

## SPECIAL REPORT

You Can't  
Smell It,  
Touch It,  
See It

# The Silent Threat In Your Home

By Gail Freedman

In January 1984, after a holiday vacation, George and Bertha Jean ("Bert") Fellows returned home to Colorado Springs, Colorado, in the midst of an extended cold snap. "We cranked up the heat," says Bert, "built a roaring fire, and decided to stay in all day, rather than rush back to reality."

That evening, Bert felt queasy and flulike and retired early. Shortly after 6 A.M. the next morning, the Fellowses were awakened by a phone call. That call probably saved their lives.

"The phone was across the room," George recalls. "I was so dizzy I could barely reach it. I tried to walk, but I just collapsed in a heap. I knew at that point Bert and I were in trouble."

Dazed and confused, but blessed with some uncanny instinct, George crawled to the front door and stumbled outside, while Bert managed to phone their son, who summoned help. When the paramedics arrived, they whisked the couple off to the hospital. The fire department inspected the house and discovered a deadly level of carbon monoxide gas, caused by a cracked heat exchanger in the furnace. Family physician Robert Kent, M.D., confirmed the diagnosis: "It was conclusive. George and Bert had carbon monoxide poisoning."

With medical treatment the Fellowses recovered. But they're among the lucky ones. According to the Consumer Product Safety Commission (CPSC), about 200 Americans die each year from carbon monoxide (CO) poisoning associated with home heating equipment. Some experts, including physicians and engineers, feel that that number underestimates the actual death toll. What's more, scores of people across the country are injured each year by CO. And because CO poisoning mimics other illnesses, many less acute—but nonetheless dangerous—cases are never properly documented.

Critics charge that although the CPSC is aware of the risks associated with furnaces, little is being done to protect the public. "It's a disaster waiting to happen," says Lester R. Moskowitz, a registered professional engineer who has extensive experience in safety and forensics. "Carbon monoxide is a 'silent' hazard—it's a colorless, odorless gas that can leak undetected from an appliance that is hidden in our homes, an appliance most of us take for granted and don't even understand."

Although your chances of being poisoned are low, there are simple ways you can protect yourself and your family from the dangers of CO. (See "How to Protect Yourself" on page 46.)

**Carbon monoxide poisoning from home furnaces is a hazard few people are aware of.**

### A Critical Defect

Forced-air furnaces—the most common kind—pose the greatest risk, because contaminated air can be circulated all through the house. Gas appliances—slightly more than half of all furnaces in the United

States are gas fired—are more problematic than oil appliances: If an oil unit is leaking CO, the foul odor of other combustion products—called aldehydes—will generally warn people of danger. (Oil furnaces have their own safety drawbacks, primarily because pumps can malfunction, creating a fire hazard.)

Heat exchangers, pieces of highly conductive metal in forced-air furnaces that transfer the heat produced by combustion to

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the air, have a tendency to corrode, as do some vents and flue pipes. Even though the furnace may continue to operate normally, under some circumstances a corroded or cracked heat exchanger can provide a route for carbon monoxide to enter the home. "Every heat exchanger is going to fail," claims Moskowitz. "It's not a question of *if*, just *when*. It's a critical defect."

The industry insists there is no major problem because a damaged heat exchanger doesn't always cause CO poisoning. "It's a disservice to people who use gas heat to get them overly spooked about cracked heat exchangers," says Jack Langmead, vice president and director of technical service for the Gas Appliance Manufacturers' Association (GAMA). "Most poisonings I've seen are the result of improper service or installation."

Equipment defects or failure, improper installation, lack of maintenance or a combination of these factors can all cause a furnace to produce too much CO. "Sometimes even very subtle changes, like tightening up your house with insulation or running exhaust fans, can interact with one or more system defects and make the difference between life and death," says Alan Bullerdiek, a chemical engineer with over 30 years of expertise in home heating systems and consumer safety issues.

That's just what happened to the Fellowses. In a tightly insulated home with a roaring fire, the furnace became starved for air and began to produce large quantities of CO. The cracked heat exchanger allowed that CO to escape into the house, rather than out the flue.

## Fatal Flaw

The Christmas season held a different fate for Mark and Donna McDonald, their 3-month-old daughter, Megan, and Donna's visiting parents. Their tree—festooned with glittery ornaments and surrounded by presents—was already up in their Mobile, Alabama, home when all five

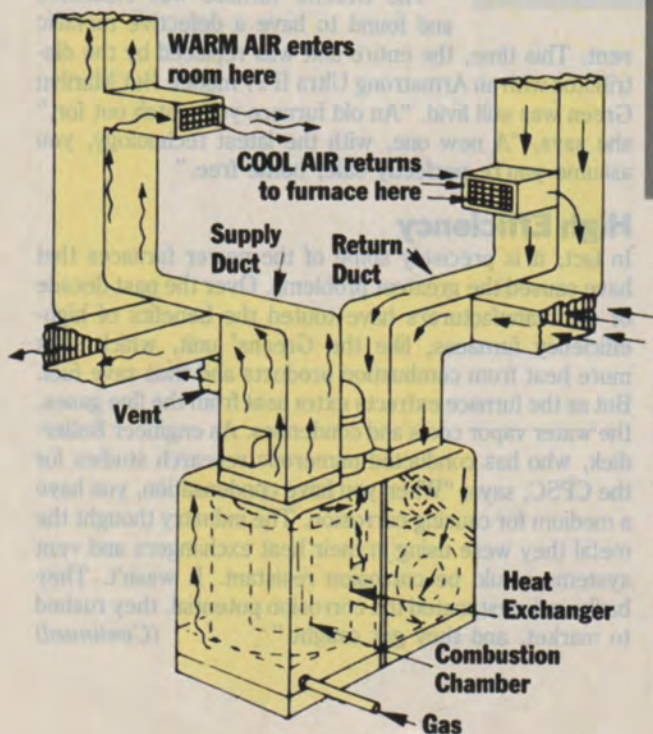


**Edward and Marilyn Green flank their defective furnace.**

perished from CO poisoning on December 23, 1985. The culprit? An improperly installed 1979 Luxaire closet furnace.

Donna's uncle brought a massive lawsuit against the local utility, Mobile Gas Corporation, which settled out of court for \$11.5 million, according to court documents. He then sued Luxaire, a wholly owned subsidiary of Westinghouse, charging that the company knew, or should have known, that the installation procedure outlined in its manual was dangerous, based on information available as far back as 1949. Moreover, the plaintiff's attorneys argued that the furnace lacked a device called a vent safety shut-off switch, which could have prevented this tragedy. These switches were finally adopted by the industry as a voluntary standard in late 1987, but they were both well known and proposed to manufacturers as early as the 1970's. (However, manufacturers are permitted to build under old standards for up to five years.) The jury agreed, and in March 1990 brought in a record-setting \$50 million verdict against Luxaire. Luxaire appealed; ultimately the case was settled out of court prior to argument.

## How a Furnace Works



## Signs and Symptoms

Headline-grabbing legal cases highlight how staggeringly lethal CO can be. It is so highly toxic because it chemically binds to hemoglobin and rapidly displaces oxygen in the blood, causing the body's brain, heart, and other tissues, muscles and organs to become oxygen starved. The most common symptoms are headache, fatigue, dizziness, nausea, vomiting, trouble thinking and concentrating, vision problems, shortness of breath and heart palpitations. Not surprisingly, it is often misdiagnosed as a cold or the flu, even in hospital emergency rooms.

**A forced-air furnace takes heat produced by combustion and transfers it to the air through a piece of metal called a heat exchanger. The warmed air is then circulated into a home through supply ducts. The products of combustion—carbon dioxide, water vapor and carbon monoxide—exit through a vent or flue pipe. But if the heat exchanger, vent or flue pipe is defective, carbon monoxide may enter the home.**

Recently, more has been learned about (Continued)

Mickey Osterreicher/Black Star

chronic exposure to low levels of CO, which can be as bad as brief exposure to high levels. With repeated, prolonged low exposure (four or more hours), CO can penetrate the body's cells. "When carbon monoxide enters the cells, it disrupts metabolism and leads to a whole additional kind of harm, including delayed neurological symptoms," says Eric Kindwall, M.D., director of hyperbaric medicine at the Medical College of Wisconsin.

Richard Paul Bonfiglio, M.D., vice president for medical affairs and medical director of Bryn Mawr Rehabilitation Hospital in Malvern, Pennsylvania, has witnessed the results of this intracellular damage. "At lower levels of exposure, we see very diffuse symptoms—subtle personality changes, memory deficits—things that can be hard to quantify but have a significant impact on a person's level of functioning," explains Dr. Bonfiglio.

### Difficult Diagnosis

Edward Green certainly wasn't functioning very well in mid-1987. A groundsman for a public school system near Buffalo, New York, Green, then 41, nearly lost his job. "We thought Ed had early Alzheimer's," says his wife, Marilyn. "He got into all sorts of trouble at work. He couldn't remember what day it was. He'd go out of the house and leave the door wide open. We planned a vacation to Yellowstone that year because I felt it might be the last trip we'd be able to take as a family."

Marilyn had her own symptoms, too—headaches, fatigue, sore arm and shoulder joints. Her doctor told her it was stress caused by her husband's condition. Even their daughter, Megan, then 9, was lethargic and complained of headaches. But the Greens never suspected their furnace—an energy-efficient Magic Chef Ultra 87—because it was less than three years old and had been purchased to replace an old unit that, during an annual inspection, was found to have developed a cracked heat exchanger.

Shortly after Christmas, Ed thought he had the flu and stayed inside for two days. "He sat in a chair downstairs," Marilyn recalls. "The furnace is in the next room, and the heating duct comes out the top of it. There's a vent right over his chair! We didn't know it then, of course, but he was getting a major dose of carbon monoxide from the first, closest vent off the furnace."

On Sunday, January 10, 1988, Marilyn and Megan went to church. They returned home to find Ed "sicker than a dog," says Marilyn. "He turned to me and said, 'I think

## How to Protect Yourself

**Furnace inspections:** Because of the sophistication of most home heating equipment, a professional technician should routinely inspect and service it. Qualified service is usually available from a local utility, private fuel supplier or equipment installer, and inspections cost from \$40 to \$50, depending on locality. An inspection for a gas-fired furnace should include the following (oil units require somewhat different servicing): **1.** Clean and change filters. **2.** Clean combustion chamber. **3.** Check and adjust burners and burner safety control; check color of flame—it should be blue, not yellow. **4.** Check ignition system. **5.** Measure amount of CO in flue gases. **6.** Clean and lubricate blower and motor. **7.** Clean and check heat exchanger for leaks by injecting chemicals or a "smoke bomb" to see if anything escapes the system. **8.** Inspect chimneys, vents and flues for deterioration, corrosion and blockage, as well as secure fittings. **CO detectors:** The CPSC recommends installing two CO detectors—one above the furnace, the other outside the bedroom. The detectors cost from \$40 to \$100. Buy only those that meet the requirements of Underwriters Laboratories standard #2034.

**Recall information:** Call CPSC's hotline at 1-800-638-2772. □

maybe we're getting carbon monoxide poisoning!' I called the gas company immediately, but the man came out without a CO meter. He took one look and said, 'Lady, it can't be your furnace! It's brand new. Everything's fine. I think your husband has the flu.'"

Marilyn persisted. The next day, another repairman came with a CO meter, took a reading and said, "You're getting carbon monoxide poisoning, all right. I have to shut down your furnace." Sure enough, the furnace had a corroded heat exchanger. The Greens had to wait two weeks in the middle of winter in frigid Buffalo for the part to be replaced. With the furnace off for two weeks "Ed's memory improved 100 percent," Marilyn says. "But the soreness in my joints lasted for two years, and I still don't have the strength I used to have."

That's not the end of the story. Two years later, in 1990, the Greens were notified of a recall by Lennox International, the parent company of Magic Chef. In late 1988 Lennox had acquired part of the furnace division of Magic Chef from Maytag, which claims it was unaware of possible corrosion problems. "We addressed the problem when we bought the company," explains Dave Chase, vice president of government and public relations for Lennox. "We immediately notified all owners through our network of distributors and installers. We offered to inspect and repair or replace either the heat exchanger or the furnace at low or no cost to consumers."

The Greens' furnace was examined and found to have a defective metallic vent. This time, the entire unit was replaced by the distributor with an Armstrong Ultra II 97 model. But Marilyn Green was still livid. "An old furnace you watch out for," she says. "A new one, with the latest technology, you assume you're perfectly safe, home free."

### High Efficiency

In fact, it is precisely some of the newer furnaces that have caused the greatest problems. Over the past decade or so, manufacturers have touted the benefits of high-efficiency furnaces, like the Greens' unit, which suck more heat from combustion products and thus save fuel. But as the furnace extracts extra heat from the flue gases, the water vapor cools and condenses. As engineer Buller-diek, who has conducted numerous research studies for the CPSC, says, "When you have condensation, you have a medium for causing corrosion. The industry thought the metal they were using in their heat exchangers and vent systems would be corrosion resistant. It wasn't. They badly underestimated the corrosion potential, they rushed to market, and they got caught." (Continued)

Ironically, Lennox's Chase echoes that criticism of his own industry. "Lennox forced the market by being first out of the gate in 1982. The difference is we spent five years and \$7 million on research and development beforehand. So we knew about the potential for acidic condensate and designed around it. We've made over one million units and never, never, never had a problem with corrosion. The other guys knew we'd caught a fat hog. In their rush to catch up, they tried to use their existing technology and just tweak it a bit. They got high efficiency, all right, but they also got big-time corrosion."

GAMA's Langmead acknowledges a series of corrosion "fiascoes," but says the industry is policing itself and taking care of the problem. And he maintains that the newest generation of furnaces have many more safety devices to prevent catastrophe.

Currently, performance standards designed to insure quality and protect the public are voluntary and are written by committees comprised largely of furnace manufacturers and gas utilities. Engineer Moskowitz feels those standards are deficient. "The competition is fierce," he says. "Every \$10 matters. In business you put out the least you can for the cheapest price. Safety always seeks the lowest common denominator."

"That is absolutely false," fumes Langmead. "It's exactly the opposite. Industry puts out the most they can for the cheapest price. And in all my dealings, I have never seen safety take a back seat to economics. With all the concerns for product liability, companies can't afford to do that. If they did, they'd be out of business."

## Corrective Action

Engineers like Moskowitz and other critics feel that the industry is under too much economic pressure to police itself adequately and believe the Government needs to exert more influence. Larry Hershman, CPSC's compliance officer specializing in gas-fired appliances, says the agency investigates potentially dangerous furnaces, and if specific defects are found, it negotiates a "recall," which may mean "to repair, replace or refund." The vast majority of the time, rather than go to court or issue an outright ban, CPSC convinces the company to undertake a "voluntary corrective action program."

But even when companies bite the bullet, critics charge that the process can be a case of "too little, too late." Attorney Leonard Goldstein says that's just what happened to his clients Verle and Karyn DeYong and their two young children.

In March 1988 the DeYongs rented a house in Sioux Falls, South Dakota. As autumn turned to winter, all four began to experience chronic fatigue and nausea, and were

unable to concentrate. In March 1989 a neighbor suggested they check their furnace. A six-foot section of the flue pipe was found to be riddled with rust holes.

The DeYongs learned that their home's high-efficiency furnace, advertised as "built from the finest materials available," was, in fact, part of a CPSC corrective action program that had been in force since February 1988. But over one year later, they still hadn't been notified.

The DeYongs sued the manufacturers—Arkla, Inc., and Preway Industries—charging that the companies' "corrective action" was not aggressive in seeking out consumers, and that the delay exposed them to CO over two heating seasons. This prolonged exposure caused the entire family to sustain brain damage, especially Verle DeYong, who worked from home and is now permanently disabled. The lawsuit was settled out of court in August 1992. Arkla/Preway declined to be interviewed for this article, citing a "confidentiality agreement," but according to attorney Goldstein, the companies maintain that even with the rust holes, there should be sufficient draft within the furnace to force most of the CO outside the house.

**Mark and Donna McDonald and their daughter, Megan, died in their home from CO poisoning—the result of an improper furnace installation.**



## Hopeful Signs

Now, five years later, the Arkla/Preway corrective action program is still going on. Part of the problem is that, even with the best intentions, CPSC staff members are hamstrung. In the antiregulatory climate of the 1980's, the agency's staff and budget were significantly cut. "CPSC just doesn't push industry hard enough to clean up their act," says engineer Moskowitz. "The agency identified the home heating-carbon monoxide problem in the early 1970's and has commissioned a multitude of studies since then. The push for action should have been 10 to 15 years ago!"

There are some hopeful signs. The CPSC designated CO detection as a priority project last year and for 1993. A major part of that initiative is a nationwide campaign to recommend that all consumers purchase and install new CO detectors, which the CPSC believes are as essential to home safety as smoke detectors. Recent technological advances have made the devices, similar to smoke alarms, more effective than they had been in the past.

Consumers should be aware that even the new improved alarms will not detect prolonged exposure to very low levels of CO that can be hazardous, if not lethal. For that kind of protection, and to be sure your heating system operates the way it should, preventive action is necessary. Have your furnace inspected every year—by a professional. As George Fellows says, "We were among the blessed. We got a second chance at life. We'll never take our furnace for granted again." ■