In the annals of police work, Colin Pitchfork occupies a special place. It was in 1987 that Pitchfork, a 27-year-old baker in Leicestershire, England, was turned in, as it were, by the cells of his own body. Three years earlier, researchers at nearby Leicester University had invented a technique for recording segments of DNA in a pattern resembling a grocery bar code. Police investigating the rapes and murders of two teenage girls took blood samples from more than 5,000 people—every man between 13 and 30 in three villages—and it was Pitchfork's genetic material that matched semen recovered from the bodies. Convicted and given a life sentence, he became the first murderer to be caught just by his DNA. But his story is incomplete without mentioning Rodney Buckland, the 17-year-old boy who was originally suspected of one of the murders—and, therefore, was the first person in history to be cleared of a crime on DNA evidence.

Since then, thousands of people have been convicted by DNA's near-miraculous ability to search out suspects across space and time. Hundreds of innocent people have also been freed, often after years behind bars, sometimes just short of the death chamber. The long arm of DNA investigation reached into history to implicate Thomas Jefferson in an extramarital affair with a slave, helped identify the remains of the last Russian tsar and his family and sealed the case that President Clinton was the source of the world's most famous dress stain. DNA evidence was central to the murder case against O. J. Simpson—and the case collapsed, in part, when defense attorney Barry Scheck showed how the police mishandled the crucial blood drops. The power of DNA evidence will increase enormously in the next few years as the FBI adds millions of samples to the national DNA database that went into operation last month—and so, of course, will the concerns of civil libertarians. Not too far into

The DNA D

With a new national database and other high-coming a more powerful crimefighter than ever
etectives

By Jerry Adler and John McCormick

The future are portable "labs on a chip" that will enable investigators to process a DNA sample right at the crime scene (it now takes several days to weeks in a laboratory) and match it to a suspect almost while he's still running away. And someday scientists may be able to develop a description of an unknown suspect from the genetic material in a drop of blood, which British DNA expert Kevin Sullivan calls "the Holy Grail" of criminology.

For now, DNA is still used by police essentially for identification. For that purpose, it's ideal: unique to an individual (except in the case of identical twins); unchanging throughout life; found in cells from skin, blood, hair follicles (although not the shaft), blood, saliva and semen. Technicians can obtain a usable quantity of DNA from the saliva on a cigarette butt or a single hair root. The "short-tandem-repeat" method used by the FBI to analyze DNA (graphic) takes measurements in 13 separate places and can match two samples with a theoretical error rate of less than one in a trillion. "DNA is more reliable than anything else we have," says Ronald Allen, a professor of criminal law at Northwestern University, "so long as you have a good sample and a competent lab following appropriate procedures. If those conditions are met, DNA evidence is devastating."

It was through DNA evidence that a 12-year-old Phoenix girl last month was able to convince police that she had been molested by her grandfather. After watching an "NYPD Blue" segment in which a rape victim collected semen left by her attacker, she used a swab on herself and gathered the evidence that resulted in her 59-year-old grandfather's arrest.

Linking a suspect to a crime in this way requires, obviously, that the perpetrator leave behind a DNA sample. Rapists deposit semen; intruders may cut themselves and bleed; assailants, if there was a struggle, may leave behind blood, hair or skin...
The dress: Sourcing the world's most famous stain, with odds of better than a trillion to 1

The President: DNA evidence proved what some historians had suspected—Thomas Jefferson fathered a child with his slave Sally Hemings

The doctor: DNA testing suggests that Sam Sheppard, convicted of killing his wife in 1954, was innocent

Scrappings. (A Brooklyn company now advertises, for $69.95, a flashlight-size device meant to be jabbed at attackers, to collect a skin sample for future evidence.) Post-O.J., cops have become very aware of crime-scene protocol. "We train our people to look at DNA first, because it's the most fragile," says T. K. Martin, a crime-scene specialist for the Illinois State Police. The biggest danger is cross-contamination from other samples. Material is collected with disposable tweezers and cops change gloves each time they pick up a sample; at a complex scene, Martin says, an investigator might go through 100 pairs of gloves.

Even so, DNA evidence figures in only a small number of investigations, according to Georgetown University law professor Paul Rothstein. His "educated guess" is that less than half of all rapes yield usable DNA samples—"somebody messes up the swabs, or the rapist uses a condom, or the victim comes in after cleaning up." In violent crimes other than rape, he estimates, DNA evidence figures in the case less than 1 percent of the time. But if juries come to expect DNA evidence, it will only make the job of prosecutors harder, predicts Milwaukee District Attorney E. Michael McCann. "Sooner or later," he says, "you'll see jurors asking 'Where's the DNA?'"

To make a match, cops must collect DNA from their suspect. They can just ask, of course, but he can refuse—and he'll know that he's under suspicion. That was the situation facing Sgt. Michael Puettz of the St. Petersburg, Fla., police last month as he tailed a man named Charles C. Peterson. Peterson, 39, allegedly matched the description of the "Duck Robber" (named for his distinctive toe-out waddle) suspected of 15 robberies and a double rape. He was driving his motorcycle, tailed by Puettz in an unmarked car, when he stopped at a light, turned his head—and spat. Puettz grabbed a paper towel and sopped up the evidence. A few days later, a lab reported a match with semen from the rape, and Peterson was arrested; he has yet to enter a plea. Puettz defends the constitutionality of his evidence-gathering methods; the courts, he says, have held that once you've put out your trash, you've waived your right to keep the contents private, and "I don't see why the same won't hold true for saliva."

Sometimes, though, there is no suspect, just a pool of individuals who by chance may have had the opportunity to commit the crime. Should the police be allowed to test them all? That question is being weighed right now in Lawrence, Mass., where a near-comatose young woman in a nursing home was raped earlier this year and recently gave birth to a baby girl. With no suspects, Essex County District Attorney Kevin Burke last week began seeking DNA samples from about 30 men on the nursing-home staff who had access to the woman's room. So far, "everybody has been very cooperative," said Burke, but he adds that "if they don't volunteer, we will be compelled to seek a warrant [for an involuntary sample] through a grand-
Getting Smart About DNA

DNA’s a great tool, but we could do a lot more with it. Here’s how. BY BARRY SCHECK

The startling capacity of DNA technology to resolve historic controversies has recently been on high-profile display (Thomas Jefferson, Dr. Sam Sheppard). But the forensic DNA revolution is just beginning. Its real potential lies with the responsible use of DNA databanks. Adequately funded, and strictly limited to protect civil liberties, this investigative tool will astonish law-enforcement professionals without creating an Orwellian nightmare for the rest of us.

This potential is clear to me because I now wear two unusual, seemingly contradictory DNA hats. I’m codirector of the Innocence Project at the Benjamin N. Cardozo School of Law in New York City, which uses DNA testing to exonerate inmates wrongly convicted of crimes (35 since 1992, six off death row). And I’m also a commissioner on New York’s Forensic Science Review Board, an agency charged with creating the state’s DNA databank.

Though one seems “pro-defendant” and the other “pro-prosecution,” these are actually synergistic roles. Consider this: in 11 of the cases where DNA testing has exonerated a wrongly convicted person, DNA has also led to finding the real perpetrator.

Given those results, it’s clear that doing DNA testing—at more crime scenes, right after the crimes are committed—will help immeasurably. Most important, it would link apparently unrelated crimes to the same perpetrator and generate leads at the beginning of an investigation rather than merely include or exclude suspects at the end.

The problem is DNA laboratories in the United States are so woefully underfunded they can’t type enough cases. The British have made this investment. U.K. labs do DNA typing on crime-scene samples from not only new, unsolved rapes and homicides, but also burglaries and other crimes. As a result, they are now getting between 300 and 500 “hits” per week from their databanks—either a crime-scene-to-crime-scene hit, or a convicted-offender-to-crime-scene match. Few U.S. labs can type all the rapes and homicides in their jurisdiction (they test only after police have found a suspect), and no U.S. lab routinely types new, unsolved burglaries or other crimes.

Indeed, in many states DNA labs are so backlogged that it often takes 10 months to get results in cases where a suspect has already been apprehended and awaits trial. This creates unnecessary expense for the judicial system (defendants are likely to plead guilty quickly after getting bad DNA results) and unnecessary injustices (indigent defendants, unable to make bail, spend time in jail for crimes they did not commit).

Using DNA databanks effectively does not require taking samples from all citizens, as some rightly fear, or even expanding the databank beyond felony offenders. We don’t need to test more people; we need more labs testing more crime scenes. This will not be cheap, but it is surely cost-effective compared with the hundreds of millions needed to enforce a death penalty that doesn’t deter, draconian mandatory minimum sentences for nonviolent drug offenders and the latest big-ticket proposal in Congress, building prisons to house juveniles as adults. For too long, criminal-justice priorities have been driven by punitive “get tough” rhetoric that wins elections but does little to help the cop on the street make cases. It’s time to get tough by getting smart.

SCHECK is a professor at Cardozo law school in New York City.
DNA profiling is based on the discovery that the DNA of one person differs from that of another in specific ways. The FBI analyzes 13 places on a person's DNA to produce a DNA profile and find whether it matches that of a known criminal.

**STEPS IN THE PROCESS**

1. **Collection**: Blood, semen, saliva, skin or hair is labeled and shipped to a forensic lab. Only minute amounts—a single hair root, for example—are required.

2. **Isolation**: The sample is mixed with detergent and enzymes, which break open the cells and let out their DNA. The cell fragments are removed, and the remaining mixture is spun in a centrifuge tube. That makes pure DNA settle to the bottom.

3. **Amplification**: The DNA, a double helix, is separated into two strands. Technicians add 26 short pieces of DNA, called primers: sequences of the chemicals C, A, T and G that link to the beginning and end of each of the 13 sites.

**FAMOUS DNA HITS AND MISSES**

In 1984 Dr. Alec Jeffreys, a U.K. geneticist, coined the phrase "DNA fingerprints." It was the biggest advance in crime detection since fingerprints were discovered in 1901. The landmark cases in DNA forensics:

**September 1987**: Brit Colin Pitchfork became the first person identified and charged solely on the basis of DNA testing. In solving the murderer case of two teenage girls, police found him after taking several thousand blood samples from males in local villages.

**Nov. 6, 1987**: In one of the first U.S. cases to use DNA evidence, Tommy Lee Andrews was convicted of rape after tests matched his DNA to semen found in the victim.

*With Daniel Klaidman in Washington, T. Trent Gogax in Boston, Daniel Pedersen in Florida, William Underhill in London and Peter Annin in Chicago*
4 **Replication:** When a primer attaches to the beginning of one of the 13 sites, it acts like the “start” button on a photocopying machine, turning on cellular machinery that makes 1 million copies or more of each site.

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**Image of the separated DNA fragments**

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5 **Identification:** Copies of the 13 sites, each about 100 to 600 chemical letters long, are separated by size through gel electrophoresis. In this process a drop containing millions of DNA fragments is placed at one end of a sheet of gel. Electric current pulls the fragments across the gel; the larger a fragment, the slower it moves. The fragments, tagged with dye, show up as colored bands under ultraviolet light.

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6 **Matching:** The crime lab feeds the data on the length of the 13 markers into a database. The computer searches for a match. The odds are trillions to one that the length of each of the 13 strands in one person is identical to all the lengths in another.

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**Aug. 14, 1980:** Gary Dotson’s 1979 rape conviction is overturned after the evidence is put to the genetic test. The case made *Newsweek’s* May 20, 1985, cover when the victim recanted her accusations. Her word wasn’t good enough: the court refused Dotson a retrial—then DNA exonerated him.

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**April 1994:** Convicted rapist and multiple murderer Timothy Wilson Spencer of Virginia is the first person executed primarily on the basis of evidence matching his DNA to that of semen found in several victims.

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**Oct. 3, 1995:** O.J. Simpson is acquitted of murder despite the prosecutors’ presenting 240,000-to-one odds that blood drops found at the crime scene came from him.

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**December 1996:** DNA has its limits. So far there is no match for the genetic material found under murder victim JonBenet Ramsey’s fingernails.

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**The bloody glove**

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**JonBenet Ramsey**

**Timothy Spencer**