data-gathering activity. Here you should be able to obtain a schedule from which information can be gleaned about where this particular train is headed and where it came from, as well as its daily hours of arrival and departure. Also from the schedule—or from the stationmaster—the students should be able to find out how many trains *in general* stop at this station to pick up passengers in the course of a usual day . . . and whether most of the people who ride these trains are traveling long or short distances. Then you might try to find out to what extent this station is used by people commuting to and from their jobs.

Once these questions about *how the station is used* have been answered, you are ready to direct your students' attention to the *architecture* of the station house itself. Clues found here can reveal the approximate date of the structure, as well as give you an idea as to the significance of the railroad in your community at the time that the station house was built. Architectural features to note on the inside of the building include: the shape of the doors and windows, the wall coverings and furnishings (if any), and any decorative elements such as light fixtures, fancy moldings, or stained glass. Have each child select a specific one of these features to sketch and describe briefly, using a worksheet like the one shown here.

Finally move back outside again and ask the children to finish their architectural observations, including notation of the building's overall size and any ornamental features such as railings, statues, and columns. Have the children notice also the building's stairs and steps and what materials the structure is made of. Again have each student choose an architectural feature to sketch and describe on the worksheet.

Step 4: Classroom Follow-up

Next day, back in the classroom, ask the children to describe the locomotive(s) they saw at the station. Ask: Did it have a smokestack? Then ask, Do you think the train we saw was a *steam* locomotive or a *diesel* locomotive? How could you tell?

Now explain to the students that the early trains (until about the 1940s) used steam-powered engines, and that steam locomotives were gradually replaced by the diesel locomotive. Ask the children *why* they think this happened; and after they have had a chance to speculate, tell them that in order to better understand *"why,"* we need to know something about these two different kinds of engines. Then using an opaque projector along with the illustrations and explanations on page 2 of this issue of ART TO ZOO, discuss the characteristics of steam-powered *versus* diesel-powered locomotives, and have the students help you make a list of these similarities and differences on the chalkboard.

Next ask the children if they can describe the early steam trains that once used the station you visited—and why they think the railroads finally changed from steam power to diesel power. As this discussion progresses, help the children see that the change-over from steam to diesel occurred primarily because the steam locomotives were costly to operate, used a lot of fuel, and needed a lot of maintenance. A steam engine was in operation only about one-fourth of the time. The rest of the time it was either taking on water and fuel, or being cleaned or repaired. In addition, it polluted the air with large amounts of smoke and cinders.

On the other hand, the new diesel engines in use then were cheaper to operate and used less fuel—and the new diesels in use today are even more economical and powerful than the older ones. They also cause much less air pollution than the steam engine.

Now ask the children to refer to their worksheet sketches and descriptions in discussing the *station house*. Ask them what they learned from examining the structure. Did they, for example, find out when it was built? If not, could they try to identify the general period by comparing the style of the building with the architectural styles used in this country from let's say the 1850s up to the present? For example, was the style fancy like a typical Victorian building or was it fairly plain in a more modern way? The date of the station house may well give them a clue as to when the railroad itself was built in the area. Also, judging from the architecture, do the children feel that the station was (and perhaps still is) an important building in the community?

Step 5: A Homework Assignment

As a homework assignment, ask the children to find out the answers to these four questions:

- When was the first railroad built through this area?
- What important events were taking place in the nation as a whole at about that time?
- How have the kinds of trains used on our railroad line changed over the years?
- How have changes in the railroad (including AMTRAK consolidation) affected our community?

Next day, after the children have discussed their answers to these questions, share with them the information on the history of railroading and westward expansion presented earlier in this article, emphasizing the interconnection between the building of the railroads and the growth of the United States.

Step 6: Further Research

Following this discussion, make a list on the chalkboard of several topics which the students feel need further research, such as:

- Why the railroad was first built in their community.
- Effects (if any) of the railroad on the development of the community.
- Relationship of the development of the railroads to significant national events occurring from around 1830 to the present.
- What trains of the future will be like—including engineering and design.
- How railroad folk heroes and legends reflect a period of American history.

Have the students work in committees to complete this research and report on their findings to the rest of the class. Much of the information they uncover might be recorded on a special railroad time-line (*like the one shown here*) which can be made to extend all along the classroom walls so as to provide a backdrop for a class report or exhibit.

And so, that's one way to travel the rails of America from your own classroom, an exciting adventure that most boys and girls of today might not otherwise, in reality, experience.

Data Sheet for Railroad Station Visit

Item	Sketch	Description (use words and phrases)
Station House (outside)		
Station House (inside)		
Additional Observations of Interest		

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For Teachers

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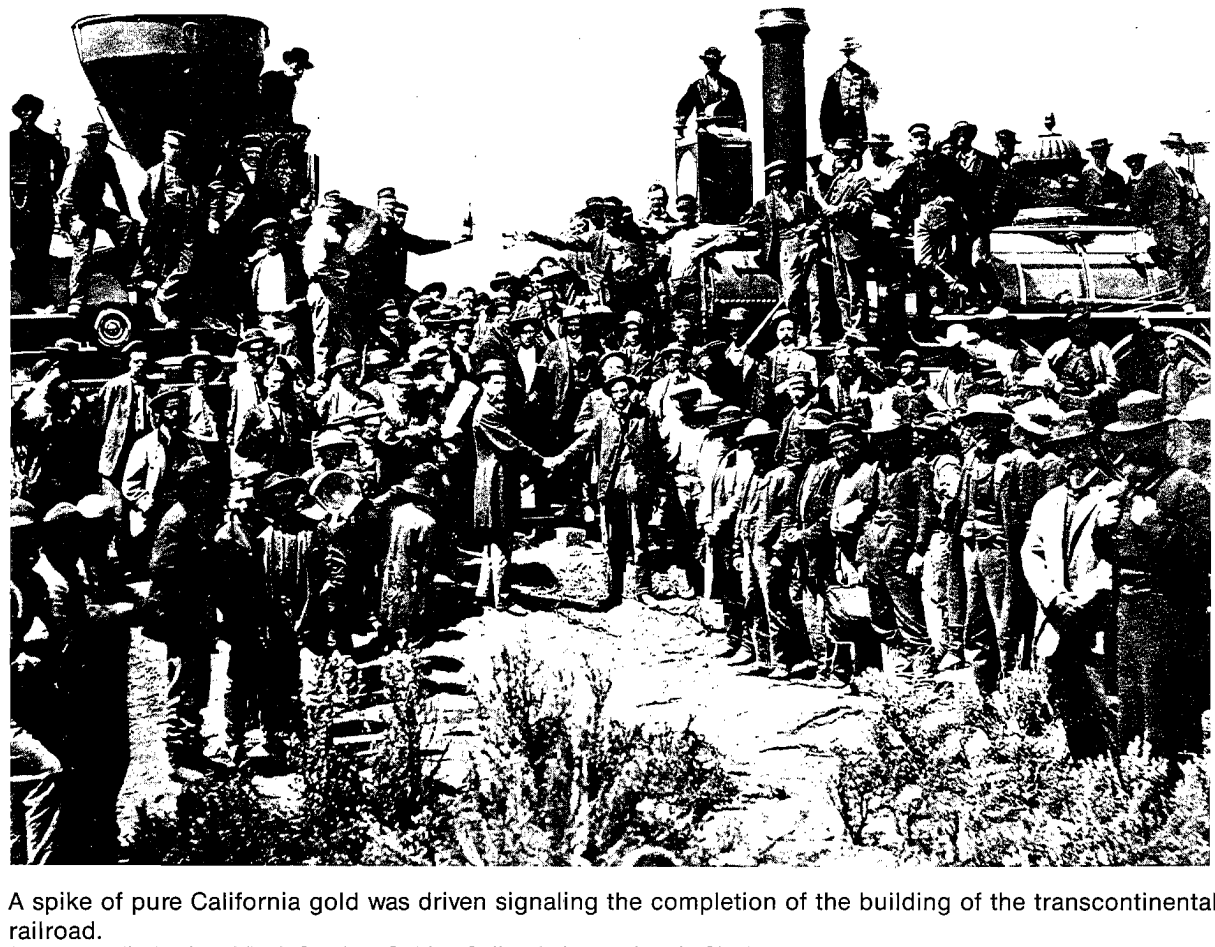
Special Resources Bibliography

1984 Steam Passenger Directory, edited by Marvin H. Cohen, available at $5.00 postpaid from Empire State Railway Museum, P.O. Box 666, Middletown, New York 01940.

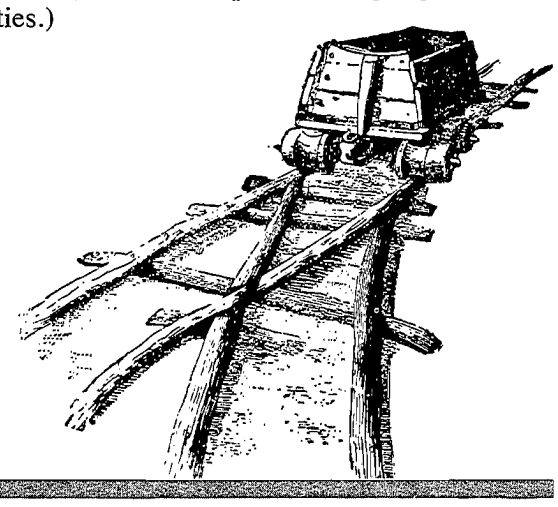
AMTRAK. For help and information regarding services and facilities in your area, contact:
East: M. Diane Elliott, Director, Special Events, Corporate Communications, National Railroad Passenger Corporation, 400 North Capitol Street, N.W., Washington, D.C. 20001.
Midwest: Deborah Marciniak, Corporate Communications, 210 South Canal Street, Chicago, Illinois 60606.
West: Arthur Lloyd, Director, Corporate Communications, One California Street, Suite 1250, San Francisco, California 94111.

Association of American Railroads, Office of Information and Public Affairs, 1920 L Street, N.W., Washington, D.C. 20036. (Write for help in locating regional societies.)

V. Allan Vaughn, Chairman, Board of Directors, National Railway Historical Society, Inc., 320 Wisconsin Avenue, Apt. 511, Oak Park, Illinois 60302. (Write for help in locating regional societies.)



A spike of pure California gold was driven signaling the completion of the building of the transcontinental railroad.
(Photo credit: National Park Service, Golden Spike National Historic Site.)



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Smithsonian Institution Press
Associate Editor: Ruth W. Spiegel

Art to Zoo brings news from the Smithsonian Institution to teachers of grades three through eight. The purpose is to help you use museums, parks, libraries, zoos, and many other resources within your community to open up learning opportunities for your students.

Our reason for producing a publication dedicated to *promoting the use of community resources among students and teachers nationally* stems from a fundamental belief, shared by all of us here at the Smithsonian, in the power of objects. Working as we do with a vast collection of national treasures that literally contains the spectrum from "art" to "zoo," we believe that objects (be they works of art, natural history specimens, historical artifacts, or live animals) have a tremendous power to educate. We maintain that it is equally important for students to learn to use objects as research tools as it is for them to learn to use words and numbers—and you can find objects close at hand, by drawing on the resources of your own community.

Our idea, then, in producing *Art to Zoo* is to share with you—and you with us—methods of working with students and objects that Smithsonian education staff members have found successful.

We are especially grateful to WILLIAM WITHUHN, Curator, Division of Transportation, National Museum of American History, Smithsonian Institution, for his advice and help in preparation of this issue of ART TO ZOO. Additional help was provided by:

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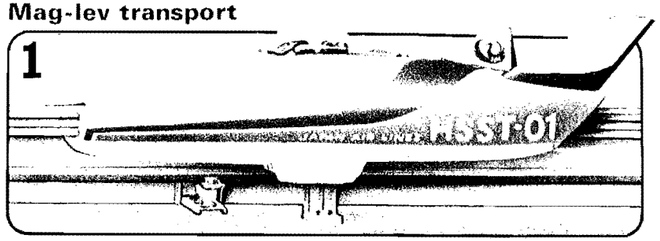
NOTE: Cut Pull-Out Page

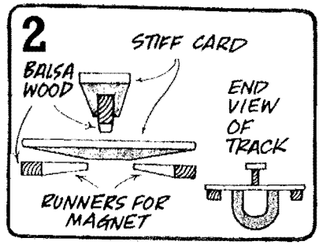
Make Your Own Model!

Mag-lev transport

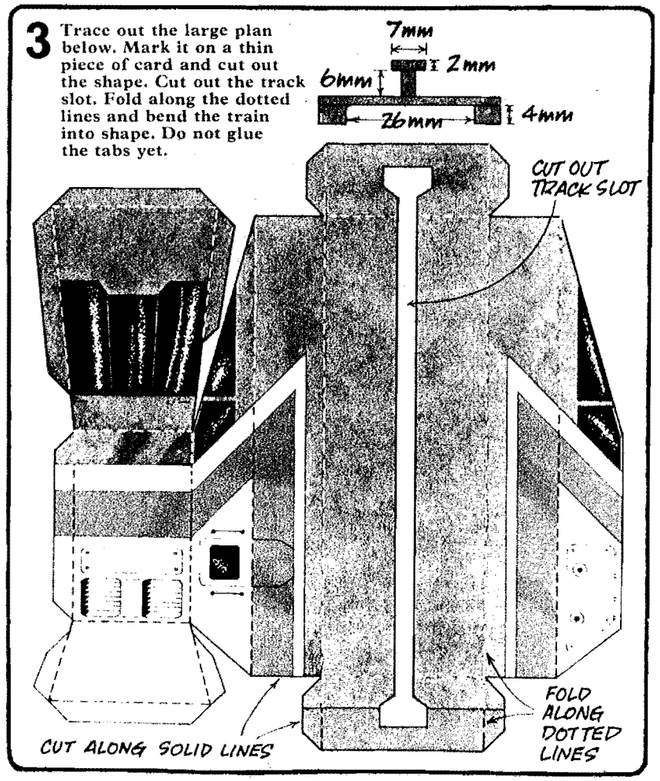


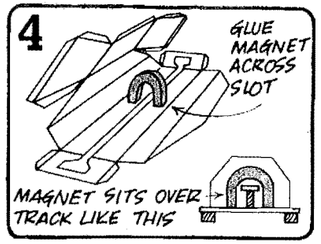
▲ The vehicle above is a test car for a magnetic levitation, or mag-lev, train made by Japan Air Lines. The High Speed Surface Transport (HSST) system will soon link Tokyo and its new airport, Narita, with trains running at 300 kph.

HSST uses electric motors to create a magnetic force, which, as well as pushing it along, lifts the train 10 mm above the track. With the model shown below you can see one way magnetism can suspend a train above its track.

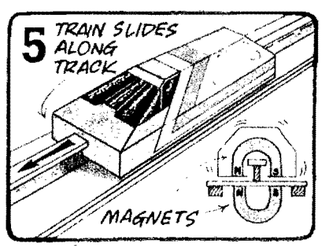


▲ You need two small horse-shoe magnets, a sheet of thick card for the track, and thin card for the train. The track should be at least 50 cm long. See frame 3 for the exact sizes needed to build the train and track.





▲ Now fix the train magnet. Use glue or sticky tape (or both). Fix it across the train, half way along the track slot. Fix it down firmly, so that when it is pushed by the magnet under the track the train lifts too. Glue the tabs to finish off.



▲ Slot the train into the track's top runner. Run the second magnet along between the runners under the track. The poles of the magnets must repel, not attract each other. As you slide the magnet along, it should push the train up and along.

Magnetic Levitation Train Model. (Used by permission of Young Engineer Book of Supertrains, EDC Publishing Company, Tulsa, Oklahoma.)

Write a Story!

You might be surprised to learn how trains and railroading are so much a part of our American folklore. In fact many of our traditional folksongs are about trains and railroad engineers. For instance, "Casey Jones" is a ballad about a real train engineer who died in the wreck of his locomotive, the "Cannonball."

Many railroad stories of heroic deeds have become legends. For example, there is the story of Kate Shelley, the daughter of a railroad man who risked her life in order to warn the engineer of an oncoming passenger train about a washed-out bridge ahead.

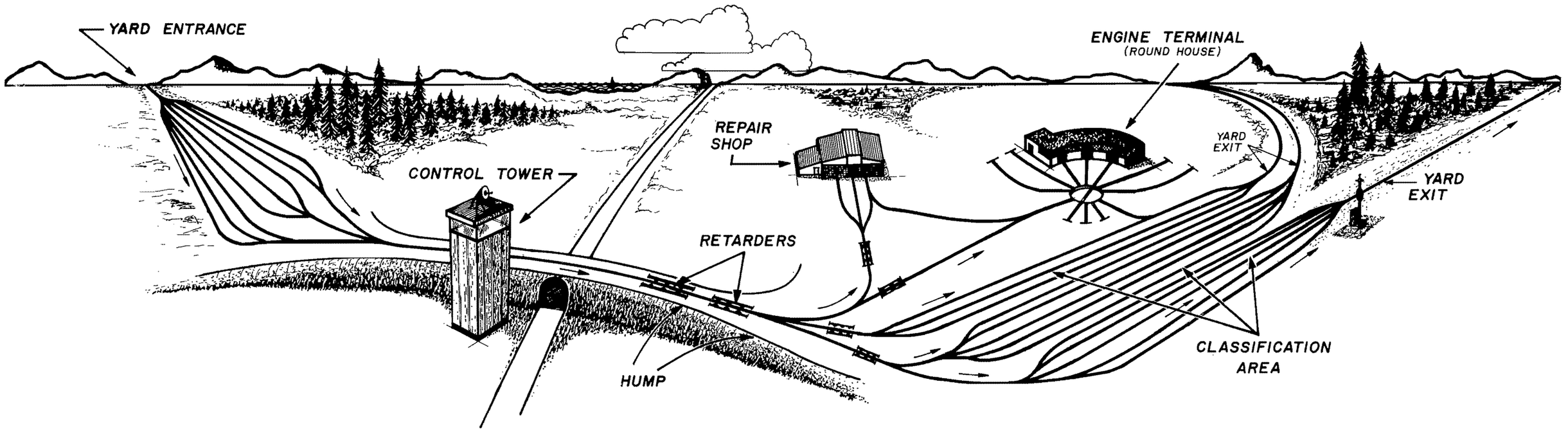
Stories of train robbers of the American West, such as the Jesse James gang, have become a part of railroad folklore along with stories about Indian attacks on trains, and of train engineers trying to outrun prairie fires.

Railroad folklore is also filled with hobo songs and stories . . . ghost stories and tall tales. One example is the *Phantom Drag*, a story about a hobo riding a fast train through space with Casey Jones, the engineer, running a race with time.

Chris Wass, whose picture you have seen in this issue, wrote a story recently about an encounter of two railroaders of the late 1800s with a "cosmic cow" from outer space.

Now . . . perhaps *you* would enjoy writing a story yourself. Using one of these ideas, or an idea of your own, create your own version of a railroad adventure—a tall tale . . . a ghost story . . . or even a science fiction or fantasy.

Good luck with your story! You might even like to send us a copy for possible use in a future issue of ART TO ZOO. Mail it to us at the Smithsonian Office of Elementary and Secondary Education, Arts and Industries Room 1163, Washington, D.C. 20560.



Freightyard drawing by Steve Williams.

FREE OFFER!

Freightyard Game

The pattern for a board game that simulates the routing of railroad cars through a freightyard may be gotten free of charge by sending your request to ART TO ZOO, OESE, Arts and Industries Room 1163, Washington, D.C. 20560.

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In the meantime, many pioneers had begun slowly to make their way into the rich lands of the central plains, creating a need for transportation that was safer and faster than lumbering wagons. Building railroads west of the Mississippi was soon planned by the railway entrepreneurs. This was to be a slow, expensive job, and the distances to be crossed were immense. Because the state and federal governments had very little cash of their own, land grants were then a popular and common way to finance public projects such as turnpikes and canals, and to encourage settlement along the routes. In 1850, President Millard Fillmore signed the first railroad land grant to aid the building of the Illinois Central Railroad. Later, land grants were used to finance additional lines building west. By 1860, Chicago had become the leading railroad center of the nation, the crossroads for many of the major lines running both east-west and north-south.

Spanning the Continent (1862–1869)

Although the westward expansion of the railroads had been slowed by the Civil War, an important impetus to growth was taken on July 1, 1862, when President Abraham Lincoln signed the Pacific Railroad Act authorizing the construction of a transcontinental railroad. In order to support this project, the government promised about $50 million in bonds and 22 million acres of undeveloped federal land in land grants. In exchange, the government would receive many times the value in preferential rates for mail, goods, and travel. Two companies were chosen to undertake the work: the Union Pacific Railroad was to start building from Omaha, Nebraska, and move westward, while the Central Pacific Railroad was to start from Sacramento, California, and move eastward. The two lines would eventually meet so as to link the East Coast and the West Coast.

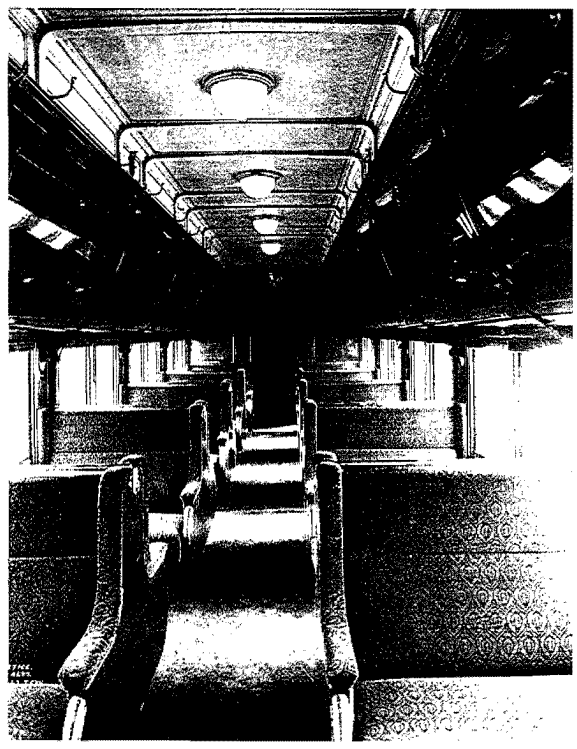
The job, begun after the war ended, was colossal—rugged mountains had to be crossed, tunnels had to be drilled, trestles had to be built across deep canyons, and rivers had to be spanned. And out on the plains, Indians often attacked the workers in an effort to stop the building. To the American Indians who lived in those areas, the railroad was a terrible thing, for they knew it would bring vast numbers of settlers to permanently displace the original people from their land and their homes.

On May 10, 1869, the two railroads met at Promontory, Utah, in what is one of the most momentous events in American history—the spanning of the continent by a continuous system of railroads. This accomplishment meant that the western states were more closely linked to the rest of the country. Before 1869, some people feared that the United States might split apart again, this time west from east. After the continental railroad was completed, however, such fears disappeared. The trip from the East to the West Coast now could be made in only seven days, thus ending the era of dangerous sea voyages around Cape Horn—and the long, hard wagon journeys.

In addition to the opening of the transcontinental railroad, two other developments were of vital importance in making various railroad lines of America a workable system nationwide. They were:

1. After the Civil War, the railroads settled on a standard "gauge"—of 4′8½″ between the two rails of a line of track—so that all lines would be able to interchange with each other.

2. In 1883, trains began operating on "railroad standard time," which quickly resulted in standardization of time nationwide since so many activities were tied to the coming and going of trains. Decades later, Congress passed the Standard Time Act of 1918, ratifying what had been in effect for years. This is the system of time we use today.



Pullman interior from about the 1920s. "Seats by day—beds by night."
(Photo credit: From the Pullman Negative Collection, Smithsonian Institution.)

Early Travel on the Railroads

An early train would consist of an *engine* providing the power, a *tender* containing water and firewood (engine and tender together constituted the *locomotive*) and several passenger or freight *cars* (sometimes called *coaches* if for passengers). The cars were connected simply by a link-and-pin coupling which meant that there was little to prevent them from bumping together as the locomotive started and stopped, often sending passengers sprawling. Fortunately, however, improvements came quickly during the 1800s.

Travel by Pullman

The greater distances Americans were beginning to travel in the 1850s prompted several businessmen to independently construct railroad cars for sleeping purposes. The most famous of these entrepreneurs was a traveling cabinetmaker, George Mortimer Pullman, who in 1859 converted a standard railroad car into a car made just for sleeping. Pullman later introduced a completely furnished dining car, with kitchen, as part of his "Pullman service."

George Pullman became the owner of a fleet of train cars, which he leased to railroad lines. After the opening of the transcontinental railroad in 1869, Pullman cars came into use by most railroad companies, making passenger travel from coast to coast much more enjoyable than before. These cars had seating sections in which the seats could be converted to comfortable berths at night. Even though competing companies provided some of the same services, by the 1890s the name "Pullman" brought to mind comfortable and often luxurious train travel, not only in the United States, but in other parts of the world as well.

Steam and Diesel

As you will see on page 2 of this issue of ART TO ZOO, there are basically two kinds of locomotives: steam and diesel. Steam came first; then, in the 1930s and 1940s, diesel. Diesel engines, greatly developed and improved, are in use today.

It Started with Steam

The era of the steam locomotive lasted for more than a century, from the 1830s until after the Second World War. Many of the very early steam locomotives were painted bright colors, with shiny brass and fancy scrollwork.

By the 1850s, many railroads had adopted a basic locomotive design, known as the "American Type" or "4-4-0." Because its running gear (wheels and their suspension system) was ideally suited to high-speed travel on often rough track, this highly successful design was used by most builders for many years. The early American steam engines were fueled by wood, which was gradually replaced by coal during the 1870s and 1880s—earlier in the east where coal was more plentiful.

Following the work of the first locomotive pioneers, locomotive designers continued to build larger and more powerful engines, until the steam locomotive reached its peak of efficiency around 1930. Some steam locomotives built between 1925 and 1950 weighed up to a million pounds, had horsepowers of up to 8000, and could pull one hundred fifty freight cars! Steam locomotives for passenger service could pull express trains at well over 100 miles per hour, in regular service, day after day.

The Change to Diesel

By 1940, locomotives burning diesel oil as fuel were becoming popular. Diesels were clean and convenient to operate, with greatly reduced maintenance costs for the railroad companies. Passengers appreciated the elimination of smoke and cinders.

Although the diesel engine itself was invented by Rudolph Diesel in the 1890s, it was not until the early 1920s that diesel-powered *locomotives* were used experimentally. The major conversion from steam to diesel began after the end of World War II in 1945. By the early 1950s, diesel locomotives were a common sight on most railroads, pulling both freight and passenger trains. By 1960, the steam locomotive had disappeared from the major railroads of America. Today the steam locomotive is used primarily for excursions on historic and scenic railroads. Most commercial railroads are operated entirely by diesel locomotives.

Rail Freight: A Profitable Business

The railroads in the United States continue to carry a greater percentage of the total intercity freight hauled in comparison to any other mode of freight transport, including trucks, pipelines, waterways, and air. (Railroads carry over one-third of all intercity freight; trucks over one-fourth.) There are railroad freight cars designed to carry almost anything you can think of—including most of the nation's coal and ore . . . most of its special chemicals . . . and even lettuce (which, via the "Salad Bowl Express," can reach a table in a New York City restaurant from a field in California in five days, including packing in California and preparation in New York!).

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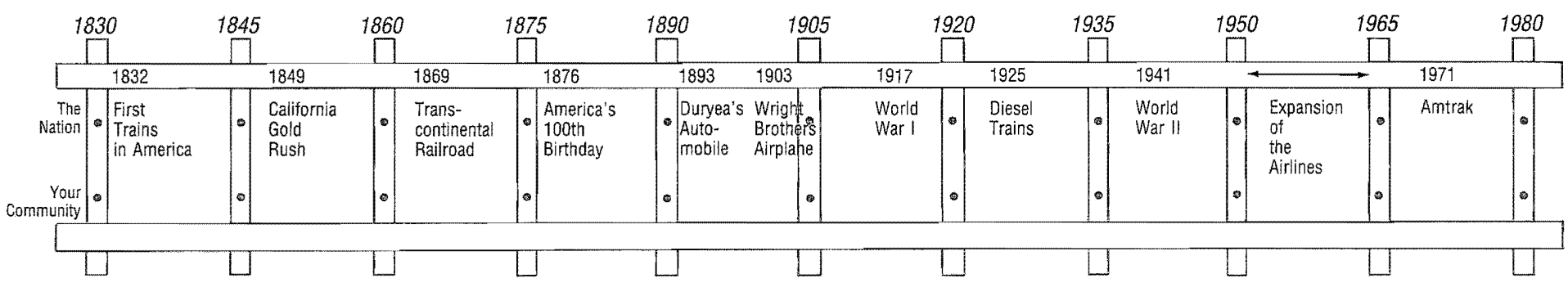

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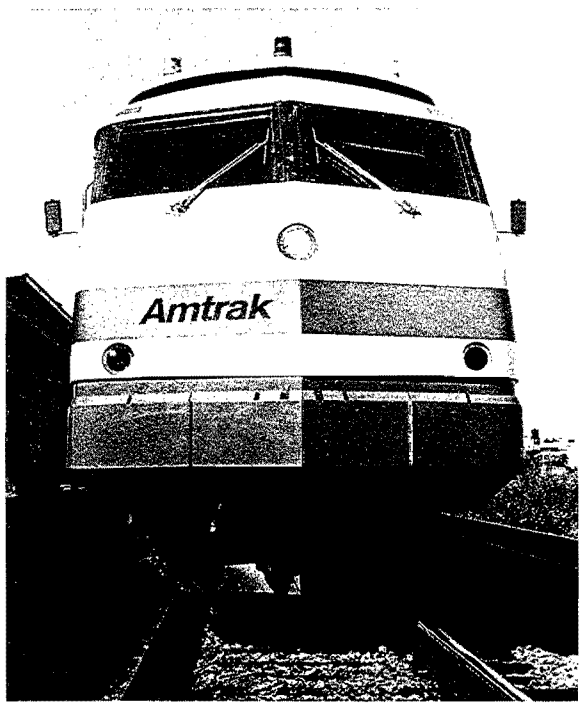
AMTRAK

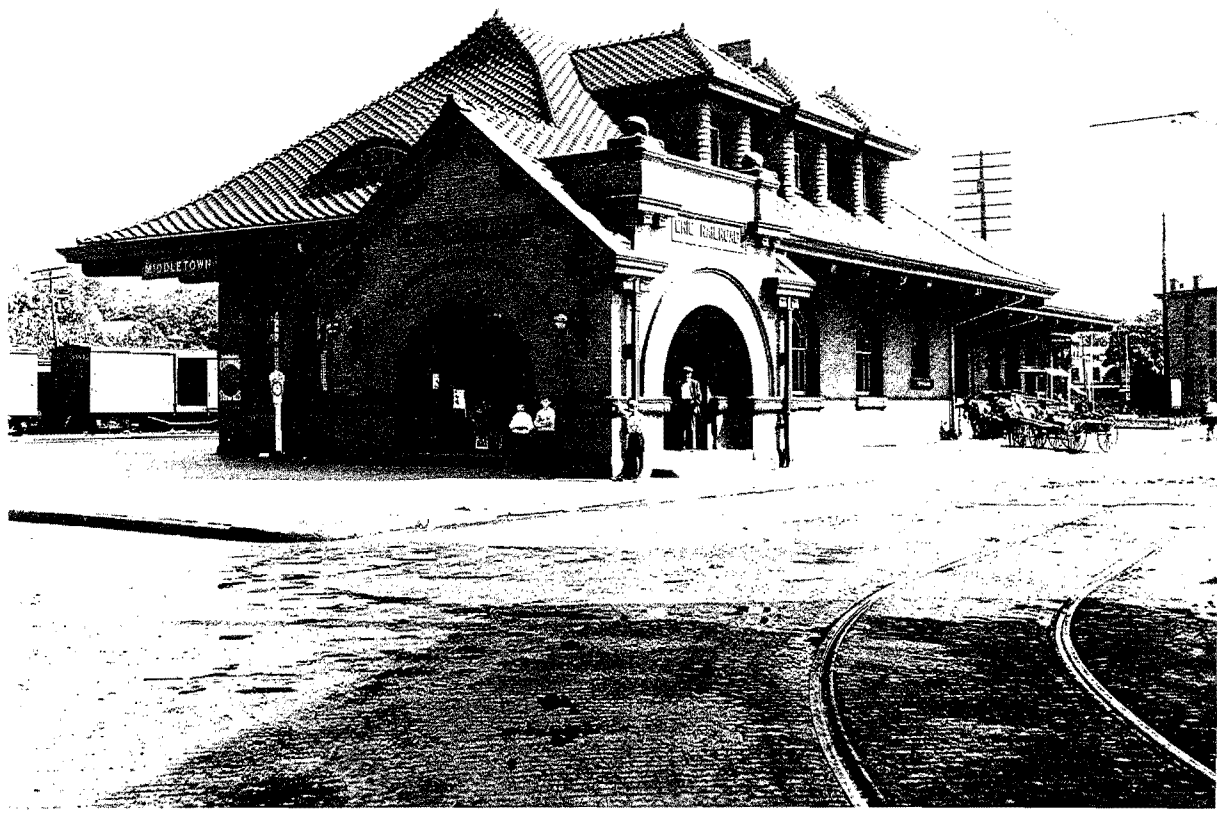
A big drop in long-distance passenger service, owing to increased dependence by American travelers on the automobile and airplane, was a prime factor in the financial crisis suffered by the railroads during the 1960s. In 1971, so as to maintain railroad passenger service in the United States, Congress created the National Railroad Passenger Corporation, AMTRAK. AMTRAK now owns and operates the passenger train service, which, except for the busy Northeast Corridor (Washington–New York–Boston), runs on rails owned by the independent freight companies.

From wooden track to AMTRAK—more than a hundred years of the romantic steam era and rapid changes following the switch to diesel. But what of the future? Perhaps trains will glide along a rail supported by a cushion of air or guided by electromagnetic force. Perhaps they will travel through underground tubes at unheard of speeds. With technology advancing so rapidly today, innovations will surely occur. In any event, the railroads will continue in efforts to meet the transportation needs of a still growing America.

Once you have familiarized yourself with all these materials on trains and railroads, you are ready to begin sharing this information through the following lesson, in which the children will *examine the role of the railroad in the development of 19th- and 20th-century America and see how railroading events in their own community reflected developments in the nation as a whole.* In the process, students will practice data-gathering, organizing, writing, and time-sequencing skills while getting the chance to make careful observations at first hand.

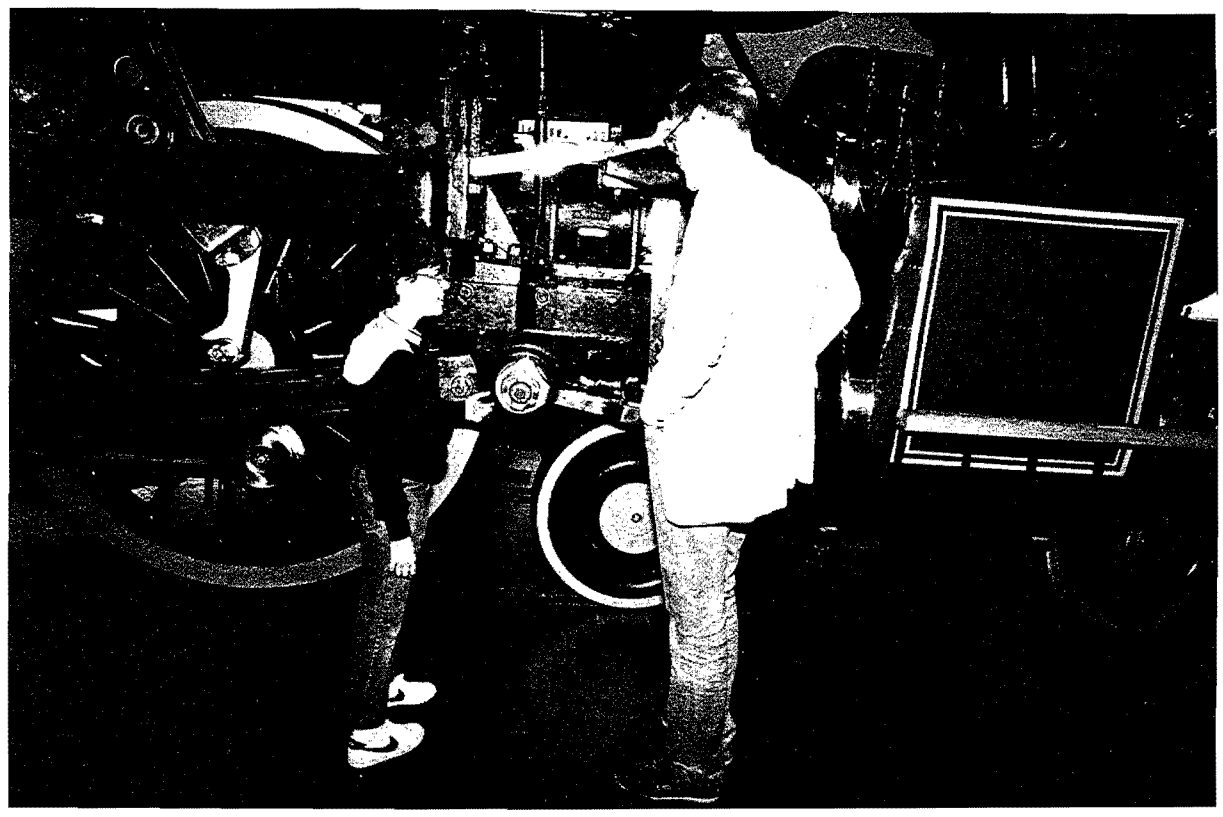


AMTRAK'S newest turboliners represent a blend of American and French designs with their modern lines and comfortable, all-electric interiors. Seven of the red, white, and blue "turbos," built by Rohr Industries in California, are in service. (Photo credit: AMTRAK.)



Middletown, New York, depot photographed in 1910 by J. E. Bailey for The Railroadians of America, Inc. (Photo credit: From a glass-negative in the Division of Mechanical and Civil Engineering, National Museum of American History, Smithsonian Institution.)

"Flanged" wheel of the "John Bull." (Photo credit: Eric Long, photographer, Smithsonian Institution.)



Train "buffs" are not of course limited to retirees. In this photo are Rich Delmar, a Washington attorney, and Chris Wass, a sixth grade student from Wheaton, Maryland—both train enthusiasts. In the photo, Chris and Rich are touring the Hall of Railroads in the National Museum of American History. Rich explained that his love of trains began when as a child he would often wait on a hill near his home to see the Pennsylvania and Jersey Central trains speed by. He remembers waving to the engineers, and the thrill of having the engineers wave back! As Rich was growing up, he continued to be intrigued by both passenger and freight trains, and recalls with delight the time an engineer actually allowed him to climb into the cab of a big locomotive. Stories of such events bring back memories, to many, of a bygone era when the trains of America were so much a part of everyday life, and were indeed the "King of the Road." (Photo credit: Fernando Sandoval.)