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Ownership and Identity

The drive to manipulate DNA has changed the economy and the law | By Daniel J. Kevles

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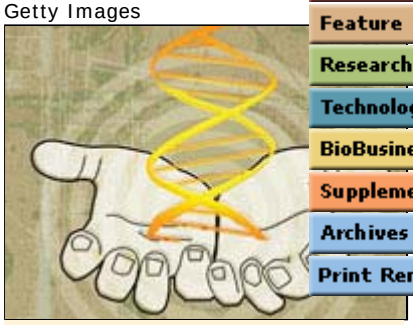

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ome a commonplace truth that DNA (or RNA) is the unique sine qua non of any living organism. As such, it comprises a material identifier, a collection of base-pair sequences that provide an individual's signature, independent of the information that any one sequence may encode. While most of the clinical payoffs remain in the future, the chemical specificity of DNA has already affected the world economy and Western society in particular, notably in biotechnology and human identification.

OWNING LIFE The recognition that the control of heredity and development resides in a molecule has greatly expanded the scope of intellectual property protection by allowing patents for living organisms. What is patentable in the United States reflects the patent law of 1793, which declared, in language written by Thomas Jefferson, that patents could be obtained for "any new and useful art, machine, manufacture, or composition of matter, or any new or useful improvement thereof."

With the exception of plants that could be reproduced asexually, which were made patentable by Congress in 1930, living organisms were held to be ineligible for protection because they are natural products. But then along came DNA--and, in 1972, Ananda Chakrabarty, a biochemist at the General Electric Company, who, having bioengineered a bacterium to consume oil slicks, filed for a patent on the living, genetically altered

bacterium.

The Patent Office rejected his claim, prompting a battle in the courts. On June 16, 1980, in the case by then known as *Diamond v. Chakrabarty*, the United States Supreme Court ruled by a vote of five-to-four in Chakrabarty's favor. Chief Justice Warren Burger delivered the majority opinion, enthusing over the broad language that Thomas Jefferson had written into the patent code, and declaring that "the relevant distinction was not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions." Chakrabarty's bugs were new compositions of matter, the product of his ingenuity, not of nature's. They were thus innovative manufactures and, hence, patentable.

During the 1980s, American patents were awarded on a plant and on a mouse. Patents were also allowed on human genes of known function--for example, the gene for insulin--in a form that did not occur naturally but had been derived from DNA by scientific manipulation. As a result, the new biotechnology industry increasingly flourished in the United States, energized by venture capitalists willing to invest heavily in companies that could patent genetically modified organisms as well as genes.

FINDING FAMILY Not long after the court's ruling, DNA began weighing in on the side of human rights. In 1984, a delegation of five biologists on a mercy mission journeyed to Argentina under the sponsorship of the American Association for the Advancement of Science. One member, Mary-Claire King, then at the University of California, Berkeley, was a veteran of the antiwar protests of the 1960s and a committed believer in using science for social benefit. The delegation hoped to assist the Grandmothers of the Plaza de Mayo in identifying the offspring of their "disappeared" children, arrested during the military dictatorship that had recently ended. The grandchildren had either been taken with their parents or born in prison. While the parents had likely been murdered, the Grandmothers had gathered enough information about their grandchildren to believe that at least 210 had survived, having been given or sold to other families.

To establish identification, King relied at first on human leukocyte antigens (HLAs), comparing this genetic feature of the found grandchildren with those of a few seemingly likely grandparents, their probable connection having been determined by social evidence. However, HLA analysis gave rise to too many random matches to be used for conclusively identifying grandchildren lacking social identifiers, since their HLAs had to be tested

against the national database established for all the grandparents.

King turned to mitochondrial DNA (mtDNA), which Allan Wilson, her mentor at UC-Berkeley, had shown to provide reliable evidence of human descent in the maternal line. With PCR, enough mtDNA could be obtained to test the sequence in the highly variable D loop for matches between children and maternal relatives. As of 1992, of the 210 children in question, 50 have been identified; 12 have been found but not matched with a family; 148 are still missing. The national database now includes sequences from the grandmothers' mtDNA. The grandmothers, King noted, derived satisfaction from knowing that, even after they die, "no one will be able to stop the children themselves from looking for their families."

FREEING PRISONERS By the early 1990s, DNA analysis, pioneered in England in 1985, had become an integral feature of the criminal justice system; American prosecutors were increasingly using it to identify and convict criminals. Restriction fragment length polymorphisms (RFLPs) from a suspect could be compared with those found in biological material (notably blood, semen, hair, or skin cells) found at a crime scene. Although its reliability was disputed on scientific grounds for several years, by the mid-1990s DNA analysis had been sufficiently improved to gain wide acceptance in both the scientific community and the courts. Forty-three states now maintain DNA databases of convicted criminals, a resource that assists in identifying the perpetrators of new offenses.

But DNA has acted as an instrument of innocence, too. In 1991, Barry Scheck and Peter Neufeld, both then legal aid lawyers in the South Bronx of New York City, established the Innocence Project, whose lawyers use DNA analysis as evidence to help exonerate people they believe were wrongly convicted. Largely because of the project, which is now located at Yeshiva University's Benjamin N. Cardozo School of Law, DNA analysis had by 2001 resulted in the acquittal and release of 40%--more than 100 prisoners--of inmates tested, many of them on death row. Most recently, its role in the release of the five young men wrongly convicted in the New York City Central Park jogger case dramatically revealed the deficiencies of plea bargaining.

DNA has thus unexpectedly spotlighted a need for reform of criminal justice. Its use in exonerating has exposed serious flaws in the prosecutorial system, especially in capital cases: the shaky reliability of eyewitnesses, the inability of the defendants to

afford private lawyers, and the inadequacy of conventional forensic data in establishing identity. Reviews of the death-penalty system have been initiated in nine states, including Illinois, where in February 2000, Governor George Ryan imposed a moratorium on executions pending the outcome of the state's assessment.

Today, DNA analysis with RFLPs and with mtDNA finds ever more uses. It is exploited by adopted children searching for their natural parents, by plaintiffs seeking to prove paternity, and by analysts attempting to identify victims of disasters. In the 1990s, DNA tests linked remains to passengers who died in the crashes of TWA flight 800 and the Swiss Air flight off Nova Scotia, and they helped determine who was buried in the mass graves in Bosnia. After Sept. 11, 2001, expectations ran high that DNA would help identify the remains at the World Trade Center site. King, now at the University of Washington, was not alone in warning that it might be impossible to identify by DNA analysis the badly burned and degraded body parts. Indeed, DNA permitted recognition of only 20% of the 804 people identified by March 2002. Still, as a reporter from San Francisco noted, "Despite its limited success, this mass genetic-matching effort is actually far from pointless.... There's nothing like truth to help people recover from atrocity."

DNA databases may eventually become an agent of homeland security, assisting in the defense against terrorists. Without proper controls, however, these databases could also imperil the right to privacy and undermine civil liberties. Little, if anything, is more personal, or worthy of protection than your DNA.

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Correction:
We apologize for errors introduced by an editor in the article "Ownership and Identity," (Jan 13 2003, page 22). The delegation led by Mary-Claire King that worked with the grandmothers of the "disappeared" children was in Argentina and not in Chile as originally stated. The mention of Pinochet's dictatorship was irrelevant to the story.

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