Bricks & Mortar

Spit, Glue and Maybe Even Chewing Gum

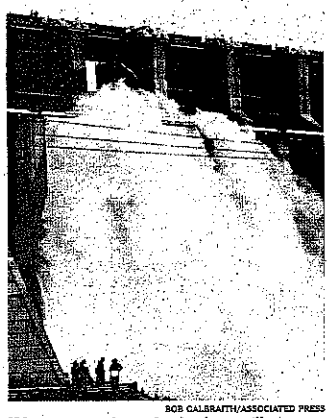
Our dams, railways, levees and water systems may look impressive. As long as you don't look too closely.

By MICHAEL M. GRYNBAUM

AMERICANS, take heed. Here is what it takes to bring one of the world's great transportation networks to its knees: a tiny electrical fire in an obscure contraption of levers and pulleys, installed nearly a century ago.

The scenario played out last week at the Long Island Rail Road, steward of more than 100,000 daily commutes in and out of New York, after a pair of cables short-circuited and set fire to a single 1920s-era signaling machine that left the railroad unable to run trains through a crucial hub station. Delays and canceled trains plagued commuters for days, and as the workweek ended officials still could not say when full service would be restored. The ancient machine had been due for a multimillion-dollar upgrade, but it turned out the program was over budget and behind schedule.

Normally blasé New Yorkers seemed stunned at the vulnerability of their railroad, but in that, they should not have felt alone. The combination



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Water surges through a broken spill gate.

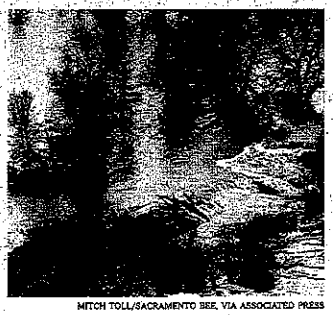
of antiquated hardware and delayed maintenance is far from uncommon in America's infrastructure, a Colossus often held together by spit and glue.

Consider the nation's dams, on average a half-century old. Despite their monumental size, the dams can be weakened by foraging gophers and squirrels, whose holes undermine the foundations. Or even by simple operator error. A major gate at Folsom Dam in California burst in 1995 after the wrong lubricant was used on its gears.

Tree stumps and rusting pipes can undermine levees in Sacramento. Water systems in Alaska and Washington State depend on wood pipes dating back to pioneer days. And locks on inland shipping routes can be weakened by simple flotsam like discarded tires.

The causes may be small, but the consequences can be grand: national commerce, essential utilities, and the homes of thousands can be threatened if these antiquated systems suddenly give out.

Here are just five examples:



MITCH TOLL/SACRAMENTO BEE, VIA ASSOCIATED PRESS

LEVEES AND THE FOOD SUPPLY

Central California

Hundreds of levees protect against floods in California's 450-mile-long Central Valley, and many date back to the Gold Rush era of 1850. "All it takes is one weak link in the basin to flood the area," said Mike Inamine, principal engineer at the state's Department of Water Resources. Levee failures in the region could threaten the drinking water supply for two-thirds of the state, but the consequences could quickly spread beyond California. The levees protect land where a quarter of the nation's fruits and vegetables are produced for sale, according to federal statistics. Serious breaks occurred in 1986 and 1997.

A tiny ancient relic can cause havoc: tree stumps and pipes, buried decades ago in an earthen levee's innards, can rot or rust, undermining the structure with no outward sign of trouble. "We had a flood site at a pumping station in 2006," said Stein Buer, who directs the Sacramento Area Flood Control Agency. The cause? "We dug down about 70 feet and pulled out a rusty and wooden pipe." Remote sensing techniques to spot such problems are being developed but have yet to be perfected.

And trespassing tree stumps aren't the only threat. "There were near-failures in 2006 as a result of just ground squirrels, who had infested a bypass levee in San Joaquin Valley," Mr. Inamine said. "Beavers and squirrels can do a lot of damage."

IOWA DEPARTMENT OF NATURAL RESOURCES

RODENTS AND DAMS

Des Moines

Levees are not alone in their vulnerability to pests. In Iowa, engineers say the appetites of gophers and muskrats can endanger dams across the state. The dam at Fort Des Moines Park, for example, has a large hole created by rodents, along with overgrown vegetation blocking an emergency passageway. It is one of 31 dams in the state that authorities consider deficient. In July, a 92-year-old dam near Delhi, Iowa, failed, destroying a beloved lake. Another dam at Lake Ponderosa, surrounded by 730 homes, was also deemed unsafe.

Simple mechanical wear and tear can threaten enormous floods, according to Iowa's Department of Natural Resources. The gates used by dams to regulate water flow are vulnerable to a Catch-22: dam operators are reluctant to raise the gates, which resemble king-size garage doors, fearing they will seize up, but failing to move them allows gears to rust and become inoperable.

KEITH SRAKOCIC/ASSOCIATED PRESS

LOCKS AND SHIPPING

Pittsburgh

The Monongahela River, a major inland shipping route, houses two of the nation's oldest continually operated locks; each is a half-century past its intended lifespan. "It's the largest, oldest and arguably most fatigued inland waterway system in the United States," said Jeff Hawk, a spokesman for the Army Corps of Engineers.

Everyday detritus, like car rims, tires and logs floating in the river, can damage the underwater wooden seals used by the lock's gate system, which allows vessels in and out. "Steel cables fall out of commercial tugboats and smash the wood seals," said Charlie Weight, the lockmaster. The seals are original: wood has been shunned by lock manufacturers since the 1950s. Steel bolts at important locations also have a tendency to become loose.

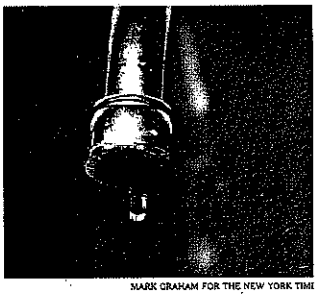
The lock at Elizabeth, Pa., dates from 1907, and through it travels about 12 million tons of cargo a month. Maintenance costs $2 million annually; Mr. Hawk compared maintaining it to "working on an old junker in the yard." A breakdown would snarl the region's coal distribution, clogging highways with extra tractor-trailers and pushing up gas and electricity rates throughout the Pittsburgh region. Federal funds to replace the lock have not been forthcoming. "This thing was supposed to be blown out of the water several years ago," Mr. Hawk said cheerfully.

COURTESY OF NEW YORK TRANSIT MUSEU

SWITCHES AND SUBWAYS

New York City

In 2005, at a kitchen-size relay room in th Chambers Street station in Lower Manhattan, fire destroyed hundreds of antique switches an circuits, nearly crippling two subway lines fo months and disrupting the commutes of 580,00 New Yorkers. It could happen again tomorrov The subway system has about 480 relay rooms 25 of which still use technology that was in plac when the subway opened in 1904. Only two com panies in the world can repair the antiquate signals, which help locate trains in the tunnels In 2005, it could have been worse: officials sai the room that caught fire was one of the leas critical in the system.



MARK GRAHAM FOR THE NEW YORK TIME

WOOD VERSUS IRON

Anchorage

Surprise: This fossil lives. In Anchorage, hom to an estimated 285,000 people, parts of the sut terranean water system still use wooden pipes carved of white cedar and wrapped in wire, relic of pioneer days when hollowed-out log were the water conveyance of choice. But Alas kans, apparently, need not worry about splinter in the throat. "What we've found, kind of unbe lievably, is that the wooden water main wrapped in that wire actually perform bette than ductile iron," said James Weise, who man ages the state's drinking water program. "The are less susceptible to fracture due to earth quake activity, and they are more flexible." Al though Mr. Weise said the Depression-era wood en mains never leak, they are gradually bein replaced with ductile iron pipes. "They pul them up, and the wood looks incredibly fresh, he said. It could be another century before w know if those new pipes are as durable.