How the waters off Catalina became a DDT dumping ground

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Not far from Santa Catalina Island, in an ocean shared by divers and fishermen, kelp forests and whales, David Valentine decoded unusual signals underwater that gave him chills.

The University of California, Santa Barbara scientist was supposed to be studying methane seeps that day, but with a deep-sea robot on loan and a few hours to spare, now was the chance to confirm an environmental abuse that others in the past could not. He was chasing a hunch, and sure enough, initial sonar scans pinged back a pattern of dots that popped up on the map like a trail of breadcrumbs.

The robot made its way 3,000 feet down to the bottom, beaming bright lights and a camera as it slowly skimmed the seafloor. At this depth and darkness, the uncharted topography felt as eerie as driving through a vast desert at night.

And that's when the barrels came into view.

Barrels filled with toxic chemicals banned decades ago.

Leaking.

And littered across the ocean floor.

"Holy crap. This is real," Valentine said. "This stuff really is down there.

"It has been sitting here this whole time, right off our shore."

Tales of this buried secret bubbling under the sea had haunted Valentine for years: a largely unknown chapter in the most infamous case of environmental destruction off the coast of Los Angeles—one lasting decades, costing tens of millions of dollars, frustrating generations of scientists. The fouling of the ocean was so reckless, some said, it seemed unimaginable.

As many as half a million of these barrels could still be underwater right now, according to interviews and a Los Angeles Times review of historical records, manifests and undigitized research. From 1947 to 1982, the nation's largest manufacturer of DDT—a pesticide so powerful that it poisoned birds and fish—was based in Los Angeles.

An epic Superfund battle later exposed the company's disposal of toxic waste through sewage pipes that poured into the ocean—but all the DDT that was barged out to sea drew comparatively little attention.

Shipping logs show that every month in the years after World War II, thousands of barrels of acid sludge laced with this synthetic chemical were boated out to a site near Catalina and dumped into the deep ocean—so vast that, according to common wisdom at the time, it would dilute even the most dangerous poisons.

Regulators reported in the 1980s that the men in charge of getting rid of the DDT waste sometimes took shortcuts and just dumped it closer to shore.

And when the barrels were too buoyant to sink on their own, one report said, the crews simply punctured them.

The ocean buried the evidence for generations, but modern technology can take scientists to new depths. In 2011 and 2013, Valentine and his research team were able to identify about 60 barrels and collect a few samples during brief forays at the end of other research missions.

One sediment sample showed DDT concentrations 40 times greater than the highest contamination recorded at the Superfund site—a federally designated area of hazardous waste that officials had contained to shallower waters near Palos Verdes.

The world today wrestles with microplastics, bisphenol A (BPA), per- and polyfluoroalkyl substances (PFAS) and other toxics so unnatural they don't seem to ever go away. But DDT—the all-but-indestructible compound dichlorodiphenyltrichloroethane, which first stunned and jolted the public into environmental action—persists as an unsolved and largely forgotten problem.

Signs warning of tainted fish to this day still cover local piers. Recent studies show our immune systems may be compromised. A new generation of women—exposed to DDT from their mothers, who were exposed by their mothers—grapples with the still-mysterious risks of breast cancer.

The contamination in sea lions and dolphins continues to stump scientists, and the near extinction of falcons and bald eagles shows how poisoning one corner of the world can ripple across the whole ecosystem.

Decades of bureaucracy and competing environmental issues have diverted the public's attention. Valentine hoped digging up physical evidence from the seafloor would get more people to care, but calls and emails to numerous officials since his discovery have gone nowhere.

Rallying for the deep ocean is not easy, Valentine acknowledged, even though we rely on the health of these waters far more than we know: "The fact that there could be half a million barrels down there ... we owe it to ourselves to figure out what happened, what's actually down there and how much it's all spreading."

Once hailed as a major scientific achievement, DDT combated both malaria and typhus during World War II. It was so potent that a single application could protect a soldier for months. The U.S. Army's chief of preventive medicine, Brig. Gen. James Simmons, famously praised the chemical as "the war's greatest contribution to the future health of the world."

Manufacturers rushed to supply the postwar demand—including Montrose Chemical Corp. of California, which opened its plant near Torrance in 1947. The chemical industry was celebrated at the time for boosting the nation into greater prosperity and preventing crop failures across the globe. The United States used as much as 80 million pounds of DDT in one year.

But there were two edges to this sword. A top U.S. Department of Agriculture scientist had urged the military not to allow DDT insecticides for commercial use without further research, worried about "the effect they may have on soils and on the whole balance of nature."

Even Swiss chemist Paul Hermann Muller, who won a Nobel Prize in 1948 for discovering DDT as a pesticide, cautioned that he himself did not fully understand how the chemical interacted with the living world. Decades of painstaking study still lay ahead for biologists, he said.

Rachel Carson, a marine biologist, heeded these words in 1962 and ignited a movement against what she called "the reckless and irresponsible poisoning of the world that man shares with all other creatures."

Her revolutionary book "Silent Spring" evoked the sudden silence of songbirds missing in the skies—alerting unknowing people to the dangers of long-term exposure, even in tiny doses, to a chemical that they could not physically avoid.

DDT is so stable it can take generations to break down. It doesn't really dissolve in water but stores easily in fat. Compounding these problems is what scientists today call "biomagnification": the toxin accumulating in the tissues of animals in greater and greater concentrations as it moves up the food chain.

Consider phytoplankton, the microscopic algae that are the base for almost all food webs in the ocean.

DDT-contaminated phytoplankton get eaten by zooplankton, which fish and whales consume by the thousands.

In 1969, shipments of jack mackerel from Southern California were recalled because DDT levels were as high as 10 parts per million, or ppm—double what the U.S. Food and Drug Administration considered safe for consumption at that time.

Tumors started appearing on bottom-feeding fish like white croaker.

In that same year, California brown pelicans, which eat the fish, laid eggs on Anacapa Island with chemicals broken down from DDT averaging 1,200 ppm.

Scientists discovered that the chemicals led to eggshells so thin that the chicks would die. Bald eagles had also vanished from the Channel Islands, along with peregrine falcons and the brown pelicans.

Similarly, sea lions with more than 1,000 ppm in their blubber were giving birth to pups prematurely. Bottlenose dolphins had concentrations as high as 2,000 ppm.

Montrose executives aggressively defended DDT through the 1960s as the public reckoned with these alarming new concerns about food chains and poisoned ecosystems.

They said in letters and editorials that DDT played a vital role in society when properly used and was not a serious threat to human health. They accused environmentalists of scare tactics and misleading information and touted the company's reputation of making the best DDT in the world—a technical grade sold to other firms that would then dilute it into specific insecticides.

The company was supplying governments from Brazil to India, they said, and even the World Health Organization. International malaria eradication programs turned to Montrose for supplies.

But after years of intense inquiries, government officials said they were convinced that the chemical posed unacceptable risks to the environment and potential harm to human health. In 1972, the U.S. finally banned the use of DDT.

Demand was still strong in other countries, however, so the chemical plant in Los Angeles kept churning out more. Montrose managed to operate for another 10 years before the factory, looming over Normandie Avenue near Del Amo Boulevard, finally went dark.

In the early 1980s, a young scientist at the California Regional Water Quality Control Board in Los Angeles heard whispers that Montrose once dumped barrels of toxic waste directly into the ocean. People at the time were hyper-focused on the contamination problems posed by poorly treated sewage, but Allan Chartrand was curious about the deep-sea dumping and started poking around.

He called Montrose, and to his surprise, the staff pulled out all their files. He and a team of regulatory scientists combed through volumes of shipping logs, which showed that more than 2,000 barrels of DDT-laced sludge were dumped each month. They did the math: Between 1947 and 1961, as much as 767 tons of DDT could have gone into the ocean.

"We found actual photos of the workers at 2 in the morning dumping—not only dumping barrels off of the barges in the middle of the Santa Monica Basin," he said, "but before they would dump the barrels, they would take a big ax or hatchet to them, and cut them open on purpose so they would sink."

On a recent morning, Chartrand rummaged through

stacks of yellowing papers and reports detailing everything he had discovered so many decades ago. Now a seasoned eco-toxicologist in Seattle, he never understood why all this information wound up gathering dust—undigitized and largely forgotten.

He pulled out faded reports that his team had published from 1985 to 1989, summarizing what they had found at Montrose and in the water quality control board's own records. "This makes my heart sing," he said, as he reread conclusions that still resonate today.

Chartrand said he was astonished to learn this kind of activity was allowed. Federal ocean dumping laws dated back to 1886, but the rules were focused on clearing the way for ship navigation. It wasn't until the Marine Protection, Research and Sanctuaries Act of 1972, also known as the Ocean Dumping Act, that environmental impacts were considered.

Dumping industrial chemicals near Catalina was an accepted practice for decades.

Landfills could hold only so much, and people were concerned about burning toxics into the air—but the Pacific Ocean seemed a good alternative. Explosives, oil refinery waste, trash and rotting meats all went into the ocean, along with beryllium, various acid sludges, even cyanide.

Dilution is the solution to pollution, the saying used to go, but at what cost? The ocean covers more than 70% of the planet, but it can absorb only so much. What we eat, what we breathe is ultimately dictated by what we do to the sea.

"It's just sad, sad, sad," Chartrand said. "When stuff's being dumped offshore like that, it's in the dead of night, nobody's seeing it. It's out of sight, out of mind."

For years, a company called California Salvage docked at the Port of Los Angeles, loaded up Montrose's DDT waste and hauled everything out to sea. Workers were instructed to dump in a designated spot, dubbed Dumpsite No. 1, that was about 10 nautical miles northwest of Catalina.

But compliance inspections were infrequent, and crews sometimes took shortcuts. Chartrand discovered notes from California Salvage indicating they had decided to dump elsewhere because Dumpsite No. 1 was in line of a naval weapons firing range.

The report concluded that these companies likely dumped in closer, much shallower waters.

"Our report caught them red-handed," Chartrand said. "Here I was this young guy—newly married, just had my first kid, got my new job at the water quality control board—heard about this dumping, went down to Montrose ... and it very quickly got so much bigger than me."

In 1990, a few years after Chartrand compiled his reports, the Environmental Protection Agency teamed up with the state and launched a court battle against Montrose and a number of other companies under the Superfund law. Environmental groups expected the lawsuit—the largest in U.S. history alleging natural resource damages from chemical dumping—to be a landmark case in resolving coastal pollution issues.

Chartrand and dozens of others were pulled in to testify. Science was disputed in court, evidence debated, expertise challenged. In numerous depositions, former factory workers were grilled on how they operated.

Bernard Bratter, a Montrose plant superintendent, described how they would call California Salvage to dump its acid waste in bulk: "The trucks would come in, we'd load the trucks, they would then haul them down to the harbor where they had their barges, and the truck would unload into the barge, and when there was enough liquid in the barge, they'd haul the barge out to the specified area in the ocean and release the acid."

Montrose officials, who had filed counterclaims, asked the court to exclude the evidence presented on ocean dumping—arguing that such dumping wasn't relevant.

They said the government's natural resources damage claim was based solely on the release of

DDT through the sewer system to the Palos Verdes shelf, and that attorneys could not prove that Montrose's disposal of DDT-contaminated waste into the deep ocean actually hurt various bird species.

They also questioned Chartrand's calculations of how much DDT went into the ocean and made the point that there was nothing secret or illegal about the dumping at the time. The government, they said, allowed this to happen.

In an interoffice correspondence in 1985, Samuel Rotrosen, Montrose's president at the time, wrote that "it is true that from 1947, when the plant started up, until sometime in the 1950s we disposed of our waste sulfuric acid at sea through California Salvage Company who barged it out to state-approved dumping areas.

"We stopped this disposal after we installed our acid-recovery plant, at which time we sold the acid to fertilizer makers," he said. "Because our acid contained traces of DDT (50-250 ppm) ... the fertilizer producers would no longer take it, and so we disposed of it at landfills."

As the court battle waged on, a handful of curious scientists kept trying to solve the DDT questions at the bottom of the ocean.

Chartrand did not have a deep-sea robot, but he figured out a way to collect sediment samples and clumps of tar by dragging a large otter trawl net along the seafloor. He also took samples of rattails, kelp bass and other fish from different depths of the ocean.

He called Robert Risebrough, a legend among DDT scientists whose testimonies in the 1960s and early 1970s helped Congress understand why the chemical should be banned. Risebrough, a UC Santa Cruz research ecologist at the time, ran the samples and authored a sweeping study. He confirmed the existence of considerable concentrations of DDT chemicals in both the sediments and the "tar cakes" by the dumpsites.

It was unclear how much the DDT could move through the water at such depths, where there is little oxygen, he said, but the dumping was close enough to the Channel Islands that the upwelling of deeper water common in this area could stir up what enters the food chain.

And if the barrels were indeed punctured, he added, some of the sludge could have leaked out on its way down to the seafloor.

He had a strong suspicion that the disappearance of bald eagles from Catalina was connected to the dumping operations, but he didn't have the data to confirm it. DDT contamination was also significantly higher in birds that fed on fish, compared with birds that ate mostly rodents and prey on land—another clue that the DDT from the ocean dumping was harming wildlife.

He called for more studies to connect the dots, but Chartrand had run out of funding. Chartrand held on to what he could—even the remaining samples that neither he nor Risebrough could bear to throw away. Some of that deep sea sediment has yet to be tested.

"They're in a deep freeze now, but because it's DDT, even though it's been 30, 40 years, they're still valid," Chartrand said. "If we could get the funding, those are still worth running."

"They were supposed to take it out to sea. I think beyond the Continental Shelf. But there was a common joke among people that they only took it as far as they needed to, just out of sight, and started dumping right there."—Deposition of Ferdinand Suhrer, Montrose employee, July 30, 1996

M. Indira Venkatesan, a geochemist at UCLA who studied how chemicals moved through the sea, had taken one of these samples in the early 1990s and run her own analyses. She, too, concluded there must be a DDT source in the ocean much larger than just what had come out of the sewage closer to shore.

She collected additional sediment cores from the seafloor by a manual pulley that her technicians and graduate students spent hours pulling up. Her team distinguished the DDT "fingerprint" for

Montrose's ocean-dumped waste and discussed the upward and downward diffusion of DDT in the sediments.

"It gets resuspended and remobilized. That's why you see it all over the basin," she said. "I knew, I just knew, this DDT source was significant, just from the chemical analysis, but we couldn't show the extent of the dumping, nor the number of barrels."

Back in court, the arguments were focusing on the more tangible: the hundreds of tons of DDT and PCBs, another toxic chemical, that had been released two miles off the coast of Palos Verdes where the sewage emptied into the ocean. Many saw the need to make this public health problem—much closer to shore, with visible harm to humans and the ecosystem—a top priority.

The site—spread across more than 17 square miles—was declared a Superfund cleanup in 1996. About 200 feet deep, it was considered one of the most complicated hazard sites in the United States—at least three times deeper than similar Superfund sites in Boston and New York harbors.

By late 2000, the parties decided to settle. They negotiated a consent decree midway through trial—no sides admitting fault, with an agreement that more than $140 million would be paid by Montrose, several other companies that owned or operated a share of the plant, and local governments led by the Los Angeles County Sanitation Districts.

The settlement—one of the largest in the nation for an environmental damage claim—would pay for cleanup, habitat restoration and education programs for people at risk of eating contaminated fish.

"This Decree was negotiated ... in good faith at arm's length to avoid the continuation of expensive and protracted litigation and is a fair and equitable settlement of claims which were vigorously contested," according to the decree, which mentioned that the damage claim includes "any ocean dumpsites used for disposing of wastes from the Montrose Plant Property."

Attorneys representing Montrose, when contacted by The Times, declined to comment on the new underwater data and noted that the ocean claims related to the DDT operation were resolved 20 years ago. Litigation continues to this day over other impacts from the former plant. In August, a $56.6 million settlement was finally reached over groundwater contamination.

Back at UCLA, on a recent morning in the geology building, Venkatesan thought ruefully back to those DDT years. KCBS had run a local news series on the barrels, and The Times followed the story for a brief period.

The information caught the attention of Assemblyman Tom Hayden, D-Santa Monica, the 1960s activist turned lawmaker who married Jane Fonda and was remembered as "the radical inside the system." For a few years, he pushed for more information about the barrels and an action plan, but so many unchecked environmental problems demanded attention back then.

Even Venkatesan got pulled away. As public concerns shifted from water to air pollution, her research focus changed to aerosols.

She had tried for a while longer to get the word out—giving public lectures in Santa Monica bookstores and telling whoever would listen that the deep ocean also needed healing.

"I didn't know what to do with this data; I felt bad," she said. "As scientists, we thought we could leave it to the politicians and the government to do their job.... But if the government is not proactive, then people don't care. If people don't care, then the government doesn't do anything."

Now that she's retired, her filing cabinets—filled with her work since she started in 1975—have been moved into a basement at UCLA. She recently reviewed the data that the UC Santa Barbara researchers had uncovered with deep-sea robots, which validated Chartrand's estimates, as well as her own.

She held out her hands and said she was trembling with excitement, knowing that people might care

about this issue again.

"Disposing any waste, where you don't see and forget about it, does not solve the problem," she said. "The problem eventually comes back to haunt us."

One afternoon in Santa Barbara, hunched over a computer humming with data, Valentine and Veronika Kivenson, a Ph.D. student in marine science, scrolled through the eerie images they had gathered underwater.

They leaned in to examine an iciclelike anomaly growing off one of the barrels—a "toxicle," they called it—and wondered about the gas that bubbled out when the robot snapped one off. To have gas supersaturated in and around these barrels so deep underwater, where the pressure was 90 times greater than above ground, was unsettling. They couldn't help but feel like they were poking at a giant Coke can ready to explode.

One thing was clear, Kivenson said: This stuff is spreading. She had tried to collect sediment many meters from the barrels as a baseline to compare the samples collected right next to the source. But the baseline turned out to also have similarly high concentrations of DDT—most of them higher than the permissible threshold established by the National Oceanic and Atmospheric Administration.

"These barrels do seem to be leaking over time," she said. "This toxic waste is just kind of bubbling down there, seeping, oozing, I don't know what word I want to use. ... It's not a contained environment."

So much of this data, collected in 2011 and then again in 2013, came down to timing and good luck: The underwater robots had been on loan for a different project, but that research cruise was ahead of schedule, so they had a window of extra time to explore.

A scientist involved in the discovery of the Titanic happened to be on board, so he helped them program the robots on where to go and how to search for the barrels. A marine geochemistry lab at Woods Hole Oceanographic Institution ran the samples, and Kivenson, whose graduate fellowship and tuition were the only funding for this research, analyzed them for her Ph.D.

She tracked down the patent for the DDT acid waste that supposedly went into the barrels. She combed through EBay for out-of-print research books on ocean dumping and flipped through rolls of microfilm in the archive rooms of court buildings and government agencies.

She validated Venkatesan's conclusion that the DDT near the barrels did not have the same characteristics as the Superfund site—ruling out the possibility that this was just DDT from Palos Verdes that somehow traveled farther into the ocean and settled onto the deep seafloor. One key difference was that the barrel samples contained no PCBs, which are abundant in the contamination near the sewage outfall.

Each barrel seemed to contain acid waste with about 0.5% to 2% technical-grade DDT—which, at half a million barrels, would amount to a total of 384 to 1,535 tons of DDT on the seafloor. The distribution was patchy; one hot spot had a concentration of DDT that was 40 times higher than the highest level of surface sediment contamination recorded at the Superfund site.

All told, she concluded that the total amount of DDT from the dumping seemed comparable to the estimated 870 to 1,450 tons that had been released through the sewer.

But in the end, these are still extrapolations—we don't know how much is actually down there, said Kivenson, who published these findings last year in the journal Environmental Science & Technology and is now a postdoctoral fellow at Oregon State University. Logical next steps would be to somehow map and identify just how many barrels there are, determine any hot spots, and study how much the chemical is leaking and spreading and accumulating.

Valentine tried calling those with the power to do something about these barrels: the EPA, which has been in charge of cleaning up the Superfund site. But the EPA, it turns out, hasn't even figured out

what to do with the DDT problem that got all the attention and millions of settlement dollars. After more than 20 years of meetings and high-level studies, the site off the Palos Verdes shore has become its own controversial saga.

A pilot experiment more than a decade ago to bury the DDT under a thick cap of clean sand showed mixed results. Then sampling in 2009 suggested that most of the DDT had mysteriously vanished—prompting a burst of headlines and more internal paralysis. The longtime project manager unexpectedly retired, and many of the scientists who had dedicated decades of their careers to the chemical have also either retired or moved on.

Many, when reached, said they had not been involved with the site for a number of years.

"I feel like something's happened at the site; it just sort of died. It's been very weird," said Robert Eganhouse, a research chemist at the U.S. Geological Survey who had been studying the Superfund site and the breakdown rates of DDT since the 1970s.

His last meaningful exchange with the EPA was in late 2016, when he submitted an immense amount of data and a final synthesis report for the site—a research endeavor that took more than eight years and cost millions of dollars. To this day, Eganhouse, who recently retired, is not quite sure what the EPA did with this information.

Judy Huang, the Superfund's project manager for the past decade, when reached by The Times, directed questions to regional headquarters.

In an email, an EPA spokeswoman said the agency had suspended capping efforts and collected new data that showed twice as much DDT as the 2009 results. The EPA is now reassessing its approach: "We are updating our evaluation of the mechanisms of how the DDTs and PCBs in the sediment impact human health and the environment in this complex system."

In the meantime, projects to restore local kelp forests, wetlands, seabirds and underwater habitats have been supported over the years with the settlement money, as well as education outreach that helped prevent anglers and vulnerable communities from eating poisoned fish.

Fish remain contaminated, but the concentrations seem to be slowly going down, according to findings from the EPA's most recent five-year review of the site, released last fall. The bald eagles and peregrine falcons are coming back after years of human assistance, and nature seems to be healing itself over time.

After all these years of costly stops and stalls, some think a so-called monitored natural recovery approach might just be the best solution. The EPA plans to start a new feasibility study that aims to lead to a final cleanup strategy. That study is not expected to be published for another four years.

Mark Gold, who had championed the DDT problem as a marine scientist since the 1990s, could barely find the words to describe how he felt about the attempted cleanup of the Palos Verdes shelf.

"To have the EPA say, 25 years later, that maybe the best thing to do is to just let nature take its course is, frankly, nothing short of nauseating," he said.

When asked about the barrels, he was so shocked he had to pause and grab a calculator to process the amount of DDT that could be in the deep ocean. At an absolute minimum, he said, there needs to be further investigation into how much is actually down there and how much this dumping has harmed the ecosystem.

Gold, who is now Gov. Gavin Newsom's deputy secretary for coast and ocean policy, said he had heard stories of illegal dumping back when he was helping state and federal officials build the case against Montrose. But there was no firsthand evidence in the 1990s, he said, nor a sense of whether it was five barrels, 10 or 20.

"Nobody in their worst nightmares," he said, "ever thought there would be half a million barrels of DDT waste dumped into the ocean off of L.A. County's coast."

For scientists today, DDT poses a new generation of complications. Dilution, it seems, just means the problem re-accumulates elsewhere. In the environmental health laboratory at San Diego State's School of Public Health, Eunha Hoh recently discovered the chemical had wound its way into dolphins in unexpected ways.

Marine mammals, like humans, nurse their young and live long lives. Slow to evolve, their long-term health is a window into the lasting impacts of chronic exposure and accumulation—and how these chemicals get passed onto babies. As some of the largest predators of the sea, they're also an important indicator of the ocean's overall health.

So when Hoh sampled the blubber of eight adult dolphins that had lived deeper off the coast of Southern California, she was surprised to find significant amounts of 45 DDT-related compounds. Every dolphin she tested had washed up dead—and had accumulated much more of these chemicals than dolphins tested in Brazil and elsewhere around the world.

"DDT contamination—is it really going down in Southern California? Can we really say that, or are we missing something," said Hoh, who also serves on the California Ocean Protection Council's science advisory team. "Sure it was banned decades ago, it might be manageable globally, but Southern California? We're different. Our ocean is so much more polluted with DDT. We cannot just say, 'That's done; we can move on to other things.'"

Hoh's expertise is in discovering new chemicals, but she remains mystified by how DDT keeps reappearing in new and unexpected ways. Where, she often wonders, is all this DDT coming from?

When she first heard about the barrels scattered across the seafloor, it was as if someone finally handed her missing pieces to a puzzle that had never quite added up.

The questions came tumbling out. If that much more DDT is out there but forgotten, and no one knows to study it, she said, how will we ever understand the true legacy of this chemical?

Current monitoring shows that the local ecosystem, on the whole, is stable. But what's unclear are these long-term unknowns, said Keith Maruya, who co-authored the dolphin study and retired last year as the Southern California Coastal Water Research Project's head of chemistry.

"It's not like something's going off the cliff. But what we don't know is whether these things are going to have a longer-term, more subtle effect—are some populations really, really slowly going to be declining?" he said. "We don't know the answer. Moreover, we don't really have the tools yet to answer that question fully."

He jolted up in his chair when the discovery of the barrels came up in a recent conversation.

"Wow. Wait, how many did they find? I need to write this down."

He jotted a few numbers, then silently compared this with the known quantity of DDT dumped at the Superfund site.

"If nobody accounted for this second source ... if you've got twice the amount," he said, thinking aloud. "It's such a staggering number, but what does this mean? ... The bottom line is always going to be: So what? We have a chemical out there, so what?"

At the Scripps Institution of Oceanography, in a developmental biology and environmental toxicology lab overlooking the sea, Amro Hamdoun has been pondering this question for much of his life.

He's found through molecular studies that "persistent organic pollutants," like flame retardants and DDT, can block a key protein from eliminating toxins from the human body—a clue, perhaps, into why they bioaccumulate. Even in small amounts, these contaminants could interfere with the human body's natural ability to defend itself.

Hamdoun teaches "Silent Spring" and DDT to his students as an example of how the world used to be—but can't help but wonder how much the jobs and science of the future will be dealing with these

messes of the past.

"There's a broader problem of thinking of the ocean as this unlimited garbage dump that's going to take up our CO2, take up our mercury, deal with the plastic that we don't throw away properly, be a dumping ground for pesticides, deal with whatever is in runoff—and that our health is going to be separable from that," he said. "But what we're learning more and more is that our health and the ocean's health are pretty inseparable."

At what point, he asked, does it become our prerogative, as people who live in a shared society, to decide what it is that we want to put in our environment—and our bodies?

He leaned forward in his chair, hands clasped, head bowed, like Valentine and Chartrand and so many who came before.

"These chemicals are still out there, and we haven't figured out what to do," he said. "They are an issue, and we still don't have a plan."

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