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The Great Experiment

Part two of a three part series

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SOMETIME IN LATE 1997, 3M Corp. medical director Dr. Larry Zobel learned of a troubling stain on his company's signature product:

Everyone's blood in the United States apparently was contaminated with a tiny amount of a chemical used to make Scotchgard, his company's famously successful stain-resistant spray.

Zobel discovered this as his lab was checking workers' blood for perfluorooctane sulfonate, or PFOS — a key chemical used to manufacture the product.

That the compound contaminated workers' blood came as no surprise. But the chemical was showing up in the supposedly clean blood samples used to verify the results.

So 3M contacted two biological supply companies, bought pooled samples representing some 760 random United States blood donors and ran the same test.

It found PFOS in every sample.

Zobel then went to the Red Cross and asked for samples from 600 different donors. Same result. He turned to Europe, pooling samples from blood banks in Belgium, the Netherlands and Germany.

Same result.

- Chemical reform hampered by opposition

Zobel's lab would go on to test the blood from 238 elderly people around Seattle, 645 more Red Cross donors and 598 U.S. children.

It would find the compound in every sample but two, with some children scoring at or above the level 3M found in its workers.

Alarmed, 3M in 1998 notified the U.S. Environmental Protection Agency of its findings. Two years later, in May 2000, 3M announced it would cease production of PFOS and a related chemical, perfluorooctanoic acid, or PFOA.

Together, the two are critical for many consumer and industrial products — from GoreTex and Teflon to firefighting foam, power plant pipe linings and jet engine gaskets.

After 50 years of providing the world with the chemical, 3M was out of the business.

University researchers the world over, suddenly alerted to the problem, started finding both PFOS and PFOA everywhere they looked — polar bears in the Canadian Arctic, cormorants in the Sea of Japan, the blood of Inuits in Alaska.

Four qualities set off a toxicologist's alarm bell when investigating a pollutant: Does the compound accumulate as it works up the food chain, does it stick around for a long time in our bodies, is it widespread and does it cause cancer?

PFOA and PFOS persist. This year the EPA declared PFOA a potential carcinogen. There's no question they're everywhere.

"I would've never predicted it," Zobel said in an interview. "I am amazed."

ADVANCES in synthetic chemistry have made our lives more comfortable and secure than possible even a generation ago. GoreTex, nylon and polystyrene are the fabric of our lives. Perfumes come from petroleum, vinyl siding protects our homes. You can shop all day and touch nothing but plastic.

In short, synthetic chemicals are the material foundation of our society.

The downside of that transition is increasingly apparent: In the course of a generation, we have contaminated virtually all of Earth's biological systems.

Every day we expose millions of people to chemicals and chemical mixtures for which the toxicity is unknown, said Michael Wilson, a research scientist with the Center for Occupational and Environmental Health at the University of California, Berkeley.

"A disturbing pattern of human health damage has emerged that appears to be linked to … synthetic chemical substances." Regulators did not realize how widespread PFOA and PFOS exposure were until 3M alerted them. They had no way to test for the compounds until 3M provided the method. They had no idea how long they stayed in our bodies until 3M scientists offered an

estimate — four years for PFOA and eight for PFOS until the body rids itself of just half the load.

Regulators have no data, however, on what they do in humans, though scientists say PFOS alters thyroid metabolism in monkeys and acts as a developmental toxin in mice. 3M says years of medical surveillance find no problems attributable to the chemicals among its workers.

Society's blindness to PFOA and PFOS is far from unique.

The EPA receives 108 applications on average per month from companies seeking to introduce new chemicals on the market — 32,559 since 1979. With the application comes "all available data" on production volume, use and environmental release but not a word on toxicity unless the manufacturer happens to have some data.

Other information the EPA might want — be it the chemical's effects, physical properties, health impact — comes from agency files or public databases. And the burden rests with the EPA to prove a problematic chemical should be restricted.

So perhaps it comes as no surprise that, since 1979, the agency has forced restrictions on just nine applications.

3M AND ON OF ITS largest customers, DuPont, had every reason to suspect fluorinated compounds like PFOA and PFOS would show up far, far away from the garments and carpets their products protected.

As early as the 1970s, company documents obtained by the Environmental Working Group show industry researchers knew the compounds were virtually indestructible.

When scientists want an idea how fast bacteria can break down an industrial molecule, they turn to activated sewage sludge. Undisturbed in soil, PCBs have a half-life — the time it takes half the molecules to decompose — of 25 years. In sewage sludge, the half-life is 28 days. DDT in such sludge has a half-life of seven hours. PFOA and PFOS show no change, according to 3M data given to the EPA.

Their resiliency is one of their greatest selling points.

"They're just essential," said Robert C. Buck, a chief scientist for DuPont's surface protection solutions division. "They're very, very stable at very high temperatures. … They're not cheap and they're not easy to fabricate. We're still selling these materials, even though they're expensive, because they're extraordinarily useful."

PFOA serves only one purpose: to mix oil and water. Technically a "processing aid," not an ingredient, PFOA acts much the way a few drops of soap do when added to a jar of water and cooking oil.

"It helps bring things together that normally wouldn't get together," Buck said.

Without it, we would have no Teflon, no Stainmaster, no GoreTex. Car engines would be larger and less efficient without PFOA-made polymers to withstand higher oil and engine temperatures. Silicon Valley would be hard-pressed to make such miniature chips without that high performance plastic pipe liners to keep impurities from leaching into etching solutions.

Power companies depend on fluoro-products to keep pollutants from the environment. Firefighters spread fluorotelomer-based foam over fuel spills to smother flames. When a jet crashes on a tarmac, nothing extinguishes a fire faster.

The stability also explains why they show up in the blood of virtually everyone tested. Half the people in the United States, based on 3M's and other scientists' estimates, have 30 or more parts-per-billion PFOS in their system. For PFOA, the median exposure is 5 ppb.

Mashed potatoes seasoned at that concentration would have five grains of salt among 110 pounds of spuds.

The question now is straightforward: Does exposure pose a problem for our health? Because we can't go back.

"We don't understand how much a rat, let alone a human, can withstand before long-term effects begin to catch up," said Jonathan Martin, an associate professor with the University of Alberta, who is studying fluorinated compounds. "We're going to be exposed to them presumably long-term, and we don't know what the long-term consequences are."

DuPont disagrees. In a study released earlier this year of 1,024 PFOA workers, the company reported no ill health effects beyond a 10-point rise in cholesteral levels among the most-exposed.

Either way, industry has no replacement for PFOA.

"We have to have it," said David Boothe, strategic planning manager for DuPont's fluoroproducts division. "We've looked for 30 to 40 years and not found an acceptable substitute."

So when 3M announced it was out of the PFOA business, industry sat up. Someone needed to make it.

TODAY AT DuPONT'S sprawling Fayetteville Works production facility in North Carolina, a modest plant produces the United

States' only domestic supply of PFOA.

DuPont started building the plant in 2000, after 3M's announcement. It has 99 percent less PFOA emissions than 3M's old plant.

DuPont maintains the chemical is largely obliterated during the manufacture of consumer goods. Trace amounts might exist in some products, but nothing approaching levels found in humans, the company says.

So how does it get everywhere around the globe? Scientists have lots of theories but are largely certain of one thing: Somehow this compound is, contrary to industry's claim, ending up in everyday consumer items — our pots, coats, carpets and clothing.

"If you're thinking global spread, it's the products," said Kurunthachalam Kannan, an associate professor at the State University of New York, Albany, School of Public Health.

But that's where the knowledge largely ends.

IN THE WAY, PFOA is part-way down a well-trod path blazed first by PCBs, DDT, hexane and asbestos. All went on the market with, at best, an incomplete understanding of their health effects. All were largely unstudied until problems began showing up. All have been banned or sharply limited.

But chemical policy is driven by our demand for products. The benefit of the doubt goes to the chemical. Regulators and activists must prove harm before restrictions kick in.

PFOA is just one of 81,600 chemicals produced or imported today in the United States, and critics note 3M's after-the-fact discoveries about PFOS and PFOA could be said for any number of those others.

Federal law, in place since 1979, directs regulators to assess the hazards of chemicals in commerce and control those of the greatest concern. But in the past 20 years, four agencies — the National Academy of Sciences, the General Accounting Office, the Congressional Office of Technology Assessment and the U.S. EPA — have said little progress has been made on either front. The Toxic Substances Control Act, they all conclude, has fallen short of its objective.

"Do we know there's a hazard?" asked Wilson, the UC Berkeley researcher. "We don't even have the data to begin thinking about it."

Wilson notes that industry can produce safer chemicals if they chose — and fails to do so at its peril.

Take lead solder.

In the early 1990s, the American electronics companies fought regulations driving lead — a neurotoxin — from solder. European and Japanese manufacturers moved to lead-free technology, Wilson said, and today the domestic electronics industry lags its overseas competitors.

But don't blame industry alone. Our appetite for these chemicals drives the market — and to some extent, regulators.

In the last 25 years, the country's consumption of synthetic chemicals increased 8,200 percent, Wilson said. Looking just at the 100 highest-volume compounds, the United States put 975 billion pounds into our products and environment in 2002, 16 percent more than in 1992.

The law does not require routine testing of chemicals, and critics contend required tests provide only limited information about new chemicals. The EPA has no power to order more testing or in many cases to make their information public, because the law protects data businesses claim as confidential.

To approve a new chemical for commerce, EPA chemists compare its structure to a list of similar compounds. If no red flags pop up, off to the market it goes. The EPA has 90 days to review a chemical, though approval typically comes earlier because the agency has accumulated enough chemistry data to fast-track large categories of compounds.

Ken Moss, policy analyst for the EPA's Office of Pollution Prevention and Toxics, says new chemicals get a "very robust and active" review. The agency may not have the power to require more tests from manufacturers, but it can and often does coerce more data from industry, he said.

"We do have the power of the office and the power of the pocketbook," he said. "It's not perfect, but it does make the point (to industry) that we need to see further testing."

But there are gaps.

When the law went into effect in 1979, PFOA, PFOS and 58,000 other chemicals already in use got grandfathered in, no questions asked. Of the 32,550 applications for new chemicals received since, 1,662 were withdrawn after the EPA suggested changes or restrictions, 300-plus underwent more testing and a handful were flat-out rejected.

Thousands of chemicals are found in everyday consumer products. The EPA has full toxicity data for about 25 percent.

THERE AREalternatives.

Europe in 2006 is set to switch to a chemical policy that requires chemicals be evaluated for safety before going on the market. Called REACH — Registration, Evaluation and Authorization of Chemicals — the policy promises to revolutionize the way European regulators look at chemicals.

"They're basically saying no data, no market," said Dr. Ted Schettler, science director for the Science and Environmental Health Network. "That, of course, is calling in the cards, and the industry is just up in arms about it."

What's needed, Schettler and other critics of current policy say, are rules that place precaution first.

Europe's move has other governments taking a look. The California Legislature, for instance, has asked the University of California to assess the state's chemical policy. That report is due to the Legislature later this spring.

Two years ago, the state became the first to enact a ban of two classes of a common flame retardant, polybrominated diphenyl ethers, or PBDEs. California's law, effective 2008, is modeled after a European Union ban on those compounds. Hawaii, Maine and Michigan since have followed.

The Bush administration, however, is moving the opposite direction. The Commerce and State departments, in concert with industry, are attempting to water down REACH, according to a report produced for the House Committee on Government Reform. One example: A 2002 e-mail from the U.S. Trade Representative's office to industry groups urges industry to "get to the Swedes and Finns" — who lead the world in environmental pollutant research — "and neutralize their environmental arguments."

This comes as surveys of breast milk and blood show Americans have the highest levels of PBDEs in the world — 10 to 100 times the concentration the Swedish researchers have found in their population.

Levels have shot up so high, so fast that 5 percent of the population — 15 million Americans — are thought to have PBDE levels near those that cause thyroid problems in laboratory rats, said Tom McDonald, a toxicologist with the California Office of Environmental Health Hazard Assessment.

An Oakland Tribune investigation of a Berkeley family, picked in part because they lead a largely chemical-free life, found that. Laboratory analysis of their blood found surprisingly high levels of PBDEs, particularly in the children.

Researchers, industry scientists and doctors working with the family on the Tribune's behalf see no reason for such high exposures.

There's also the question of risk. Industry officials repeatedly note that a few parts-per-billion of a contaminant in one's blood represents an unknown threat.

"It gets to be a little exasperating," said Peter O'Toole, U.S. program director for the Bromine Science and Environmental Forum, which represents the world's bromine manufacturers. "Why don't we talk about the levels of risk when you take a fire retardant out of a product?"

"The fire safety risk is ignored and tends to be ignored at people's peril. … You're replacing a real precaution with a theoretical one."

And that perhaps is the point. The information to make a decision isn't there. Which makes it awfully tough to make a case for banning a compound as important — or as invisible — as PFOA or PBDE.

If the EPA said industry couldn't make any more PFOA, for instance, would our health be any better?

"We don't know," said Martin, the University of Alberta researcher. "Until that's straightened out, it's difficult to take any action. It's not fair to the manufacturer and it may not do anything."

BACK AT DuPONT, Robert Rickard, the company's chief toxicologist, has spent a lot of time thinking about that very issue.

He looks at PFOA's persistence and global reach and, without downplaying them, pulls out another set of statistics.

The chemical has been in commerce for the better part of 50 years. Products made from it permeate every facet of our lives. Tests on archived blood samples show exposures are increasing almost imperceptibly: about 1 ppb a decade.

So in a society where tobacco use kills 440,000 every year and obesity is an epidemic, how important is it to get worked up over PFOA, a contaminant that may be present in microscopic amounts in a fast-food hamburger's wrapper or your Stainmaster-treated carpet?

"It is appropriate, when we identify a biopersistent material found in the entire population, that we understand that chemical," Rickard said.

"But let's not overreact because that chemical is there."

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