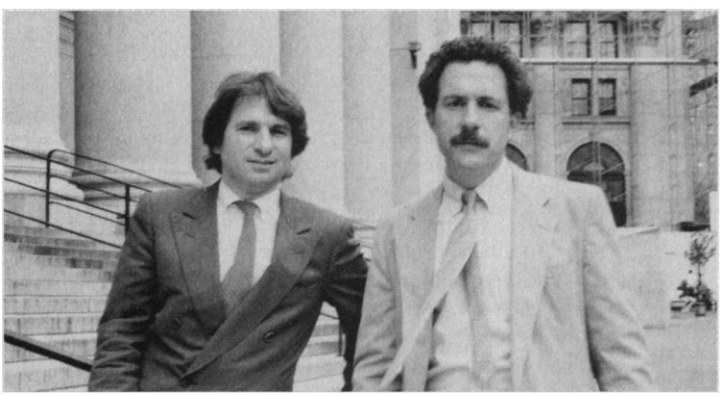
DNA Typing on the Witness Stand

Expert witnesses called in to testify on the reliability of forensic DNA fingerprinting rebel against lawyerly maneuverings and take matters into their own hands

"UNPRECEDENTED in the annals of the law." That's how New York attorney Peter Neufeld describes a recent gathering of scientists, experts all on DNA fingerprinting. Called by defense and prosecution attorneys as expert witnesses in a double murder case, the scientists had become so concerned over the possibility that the court might be misled by the complexities in science's newest approach to forensic evidence, they decided to ignore which side they were on and have a mini-scientific conference.



On the defense: *Barry Scheck (left) and Peter Neufeld were concerned about the reliability of DNA typing evidence.*

"We wanted to be able to settle the scientific issues through reasoned argument, to look at the evidence as scientists, not as adversaries," explains Cold Spring Harbor molecular biologist Richard Roberts, who had been lead witness for the prosecution. Asked in court if any lawyers had been present at the gathering, Roberts replied emphatically: "Absolutely not."

The result of the gathering was a consensus statement that effectively pulled the plug on the scientific evidence that had been offered by the prosecution in support of its case. "Overall, the DNA data in this case are not scientifically reliable enough [to reach a reliable conclusion]" reads the consensus statement. "If this data were submitted to a peer reviewed journal in support of a conclusion, it would not be accepted."

The prosecutor, district attorney Risa Sugarman, objected to the consensus statement being accepted as evidence in the hearing, stating that it was hearsay. With Sugarman's technical objection sustained by the judge, the burden of the statement, which was so very damaging to the prosecution's case, was finally introduced to evidence by the simple expedient of the defense calling two of the expert witnesses back to testify on its substance. Sugarman declined to comment on the case to *Science*.

The case, which is being heard in the Bronx Courthouse—known locally and to readers of Tom Wolfe's *Bonfire of the Vanities* as the Fortress—is the first time the reliability of DNA fingerprinting evidence has been seriously and extensively challenged in the courts. Less than 2 years ago the technique had not been heard of in the courts, and now it seems to be all the rage. "There have been more than 100 cases in which DNA typing has been used as evidence in this country," says Neufeld, one of the defense attorneys in the Bronx case. "Mostly the evidence has come in without any objections, because the lawyers haven't known how to respond to it. They were echoing what a juror in Queens County said last year: 'You can't argue with science.' That's frightening."

Neufeld had reason to be frightened. "My colleague Barry Scheck and I had recently become concerned about the use of DNA typing evidence in the courts," he explains. "We therefore decided to make the Castro case the first in which there would be a comprehensive inquiry into the various issues that comprise DNA typing." Testimony in the Bronx case—*People* v. *Castro*—lasted almost 4 months, ending just last week. "These kinds of hearings usually take a few days, if they are held at all."

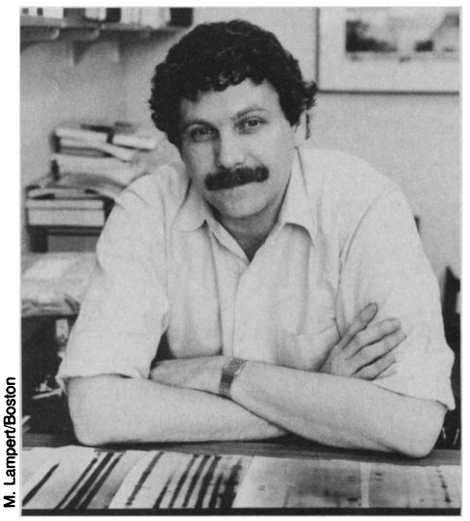
As a result, this pre-trial hearing in *People* v. *Castro* has become more than just a test of the quality of DNA fingerprint evidence presented in this case: it has put forensic DNA fingerprinting as a whole onto the witness stand. "It's absolutely right that the technique should be more closely scrutinized than it has in the past," says Simon Ford, a molecular biologist at the University of California, Irvine, who has made a special study of the legal context of the technique. "But my greatest fear is that as a result of the Castro hearing DNA typing will be thrown out of the courts altogether."

What, then, has happened to bring the reputation of DNA fingerprinting crashing down like this? After all, it is less than 2 years since the technique was introduced into the courtrooms with great fanfare, an apparently infallible tool of modern molecular biology. Juries were being told that, for instance, the DNA evidence fingered the accused person as the malefactor in the case, with a certainty of greater than 100 million to one, sometimes more than 100 billion to one.

"It is a potentially powerful technique, no doubt about that," acknowledges Ford. "But it has become apparent that the experimental procedures sometimes aren't as sound as they should be. And certainly the statistics they come up with—these huge odds—must be highly suspect." These are the issues that have come under such excruciating scrutiny in the Castro case.

Jose Castro, a-38-year old Hispanic, is accused of murdering Vilma Ponce and her 2-year-old daughter, who lived in a neighboring building in the Bronx. Identified as the murderer by Ponce's common law husband, Castro is also alleged to be linked to the victims by a spot of blood on his watch, said by the prosecution to have been identified by DNA typing as that of the murdered Ponce. The analysis was carried out in the summer of 1987 by Lifecodes Corporation, New York, the major commercial player in DNA typing. It was one of their earliest cases.

The forensic report Lifecodes submitted to the Bronx District Attorney's Office on 22 July 1987 looked convincing: "The DNA-Print™ pattern from the blood of Ponce [the murdered woman] matches that of the watch with three DNA probes. The frequency of these patterns in the general public is 1:189,200,000." With the wheels of the legal machine grinding characteristi-



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"What is missing in forensics is a set of adequate guidelines."

—Eric Lander

cally slow, the case finally came up in February this year. The defense attorney was uneasy about the DNA evidence and elected to have it challenged in a pretrial hearing known as a Frye hearing (see box). Unfamiliar with the technicalities, however, he asked Neufeld and Scheck if they would like to become involved. The timing was right.

"We had been to a meeting on forensic DNA typing at the Banbury Center, Cold Spring Harbor," says Neufeld. "This was the first conference where there was any discussion of potential problems with the technique. Previously, all you'd hear was how great it was, and so on." There were molecular biologists there, defense lawyers, prosecutors, people from the FBI. And there was Eric Lander, invited as an observer by Banbury Center director Jan Witkowski. Lander now half wishes he had refused.

"I was a little disturbed by what I heard at that meeting," says Lander, who is a human geneticist and something of a mathematical wizard at the Whitehead Institute in Cambridge, Massachusetts. "Among other things, Michael Baird [of Lifecodes] showed a slide of an autorad with two lanes. The bands didn't line up, but he called them a match anyway, saying that one lane ran faster than the other." This difference in lanes is known as band shifting, not uncommon in these kinds of experiments. "There was a good deal of discussion about this, and I got up and said, 'How can you tell it's band shifting? Where are the internal controls?' "

An internal control is simply the study in each lane of a fragment of known length: if the lanes run at different rates the different positions of these identical fragments will indicate the extent of band shifting. "It's basic molecular biology practice, basic scientific practice, to have controls," says Lander. "They weren't there. It wasn't just Lifecodes. In another presentation, by Cellmark, a match was called even though all bands didn't correspond, but for a different problem, DNA degradation. No controls here. I wasn't impressed."

In principle the fingerprint technique is straightforward, and depends on the existence in the genome of specific nucleotide sequences, the actual length of which might vary between individuals. If you chop up someone's DNA with a restriction enzyme, run the resulting fragments on a gel, and light up the specific fragments you are interested in with a radioactive probe, you produce a pattern of bands on an autoradiogram. The number of bands in the pattern can vary between one and several dozen, depending on the specific sequences being probed. But it is the position of each radioactive band on the gel that is crucial, because this indicates the length of the sequence fragment: this is an individual's DNA fingerprint.

The type of probes used in the United Kingdom, where Alec Jeffreys of Leicester University developed the technique, differs from that used in the United States. In both cases, however, the approach is the same: when comparing patterns from two DNA samples you need to be able to show that the bands line up, that they match, in order to conclude that the samples might have come from the same individual. And if you know something about how many different size variants of the core sequence occur in the population, you can calculate the probability of such a perfect match coming about by chance. If the comparisons are performed precisely the odds are usually very long indeed.

Lander left the Banbury meeting disturbed, but ready to get back to business as usual. A few weeks later Neufeld, who had met Lander at the Banbury meeting, called and asked Lander if he would like to be an expert witness in the Castro case. "Oh please. . . . I need this like I need a hole in the head," replied Lander. He did, however, agree to educate Neufeld and Scheck on the technicalities of DNA typing.

The lawyers sent Lander the autorads; they sent data; they asked questions; and, as the hearing got under way, they sent copies of testimony. "I could see all kinds of problems," says Lander. "I thought I would simply give the defense lawyers questions to ask, that they would force the prosecution

David Greene

"We all did so much better when we sat down without the lawyers."

—Richard Roberts

witnesses to admit the problems, and the case would fall apart." No such luck.

"Testimony came back that didn't make much scientific sense to me. It appeared you could ask anything, but it wouldn't make any difference. There would always be some excuse. Eventually, I broke down and agreed to testify." That decision led Lander into 350 hours of work on the case, 6 days on the witness stand, and the preparation of a 50-page report for the judge. (Lander, incidentally, declined the usual $1000-a-day expert witness fee, as he believes it would constitute a conflict of interest.)

Towards the end of April there was another meeting at Cold Spring Harbor, this time on genome mapping and sequencing, much more in Lander's normal line of work. Richard Roberts was there too, and the two fell to discussing the Castro case, Lander explaining his concerns, which by now were outlined in his long report. "I hadn't really seen the evidence in great detail before," says Roberts, "and I quickly became rather concerned. Eric left his report with me, so that I could go through it thoroughly. I soon realized something had to be done."

About 4 days later Roberts was in Boston on some other business, but called in at the Whitehead to see Lander. He had a proposal to make. "I suggested that the expert witnesses—from both sides—should get together and discuss the issues as scientists, none of this lawyerly talk," says Richards. Lander agreed, and all the other expert witnesses—eight in total—were contacted. Only four would be able to attend—Rob-

erts, Lander, Carl Dobkin and Lorraine Flaherty—the rest giving their OK for the meeting to go ahead.

Roberts and Lander informed the lawyers and the judge of their revolutionary plan, and received a go-ahead. "I was extremely surprised," says Neufeld, "but I thought it was a great idea." The meeting of the expert witnesses took place in a New York law office. "We were able very quickly to resolve the issues," says Lander. "It was comparatively straightforward, in the absence of the lawyers," agrees Roberts.

A two-page consensus statement was produced, which addressed the inadequacy of the scientific evidence in the case and the procedures for assessing the validity of that evidence. "All experts have agreed that the Frye test and the setting of the adversary system may not be the most appropriate method for reaching scientific consensus," notes the statement. "The Frye hearing is not the appropriate time to begin the process of peer review of the data. Initiating peer review at this time wastes a great deal of the court's and experts' time. The setting also discourages many experts from agreeing to participate in the careful scientific review of the data."

Randolph Jonakait, a leading expert on conventional genetic markers at New York Law School, suggests that DNA typing is in for a rough time in the courts as a result of the Castro case, but suspects that "ultimately it will be accepted, but with more testing." The forensic science community is rather isolated, he says. "The claims of the scientists involved are often not reviewed as thoroughly as they would be in conventional science, unless someone from the outside does, as has happened with Castro."

Although each jurisdiction is something of a law unto itself, "the Castro case is likely to have a ripple effect in the legal community," guesses Edward Imwinkelried, a professor of law at the University of California, Davis, and a leading expert on the use of scientific evidence in court. It already has. During the last week of the Castro hearing, a rape trial in the New York Supreme Court in Queens came to a grinding halt when the judge had sight of the Roberts *et al.* consensus statement. The prosecution case rested on Lifecodes' evidence. No Frye hearing had been held, because the judge had accepted similar evidence in an earlier case. Even though the rape case was in closing arguments, it is now on hold, to allow defense to challenge the evidence.

"No biologist questions the potential power of DNA typing," says Lander. "What is missing in forensics is a set of adequate guidelines. Lifecodes should not be blamed for the absence of standards. The fault lies with the scientific community for not addressing the issue." This sentiment, shared by other expert witnesses, is addressed in the consensus statement. "There is a need to reach general scientific agreement about appropriate standards for the practice of forensic DNA typing," it notes. "In our opinion, it would be desirable for the National Academy of Sciences to organize a committee to study this area."

In fact, the Academy attempted to set up a study last summer, but failed to persuade the National Institute of Justice to come up with the $300,000 required to fund it. *Science* has learned that new efforts are now underway to find funds, from the NSF, NIH, NIJ, FBI, and some private sources. "Such a study would be very important," says Jonakait.

Exactly how typical the Castro case is of forensic DNA typing in general is hard to tell. "There is a great danger of making too much of the Castro case," suggests Roberts. "From the evidence I've seen of other cases, I don't think it is typical." Expert witness Lorraine Flaherty, who is a member of a New York State Commission on DNA Typing, is not so sure: "I don't think it is possible to say what the general standard is, because very few cases have been examined in this kind of detail."

The ultimate impact of the Castro case is likely to be twofold. The first, already mentioned, is a move to establish national standards for the technique. The FBI has already begun to develop its own standards, and very soon will be a big player in this game. The second is that past convictions based on Lifecodes evidence are likely to be challenged. "No matter what the decision is in the Castro case, we believe the testimony itself is sufficient to warrant a challenge to previous Lifecodes cases," says Neufeld.

Now that the Castro hearing testimony is at an end, defense and prosecution attorneys are preparing final briefs for the judge, Gerald Sheindlin. His decision, expected in July, will rule on the admissibility of Lifecodes' evidence in this case. He also has the option of ruling on DNA typing in general, arguing, for instance, that with proper standards this kind of evidence is admissible in court. Whatever is his final decision, Judge Sheindlin has certainly learned a lot of molecular biology and fancy statistics: "This case has been an intellectual challenge."

For Roberts, the experience was not so much of a challenge as an eye-opener. The Castro case, plus the half dozen or so other appearances he has made in court as a prosecution witness, has left him a little jaundiced about the whole procedure. "The court system is adversarial," he complains, "and expert witnesses are encouraged to go further in their statements than they might otherwise be prepared to go. We all did so much better when we sat down without the lawyers, and had a reasoned scientific discussion. Perhaps it's time the system changed."

■ ROGER LEWIN

Three-Pronged Test for DNA

The acceptability of novel scientific evidence into court is one of those Kafkaesque areas of the law, with no agreed upon definitions and few solid guidelines. "The Frye hearing is the forum in which such acceptability is put to the test," explains Neufeld, who gave a presentation on the subject at last November's Banbury conference. "In any judicial dispute the judge has the ultimate responsibility to screen challenged scientific evidence and determine its suitability for the jury. Unfortunately, the legal standards and methodology employed by judges in the screening process vary considerably and thus routinely lead to inconsistent results."

The Frye hearing was set up following a 1923 case in which the decision said: "the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs." Straightforward as that may seem, the identification of the appropriate field and the notion of general acceptance are often problematical, says Neufeld.

Those snares notwithstanding, what it all comes down to is the three-pronged Frye test, as Neufeld explains: "The validity of evidence derived from a scientific theory requires proof of three factors: 1. the validity of the underlying theory, 2. the validity of the technique applying that theory, and 3. the proper application of the technique on a particular occasion."

How does DNA typing fare in relation to the Castro Frye hearing? "I'd say it fails the test," opines Neufeld. "It appears that so far there is no consensus in the scientific community over the way the technique should be carried out in a forensic situation. We have heard testimony that certain controls are necessary, but that is just opinion. So far the scientific community has not been called upon to set guidelines for the technique as a whole." ■ R.L.