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Why This Scientist Keeps Receiving Packages of Serial Killers' Hair

Getting sufficient DNA out of a rootless hair has long been considered impossible. A scientist, better known for work with ancient fossils, has figured it out. It's a game-changer for crime and surveillance.

By Heather Murphy
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Those fortunate enough to have a head of hair generally leave 50 to 100 strands behind on any given day. Those hairs are hardy, capable of withstanding years or even centuries of rain, heat and wind.

The trouble for detectives, or anyone else seeking to figure out whom a strand of hair belonged to, is that unless it contains a root, which only a tiny percentage do, it's about as helpful as a nearby rock.

These limitations emerge at trials, where forensic scientists have to explain to juries why, contrary to what's seen on TV, they can't get sufficient DNA out of a hair plucked from a sweater, and when amateur family historians stumble upon a deceased relative's hairbrush. Without a root, labs will tell them, there's no hope of generating a DNA profile for a genealogy site.

Until now. Ed Green, a paleogeneticist at the University of California, Santa Cruz known in the scientific community for his work on the Neanderthal genome, has developed a technique that makes it possible to recover and sequence DNA from hair without the root.

And over the past 18 months, he has been quietly cooperating with several law enforcement agencies, using this method to extract genetic profiles from the hairs of killers and victims in long unsolved crimes.

"It was kind of written in stone that you can't do it, and now he's doing it," said Deputy Pete Headley of the San Bernardino County Sheriff's Department in California, who was involved in a case in New Hampshire that Dr. Green's technique helped crack.

Justin Loe, the chief executive of Full Genomes, a genetics services company, called the technique "a game-changer."

"Criminals think of wearing gloves or wiping down blood," he said, "but fewer think to shave their head."

Though he's already begun directing some clients to Dr. Green, Mr. Loe, whose company often works with law enforcement, cautioned that as the technique becomes more widely known, it will create new possibilities for surveillance operatives. It would make real a sci-fi future in which evading detection requires carefully sweeping up hair from a room.

Dr. Ed Green
James Tensuan for The New York Times

The hair sent to Dr. Green is usually hand-delivered by law enforcement to his lab on the campus of the University of California, Santa Cruz.

Some packages contain a single lock, shorter than a thumbnail; others hold long clumps, twisted like spaghetti. Some belong to serial killers who have evaded detectives for decades; others to murder victims.

Once the DNA is extracted it is kept in a liquid, in a rack just across the room from the cold storage refrigerator containing mammoth bones, pieces of several dodo birds and an extinct American cheetah, among other treasures.

Dr. Green is not at liberty to share details of the investigations he's involved in, beyond the one case in New Hampshire. Neither can he say with whom he is collaborating, beyond that his point people are often Steve Kramer, a lawyer in the F.B.I.'s Los Angeles office, and Barbara Rae-Venter, a genetic genealogist.

In April of 2018, the duo cracked the Golden State Killer case by finding relatives of the suspect in a genealogy database, spawning a new approach to solving crimes. (The F.B.I. declined to comment on Mr. Kramer's collaboration with Dr. Green.)

"I discovered him," said Dr. Rae-Venter of Dr. Green. In 2017, she was recovering from heart surgery and "bored out of my mind."

While reading a newspaper, she stumbled across something that excited her. It was the word "hair" in an article about a tiny coffin found in a San Francisco couple's yard. While renovating, they had unearthed the remains of a mystery child in a white embroidered dress, who had likely died in the early 1900s. Volunteers had identified likely family. And using her hair, Dr. Green had confirmed that they were related.

At that time, Dr. Rae-Venter was working with authorities in New Hampshire to identify a woman and three girls found in barrels in a state park. The bodies had been exposed to decades of sunlight and water, degrading the DNA, even in their bones.

"Suddenly here was the solution," she said.

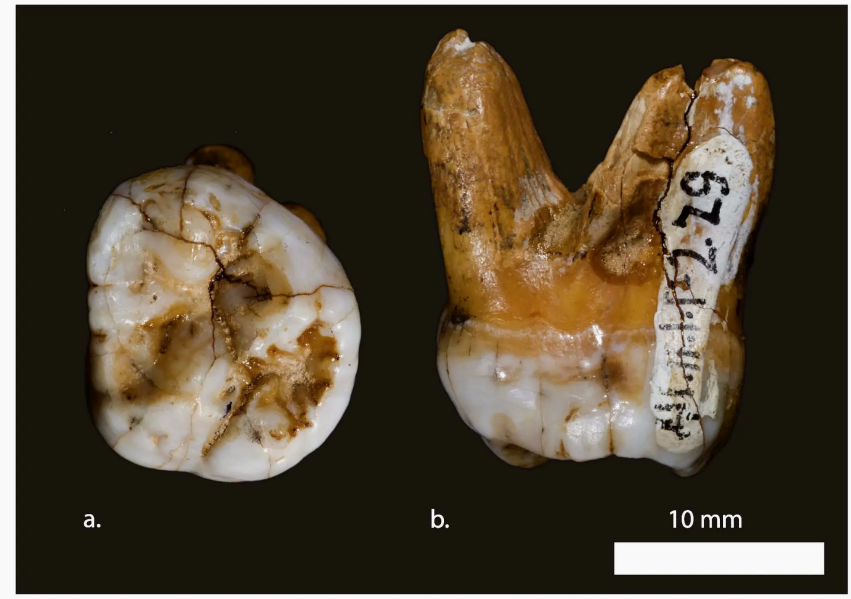
Since then, many articles and a podcast series have been dedicated to the case, known as the Bear Brook murders. But when the hair first arrived at his lab, Dr. Green knew little beyond the fact that another lab had failed to get what was needed.

Once Dr. Green had the locks in hand, his team rinsed them in a bleach solution. The novel part came next. Traditional forensic labs do work with old and rootless hair. They have a technique to obtain mitochondrial DNA — which is passed from mother to child. At most it could tell them whether the source of one hair is related to the source of another.

In order to identify a person, nuclear DNA is required. Traditional methods can get it out of hair with a root, though if it fell out more than a week ago it could be a problem, said Suzanna Ryan, a forensic consultant and lab director. "Hairs need to be in a growth stage in order to obtain nuclear DNA," she said.

Through his previous work, Dr. Green knew that wasn't necessarily true.

In 2005, he was part of a team at the Max Planck Institute in Leipzig, Germany, which developed an advanced genetic sequencing technology to read DNA extracted from fossilized bones. In 2010, he was involved in sequencing the entire Neanderthal genome from shards of bone that were at least 38,000 years old.



Dr. Green was also involved in extracting the entire genome of the Denisovans. Max Planck Institute for Evolutionary Anthropology

Carlos Bustamante, a geneticist at Stanford University, credited Dr. Green with creating a series of technologies that enabled extracting more from less. The technique transformed scientists' ability to track the evolutionary history of human populations.

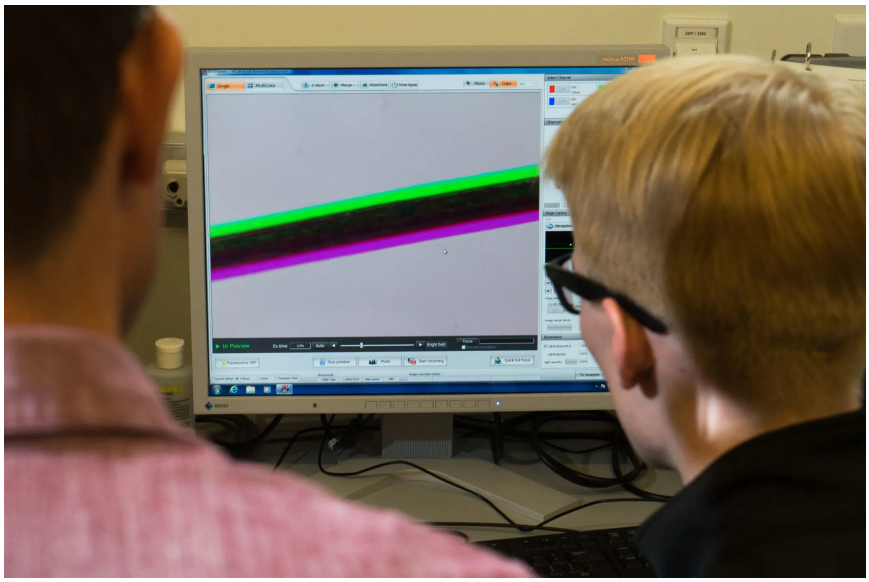
"We went from zero reliable ancient genomes to thousands and thousands of ancient genomes," he said.

Dr. Green called hair an "interesting little organ." But it wasn't a focus of his, until Dr. Rae-Venter called him.

"For really old things it's hard to find hair," he said. "It blows away."

Fine-tuning the process took about a year.

To test if he was on the right track, he took a genotype file created from his own hair and uploaded it to GEDmatch, a DNA database of around one million people. "That was the Eureka moment," he said. He generated the same relatives as he had with a file created the traditional way using saliva.



Dr. Ed Green, left, looking at a different hair sample with a lab technician, Nicholas Maurer. James Tensuan for The New York Times

By the time he finished with the mystery hairs from New Hampshire, he was confident that he had given Dr. Rae-Venter what she needed, but he didn't feel the impact until June.

That's when the authorities announced that after decades without names, three of the four murder victims had been identified as Marlyse Elizabeth Honeychurch and her two daughters, Marie Elizabeth Vaughn and Sarah Lynn McWaters.

"It's like someone invents the rocket to go to the moon," he said. "And then they see the moon landing on TV."

Many novel methods played a role in solving the case — DNA was ultimately extracted from one girl's liver — but Dr. Green's technique was central to the breakthrough, said Jeffery Strelzin, New Hampshire's associate attorney general.

From there the requests just flowed in. Dr. Green's discovery came at a crucial — and contentious — moment for genetic identification.

It used to be that DNA could solve a case only if it matched someone in a criminal database or an existing suspect. But with the rise of genetic genealogy, which enables identifying DNA through cousins in genealogy databases, DNA's value to investigators has skyrocketed.

Nearly half the time, genetic genealogists will tell you, they can turn a DNA profile into a suspect's name.

But the willingness of so many private citizens to help law enforcement use genealogy databases to solve crimes before the field has been regulated is causing alarm.

Natalie Ram, a law professor focused on genetic privacy at the University of Maryland, said that though she sees enormous potential, this could amplify a trend toward over-collection of DNA from the public.

It is also unclear how reliable the technique is. If it fails with a given hair, it wouldn't point to the wrong person — it wouldn't hit to anyone, Dr. Green and Dr. Bustamante both said. But a larger study examining success rates is still underway.

Dr. Green recently submitted a paper to a scientific journal. Once published, he's aware that the technique could be used for trivial crimes, corporate espionage or harassment and said that "there need to be rules for how that power is wielded."

But he's hopeful it will be used for good. Ms. Ryan, who recently forwarded him a case involving a woman's embalmed head, shares this wish.

There are 200,000 to 250,000 cold cases in the United States, she said, and even if hair was collected in just 10 percent, that's 20,000 cases that could benefit.

Still, neither she nor Dr. Green thinks the technique is likely to be widely embraced any time soon. Forensic labs are not set up to implement it and it's expensive. Each hair costs several thousand dollars to sequence, and that's before hiring a genetic genealogist to try to identify its source.