THE POISONER'S HANDBOOK

MURDER AND THE BIRTH OF FORENSIC MEDICINE IN JAZZ AGE NEW YORK

DEBORAH BLUM

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PROLOGUE

THE POISON GAME

UNTIL THE EARLY NINETEENTH CENTURY few tools existed to detect a toxic substance in a corpse. Sometimes investigators deduced poison from the violent sickness that preceded death, or built a case by feeding animals a victim's last meal, but more often than not poisoners walked free. As a result murder by poison flourished. It became so common in eliminating perceived difficulties, such as a wealthy parent who stayed alive too long, that the French nicknamed the metallic element arsenic *poudre de succession,* the inheritance powder.

The chemical revolution of the 1800s changed the relative ease of such killings. Scientists learned to isolate and identify the basic elements and the chemical compounds that define life on Earth, gradually building a catalog, *The Periodic Table of the Elements*. In 1804, the elements palladium, cerium, iridium, osmium, and rhodium were discovered; potassium and sodium were isolated in 1807; barium, calcium, magnesium, and strontium in 1808; chlorine in 1810. Once researchers understood individual elements they went on to study them in combination, examining how elements bonded to create exotic compounds and familiar substances, such as the sodium-chlorine combination that creates basic table salt ($NaCl$).

The pioneering scientists who worked in elemental chemistry weren't thinking about poisons in particular. But others were. In 1814, in the midst of this blaze of discovery, the Spanish chemist Mathieu Orfila published a treatise on poisons and their detection, the first book of its kind. Orfila suspected that metallic poisons like arsenic might be the easiest to detect in the body's tissues and pushed his research in that direction. By the late 1830s the first test for isolating arsenic had been developed. Within a decade more reliable tests had been devised and were being used successfully in criminal prosecutions.

But the very science that made it possible to identify the old poisons, like arsenic, also made available a lethal array of new ones. Morphine was isolated in 1804, the same year that palladium was discovered. In 1819 strychnine was extracted from the seeds of the Asian vomit button tree (*Strychnos nux vomica*). The lethal compound coniine was isolated from hemlock the same year. Chemists neatly extracted nicotine from tobacco leaves in 1828. Aconitine—described by one toxicologist as "in its pure state, perhaps the most potent poison known"—was found in the beautifully flowering monkshood plant in 1832.

And although researchers had learned to isolate these alkaloids—organic (carbon-based) compounds with some nitrogen mixed in—they had no idea how to find such poisons in human tissue. Orfila himself, conducting one failed attempt after another, worried that it was an impossible task. One exasperated French prosecutor, during a mid-nineteenth-century trial involving a morphine murder, exclaimed: "Henceforth let us tell would-be poisoners; do not use metallic poisons for they leave traces. Use plant poisons . . . Fear nothing; your crime will go unpunished. There is no corpus delecti [physical evidence] for it cannot be found."

So began a deadly cat and mouse game—scientists and poisoners as intellectual adversaries. A gun may be fired in a flash of anger, a rock carelessly hurled, a shovel swung in sudden fury, but a homicidal poisoning requires a calculating intelligence. Unsurprisingly, then, when metallic poisons, such as arsenic, became detectable in bodies, informed killers turned away from them. A survey of poison prosecutions in Britain found that, by the mid-nineteenth century, arsenic killings were decreasing. The trickier plant alkaloids were by then more popular among murderers.

In response, scientists increased their efforts to capture alkaloids in human tissue. Finally, in 1860, a reclusive and single-minded French chemist, Jean Servais Stas, figured out how to isolate nicotine, an alkaloid of the tobacco plant, from a corpse. Other plant poisons soon became more accessible and chemists were able to offer new assistance to criminal investigations. The field of toxicology was becoming something to be reckoned with, especially in Europe.

The knowledge, and the scientific determination, spread across the Atlantic to the United States. The 1896 book *Medical Jurisprudence, Forensic Medicine and Toxicology*, cowritten by a New York research chemist and a law professor, documented the still-fierce competition between scientists and killers. In one remarkable case in New York, a physician had killed his wife with morphine and then put belladonna drops into her eyes to counter the telltale contraction of her pupils. He was convicted only after Columbia University chemist Rudolph Witthaus, one of the authors of the 1896 text, demonstrated the process to the jury by killing a cat in the courtroom using the same gruesome technique. There was as much showmanship as science, Witthaus admitted; toxicology remained a primitive field of research filled with "questions still unanswerable."

IN THE EARLY TWENTIETH CENTURY industrial innovation flooded the United States with a wealth of modern poisons, creating new opportunities for the clever poisoner and new challenges for the country's early forensic detectives. Morphine went into teething medicines for infants; opium into routinely prescribed sedatives; arsenic was an ingredient in everything from pesticides to cosmetics. Mercury, cyanide, strychnine, chloral hydrate, chloroform, sulfates of iron, sugar of lead, carbolic acid, and more, the products of the new chemistry stocked the shelves of doctors' offices, businesses, homes, pharmacies, and grocery stores. During the Great War poison was established as a weapon of warfare, earning World War I the name "The Chemist's War." And with the onset of Prohibition a new Chemist's War raged between bootleggers and government chemists working to make moonshine a lethal concoction. In New York's smoky jazz clubs, each round of cocktails became a game of Russian roulette.

There was no way for the barely invented science of toxicology to keep up with the deluge. Though a few dogged researchers were putting out manuals and compiling textbooks on the subject, too many novel compounds had yet to be analyzed and most doctors had little or no training in the subject.

IN 1918, HOWEVER, New York City made a radical reform that would revolutionize the poison game and launch toxicology into front-page status. Propelled by a series of scandals involving corrupt coroners and unsolved murders, the city hired its first trained medical examiner, a charismatic pathologist by the name of Charles Norris. Once in office, Norris swiftly hired an exceptionally driven and talented chemist named Alexander Gettler and persuaded him to found and direct the city's first toxicology laboratory.

Together Norris and Gettler elevated forensic chemistry in this country to a formidable science. Trailblazing scientific detectives, they earned a respected place in the courtroom, crusaded against compounds dangerous to public health, and stopped a great many Jazz Age poisoners in their tracks. As they determinedly countered the obstacles faced in each new case they developed innovative laboratory methods for teasing toxins from human tissue. Their scientific contribution became a legacy for future generations.

But this story begins before Charles Norris or Alexander Gettler took office, before forensic toxicology was considered a fully legitimate science. It begins in the gray of a frozen January in the city, when an unlikely serial killer decided to make his move in the poison game.

SIX

CARBON MONOXIDE

(CO), PART I

1926

In late January 1926, a snow-sprayed wind glittering around him, a reporter from the *New York Times* shivered on a certain street corner, the one an irate letter writer had described as the noisiest in Manhattan—"the nadir of quietness." At the designated intersection, Sixth Avenue and 34th Street, the journalist attempted to interview a traffic cop about that complaint. But the reporter worried that his task might be impossible. As he later wrote, while he could see the officer's lips moving, he couldn't hear a word of the answer.

"Bang, flop, bang, flop. A flat-wheeled surface car jolted its way over the tracks, with every nut and every bolt protesting. Blah! Blah! Blah!!! Went the semi-siren of a lumbering truck," he wrote, trying to re-create the blast of sound around him. The vehicular rush ran so thickly here, the city had assigned six officers to the one corner. The reporter had simply picked the policeman he could see best, the tallest of traffic guardians. The two men surveyed the chaos of automobiles before them: Maxwell Traveling Sedans, Dodge Brothers limousines, Packard's new six-cylinder touring sedans, Nash Specials, Chandler Metropolitans, the occasional Jordan Victoria, Willys Knight's compact four-passenger coupe, stretched-out Cadillac Suburbans, sporty Buick Country Club Specials, and Ford Model Ts, a motorized stampede of mostly black, boxy vehicles, some in the old open design, many with the new flat roofs, all with blaring horns and round staring-eye headlamps.

"Hey," the police officer shouted at a speeding driver. "He put his whistle between his lips and presumably blew it," the reporter noted. Nine more motorized vehicles went by, sixty-nine pedestrians, two baby carriages, and three more surface cars—the name for streetcars, to distinguish them from the railcars screeching overhead on the elevated tracks.

The traffic cop leaned down and put his lips to the writer's left ear: "It's the noisiest place in the world."

OTHER POLICEMEN might have argued for that honor, at other street corners, in countless other cities. Traffic jammed intersections across the country, bred by the automobile craze of the 1920s. Everyone wanted a car—for the speed, the independence, and yes, the status. Four million new cars had been sold nationwide in 1925, and automobile manufacturers predicted with absolute confidence that those numbers could only rise. The National Automobile Show, held at Manhattan's Grand Central Palace, showcased more than five hundred new models in 1926—bigger cars, more powerful cars, cars riding on the new, cushier balloon tires. Cheaper cars. The Dodge brothers (Horace and John) had reduced the price of their luxury Type A sedan from $1,280 to $1,045, in an effort to lure more customers.

In New York City a personal automobile offered escape from standing on a snow-slushed sidewalk waiting for a surface car, and from risking one's life in the rackety elevated trains. Reliable public transportation had yet to be realized; Mayor Hylan blamed strong resistance and political lobbying by private transportation companies: "Let the people know that selfishness is still rampant in this city." At party headquarters these denunciations of lucrative donors were not appreciated. In 1926 he was replaced as mayor by Tammany Hall's new favorite, the luxury- and limousine-loving James J. Walker.

Even Charles Norris had developed car fever.

His examiners had been taking taxis to death scenes. They'd wasted hours waiting for those city-chartered cabs, and more hours walking, after the cars failed to start. "I understand that the taxicabs at present time are in very poor condition" and are constantly breaking down, Norris wrote to the city's transportation manager. Please, could some cars be permanently assigned to the medical examiner's office? He could make do with a meager two.

Norris received an apologetic refusal; the city had no cars to spare at the moment. The new mayor's office was using them all.

Frustrated, Norris turned his own private car, and chauffeur, over to department use. He did persuade Bellevue to pay the chauffeur's $1,000-a-year salary. The driver was as necessary as the car itself, as most of Norris's city-born employees didn't know how to drive. For that matter, it seemed, neither did the people who were, at the moment, careening around Sixth Avenue in their newly purchased automobiles.

In 1920 the medical examiner's office tallied 692 people killed by automobiles in New York City; five years later that number was 1,272, despite a state law, passed in 1922, that required drivers to be licensed. Both Norris and the Manhattan district attorney, Joshua Banton, had worked hard to get the licensing law passed. Their joint public position was brief and completely clear: "There are many persons driving automobiles in this city who ought not to drive."

THE MOTORIZED STAMPEDE pressured the federal government to resolve the risk posed by lead additives to gasoline. In January 1926 the Public Health Service released its report on tetraethyl lead, concluding that there was "no danger" in adding the compound to gasoline, and no reason to prohibit the sale of leaded gasoline as long as workers were well protected during the manufacturing process.

The scientists who wrote the report had been recruited by both the government and industry. They'd studied the risks associated with everyday exposure by drivers, automobile attendants, and gas station operators and found it to be minimal. True, all the drivers tested showed trace amounts of lead in their blood. But a low level of lead could be tolerated, the scientists believed; none of the test subjects showed the extreme behaviors and breakdowns associated with the "looney gas building."

Critics, even then, charged that the panel was biased, deliberately underestimating the risks. But, in fact, the conclusions weren't entirely wrong: the extra protections recommended for industrial workers did make the factories safer. Workers exposed to TEL at lower levels did not drop to the ground or show immediate signs of ill health. Workers who were well buffered against the additive were not rushed to the hospital or strapped into straitjackets. There was no arguing with the report's finding that safety precautions did the job.

The federal panel did issue one cautionary note however: exposure levels would probably rise as more and more people took to the road. Perhaps at a later point, the scientists suggested, the research should be taken up again. It was always possible that leaded gasoline might "constitute a menace to the general public after prolonged use or other conditions not foreseen at this time."

But that was the future's problem. In 1926, citing evidence from the TEL report, the federal government revoked all bans on the production and sale of leaded gasoline. The reaction of industry was jubilant; one Standard Oil spokesman likened the compound to a "gift of God," so great was its potential to improve automobile performance.

TOXICOLOGISTS like Alexander Gettler had more urgent worries about risks in the age of the automobile: focusing on other chemicals released in engine exhaust. When gasoline or any other carbon-rich fuel burned in the modern engine, a cascade of reactions resulted, atoms separating and recombining, loose carbon bonding with circulating oxygen. Those carbon-and-oxygen connections, in particular, created two differently troublesome gases: carbon dioxide and carbon monoxide.

In general, when fuel combustion is highly efficient, the main by-product is carbon dioxide—a single carbon atom attached to two oxygen atoms. No scientist really considers carbon dioxide a poison, not in the routine sense of the word. It is a natural by-product of the human metabolic process, among other things. When people breathe, inhale air, they take in oxygen, then exhale back out carbon dioxide (created in the carbon-rich interior of humans and other animals).

Carbon dioxide (CO_2) occasionally killed directly in the 1920s, but rarely. Such deaths occurred when CO_2 displaced oxygen in a tightly closed space. In transporting fruits and vegetables, for example, shippers often kept the produce cold with superchilled carbon dioxide. At about 103 degrees below zero Fahrenheit, the gas freezes to a solid, turning into glassy-looking chunks of exceptionally cold material. As the chunks warm and "melt," they return directly to a gaseous state, giving the material the nickname "dry ice." In an unventilated space, this seeping release of carbon dioxide will gradually replace oxygen, suffocating anyone inside.

Five longshoremen were once found dead in the cargo hold of a steamer docked in Brooklyn on the East River. The boat had been carrying cherries from Michigan, preserved in a chamber kept chilled with dry ice; the boat workers had been bunking in the room where the fruit was stored. Norris's office found that the men's blood was "saturated with carbon dioxide and the men had obviously died from asphyxia." Hastily taken air samples had confirmed that the room was saturated with the gas.

But as the pathologists emphasized, they'd had to move quickly before the gas was diluted. Carbon dioxide is always found in human blood; and it rises to unusually high levels with other forms of suffocation as well. So carbon-dioxide-rich air samples were essential to determining the method of suffocation. "Exactly the same autopsy picture would have been found if the men had died from being smothered by holding, say, a pillow over their mouths," one of the medical examiners noted later in his memoir.

"This brings up a rather interesting possibility for a method of murder that would be extremely difficult to detect," the doctor, Edward Marten, continued. "I pass this on, for what it is worth, to writers of detective stories." In his scenario, a sleeping or heavily intoxicated person slumbers in bed. The killer places a bucket, packed with dry ice, on the floor and carefully shuts the windows and door as he leaves. Within a few hours the victim suffocates. When someone opens the door, normal air refills the room, whisking away all trace of the murder weapon: "The trick is that when dry ice evaporates it leaves absolutely no trace behind, so that the investigating detectives would find nothing except a dry and completely empty pail." Still, Marten considered that a better tip for fiction writers than for real-life killers. The purchase of dry ice was easy to track, the material was tricky to handle, and the gas was rarely and unreliably deadly.

ON THE other hand, carbon monoxide proved an exceptionally reliable killer.

Carbon monoxide (CO) is also largely an industrial by-product. When fuel does not burn cleanly away, the process is called incomplete combustion. This less efficient use of fuel makes less oxygen available, creating a situation where, frequently, each atom of carbon bonds with only one atom of oxygen, a connection multiplied millions of times over.

CO is relatively rare in nature—it forms in the wake of lightning strikes, forest and grass fires, and any event that causes a carbon-rich fuel to burn. Once in the atmosphere, it tends to attach to other free oxygen, converting to carbon dioxide and dispersing. Still, as a 1923 toxicology text noted, it is always present "to a more or less extent wherever man lives and works."

The gas was first synthesized by a French chemist, who in 1776 heated zinc oxide with coke (a concentrated form of coal). He'd watched the coke ignite with a beautiful blue-violet flame, a color that scientists would later realize was a signature of carbon monoxide as it burned.

Carbon monoxide drifted out of lime kilns, brick kilns, charcoal kilns, burning buildings, stoves, grates, braziers, salamanders (broilers), coal-stoked furnaces, gas-water heaters, gas lighting, the smokestacks of trains, and of course, the tailpipes of automobiles. Auto exhaust contained up to 25 percent carbon monoxide, according to tests done in 1926. An even more concentrated source, though, was illuminating gas. This fuel, produced from coal processing, consisted mostly of carbon monoxide and hydrogen. Illuminating gas was preferred for lighting because it produced a particularly bright flame, but it was also used to power stoves, heaters, and even refrigerators. Some of these appliances had registered gas leaks containing more than 40 percent carbon monoxide.

The risks associated with inhaling high levels of carbon monoxide had been realized quickly, mostly because they made themselves so apparent. Consider the effect of even a small car, a 22-horsepower Model T, left running in a closed garage. An engine that size generated twenty-eight liters of carbon monoxide a minute. Some toxicologists calculated that "this is sufficient to render the atmosphere of a single car garage deadly within five minutes, if the engine is run with the door closed." The federal government issued a more conservative estimate of ten minutes.

Charles Norris estimated that carbon monoxide killed nearly a thousand residents of New York City every year. Breaking Norris's numbers down further—say, for the single year 1925—his records showed 618 accidental carbon monoxide deaths, 388 suicides, and three homicides. The most inventive of the murders involved a man killed by having a gas tube forced into his mouth until the carbon monoxide killed him. The killer then put the dead man into a water-filled bathtub and reported his death as an accidental drowning.

Unfortunately for the murderer, the man's lungs contained no water. And when Gettler ran the toxicology tests, evidence of carbon monoxide almost literally spilled out of the blood.

MOST CARBON MONOXIDE murders involved faking an accident. The standard approach was to blame the death on a leaky heater or poorly closed gas valve, setting it up as just another of the many sad fatalities in the city. Both police and medical examiners acknowledged that these crimes were often difficult to detect, and undoubtedly some murderers were never caught.

But law enforcement officials had exposed enough of these schemes to warn against homicidal overconfidence.

One such success, which would be cited by forensic scientists for years following, occurred in the fall of 1923. An out-of-work painter named Harry Freindlich took out a $1,000 life insurance policy on his twenty-eight-year-old wife Leah, smothered her while she lay sleeping, and then attempted to cover it up.

Freindlich was desperate for money at the time, desperate about everything: he was jobless and unable to pay the rent, much less provide food for his family. The family home was a bare cut above living on the street anyway, a battered tenement on Manhattan's Lower East Side. The paint was peeling off the walls. The floors were splintered. They'd been patching the appliances together with cardboard, glue, solder, anything. It was one of these cracked appliances that gave him the idea—a gaslight in the bedroom with a troublesome broken fitting that he had soldered back together more than once.

On an early October morning Freindlich put a pillow over his wife's face and pressed it tight until she quit breathing. He then tossed the pillow aside and wrenched apart the soldered light. When he heard the hiss of the gas, he hurriedly left the room, closing the door sharply behind him, leaving his dead wife lying beside the baby son she'd brought to bed with her. As the police pieced it together, he then walked out of the apartment, not trying to save the baby or any of the other children sleeping there.

But that tossed-aside pillow had dropped right on top of the sleeping infant. The little boy abruptly woke and began crying, struggling to get free. The Freindlichs' oldest child, a ten-year-old boy, heard his baby brother wailing and ran in to see what was wrong. He tried to shake his mother awake. But she didn't respond, no matter how hard he shook her. Now sobbing, he grabbed the baby and ran to the apartment next door. The neighbor grabbed a candle and hurried to check the darkened apartment. When she saw the dead woman in the bed, she ran to the grocer's place downstairs to call the police.

At first it looked like just another accident, maybe a suicide. Leah had been a sweet woman, the neighbors told the police, but worn down, just tired out. But something about the neighbor's story bothered the beat cops. If there was a lethal amount of illuminating gas in a room, it almost always ignited in the presence of fire, thanks to its explosive mixture of carbon monoxide and hydrogen. Apartments in the city blew up on a semiregular basis when someone unwittingly struck a match in a gas-filled room; Norris's office kept a file full of pictures showing blackened walls and fragmented furniture.

If illuminating gas had poisoned Leah Freindlich, it would have built up in the apartment. The room should have flashed to fire when the Good Samaritan ran in with her candle.

Back at the Bellevue morgue, the pathologist found the scenario equally dubious. The dead woman was sheet pale, all wrong for carbon monoxide poisoning, which tended to flush the skin pink. Before beginning an autopsy, he drew blood samples from her body and asked for a quick analysis from Gettler's laboratory. The lab results showed that the blood was loaded with carbon dioxide, the typical finding in suffocation, but there was no evidence of carbon monoxide. When the pathologist looked more closely at the body, hidden in the hair at the back of her neck he found a black bruising of fingerprints where someone had pressed fiercely against her skin.

Freindlich broke into sobs when he was arrested and begged the police to take him to the roof so that he could throw himself off. He couldn't have killed his wife, he said—no one could have wished her harm. He couldn't go to jail; what would happen to his children?

He wanted his old life back.

Carbon monoxide can be considered as a kind of chemical thug. It suffocates its victims simply by muscling oxygen out of the way.

In humans and many other animals, oxygen is transported in the bloodstream by the protein hemoglobin. Hemoglobin is classed as a metalloprotein because it contains the metal iron. Its structure, known as a heme, resembles a bright cluster of protein balls around a darker iron core. The iron in hemoglobin stains red blood cells, giving them that deep crimson color even as the protein itself efficiently moves oxygen through the body.

When a person inhales oxygen, the gas diffuses out of the lungs and into the bloodstream. Then because oxygen molecules are so attracted to iron, they bond to the hemoglobin. The result is called oxyhemoglobin, and in that neat package, the life-sustaining gas is delivered to cells throughout the body. It seems a beautifully designed system. But a chemical vulnerability is built into it, which becomes very apparent with exposure to a poison such as cyanide or carbon monoxide. Both poisons attach to hemoglobin far more effectively than oxygen.

Thus, these two chemical compounds are life-threatening because they are opportunistic, making deft use of the body's essential metabolic systems. The attraction between hemoglobin and carbon monoxide is some two hundred times stronger than that between hemoglobin and oxygen. No wonder that CO—as an invading gas—can cram into the blood cells, its tighter grip allowing it to displace the looser oxygen bonds.

Oxyhemoglobin disappears; the blood becomes saturated instead with carboxyhemoglobin, crowding oxygen from the blood, locking it out of cells. The result is a chemical suffocation.

The early symptoms of acute CO poisoning are drowsiness, headaches, dizziness, confusion, and occasional nausea. In the alcohol-hazed 1920s doctors tended to mistake CO poisoning for drunkenness, according to records kept by Norris's office. Sometimes the physicians just dismissed signs of CO poisoning as the common mental illness seen among the city's derelicts. That wasn't necessarily surprising either. Exposure to carbon monoxide can also induce dementia, memory loss, irritability, a staggering loss of coordination, slurred speech, and even a deep feeling of depression.

Physicians so often got it wrong, at least in 1926, that a CO poisoning was often recognized just at the point when it was too late to save the victim. Or after the patient had been sent to the morgue.

THERE AT Bellevue, in that sanctum of the dead, it took only a few simple tests to reveal a carbon monoxide death—or the absence of one, in the case of Leah Freindlich.

As CO absorbs into cells, it turns arterial blood from its normal dark bluish-red into a bright cherry color. The bright blood pinkens the skin at the same time, flushing it a deep rose color, sometimes mottled with red spotting. That was why Leah Freindlich's pallor alerted the pathologist on duty—he knew it contradicted the scene set by her husband.

On autopsy, following a carbon monoxide death, the muscle tissues gleam with crimson; so do the organs. The membranes of the throat and lungs are bright red, often covered by a weirdly frothy mucus layer. The brain can appear battered—swollen, dripping with bloody fluid. The cortex can be softened and blood-streaked. Some toxicologists argue that CO ultimately kills by damaging nervous system tissue until the lungs themselves are paralyzed.

In Alexander Gettler's laboratory, one of the simplest ways to test for CO was to extract blood from the corpse, pour some of it into a porcelain dish, and stir in some lye. Lye (a compound of sodium, hydrogen, and oxygen also known as caustic soda) turns normal blood into a dark, gelatinous ooze that, when held to the light, shows murky layers of greenish brown. But blood saturated with carbon monoxide doesn't darken that way; it stays an eerie, after-death crimson even as it jells, resembling glossy reddish aspic set into the white dish. In every chemical test, though, no matter what combination of materials is mixed into the blood, the dark/bright distinction persists. Blood containing oxyhemoglobin thickens to black, dark brown, or gray. Blood containing carboxyhemoglobin remains, as they say, blood red.

Chemists weren't sure exactly what produced that contrast, but they suspected it had something to do with the relentless grip that carbon monoxide exerts on iron components in hemoglobin. The strength of that connection, scientists speculated, might prevent the hemoglobin from breaking down so quickly, thus enabling it to keep staining the blood cells iron-red. But the looser bonds with oxygen might, instead, allow a decomposition of the iron, essentially causing a kind of tarnishing effect, in the way of any oxidized metal, darkening the blood as it did so.

That explanation was mostly educated guesswork, but of this one thing Gettler and his fellow toxicologists were certain: carbon monoxide did not like to let go of hemoglobin. Left for weeks during time tests, residing in stoppered bottles on the wooden counters of Gettler's lab, solutions containing carboxyhemoglobin would glow like the crimson hourglass on the abdomen of a black widow spider, like the clear carmine red of warning lights signaling danger to those who got too close.

WHEN Charles Norris started as medical examiner, he'd decided to track every accidental illuminating gas death that occurred on his watch.

During his first month in office—January 1918—there were sixty-five such fatalities, an average of two a day.

The details of those deaths made it obvious that carbon monoxide does not discriminate in its victims. In the right circumstances, it will kill anyone. A newly married couple in an elegant brownstone just off Fifth Avenue on the Upper East Side were killed by gas escaping from a defective rubber hose; a woman living in midtown Manhattan was killed by gas escaping from tubing leading to a stove; a man on the Lower East Side was poisoned by gas escaping from a radiator; a man on the Upper West Side fell into bed drunk and failed to notice that the flame had blown out on two gas jets that fed the lamps in his room; a city inspector was killed by illuminating gas while inspecting the water meter in a basement; a man on Morningside Avenue, on the Upper West Side, was killed by gas escaping from a small gas heater in the bathroom.

In 1925 the details were of the same order, but the number of fatalities had gone up.

That January fifteen people were killed by gas in one terrible day. Among them—a man in Yonkers, killed by gas escaping from an unlighted burner on a stove; a baby, dead when his mother placed him by a poorly fitted stove for warmth; a Long Island man, killed by a leaky furnace; a Bronx man, his wife, and a guest staying in their apartment, dead due to another unlighted stove burner; a young mother and her baby, killed in Brooklyn by a faulty gas heater.

The U.S. Bureau of Mines, which had been investigating carbon monoxide risks in coal mines, released a report in the summer of 1926 stating that "the public generally does not appreciate the danger from gas leaks." The government was also weary of people reporting that a trained killer had set off a bomb when in actuality someone had merely left a gas jet open and then lit a cigarette. The bureau wanted to reassure the country's citizens that not every residential explosion was the work of the Black Hand Society.

It was usually the result of common carelessness.

. . .

The Black Hand—*La Mana Nera* in Italian—was an extortion syndicate organized by immigrants in New York and elsewhere (Chicago, San Francisco, and New Orleans) that used a simple and successful formula to acquire money. A letter was sent to a given target (often another Italian-American) threatening murder, arson, or kidnapping, sometimes all three, unless the society was paid off. The syndicate thrived by making good on its threats. It also believed in theatrical demonstrations, such as blowing up a car or apartment, shredding both property and victim into pieces. As its reputation for terror grew, the letters needed only the most basic signature—a hand printed in black ink.

In New York the Black Handers were mostly former Sicilians, headquartered in the neighborhood of Little Italy. One of the society's leaders, nicknamed Lupo (the Wolf), was so feared by other immigrants that they routinely crossed themselves at the mention of his name. The Wolf's favorite way to kill was to strangle a victim and then set the body on fire, preferably in a park for public viewing. Lupo and his colleagues did their best work in the early twentieth century, killing even police officers who interfered with their work. In 1909 the syndicate murdered a Manhattan police lieutenant in charge of the city's Italian Squad, which had been created as a response to organized crime. The lieutenant's funeral drew 250,000 mourners, a testament not only to how much he was admired but to how much the society was hated.

By the mid-1920s the Black Hand's tactics had mostly fallen out of fashion. The newer crime bosses felt that the extortion ring attracted too much attention; furthermore, the profits from bootlegging made blackmail schemes unnecessary. (The federal government estimated liquor syndicate profits at $3 billion in 1926.) But its name was still invoked to terrorize the disobedient. Thus the reaction to explosions that the government found so irritating. "Many disastrous explosions in buildings that are attributed to the Black Hand bombs or other mysteriously placed explosives are found on investigation to be caused by gas accumulations from leaks or burners that have become extinguished by drafts," the bureau noted stiffly.

The government suggested that the greater risk was the silent, far-too-pervasive leaking of illuminating gas into people's homes. In New York City alone deaths from illuminating gas continued to rise: 519 accidental asphyxiations reported in 1924 and 607 in the following year.

The Black Hand, at the height of its power, had never killed so many in one year.

THE LEAH FREINDLICH case posed a fascinating question for Gettler, at least the kind of question that obsessive forensic toxicologists find fascinating: could carbon monoxide be absorbed after death?

Leah Freindlich's blood had contained no meaningful carboxyhemoglobin, proving that the illuminating gas hadn't killed her. But what if the baby hadn't cried? What if the neighbor hadn't hurried to help, or the police had been slower to arrive? What if her body had had a few more hours to steep in the gas? Given more time, would the evidence have been blurred as the gas crept into the body?

There were a few tentative reports concerning such questions. For example, in a 1909 experiment a German researcher had exposed four stillborn babies to carbon monoxide for a full day. He reported that he saw signs of the gas in the lungs but nothing in the blood, not even in the heart. His conclusion was that if the gas were absorbed after death, it was only in bare trace amounts. Gettler thought the German scientist might be onto something. He just wished the study had been more meticulous. The researcher had merely recorded his observation of cherry-red color in lung tissue. He hadn't run tests for carboxyhemoglobin; he hadn't analyzed blood samples; he hadn't produced the kind of enduring results that could be considered valid some fifteen years later.

Alexander Gettler wanted solid numbers, real data, as close to certainty as he could get. If the experiment he wanted didn't exist, he would just create it himself.

He started with a small collection of dead cats, collected from a city animal shelter. He then methodically exposed the bodies to carbon monoxide, putting them one at a time into a metal box, piping in illuminating gas through a small hole, sealing the box, and letting the cat corpses remain in that CO-soaked environment for one to five days. Gettler then drew blood from the animals, from locations around the body, including the heart.

He was looking for that familiar bright discoloration in the blood, for the chemical signature of carboxyhemoglobin. First, though, he would have to adjust for an environmental complication: exposure to city air.

THANKS TO THE streets overflowing with automobiles, the increasing reliance on gas appliances, and the sprouting of industrial factories along urban corridors, every living creature, especially in the big cities, now inhaled a constant dose of carbon monoxide.

Animal studies conducted in New York showed that dogs and cats, for instance, had a predictable amount of carboxyhemoglobin saturating their blood. The average saturation in rural areas was less than one percent; but in New York City, CO levels in household pets and feral cats, like those in Gettler's study, ran 1.5 percent or higher.

Even after five days of concentrated CO exposure, however, Gettler's dead cats remained at a basic urban blood level. That result suggested that the gas did not permeate their bodies after death. It seemed probable that the same would be true in people. To be sure, he needed to conduct similar experiments on dead human beings.

This was where working in a medical examiner's office offered an important advantage; dead bodies were the routine of each working day.

Most of the corpses that came to the morgue had families, friends, or lovers who claimed them. But others seemed to belong to no one. They were the unwanted children—the baby who had been found stuffed into a Gladstone bag and left on an Upper West Side sidewalk—the floaters from the East River, the bums from the Bowery who drank a lethal dose of Smoke and turned up tumbled along the brick wall of an alley. Their bodies ended up in Potter's Field, the city burial ground for the John and Jane Does of the morgue, the unknowns, the lost, the bodies left unclaimed because their families couldn't afford to give them a burial.

The city and the state now had so many alcohol-poisoned dead that one New York assemblyman compared Prohibition enforcers to the Borgia family. "The government," he warned, "is surpassing the Italian fiends of the Middle Ages by dealing death to its own people, who constitute the backbone of the Republic." There were so many corpses that the city could hardly keep up with burying them. In the midst of that overload, Norris decided to let Gettler experiment on three of the Bowery dead, currently residing in the refrigerated drawers of the morgue's storage room, destined for unmarked pauper's graves.

To do the experiment, Gettler had a larger metal box built: six feet long, two and half feet wide, and two feet deep. The tightly fitted lid had a rubber gasket set in place where a tube could be inserted to pipe in carbon monoxide. Each end of the box was fitted with a stopcock. Each time "the body was placed in the box and the lid was fastened tightly," Gettler wrote, "illuminating gas was passed through the box for thirty minutes and the stopcocks then closed."

He left the first two dead men in the box for twenty-four hours, the third for forty-two hours. In all three cases, just as with the cats, the blood in the dead men's hearts remained at normal urban levels. Soaking in carbon monoxide for hours after death had had no effect at all. Death created its own bleak protective shield; without breath, carbon monoxide was just another gas aimlessly swirling in the air.

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IN OCTOBER 1926 Norris issued his yearly analysis of deaths in New York City. He'd instituted that procedure when taking office. Insurance companies around the country now requested the report.

This one confirmed that automobiles and their often-drunken drivers remained the city's greatest killers, taking 1,272 lives in a year. There had also been 984 suicides (almost 400 by illuminating gas), 356 murders (mostly shootings), and 585 alcohol-related deaths. There was also the elevator problem: 87 people had died in elevator accidents during the year—47 falls into open shafts, 36 crushed by the doors, three killed when cables broke and the machines fell.

Then six people had been killed playing baseball, six people had died in sleighing accidents, football had killed one, three had died in fistfights, and eight people had lost their lives in diving accidents. The list could go on and on—and did. The medical examiner's office counted a total of 5,581 deaths from such nonnatural causes that year, which—as Norris also noted—was pretty average for the city.

THE GLOOMY STATISTICS led the way into a chilly December, clouded by fog. The mist lapped along the rivers and muffled the harbors; stranded vessels in low-floating clouds gave an eerie unreality to the usual creak of boats rubbing against docks in the water. Footsteps thudded unexpectedly in the mist; people startled at the most ordinary sound.

In the first week of that foggy month, far too early in the morning, a Brooklyn police officer patrolling along the East River saw a man moving stealthily toward a poorly lit part of the wharf where freight-bearing ships from India docked. There was a full moon and the wind was shuffling the mist. The officer could see that the man was bent slightly, carrying a heavy-looking bundle, as he approached the India Wharf.

Curious, the patrolman edged closer. The man placed his burden on the edge of the pier. Officer James Anderson shouted for him to stand still. He wanted to look at the bundle. But the man instead kicked the object into the river and fled into the mist. Anderson shouted again, and then pulled out his revolver and fired it three times into the air.

Another patrolman, hearing the shots, came running and almost collided with the fugitive, tackling him to the ground. What was that package? the police asked. Who are you? What are you doing here? The man looked like a workman, dressed in corduroy pants, a heavy pea jacket, and a cap pulled down over his forehead. He was dark, short, and silent. He shook his head, refusing to answer.

The policemen's voices became louder, repeating the questions. The man still shook his head, glaring back at them. The rumble of a car's engine drawing closer made them all jump. It was a battered black taxi, and the driver, on his way home, had seen the chase. He could at least identify the man in the pea jacket as his neighbor. Both lived in a cluster of apartments on Sackett Street in Brooklyn. The man being questioned was a longshoreman named Francesco Travia.

Even through the shadows, the cops thought Travia looked ill, oddly flushed, his face rimed with black stubble. He folded his arms tighter. He wouldn't tell them what was in the bundle, now vanished into the river. He wouldn't tell them why he was there on the India Wharf. They took him back to the Hamilton Street police station and studied him in the light. The bottoms of his gray trousers were smudged dark red. Take off your shoes, they said. His socks were sodden with blood.

The officers locked him into a cell and went directly to his apartment. It was what people sometimes called a bloody shambles. On the kitchen floor was a dead woman. Or rather half a dead woman. The upper part of the body—torso, arms, battered head—lay between the table and the stove in a clotted pool of red. A spattered butcher's knife and a chisel sat on a table, smeared and streaked with gore.

The officers returned hastily to their precinct station and formally arrested Travia on murder and dismemberment charges. A day later the medical examiner's office, Charles Norris and Alexander Gettler working in tandem, would prove the police wrong.

THE OFFICE was short-staffed that night, so Charles Norris was on call. He made his usual entrance, even at three in the morning, stepping out of his chauffeur-driven automobile, dressed against the cold in dark overcoat and fedora. He followed the policemen up the wooden stairs to Travia's apartment, laid his outer garments on a chair, and walked over to inspect the dismembered corpse.

His thick eyebrows drew together in a familiar frown. The blood pooled around the half-body was a bright cherry red. He bent to look closer at the woman's face. It was flushed pink, even following this horrible death. Norris's reaction was recorded by a crime writer and would later become part of his often theatrical legend. He walked over to the waiting detectives and announced, "Boys, you can't hold this man for murder."

The Brooklyn police assured him that they could.

The body was taken to the Bellevue morgue. It had barely arrived when the cops at the Hamilton Street station called to say they were sending a man and his daughter down to look at the body. The sixteen-year-old daughter had come to the police station to report her mother missing. The girl's description—a stocky woman in her early forties with dark hair, heavy brows above brown eyes, a round face, and a thick neck—matched their corpse perfectly.

It took Alice Fredericksen and her father, Frederick, a while to get to Bellevue by train and surface car. In the interim the morgue attendants did their best to disguise the damage, heaping sheets over the corpse until only the face was visible. When Fredericksen arrived, he took one shrinking look and identified his wife, Anna, lying on the marble table.

On further inquiry, it turned out that the Fredericksens knew the murder suspect. Their family ran a rooming house on Henry Street, around the corner from his apartment building. Travia was a loner and a drinker, but no one had thought of him as a violent man. And Anna had been plain easygoing, not the kind of woman to provoke a murder. Both father and daughter were shocked—and bewildered.

IN HIS quiet laboratory, Gettler took blood from Anna Fredericksen's heart and began putting it through the standard chemical tests. In each glass vessel, each ceramic dish, the bloody solutions, instead of turning the darkish grays of normal oxygenated blood, flamed that brilliant red. Her blood was saturated with carboxyhemoglobin. And as corpses didn't absorb the gas, and as the saturation level was lethal, Anna Fredericksen had been dead, Gettler reported, before Travia had picked up his knife.

FRANCESCO TRAVIA had come to New York with his children twenty-two years earlier, after his wife died in Italy. His parents had immigrated before him; they still lived in Coney Island. Once in New York, he'd decided on a new and solitary life. He took to calling himself Frank, left his children with his parents, found a job, and stayed alone in his little apartment. He preferred to drink alone as well, spending his Saturday nights with a pint of whatever bootleg whiskey was available.

As he told investigators—in a sudden, frightened confession—Anna Fredericksen had come by in search of some booze. They were out of alcohol at home, she complained. She was known as a heavy drinker in the neighborhood. Her husband admitted to police that she "frequently drank intoxicants" and that her usual bootlegger had been unable to deliver that weekend.

Travia said that he and Anna had finished his own supply of liquor, sitting at his kitchen table. When he tried to get her to leave, they'd fallen into an argument, and then, well, he'd felt incredibly sleepy and had fallen asleep at the table. He woke sometime later, he wasn't sure, foggy-headed. She was still there, lying on the floor. He went to shake her awake. She was creepily cold to the touch, creepily stiff. He could only think, he told police, that he must have killed her while they'd argued, shaken her to death, strangled her, he didn't know. But he did know there was a dead woman on the floor. And, he was absolutely sure that he'd be charged with murder once she was found.

So there in the dark of early morning, he decided that his only chance was to get rid of the body. But she was a big woman, tall and chunky, too large to simply haul away over a shoulder. Maybe the alcohol had confused him, he admitted, or maybe it was something else. But Travia decided that he'd have to cut her into smaller pieces and then get rid of her one part at a time.

He used his butcher knife to do the sawing and his chisel to splinter through the bones. Then he wrapped the lower half of her body in newspapers, burlap bags, and an old raincoat and carried it down to the river. He hadn't figured out what to do with the upper half, but then he never got that chance. That was his story. He swore it was true. And whether one believed it depended on whether one believed in the scientific results from Bellevue.

NORRIS COULD talk all he wanted about the significance of pink faces; Gettler could discuss carboxyhemoglobin until he grew hoarse. But in Brooklyn the police found bloody knives and body parts more convincing.

Which meant that Francesco Travia was, after all, arraigned to stand trial on murder. And as Charles Norris saw it, the New York City medical examiner's office would have a date in court, a chance to prove very publicly that scientific evidence was a tangible thing, as real, as convincing—and as influential—as any other evidence presented in a courtroom.

Some months later, in March 1927, a Kings County jury acquitted Frank Travia of murder. Norris had predicted that the gruesome nature of the case would make sure people paid attention. In fact, publicity surrounding his case had gained Travia an unusually well-connected young lawyer, Alfred E. Smith Jr., son of the governor of New York.

It was Smith Jr.'s first case, and it went perfectly for him. Unlike the police, he'd found the medical evidence very impressive, enough so that he built his whole case around it. Smith's witness list was short: the building owner, to say that he'd discovered that a coffeepot on Travia's stove had boiled over, putting out the burner flame, allowing gas to drift through the apartment; Alexander O. Gettler, to testify that carbon monoxide poisoning had caused the woman's death; and Frank Travia, to describe his panicked reaction on finding her dead.

Travia was found not guilty of murder but guilty of illegally dismembering a dead body. The difference was enormous; it meant that he went to prison instead of the electric chair. When the trial concluded, Travia's attorney returned home and found a telegram from Albany waiting for him. The governor wanted to congratulate him on his debut as a criminal lawyer, on proving that the cause of death was not a drunken Italian laborer but an all-too-common, all-too-lethal household gas.

THE GOVERNOR did not also congratulate the scientists of the medical examiner's office, but they celebrated anyway. All that patient chemistry, all Gettler's time-consuming experiments with carbon monoxide, had helped save a man from the electric chair, despite the doubts expressed by the police. As much as Norris's lectures at the police academy, as much as those scheduled tours of Gettler's laboratory, the Travia case illustrated that forensic toxicology was a powerful—and credible—tool.

The days when chemists killed cats in courtrooms, and medical experts waved chloroform vials in front of nervous jurors, were demonstrably over.

They could make their points with sober testimony and charts of chemical analysis. They hadn't entirely figured out carbon monoxide, true, and no one was sure how to contain the environmental hazards posed by the gas. But Norris and Gettler had saved one life this day, and they were confident that they could save others.

Call it a coming-of-age party for forensic toxicology—there in the third-floor laboratory at Bellevue the bubble and hiss of beakers sounded like victory music in the air around them.