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INDUSTRIAL ACCIDENTS

What was **Love Canal**?

When Love Canal, a community east of Niagara Falls, New York, made international headlines in August of 1978, it was only after the neighborhood had already been the subject of local newspaper stories since 1976. And sadly, more headlines followed—into 1980. What had become clear during these years was that Love Canal was toxic. Community residents had experienced unusually high incidences of cancer, miscarriages, birth defects, and other illnesses. There were also reports that foul odors, oozing sludge, and multicolored pools of substances were emerging from the ground; and children and animals returned from outdoor play with rashes and burns on their skin.

Unbeknownst to the residents, all of these problems were attributable to the history of the site upon which their community had been built. Beginning in 1947, the Hooker Electrochemical Company had used Love Canal, with its clay walls, to dump 21,800 tons (43 million pounds) of chemical waste. In 1953, the company sold the canal to the Niagara School Board for the sum of one dollar. The deed acknowledged the

buried chemicals, although it did not disclose their type or toxicity. A disclaimer protected the firm from future liability. The canal pit was subsequently sealed with a clay cap designed to prevent rainwater from disturbing the chemicals. Grass was planted. Soon Love Canal had become a fifteen-acre field. The following year, a school was under construction on the site. In 1955, four hundred elementary school children began attending classes there and playing on the surrounding fields. Development happened fast: roads, sewers, and utility lines crisscrossed the site, disrupting the soil.

While residents began to discern problems as early as 1958, when they complained of nauseating smells and incidences of skin problems, it was not until the mid-1970s that the extent of the hazard became evident. It was then that unusually heavy rainfalls caused chemicals to surface. A portion of the schoolyard collapsed, strange substances seeped into basements, and trees and gardens died. In October 1976, the *Niagara Gazette* began investigating these problems, but an official investigation did not begin until the following April. By this time, the site was a disaster: toxins were found in storm sewers and basements, exposed chemical drums leaked substances, and air tests detected dangerously high chemical levels in homes. Further testing identified more than two hundred different compounds at the site, including twelve carcinogens and fourteen compounds that can affect the brain and central nervous system.

The residents of Love Canal organized, forming citizen groups including the Love Canal Homeowners Association. These groups succeeded in getting media coverage and in pressuring public officials to act. Finally on August 2, 1978, the New York State Health Commissioner declared Love Canal unsafe. Six days later, President Jimmy Carter approved emergency assistance and New York Governor Hugh Carey announced that funds would be used to purchase homes nearest to the canal.

While more than two hundred families perceived to be in danger were moved, in 1980 problems resurfaced when researchers found that blood tests of residents showed abnormally high chromosome damage, and the state recommended that pregnant women and infants be removed from homes—even those that had been certified as safe. In May 1980, conflict ensued between three hundred Love Canal homeowners and officials from the Environmental Protection Agency. On May 21, President Carter declared a second emergency at Love Canal. This time the actions were more comprehensive: Almost eight hundred families were

evacuated, and their homes were either destroyed or declared unsafe until further clean-up could be done. Four years later, a new clay cap was installed over the canal. It was also in 1984 that Occidental Petroleum, parent company of the firm that had dumped chemicals in Love Canal, reached a $20-million settlement with residents.

What **impact** did **Love Canal have**?

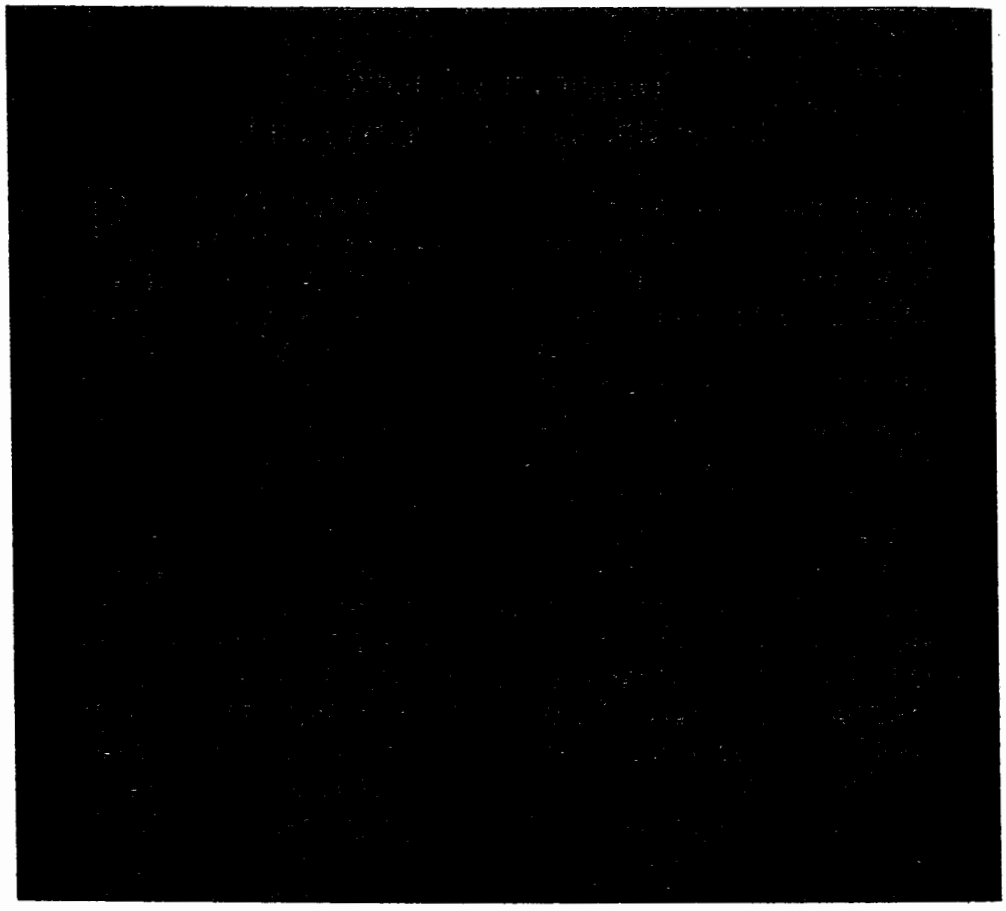
The effect of the crisis was felt on many levels—by area residents whose lives were forever changed by the hazards, by residents nearby Love Canal who feared for their own safety, by Americans across the country who lived near other chemical waste sites, as well as by every American adult for whom Love Canal had become synonymous with hazardous-waste problems.

At the government level, the tragic events at Love Canal helped to speed the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Also known as the "Superfund," the legislation set up a multibillion-dollar fund to clean up the nation's worst toxic disasters. The Environmental Protection Agency (EPA) assigned clean-up priority to some twelve hundred abandoned and potentially contaminated waste sites.

Along with the chemical plant explosion at Bhopal, India, in 1984, Love Canal also contributed to a "community-right-to-know" provision, which was part of the 1985 Superfund Amendments and Reauthorization Act. The new legislation gave all citizens the right to know what chemicals were produced, stored, or buried in their neighborhoods.

What happened at **Three Mile Island**?

The March 1979 accident, which might be called a near melt-down, at the nuclear power station near Harrisburg, Pennsylvania, was eventually contained. Had it not been, the damage would have been on a level with that of the Chernobyl (Ukraine) disaster, which happened some seven years later. Instead, Three Mile Island served as a wake-up call, reminding the American public and its utility companies of the potential risks involved in nuclear energy.



The sequence of events at Three Mile Island was as follows: At 4 a.m. on Wednesday, March 28, an overheated reactor in Unit II of the power plant shut down automatically (as it should have); Metropolitan Edison Company operators, guided by indicators that led them to believe water pressure was building (and an explosion was therefore imminent), shut down those pumps that were still operating; the shut-down of all the pumps caused the reactor to heat further; then, tons of water poured out through a valve that was stuck open; this water overflowed into an auxiliary building through another valve that was mistakenly left open. This final procedure, which took place at 4:38 a.m., released radioactivity.

Since there was no cooling system in operation, the reactor in Unit II was damaged. But this was not the end of it: The radiation within the

buildings was released into the atmosphere and at 6:50 a.m., a general emergency was declared. Early that afternoon, the hydrogen being created by the uncovered reactor core accumulated in a containment building and exploded. Since hydrogen continued to be emitted, officials feared another—catastrophic—explosion. Worse yet, they feared the reactor would become so hot that it would melt down. The effect of a meltdown would be that the superheated material would eat its way through the bottom of the plant and bore through the ground until it hit water, turning the water into high-pressure steam, which would erupt, spewing radioactivity into the air.

As technicians worked to manage the crisis, radiation leaked into the atmosphere off and on through Wednesday and Thursday. On Friday the governor of Pennsylvania ordered an evacuation: some 144,000 people were moved from the Middletown area. The situation inside the plant remained tenuous as a hydrogen bubble developed and increased in size, again raising fear of explosion. Meantime, public alarm was mounting as the media attempted to monitor the ongoing crisis. Finally, on Sunday, April 1, the plant was visited by President Jimmy Carter. At about the same time, the hydrogen bubble began to decrease in size, ending the crisis.

What was the **worst industrial accident** in world history?

It was the gas leak at a Union Carbide chemical plant in Bhopal, India, on December 3, 1984. At about 12:30 a.m., methyl isocyanate (MIC), a deadly gas, began escaping from the pesticide plant, and it spread southward, eventually covering forty square kilometers. Within a few hours, thousands of Bhopal residents were affected by the asphyxiating gas. General symptoms included severe chest congestion, vomiting, paralysis, sore throat, chills, coma, fever, swelling of legs, impaired vision, and palpitations. Estimates of the total death toll range from the official government estimate of three thousand up to ten thousand victims, a figure based on what medical professionals described. In total, two hundred thousand people were directly or indirectly affected by the poisonous gas.

Bhopal police had moved into action within hours of the accident, closing the plant and arresting its manager and four of his assistants. The five men were charged with "culpable homicide through negligence."

Union Carbide dispatched a team of technical experts from its Danbury, Connecticut, headquarters, but upon arrival at the plant, they were turned away by local authorities. Meanwhile, the Indian Central Bureau of Investigation seized the plant's records and log books and ordered an inquiry into the accident. Union Carbide Chief Executive Officer Warren M. Anderson flew to Bhopal, but he was promptly arrested, along with two officials of the company's Indian subsidiary. The corporate executives were charged with seven offenses including criminal conspiracy, culpable homicide not amounting to murder, making the atmosphere noxious to health, and causing death by negligence. Anderson was later released on bond.

Upon learning of this horrific event, U.S. President Ronald Reagan sent a message conveying the grief shared by him and the American people. Multinational corporations, including Union Carbide, were vilified in the press; the Soviet news agency accused such companies of marketing "low-quality products and outdated technology to developing countries." Indian Prime Minister Rajiv Gandhi, who had visited the disaster site and announced immediate creation of a $4-million relief fund for victims, vowed that he would prevent multinational corporations from setting up "dangerous factories" in India.

The implications of the industrial accident were many. It prompted public scrutiny of safety systems at chemical plants around the globe. Given the number of plants where poisonous chemicals are produced and stored, some observers believe chemical accidents could happen as often as once in every ten years. Union Carbide, of course, suffered financially; the stock dropped more than twelve points, wiping out 27 percent, or almost $1 billion, of its market value, in about one week. Damage claims were filed on behalf of the victims, with noted American criminal attorney Melvin Belli filing one of them in the amount of $15 billion.

In addition to the thousands who died in Bhopal, others suffered from long-term effects including chronic lesions of the eyes, permanent scarring of the lungs, and injuries to the liver, brain, heart, kidneys, and the immune system. In the years after the accident, studies showed that the rate of spontaneous abortions and infant deaths in Bhopal were three to four times the regional rate.

An aerial view of the Chernobyl Nuclear Power Plant.

What caused the **nuclear accident** at **Chernobyl**?

The April 1986 accident—the world's worst nuclear power plant disaster—was caused by explosions at the Soviet power plant, sending radioactive clouds across much of northern Europe. The trouble began at 1:24 a.m. on Saturday, April 26, when Unit 4 of the Chernobyl Nuclear Power Plant, about seventy miles outside of the Ukrainian capital of Kiev, was rocked by two enormous explosions. The roof was blown off the plant and radioactive gasses and materials were sent more than a half mile into the atmosphere. Though two workers were killed instantly, there was no official announcement about the hazardous blast. It was the Swedes who detected a dramatic increase in wind-borne radiation, and on April 28—two full days after the accident—news of the event was briefly reported by the Soviet news agency, Tass.

Two weeks later, on May 14, First Secretary Mikhail Gorbachev appeared on national television to explain what officials knew about the accident. Over the following months, more details were revealed. The explosions had been caused by an unauthorized test carried out by plant operators, who were trying to determine what would happen in the event of a power outage. However, there were six critical errors made by workers

during the testing, which combined to spell disaster. Perhaps the most significant of these mistakes was turning off the emergency coolant system: Once the test was under way, further mistakes caused the core to heat to more than 5000 degrees Celsius, producing molten metal that reacted with what cooling water was left to produce hydrogen gas and steam, resulting in a powerful explosion. What caused the second explosion is not as clear and experts disagree on what might have happened. Some theorize that it was a pure nuclear reaction.

What was the **impact** of the **disaster at Chernobyl**?

As the worst nuclear power plant disaster to date, the Chernobyl accident had far-reaching effects. More than thirty firefighters and plant workers died just after the accident, but the long-term effects are far more grave: experts estimate that between 6,500 and 45,000 people could die as a result of cancer caused by exposure to radiation. Total fallout from the accident eventually reached a level ten times that of the atomic bomb dropped on Hiroshima, Japan, during World War II.

No one was more severely effected than the Ukrainian people who had made their homes nearby. All plants and animals in the immediate area and downwind of the plant were heavily contaminated with radioactive fallout. More than ten years after the accident, food still could not be planted in the region, and some experts predict the surrounding farmland will not be arable again for tens or maybe even hundreds of years. Since the soil is still contaminated, residents continue to face serious health risks posed by their environment. The death toll is high, and mounting, as those exposed to the radiation suffer long-term effects that turn fatal.

Still other parts of the European continent were also effected: some Italian vegetables were found to be contaminated; reindeer meat in Lapland was declared unfit for human consumption, also due to radioactive contamination; and for a time, fresh meat from Eastern Europe was banned by the EC (European Community).

There are continued worries that Unit 4, where the accident took place, is still emitting dangerous levels of radioactivity. In an attempt to seal it, a steel-and-concrete structure was built over the ruins, but by 1992, it had leaked, prompting officials to lay plans to build a second enclosure—on top of the original.

Since the type of nuclear power plant (called RMBK) in use in the former Soviet Union is no longer in use elsewhere in the world, non-Soviet scientists had few lessons to learn from the event. One American nuclear expert remarked that "most of the lessons from Chernobyl have been learned already and applied in the United States." However, opinion remains divided over the relative safety of nuclear power in general.

What happened to the **Tacoma-Narrows suspension bridge**?

In 1940, the new 853-meter (about 2,800-foot) bridge carrying traffic across Washington's Puget Sound was hit by high winds, causing it to buckle and undulate. In the simplest of terms, an engineering error allowed one of the suspensions to give way in the wind, and the bridge became ribbon-like, moving in waves. It was ten years before a second span was opened over the body of water. The 1940 accident prompted engineers and bridge designers to be more cautious in the design of suspension bridges. The first wire suspension bridge in the U.S. had been built in 1842: The 358-foot-long and 25-foot-wide bridge spanned the Schuylkill River, near Philadelphia, Pennsylvania. It was supported by five wire cables on either side, and was built by U.S. civil engineer Charles Ellet Jr. The first chain suspension bridge in the U.S. was built in 1800.