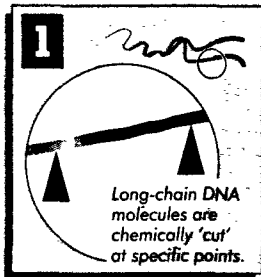




Genetic 'fingerprinting' helps identify criminals, but critics raise concerns about its reliability and misuse

JOHN VAN PELT - STAFF

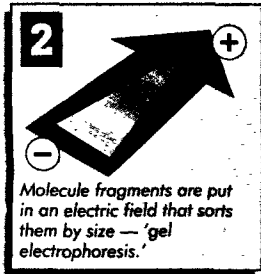
Fingerless 'Fingerprinting'



Long-chain DNA molecules are chemically 'cut' at specific points.

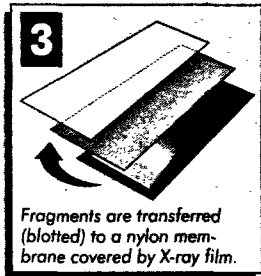
Every cell of the human body contains a complete copy of that individual's DNA — deoxyribonucleic acid, the genetic blueprint of organic life.

Surprisingly, most of DNA that all humans share is identical. Only 1 percent of the genetic code between any two individuals has any difference at all, says Dr. Paul R. Billings, chief of genetic medicine at the Pacific Presbyterian Medical Center in San Francisco. DNA identification testing finds those differences and makes them plainly visible.



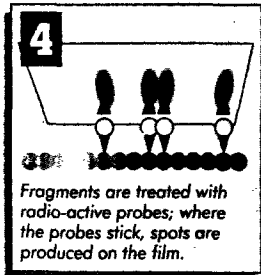
Molecule fragments are put in an electric field that sorts them by size — 'gel electrophoresis.'

In the test, DNA is chemically extracted from a small number of cells — from a drop of blood, a semen smear, a drop of saliva, or a few hair roots. The long chains of the DNA molecule are treated with special enzymes that cut the molecule at specific points, wherever particular patterns of DNA occur (1). These patterns occur at different places on each individual's DNA.



Fragments are transferred (blotted) to a nylon membrane covered by X-ray film.

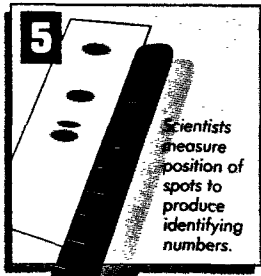
Next, the DNA fragments are put in an electric field that sorts them by size (2), a technique called gel electrophoresis, and then are transferred onto a nylon membrane (3).



Fragments are treated with radio-active probes; where the probes stick, spots are produced on the film.

Finally, the DNA fragments are treated with radioactive probes (4). The probes stick to some DNA fragments but not to others. A piece of X-ray film is put on top of the membrane; wherever the probes stick, a spot is produced on the film.

Typically, each probe produces two spots: one for the genetic contribution from each parent. Using a ruler, scientists measure the position of the spots on the film and produce a set of numbers (5).



Scientists measure position of spots to produce identifying numbers.

Actual DNA tests use at least four probes. Experts claim that the pattern of numbers is unique, and the odds of two individuals having the exact same match are millions to one.

— S. L. G.

The Jury Is Out on DNA

By **Simson L. Garfinkel**
Special to The Christian Science Monitor

BOSTON

MORE than a dozen police laboratories around the United States use DNA, the genetic code in every human cell, to perform identity tests. This relatively new forensic technique is rapidly gaining in popularity.

"The FBI has trained over 240 crime laboratory technicians from 80 different agencies around the country," says John Hicks, assistant director of the Federal Bureau of Investigation Laboratory in Washington, D.C. "Within the next year, I would expect that you would see a tremendous increase in the number of laboratories that are on-line."

The FBI is also laying the groundwork for a national databank of DNA information collected from crime scenes and convicted felons. Such a databank would help in the investigation of crimes and in catching repeat offenders, Mr. Hicks says.

DNA — deoxyribonucleic acid — is the molecular basis for heredity. Scientists say that each individual, except for identical twins, has a unique sequence of DNA.

But DNA identity tests are increasingly coming under attack. Last month in Massachusetts, the state's Supreme Judicial Court ordered a new trial for a man convicted of raping a 14-year-old disabled girl, saying that the scientific community does not have widely accepted uniform methods for testing and interpreting DNA evidence. In Arizona, a superior court judge ruled that the results of a DNA test could not be introduced in a trial because the apparent scientific accuracy of the test might convince a jury of the defendant's guilt, even though the scientific community itself has questions about the underlying test.

"They've rushed to the courts with this, instead of doing the real hard groundwork that they need to make a good system," says Richard Lewontin, a professor of population biology at Harvard University, who is an outspoken critic of DNA identification systems.

Proponents of the technology disagree. "Having testified as an expert in over 50 cases, I would say that the introduction and the acceptance of this technology has been very good in the courts," says Michael Baird, director of research at Lifecodes, a New York company that pioneered the identification technique. Dr. Baird says DNA evidence has been used in more than 400 cases.

Using DNA identity testing, sometimes called "DNA fingerprinting," scientists say they can determine if two samples of human tissue or bodily fluids came from the same person. The test needs only tiny amounts of genetic information for success: a drop of blood, saliva, or semen, a few hair roots, or a piece of skin.

THE tests were pioneered between 1982 and 1986 by Cellmark (Rockville, Md.) and Lifecodes (Valhalla, N.Y.). In 1986, the FBI developed its own system, Hicks says. DNA testing is likely to have the biggest impact in rape cases, says Bruce Budowle, an FBI re-

Archaeo-Chemists Track Ancient DNA

THE molecule that carries the genetic blueprints of plants, animals, and humans — DNA — has opened a new window into the past.

Its ability to reflect both differences and linkages between individuals and families, as well as between larger groups, is the key to a fast-growing science of biomolecular archaeology that would have seemed a science fiction dream even a decade ago.

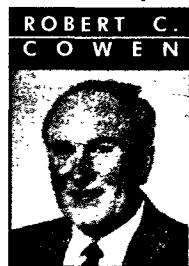
In one of the latest developments, Peter Parham and David A. Lawlor at Stanford University in Palo Alto, Calif., and William W. Hauswirth and Cynthia D. Dickel at the University of Florida at Gainesville have studied DNA from the nuclei of cells in human brain tissue. It is preserved at what is known as the Windover site — a swampy pond in central Florida. Remains of 165 individuals in the pond are 6,990 to 8,130 years old.

As the archaeo-chemists explain in describing their research recently in Science, they have just begun to study distinctive features in such DNA. They say that further work "may determine familial relationships between Windover individuals and further define the relationship between this ancient population and modern Amerindian populations."

That would supplement a 1989 study by Swedish biochemist Svante Pääbo. While doing post-doctoral work at the University of California, Berkeley, Dr. Pääbo extracted DNA from a 7,000-year-old human brain preserved in another Florida bog called Little Salt Spring. This raised a question about the first migrations of Amerindians from Asia. Modern Amerindians show only three distinct DNA lineages. Pääbo found indications of a fourth lineage. Such studies may

eventually show approximately where in Asia the original migrating groups came from and how many people were in each group.

This is different from the DNA "fingerprinting" used to link criminals with their crimes. Ancient DNA is hard to work with. It's scarce and generally is damaged. The technical breakthrough that makes the new molecular archaeology possible was developed six years ago at Cetus Corporation in San Francisco. Called by a name that only a chemist would love — polymerase chain reaction — it enables a researcher to pick out a desired DNA segment even when the sample is small and damaged. It then makes hun-



dreds of thousands of copies of that segment to produce enough material for standard analyses.

Until now, researchers such as Pääbo have worked with DNA from mitochondria. These units, which are employed in energy production within a living cell, lie outside the cell nucleus. They have limited genetic information and are inherited only from mothers. DNA in the nucleus has much more genetic information and is inherited from both parents. But it is very scarce. Now Parham and his colleagues have learned to work with nuclear DNA, opening up a potentially rich research field.

This kind of work has implications beyond archaeology. The hundreds of millions of dead and dried specimens in museums potentially are a rich store of DNA that biologists could use to trace evolution of both extinct and living species.

Thus a technical breakthrough in one field — in this case DNA chemistry — can open new research avenues in other fields. As Pääbo has noted, the new techniques "have enabled us to ... catch evolution red-handed."

Identity Tests

search chemist. Dr. Budowle notes that "78 percent of rape cases involve semen." With the test and a blood sample from the defendant, law enforcement officials say that they can prove if the semen found with a rape victim came from the suspect.

Indeed, lawyers and prosecutors have latched onto DNA testing as a "magic bullet," says Marjorie M. Shultz, a professor at the University of California's Boalt School of Law. "The hunger for the DNA evidence is the result of our desire to have the perfect truth," she says.

But as with blood types, critics argue, DNA testing can only prove innocence. If two samples of DNA are different, they came from different people. But if two samples are the same, there is always a chance of a random match, because only a tiny fraction of a person's DNA is actually analyzed in the test. Scientists then must use statistics to determine the probability of a chance match, which requires knowing the frequencies of different kinds of DNA in the population being studied.

The problem, Harvard's Dr. Lewontin says, is that geneticists really don't know how many people have the genetic markers used in the tests. "There is a lot of variation from subgroup to subgroup in the American population.... A group of Italian-American extraction might have 200 times the chance of having a particular DNA profile" compared with the rest of the population, he says.

"The FBI doesn't have the databases for the different subgroups. They can't use [the technique] to calculate" the probability of the match, he argues.

FBI scientists disagree. "The population data ... demonstrates that there is very little difference between the Caucasian subgroups and very little difference between the black subgroups," Hicks says. "Between blacks and Caucasians there are some differences, but it is remarkable how small those differences are."

Increasingly, the scientific establishment seems to be accepting the legitimacy of the tests. Last summer, a report issued by the US Congress Office of Technology Assessment (OTA) concluded that "forensic uses of DNA tests are both reliable and valid when properly performed and analyzed by skilled personnel." The report called questions about the validity of the technology or the underlying population genetics "red herrings that do the courts and the public a disservice."

What's needed now, the OTA says, is to make sure that lab technicians are well trained and tests are uniformly interpreted.

Nevertheless, concerns remain about what impact genetic testing will have on the courts and on society at large.

A major factor is cost. Although Lifecodes sells a kit that a police laboratory can use to do 50 DNA identification tests for \$1,000, the company itself charges \$485 to analyze a single sample, Lifecodes' Baird says. The cost of labor and laboratory time accounts for the difference. Test results must be presented in court by experts, adding another \$800 to \$1,200 per day.

CIVIL libertarians are more worried by the prospect of large-scale DNA testing. "It seems likely that this technology will lead to a national identification system," says Dr. Paul R. Billings, chief of genetic medicine at the Pacific Presbyterian Medical Center in San Francisco.

Today, police forces and legislatures around the country are trying to establish databanks to hold the DNA of people convicted of violent crimes. Such a databank would make it possible to easily identify repeat offenders — especially for crimes like rape. "Women's community groups and sexual assault support groups are very much in favor of this," says Philip L. Bereano, a professor of engineering and public policy at the University of Washington in Seattle. "It has been proposed that since we take the blood from every newborn, we should just run the DNA test and keep the [record] bars on file."

Already California and Virginia have started taking blood samples from convicts before they are released, Hicks says. And, Dr. Bereano says, "Eleven states have the requirement that DNA typing be done of convicted offenders."

DNA stored in such a databank might be later reanalyzed for other purposes. "Political pressures will grow from the private sector — particularly the insurance industry — to get access to that file," Bereano says.

A person's DNA contains all the individual's genetic information. Future tests might be able to analyze DNA for predisposition to disease or even behavioral characteristics, such as tendency to violence. People whose DNA tested positive might find it impossible to obtain insurance or might be subject to surveillance by the police.

"My own perspective is that it is relatively easy to set up administrative controls to limit the use of and limit access to those kinds of samples," Hicks says. "It would be relatively easy to establish sanctions against those who might abuse the samples."

BOOKS

In Praise of Nixon

By Stanley I. Kutler

SINCE he resigned in disgrace in August 1974, Richard Nixon has remained with us, tenaciously waging his last campaign. For more than 16 years, the former president has labored mightily to revise his history and refurbish his reputation. We have been subjected to recycled memoirs, carefully staged television interviews, Olympian pronouncements on politics and foreign policy, and the opening of a museum disguised as a library.

Nixon has had no more valuable ally than the news media, despite popular beliefs that journalists have been his longtime enemies. When Nixon dedicated his museum in July 1990, the American media treated the event as if it were a Second Coming. Tom Brokaw gained an "exclusive" interview — no doubt because NBC News agreed to anchor its evening news from the museum — and tossed Nixon one fat pitch after another: "What would your mother have advised you during Watergate, Mr. President?" Whether as enemy or pliant tool, Nixon has regarded the media with contempt.

Tom Wicker's new book will lend Nixon great comfort and confirm his cynicism. Recanting his contemporary criticism, Wicker now finds Richard Nixon one of the great presidents, deserving mention in the same breath as Abraham Lincoln. Nixon, according to Wicker, was a man of great strategic vision, and while given to breaking the Constitution and the law on occasion, really is "one of us." Fittingly, William Safire, Wicker's colleague and onetime Nixon speech writer, has trumpeted this book as a "stunning reassessment." It is no such thing.

Avowedly revisionist, yet hardly new, Wicker slavishly follows the memoirs of Nixon and his immediate entourage. Wicker displays little familiarity with the available archival record. Roger Morris, a recent Nixon biographer, has added fresh details and insights on Nixon's initial campaign in 1946 that only darken Nixon's image further. But Nixon, Wicker writes, behaved like any other politician; he was "in a game the ethic of which is to win." What Wicker means, of course, is that "winning is the only thing."

Wicker has spent long hours with such Nixon aides as domestic policy adviser John Ehrlichman and has concluded that Nixon's domestic policies were spectacular. In his memoir/apologia, Ehrlichman advanced precisely the same idea.

A careful scrutiny of the Nixon domestic record will demonstrate more achievements than contemporary critics conceded, but something far short of the uniqueness claimed by his admirers. But Wicker has done little research, suspended all critical analysis, often relied on anonymous sources (for stories readily confirmed in documented records), and swallowed the Nixon line whole. Ehrlichman could not have said it better.

Nixon's record in foreign policy remains contested ground. The opening to China, of course, is unforgettable, however opportunistic or cynical

it may have been. His oft-stated assertion that he would not be the first president to "lose" a war, followed by a "peace" settlement that allowed North Vietnam to maintain troops in the South and inevitably doomed our Saigon clients after a "decent interval," mocks the Nixon-Kissinger claims for the virtues of their Southeast Asia policy. Vietnamization and escalation, Wicker recognizes, simply never had a chance of securing South Vietnam's independence. But he glides over the fraud and bankruptcy of the policy, and Nixon and Kissinger's subsequent distortions of the historical record.

Nixon, in his twilight years, has successfully promoted himself as America's Elder Statesman. Pretensions to a title do not prove the claim. Yet Wicker is determined, as if to expiate his guilt over past judgments, to enshrine Nixon in the nation's pantheon.

Elder Statesman? Nixon, it should be remembered, opposed Reagan's nuclear weapons treaty with the Soviets in 1987 — Gorbachev's clearest

signal that he no longer wished to participate in the superpower game. At the opening of his museum three years later, Nixon dismissed any idea of Germany and Japan as superpowers. "They don't have nuclear weapons," he said — as if atomic weapons are the sole currency for world power status.

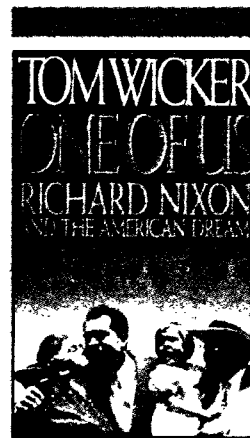
Wicker evaluates Nixon along a familiar line: Like the rest of us, Nixon had better and worse sides. Wicker argues that Nixon represented the best within us when he decided not to challenge Kennedy's narrow victory in 1960 and when he bowed to the Supreme Court's decision ordering him to surrender the tapes in 1974.

Like Nixon and his men, Wicker contends that vote fraud in Illinois tarnished the Kennedy victory in 1960. But Illinois alone would not have overturned the result. The Republican-dominated Illinois election board duly certified Kennedy's victory, and recent scholarship minimizes the extent and effect of fraudulent ballots on the presidential race. Nixon had little to challenge; furthermore, he had no significant allies.

Surely, Wicker is not serious about 1974. Nixon desperately looked for "air" in the court's decision to avoid compliance. Just what alternatives existed? Republicans almost totally deserted Nixon, even after he complied. Imagine if he had not.

In anointing Nixon as "great," Wicker necessarily minimizes Watergate, more or less rationalizing the president's actions as something "everyone" did. Historians will not dismiss Watergate as lightly. Watergate is Nixon's tar baby, and his resignation has distinguished him from all his predecessors. That is his uniqueness. Nixon swore to uphold the Constitution and the law, "but," Wicker says, he "skirted it when he could, [and] that was American still."

"One of us," as Wicker contends? No, he was supposed to be better. He was, after all, the president.



**ONE OF US:
RICHARD NIXON AND
THE AMERICAN DREAM**
By Tom Wicker
Random House
731 pp., \$24.95

■ Stanley I. Kutler is the author of "The Wars of Watergate: The Last Crisis of Richard Nixon."