DNA's Dirty Little Secret

A forensic tool renowned for exonerating the innocent may actually be putting them in prison.

By Michael Bobelian

Three days before Christmas 1972, a twenty-two-year-old nurse named Diana Sylvester wrapped up her night shift at the University of San Francisco Medical Center and made her way to her apartment, halfway between the hospital and Golden Gate Park. She arrived around 8:00 a.m. and set her newspaper and purse on the kitchen table. A few minutes later, Sylvester's landlord, Helen Nigidoff, heard loud thuds and screams emanating from Sylvester's unit upstairs. With her apron still on, Nigidoff rang the doorbell before opening a door leading up to Sylvester's apartment, where she came face-to-face with a stranger. "Go away," he growled angrily. "We're making love." As Nigidoff raced downstairs to call the police, the man ran out of the building holding a denim jacket over his face.

When the officers arrived a half hour later, they found a gruesome scene. Sylvester lay motionless next to the Christmas tree on her living-room floor, her mouth unnaturally agape, blood oozing from her chest like molten lava. An autopsy revealed that Sylvester's attacker had forced her to perform oral sex and then strangled her, before plunging a knife into her chest two times. One stab pierced her heart. The other tore through her left lung, drowning her in her own blood.

Police immediately scoured Sylvester's apartment and questioned the landlady, who offered a description of the assailant: white, medium height, and heavy-set, with curly brown hair and a beard. But neither these details nor the bits and pieces of evidence they collected in the months-long investigation

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that followed were enough to pinpoint the culprit. The few leads investigators turned up fizzled, and the case went cold.

Then in early 2003 the San Francisco Police Department, which had received a grant to use DNA technology to crack unsolved crimes, dug Sylvester's case file out of storage and discovered a slide with sperm that had been swabbed from Sylvester's mouth after her death. The sample was badly deteriorated and contained less than half the DNA markers that are normally used to link a suspect to a crime. But investigators ran the profile through California's DNA database and turned up a match: an ailing seventy-year-old man named John Puckett, who had a history of sexual violence. There was no other physical evidence linking him to the crime. But Puckett was arrested, tried, and eventually convicted based mostly on the DNA match, which was portrayed as proof positive of his guilt—the jury was told that the chance that a random person's DNA would match that found at the crime scene was one in 1.1 million.

Juries in cold-hit cases are rarely, if ever, presented with evidence on the high probability of coincidental DNA matches. When they see DNA evidence, most defense attorneys assume the case against their client is airtight and start praying for a plea bargain.

If Puckett's were an ordinary criminal case, this figure might have been accurate. Indeed, when police use fresh DNA material to link a crime directly to a suspect identified through eyewitness accounts or other evidence, the chances of accidentally hitting on an innocent person are extraordinarily slim. But when suspects are found by combing through large databases, the odds are exponentially higher. In Puckett's case the actual chance of a false match is a staggering one in three, according to the formula endorsed by the FBI's DNA advisory board and the National Research Council, a body created by Congress to advise the government and the public on scientific issues. But the jury that decided Puckett's fate never heard that figure. In fact, his lawyers were explicitly barred from bringing it up.

Over the past quarter century, DNA evidence has transformed criminal justice, freeing hundreds of innocent people and helping unravel countless crimes that might otherwise have gone unsolved. It has also captivated the public imagination: the plots of popular TV crime shows often hinge on the power of DNA to crack impossible cases, which has helped to give this forensic tool an air of infallibility—a phenomenon known in criminal justice circles as "the CSI effect." This failsafe image is not entirely unfounded, especially when it comes to traditional applications of DNA evidence. But increasingly DNA is being used for a new purpose: to target the culprits in cold cases, where other investigative options have been exhausted. All told, U.S. law enforcement agencies have conducted more than 100,000 so-called cold-hit investigations using the federal DNA database and its state-level counterparts, which hold upward of 7.6 million offender profiles. In these instances, where the DNA is often incomplete or degraded and there are few other clues to go on, the reliability of DNA evidence plummets—a fact that jurors weighing such cases are almost never told. As a result, DNA, a tool renowned for exonerating the innocent, may actually be putting a growing number of them behind bars.

When police initially investigated Sylvester's murder in the early 1970s, the lead suspect was a man named Robert Baker, who just a month before the attack had escaped from a mental hospital and was living in a rundown Volkswagen bus near Fisherman's Wharf. Baker matched the description given by Sylvester's landlady, and two weeks before Sylvester's murder he had snuck into the apartment of another woman who lived just four blocks away and forced her to perform oral sex (a crime for which he was later convicted). In that case, as in Sylvester's, there was no sign of forced entry or a struggle. And while he hadn't killed the woman, he had threatened to do so, telling her, "I can rape you now or after you're dead." Days after Sylvester was killed, Baker also allegedly harassed a woman and a young girl, following them to their home just a few doors from Sylvester's apartment.

There was also other evidence linking Baker to the crime. When police searched his van, for instance, they found a blood-spattered parking ticket, and the blood type matched Sylvester's. And there was a good chance he came into contact with Sylvester just before her murder, as he was one of the street vendors peddling wares outside the hospital where she worked. In fact, that morning Sylvester had lingered around the hospital after her shift, waiting for the vendors to open for business so she could buy a candle for her boyfriend. Police suspected Baker saw her shopping and followed her home. Despite this evidence, Baker, who died in 1978, was never charged with Sylvester's murder (the reasons for this are not made clear in the case file), and the investigation eventually went cold.

Then in 2003 police reopened Sylvester's case file and found the DNA sample. When analyzing DNA, scientists ideally focus on thirteen markers, known as loci. The odds of finding two people who share all thirteen is roughly on par with those of being hit by an asteroid—about one in a quadrillion in many cases. But the fewer the markers, the higher the probability that more than one person will match the same profile, since relatives often share a number of markers and even perfect strangers usually share two or three. In Sylvester's case,

the DNA was so degraded that the crime lab was only able to identify five and half markers; California requires a minimum of seven to even run a profile against its felony database. This meant the lab had to rely on inconclusive readings for two markers—one was so inscrutable, in fact, that there were three possible interpretations, each of which presumably could have led to a different suspect.

Part of the reason for the ambiguity was that, besides being deteriorated, the material was what is known as a "mixed sample," meaning it contained DNA from both Sylvester and the perpetrator. Bonnie Cheng, the crime lab technician who did the analysis, argued that this was not a significant stumbling block—outside of the one marker, where she acknowledged a mixture was present, she testified that it was "highly unlikely" that there was much mingling of genetic material. This runs counter to the views of most experts, who insist that mixed samples tend to be blended throughout, making it exceedingly difficult to separate one person's DNA from another. In 2005, Peter Gill, then a researcher at the Forensic Science Service, which administers the national DNA database for the British police, told a conference of forensic scientists, "If you show ten colleagues a mixture, you will probably end up with ten different answers." Dan Krane, a molecular biologist at Wright State University and a leading critic of the government's stance on DNA evidence, agrees. "There is a public perception that DNA profiles are black and white," he told me. "The reality is that easily in half of all cases—namely, those where the samples are mixed or degraded—there is the potential for subjectivity."

Once the San Francisco crime lab had completed its analysis, police ran it against California's offender database, which at the time contained DNA profiles of 338,000 convicted sex offenders and violent criminals. One name turned up: John Puckett. Puckett had not been a suspect during the original 1972 investigation, and detectives didn't bother looking into any of the twenty men who were. Instead, they relied wholly on the DNA match.

Puckett first learned of the evidence against him in October 2005, when Inspector Joseph Toomey, a veteran of the San Francisco Police Department's homicide unit, made his way to the trailer park where Puckett lived with his wife on the outskirts of Stockton, a gritty, industrial enclave east of San Francisco. The suspect, who was recovering from heart bypass surgery, hobbled to the door clutching a bag of his own urine. Toomey introduced himself, then launched into questioning. Holding up a picture of Sylvester and her boyfriend that had been clipped from an old newspaper article, he asked Puckett whether he knew her. Puckett said no. "You never had sex with that girl?" Toomey prodded. "I don't know her," Puckett insisted. "Never seen her."

In the months that followed, Puckett was questioned several more times. His story never wavered, and he cooperated readily with investigators. When he and his wife decided to move to Oklahoma to be closer to her children and grandchildren, for example, he notified them months in advance. He also volunteered to give them a fresh sample of his DNA. When it matched the sample in the database, he was arrested and charged with first-degree murder.

The case was assigned to the San Francisco public defender's office, which had recently brought on a DNA specialist named Bicka Barlow. Unlike most lawyers, Barlow has a background in science—before going to law school, she earned a master's degree in genetics and molecular biology from Cornell. For years, she had been agitating against what she saw as overreach by law enforcement and prosecutors when it came to the use of DNA evidence in cold-hit cases. She believed Puckett's was the ideal case to draw attention to the issue because the DNA match was so weak. "If there was a DNA case that could be won, this was it," she told me, when I met with her at a café across from the San Francisco criminal courthouse last October. "Most jurisdictions would not have even prosecuted this case."

Barlow's main point of contention was statistics. Typically, law enforcement and prosecutors rely on FBI estimates for the rarity of a given DNA profile—a figure can be as remote as one in many trillions when investigators have all thirteen markers to work with. In Puckett's case, where there were only five and a half markers available, the San Francisco crime lab put the figure at one in 1.1 million—still remote enough to erase any reasonable doubt of his guilt. The problem is that, according to most scientists, this statistic is only relevant when DNA material is used to link a crime directly to a suspect identified through eyewitness testimony or other evidence. In cases where a suspect is found by searching through large databases, the chances of accidentally hitting on the wrong person are orders of magnitude higher.

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The reasons for this aren't difficult to grasp: consider what happens when you take a DNA profile that has a rarity of one in a million and run it through a database that contains a million people; chances are you'll get a coincidental match. Given this fact, the two leading scientific bodies that have studied the issue—the National Research Council and the FBI's DNA ad-

visory board—have recommended that law enforcement and prosecutors calculate the probability of a coincidental match differently in cold-hit cases. In particular, they recommend multiplying the FBI's rarity statistic by the number of profiles in the database, to arrive at a figure known as the Database Match Probability. When this formula is applied to Puckett's case (where a profile with a rarity of one in 1.1 million was run through a database of 338,000 offenders) the chances of a coincidental match climb to one in three.

Such coincidental matches are more than a theoretical possibility, as Chicago police can attest. In 2004, detectives investigating a string of robberies on the city's North Side found some skin cells that the culprit had left behind at one crime scene, which contained six DNA markers. When they ran this profile against Illinois's offender database, they found it matched a woman named Diane Myers. There was just one problem: when the burglaries in question were committed, Myers was already in jail, serving time on drug charges.

John Puckett was arrested and tried based mostly on the DNA evidence, which was portrayed as proof positive of his guilt; the jury was told that the chances of a false DNA match were one in 1.1 million. In fact, they were one in three.

Indeed, the little information that has come to light about the actual rate of coincidental matches in offender databases suggests the chances of hitting on the wrong person may be even higher than the Database Match Probability suggests. In 2005, Barlow heard that an Arizona state employee named Kathryn Troyer had run a series of tests on the state's DNA database, which at the time included 65,000 profiles, and found multiple people with nine or more identical markers. If you believe the FBI's rarity statistics, this was all but impossible—the chances of any two people in the general population sharing that many markers was supposed to be about one in 750 million, while the Database Match Probability for a nine-marker match in a system the size of Arizona's is roughly one in 11,000.

Barlow decided to subpoena Troyer's searches, believing the finding would be helpful for a case she was working on. To her surprise, she discovered that Troyer had unearthed not just a couple of pairs who shared nine identical markers, but 122. "That was a 'wow' moment," Barlow recalls.

As it turns out, these findings were no fluke. Searches of databases elsewhere have revealed similarly unsettling numbers. In 2006, for instance, a Chicago judge ordered a search of the Illinois database, which contained 233,000 profiles. It turned up 903 pairs with nine or more matching DNA markers. Among geneticists and statisticians, these findings have eroded faith in the FBI's DNA rarity statistics, which were based on data from just 200 or 300 people and are used by crime labs across the country. Laurence Mueller, an ecology and evolutionary biology professor at University of California, Irvine, told me that anyone who knows statistics finds the figures "laughable."

Rather than try to sort out the disparities between its numbers and database findings, the FBI has fought to keep this information under wraps. After Barlow subpoenaed the Arizona database searches, the agency sent the state's Department of Public Safety a cease-and-desist letter, warning that its conduct was "under review." Eventually, the Arizona attorney general obtained a court order to block Barlow's distribution of the findings. In other instances, the FBI has threatened to revoke access to the bureau's master DNA database if states make the contents of their systems available to defense teams or academics. Agency officials argue they have done so because granting access would violate the privacy of the offenders (although researchers generally request anonymous DNA profiles with no names attached) and tie up the FBI's computers, impeding investigations. These justifications baffle researchers. In the December 2009 issue of the journal *Science*, dozens of biologists, geneticists, and forensic experts urged the FBI to change its secretive policy, saying that there was no way that allowing a handful of researchers to run database searches, each of which takes only a few minutes, would hamper investigations. They also dismissed the agency's privacy concerns, saying, "The government frequently releases sensitive information under controlled conditions to verified researchers." Krane of Wright State University, who was the letter's lead author, believes the real reason the FBI has blocked access is to avoid revealing the shortcomings in its own system. "Analysis of the offender database is sure to expose the misconceptions and errors in the method the FBI used to arrive at its rarity statistics," he told me.

Since the crux of the government's case relied on DNA, Barlow knew that she had to get the data on the probability of coincidental matches in front of the jury to have a shot at winning. Beginning in early 2007, Judge Jerome Benson summoned the parties to his courtroom, a high-security chamber with a bulletproof wall of steel and glass separating the bench from the gallery, for a series of pretrial hearings. Puckett, who had spent the previous year and a half in the medical wing of the local county jail, rolled himself in using a government-issued wheelchair, a Bible tucked between his thigh and the chair's frame.

Barlow pled with the judge to let her present evidence challenging the government's one-in-1.1-million statistic. The

inability to reveal this information to the jury, she insisted, would violate Puckett's constitutional right to a fair trial. Prosecutor David Merin countered by presenting two seminal precedents from other courts, which had refused to admit the Database Match Probability (the one-in-three statistic, in Puckett's case). He also called the Arizona database findings "half baked," and argued that if Barlow's requests were granted, the trial would get bogged down in complex statistical debates that would "likely cause a jury to throw up their hands in confusion." Barlow found this argument infuriating. "Frankly, to sit here and say that it would be too confusing for the jury is insulting," she seethed, according to press reports. "If we can't present this evidence, then the case is gone."

In the end, the defense lost on all counts. Barlow and her fellow counsel, Kwixuan Maloof, were barred from mentioning that Puckett had been identified through a cold hit and from introducing the statistic on the one-in-three likelihood of a coincidental database match in his case—a figure the judge dismissed as "essentially irrelevant." They were also prohibited from presenting evidence on the high rates of coincidental matches found in DNA databases in places like Arizona.

This was not unusual. Juries in cold-hit cases are rarely, if ever, presented with evidence on the high probability of coincidental DNA matches. This is partly because, unlike Barlow, most defense attorneys don't understand the underlying statistical problems. When they see DNA evidence, they assume the case against their client is airtight and start praying for a plea bargain. In the rare instances where defense teams challenge the government figures, judges tend to reject their arguments. Few lawyers are savvy enough about genetics and statistics to make persuasive cases, and even those who are have trouble getting judges to comprehend the complex underlying concepts. Some powerful voices in the forensic community have also actively discouraged courts from considering information that casts doubt on the relevance of FBI rarity statistics. Bruce Budowle, the former head of the FBI's laboratory division, regularly offers testimony and written statements urging courts not to admit the Database Match Probability—a figure Budowle argues can be "very misleading to a jury or to any other layperson"—rather than the FBI's numbers. (Budowle did not respond to requests for an interview, but his stance is consistent with that of FBI crime labs, which have ignored the recommendations of the FBI's own DNA advisory board and continue to use FBI rarity statistics rather than the Database Match Probability.) And because courts are bound by precedent, each time a judge decides to bar information about the shortcomings of DNA evidence, he or she makes it more difficult for defense teams in other cases to get this evidence before juries.

During Puckett's trial, which began in January 2008 and was covered in depth by the *Los Angeles Times*, the defense was also barred from introducing any information about Robert Baker, the escaped mental patient who was the lead suspect during the original investigation. This left them with little to work with. The fragile crime scene DNA had been destroyed during testing, so the defense had no way of double-checking the results. Barlow had hoped to test the bloodstained parking ticket found in Baker's van to see if it matched Sylvester's DNA, but it had gone missing from the evidence file. She and Maloof also seriously considered digging up Baker's corpse and running DNA testing on it, but decided it was probably too decayed to do them any good.

Prosecutors had a similarly shallow trove of information to draw from. Besides the moldered DNA, there was no physical evidence linking the defendant to the crime—none of the twenty-six fingerprints found in Sylvester's apartment belonged to him, for instance. And police hadn't been able to place him in the neighborhood on the day of Sylvester's murder (though at some point he had applied for a job at the medical center where she worked). Ordinarily, prosecutors in murder cases rely heavily on testimony from the police and medical examiners who analyzed the fresh crime scene evidence, but in Puckett's case this, too, was out of the question. Everyone inti-

Puckett was found guilty of murder in the first degree and sentenced to life. When interviewed after the trial, jurors said they might have decided differently had they been presented with the statistic on the high probability of a coincidental DNA match.

mately involved with the original investigation was either dead or too senile to take the stand. Sylvester's landlady, Helen Nigidoff, was still alive when police started investigating Puckett, but for some reason was never asked to view pictures of the suspect. By the time the trial rolled around, she had died, too, leaving prosecutors and defense attorneys to haggle endlessly over whether Puckett matched her description—a stash of pictures from the 1970s that was found in Puckett's shed showed that, like the culprit, he was a white man of medium height, but he didn't have a beard or curly hair as Nigidoff described.

Still, the prosecution had some chilling circumstantial evidence to present; in 1977, Puckett had been convicted of raping two women and sexually assaulting a third, crimes for which he later served eight years in prison. Because the revelation of past offenses is highly prejudicial, most courts keep these details from jurors. But California allows prosecutors to present this information to show that a crime matches a pattern of offense. In Puckett's case, all three victims were brought in to tes-

tify. Each of them described how Puckett had conned his way into their cars by posing as a police officer and got them to drive out to a deserted area. Using a knife or an ice pick as a weapon, he then forced them to perform oral sex. "He … grabbed my throat, and I started to scream," recalled one victim. "He started to squeeze and telling me to shut up, and then I felt a knife at my throat."

These agonizing accounts no doubt influenced the jury. But in the end, the prosecution's case hung on the DNA evidence and the damning one-in-1.1-million statistic. Merin brought the figure into sharp relief with a simple calculation: the year Sylvester was murdered, he noted, California had eighteen million residents, about half of them men; given the rarity of the crime scene DNA profile, he argued that there were only eight or nine people living in the state who could have done it—and Puckett was one of them. He hammered this point home during the closing argument. "All of the DNA evidence points to the defendant and no one else," he argued. "They're devastating results that point right at Mr. Puckett, telling us that he's guilty."

Among scientists, the high rates of coincidental matches found in some DNA databases have eroded faith in the FBI's DNA rarity statistics. Laurence Mueller, a biology professor at University of California, Irvine, says anyone who knows statistics finds the figures "laughable."

The jury finally began deliberating in February 2008. Waiting in a holding tank inside the courthouse, Puckett and his lawyers were resigned to a guilty verdict, though they saw a flicker of hope early on when the jury sent Judge Benson a note asking how the suspect was "identified as a person of interest." Barlow pressed the judge to reveal that he was found through a cold hit. Doing otherwise, she argued, would lead the jury to believe that the evidence against her client was more reliable than it actually was. But Benson would not budge. He insisted, as he had from the beginning, that the information was "irrelevant" and urged the jury not to speculate on the matter.

After forty-eight hours of deliberations, the jury delivered a verdict. Puckett was found guilty of murder in the first degree and later sentenced to life in prison with a possibility of parole after seven years. Jurors told the *Los Angeles Times* that the one-in-1.1-million statistic had been pivotal to their decision. Asked whether the jury might have reached a different conclusion if they had been presented with the one-in-three figure, juror Joe Deluca replied, "Of course it would have changed things. It would have changed a lot of things."

Today Puckett is locked away in Corcoran State Prison while his case awaits appeal. His lawyers hold out some hope for the next round. Months after Puckett's verdict, the California Supreme Court tackled a similar cold-hit murder case. While the judges backed the prosecution's statistic on the likelihood of a false match—the same calculation proffered by the prosecution in the Puckett case—in a footnote they left the door open to presenting the Database Match Probability in some instances. Depending on how this is interpreted, it may give Puckett and others like him a fighting chance of getting the most relevant exculpatory evidence before the jury. But it still falls far short of the recommendations set out by the National Research Council and the FBI's DNA advisory board, which call for the Database Match Probability to be used in all cold-hit cases. And in most parts of the country, judges continue to prevent jurors from seeing this figure at all.

Outside scientific circles, this perilous distortion of DNA evidence has gotten little attention. This is partly because the underlying mathematics can be difficult to grasp for those with no training in science or statistics. But there may also be another factor at play: so far, those who have been swept up in cold-hit investigations have mostly been convicted felons and sex offenders, because theirs were the only profiles in the databases, and the possibility that people who have committed vicious crimes might be getting shabby treatment from the courts is far less likely to stir public outrage. But the list of groups cropping up in these databases is expanding rapidly. Last year, California and at least fourteen other states started cataloging DNA, not just from convicted felons, but from anyone arrested for a felony. At the same time, the FBI began collecting DNA from detained immigrants and anyone arrested for a federal offense, including those charged with petty misdemeanors, such as loitering on federal property. As a result, more than a million new profiles are being added to our nation's offender databases each year, and as DNA testing becomes more routine, it is likely that these systems will grow to include an even wider cross-section of the public. Of course, as the number of profiles in the databases swell, so do the odds of accidentally fingering innocent people. Given these facts, it's not inconceivable that one day you or someone you know will end up in Puckett's situation. WM

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