

the race, but only the winning effort would secure the intellectual property rights. This is a recipe for inefficiency, a true multi-player prisoner's dilemma.

A final point about the NIH patent application is that the policy dilemma was sure to surface. If NIH had not filed a multi-gene patent application, private firms surely would have. The terms of the debate might have been different, and it might have been long delayed and less conspicuous, as the patent application need not have been publicly known for some time, but the debate was nonetheless inevitable. Whether a quieter and later debate might have been better or worse is a matter about which we can surely speculate, but will never be certain.

One of the most interesting aspects of technology transfer related to the genome project is how the project is caught in a changing of the rules. To make this point more starkly, we can perhaps discuss what might have been different if the techniques for DNA sequencing had been patented, as surely they could have been. These techniques are at least as central to research as the polymerase chain reaction that was patented. In the long list of citations to technical origins of the human genome project, some items have been patented, and others not. The Cohen-Boyer patent for recombinant DNA was a centrally important technique of molecular biology. It was patented, but then licensed for relatively low fees. The polymerase chain reaction, discovered at Cetus Corp. in 1983 and then sold to Hoffmann-La Roche in 1991, was patented and then controlled through a complex set of relatively high-fee licenses for various applications and reagents. The two main techniques for DNA sequencing itself developed in 1975, however, were surely patentable but were never patented. Laboratory instruments, such as DNA sequencers and DNA synthesizers, were sold, with the price of the instrument and its reagents covering patent fees. These disparate ways of handling research methods and tools clearly affected who could use them, and perhaps also the pace of discovery and application, but how and to what degree was a matter of speculation and ideology more than empirical analysis.

It is far from clear what can explain these differences, aside from historical happenstance and the changing norms of biomedical research between the 1970s and the 1990s. It is even