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THE TIPPING POINT IN THE LAW'S USE OF SCIENCE: THE EPIDEMIC OF SCIENTIFIC SOPHISTICATION THAT BEGAN WITH DNA PROFILING AND TOXIC TORTS*

David L. Faigman†

INTRODUCTION

Why did *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[1] happen when it did? The *Daubert* Court held that trial court judges are the keepers of the gate through which expert testimony must pass. As gatekeepers, judges must evaluate the basis for proffered expert testimony and determine whether it is relevant and reliable.[2] The basic lesson of *Daubert* is that judges must sufficiently understand the scientific method to effectively do their jobs. This task was new and, indeed, revolutionary.[3] But why did it take until 1993 for the U.S. Supreme Court to impart this lesson? After all, by 1993, the scientific revolution was at least three centuries old, and the *Federal Rules of Evidence*, ostensibly the subject of *Daubert*, were nearly two decades old. Why did it take so long for the courts to discover science? In this Article, I suggest that this is

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† University of California, Hastings College of the Law. I would especially like to thank my colleague Evan Lee, who helped me develop the thesis for this Article with ideas and comments during our various journeys to far-flung golf courses along the California coast. I am also grateful to Margaret Berger and Lisa Snyder for their comments, suggestions, and generous encouragement.

1 501 U.S. 579 (1993).

2 *Id.* at 597 (referring to judges' "gatekeeping role" under FED. R. EVID. 702).

3 *See* David L. Faigman, *The Law's Scientific Revolution: Reflections and Ruminations on the Law's Use of Experts in Year Seven of the Revolution*, 57 WASH. & LEE L. REV. 661 (2000).

the wrong question. The better question is, what happened in the early 1990s that made *Daubert* inevitable? The short answer to this question is that scientific evidence hit "the tipping point," and since then a judicial recognition of science has surged across the legal landscape. DNA profiling was an essential component of this phenomenon.

The phenomenon known as "the tipping point" has received substantial attention in scholarly literature[4] and, recently, in the popular press.[5] In brief, the tipping point refers to the moment in time when an event breaks out of a state of equilibrium and either accelerates or decelerates at an enormous rate. Phenomena ranging from the rocketing sales of Hush Puppies shoes in 1995[6] to the AIDS epidemic[7] have been explained in these terms. Given the right set of circumstances, a product like the first Harry Potter book, which began as a moderately successful children's story, could explode seemingly overnight into an international phenomenon. In the early 1990s, scientific evidence, similarly, hit the tipping point. Although not quite as sensational a success as Harry Potter, Justice Harry Blackmun's *Daubert* decision might yet prove more enduring.

I began my teaching and writing career not long before scientific evidence hit the tipping point. In fact, the principal theme of my early scholarship revolved around my belief that those in the legal profession needed to become more sophisticated consumers of science.[8] But it was an idea whose time had not yet come. My first major article on the subject dropped into the sea with hardly a ripple. In that article, I advocated a validity standard for scientific evidence.[9] Having attended graduate school in psychology just a few years before—one with a rigorous scientific culture—this was not a

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[4] For an excellent scholarly introduction to the subject of "tipping points," see EVERETT M. ROGERS, DIFFUSION OF INNOVATIONS (4th ed. 1995).

[5] MALCOLM GLADWELL, THE TIPPING POINT: HOW LITTLE THINGS CAN MAKE A BIG DIFFERENCE (2000).

[6] *Id.* at 3-5.

[7] GABRIEL ROTELLO, SEXUAL ECOLOGY: AIDS AND THE DESTINY OF GAY MEN (1997).

[8] David L. Faigman, *To Have and Have Not: Assessing the Value of Social Science to the Law as Science and Policy*, 38 EMORY L.J. 1005 (1989).

[9] *Id.* at 1009 ("The legal relevance of social science findings should depend on their scientific strength, that is, on the ability of social scientists to answer validly the questions posed to them.").

revolutionary proposal for me to make. To the legal community, however, it posed a fundamental paradox, since most lawyers had scant training in the scientific method. As I explained then, "[n]ot until lawmakers understand the basic methods of social science are they likely to substantively rely upon research findings. Yet, in order for the investment in learning basic research methods to appear worthwhile, lawmakers must perceive a substantial need for this knowledge."[10]

Judges had to understand science in order to appreciate the need for it, and they had to be convinced of the need for it before they would invest the time to understand it. At that time, I saw no solution to this paradox. I recommended more education, believing that if only judges could be convinced of the value of science, they would begin to employ that knowledge. This proposal was doomed to failure. Education might be integral to guiding and maintaining later reforms, but it could not tip the balance toward reform. That stimulus would have to come from the law's own docket.

Little did I expect, however much I hoped, that the situation I was decrying was about to change dramatically. It turned out that I was looking in the wrong direction. My focus in 1989 was on social science, but the tidal wave of change was coming entirely from two other directions. The two main areas heralding the scientific revolution in law came from toxic torts and DNA profiling. In a very brief period of time, around 1989 and culminating in 1993 with *Daubert*, the legal profession *tipped* so that enough lawyers and judges came to realize that it was worth their time to learn basic research methods. The equilibrium then shifted. Like all epidemics, scientific sophistication among lawyers began with a few contagious individuals, people who then infected others. From that point onward, an appreciation of the need to understand science has truly spread like an epidemic through the legal community.

Although no single set of factors applies to all phenomena that have reached the tipping point, three in particular can be instrumental in achieving this state of affairs. These three are the "power of context," the "law of the

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[10] Faigman, *supra* note 8, at 1081.

few," and the "stickiness factor."[11] The first refers to the environment and concerns whether it is conducive to the spread of the particular phenomenon. The second, the "law of the few," provides that a small number of well-connected and influential people can effect huge changes. The third, the "stickiness factor," refers to whether the phenomenon is highly contagious or sufficiently memorable to leave an indelible impression as it passes through the community. Around 1990, all three factors were sufficiently present for scientific evidence to reach the tipping point. In this Article, I explore the ways in which these factors converged.[12] Moreover, I consider the extent to which we can expect the law to remain "tipped."

I. THE POWER OF CONTEXT

To a large extent, the tipping of a virus from scattered groups of illness to mass epidemic is a matter of numbers. Malcolm Gladwell offers the following hypothetical flu epidemic to illustrate the point.

> Suppose, for example, that one summer 1,000 tourists come to Manhattan from Canada carrying an untreatable strain of twenty-four-hour virus. This strain of flu has a 2 percent infection rate, which is to say that one out of every 50 people who come into close contact with someone carrying it catches the bug himself. Let's say that 50 is also exactly the number of people the average Manhattanite—in the course of riding the subways and mingling with colleagues at work—come into contact with every day. What we have, then, is a disease in equilibrium. Those 1,000 Canadian tourists pass on the virus to 1,000 new people on the day they arrive.

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[11] GLADWELL, *supra* note 5, at 29.

[12] Given the inherently scientific perspective of this Article, I should note at the start that my observations regarding the tipping point of scientific evidence are hypotheses only. To be sure, they are hypotheses based on good research conducted in other contexts. *See generally* ROGERS, *supra* note 4. However, until they are tested, they remain largely theoretical. Whether these hypotheses would themselves be admissible under a *Daubert* standard is an interesting question. Most applied science relevant in the law depends on generalizations made from research that has not directly tested the hypothesis of interest to the law. Toxicological research tests suspected toxins on animals, not people, and jury research tends to use college sophomores, not real jurors. In any case, I would certainly welcome some enterprising graduate student or social scientist to research my hypotheses on the tipping point of scientific evidence. Until then, I will continue the tried and true practice of lawyers, that of positing hypotheses about the world from the comfort of my armchair.

> And the next day those 1,000 newly infected people pass on the virus to another 1,000 people, just as the original 1,000 tourists who started the epidemic are returning to health. With those getting sick and those getting well so perfectly in balance, the flu chugs along at a steady but unspectacular clip through the rest of the summer and the fall.
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> But then comes the Christmas season. The subways and buses get more crowded with tourists and shoppers, and instead of running into an even 50 people a day, the average Manhattanite now has close contact with, say, 55 people a day. All of a sudden, the equilibrium is disrupted. The 1,000 flu carriers now run into 55,000 people a day, and at a 2 percent infection rate, that translates into 1,100 cases the following day. Those 1,100, in turn, are now passing on their virus to 55,000 people as well, so that by day three there are 1,210 Manhattanites with the flu and by day four 1,331 and by the end of the week there are nearly 2,000 and so on up, in an exponential spiral, until Manhattan has a full-blown flu epidemic on its hands by Christmas day. That moment when the average flu carrier went from running into 50 people a day to running into 55 people was the Tipping Point. It was the point at which an ordinary and stable phenomenon—a low-level flu outbreak—turned into a public health crisis.[13]

By 1990, the number of cases infected with scientific evidence, like Gladwell's Manhattan flu carriers, was piling up. The 1980s saw a major epidemic of tort litigation.[14] Much of this epidemic was fueled by cases involving Agent Orange,[15] asbestos,[16] the Dalkon Shield,[17] and Bendectin.[18] To a greater and lesser extent, these cases presented complex issues regarding deducing causation from science. More importantly, however, the numbers alone created a crisis. Hundreds of thousands of lawsuits were quickly overwhelming the legal system's ability to operate.[19]

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[13] GLADWELL, *supra* note 5, at 260-61 (endnotes for page 12).

[14] *See* Deborah R. Hensler & Mark A. Peterson, *Understanding Mass Personal Injury Litigation: A Socio-Legal Analysis*, 59 BROOK. L. REV. 961, 961 (1993) ("The 1980s marked the era of mass personal injury litigation.").

[15] *See* PETER H. SCHUCK, AGENT ORANGE ON TRIAL (1986).

[16] *See* PAUL BRODEUR, OUTRAGEOUS MISCONDUCT (1985).

[17] *See* RICHARD B. SOBOL, BENDING THE LAW (1991).

[18] *See* MICHAEL D. GREEN, BENDECTIN AND BIRTH DEFECTS (1996); Joseph Sanders, *The Bendectin Litigation: A Case Study in the Life Cycle of Mass Torts*, 43 HASTINGS L.J. 301 (1992).

[19] Hensler & Peterson, *supra* note 14, at 961.

Indeed, given the sheer numbers involved, one might have thought that the tipping point would have been reached five to ten years earlier. Early on, however, these cases were not specifically perceived as involving problems with scientific evidence. The epidemic at this point was in tort litigation, not scientific evidence. Issues surrounding management of class action suits and discovery rules occupied most courts' and scholars' attention. The reason for this was that most of the early toxic tort litigation did not involve controversial science or, to the extent that it did, courts were focused elsewhere. The scientific proof in the asbestos and the Dalkon Shield litigations, in particular, was very strong. The issue was not whether the substances caused the claimed ailments, but how best to handle the onslaught of litigation in order to ensure just and reasonable outcomes.

The situation, however, was different with the Bendectin litigation—which appropriately became the subject of the *Daubert* decision. Whether Bendectin caused birth defects was hotly disputed. With the Bendectin litigation, judges began to appreciate the complexity surrounding basic claims of scientific causation. Strange concepts such as epidemiological analysis and meta analysis began to trickle into court opinions.[20] Still, the Bendectin litigation was well contained and, at least until *Daubert*, would not infect a large number of courts. Most of the claims were resolved, in the defendants' favor, in one consolidated trial in 1985.[21] But times were changing. The new reality was beginning to settle on the judiciary.

This reality was starkly presented in another monumental event of the 1980s, the development of DNA profiling. The technique was invented in 1985 at Leicester University by Alec Jeffreys and his colleagues. It was put to almost immediate use when it was employed in July of that year to support Christina Sarbah's claim, in an immigration dispute, that a Ghanian boy was her son.[22] It was used again in 1986 to prove the innocence of a seventeen-year-old hospital

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[20] *See, e.g., Daubert*, 509 U.S. at 583-84 (Justice Blackmun refers to meta analysis as "reanalysis" in his opinion.).

[21] *See* Hensler & Peterson, *supra* note 14, at 979.

[22] *First "Gene" Rape Conviction*, CHI. SUN TIMES, Nov. 14, 1987, 1987 WL 4120263.

worker suspected of two murders in Leicester.[23] In November 1987, the first conviction based partly on "genetic fingerprinting" was rendered in London.[24] The defendant was convicted of raping a forty-three-year-old disabled woman after DNA from his blood matched DNA in the semen found on the victim's clothing.[25]

Given the tremendous power and utility of this new technology, its immediate popularity was not surprising. Of greater consequence, however, was the fact that judges immediately realized the need to understand something about science in order to use this powerful new tool. Unlike the perceived advantage of the other identification sciences, such as fingerprinting or ballistics, the matching characteristics could not be seen at all and they could not be understood without a refresher course in basic biology.[26] Even courts applying the general acceptance test from *Frye*[27] wrote opinions replete with terms from molecular biology and population statistics.[28] In addition, the new science spread quickly through the case law.[29] These cases, of course, are not all DNA profiling

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[23] *Id.*

[24] *Id.*

[25] *Id.*

[26] The perceived differences between DNA profiling and the other forensic sciences are merely illusory. As forensic scientists, and the prosecutors who employ them, are beginning to learn, all matching sciences, from ballistics to hair, are probabilistic. The difference is that today we have a pretty good idea of the probabilities associated with DNA, but, since the research has yet to be done, little is known of the error rates associated with many other forensic sciences.

[27] *See* Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).

[28] *See, e.g.*, State v. Pennington, 393 S.E.2d 847 (N.C. 1990).

[29] A quick and dirty study done of the allstates and allfeds data fields on Westlaw on March 4, 2001, found the following numbers of cases citing the letters "DNA."

Dates	Allstates	Allfeds
1985-1986	3	7
1987-1988	17	24
1989-1990	92	40
1991-1992	245	55
1993-1994	401	86
1995-1995	605	184
1997-1998	822	177
1999-2000	1116	204

cases and many do not delve into the details of either the science or the technology. Nonetheless, and in due recognition of the limitations of my hurried data collection, the numbers roughly support my general thesis. Over the 1990s, the courts increasingly confronted DNA and other scientific subjects to the point at which their need to understand and deal with the subject became unavoidable. The DNA helix became a new icon.[30] The courts found themselves in a new position. They were on the cutting edge of science.

The context was thus ripe for tipping to occur in the law's use of science. Especially across the torts frontier, science was increasingly a huge presence that had to be handled. In addition, to the extent mass toxic lawsuits were thought to be spiraling out of control, greater supervision of the underlying science offered a possible solution. At the same time, the new science of DNA profiling hit courts suddenly and in great numbers. DNA profiling required judges to understand certain basic concepts of biology and elementary statistics. Scientific evidence was beginning to tip, and all that it needed was a few influential people to push it over.

II. THE LAW OF THE FEW

People are social animals and we get many of our best ideas from those around us. The clothes we wear, the style of our hair, and the restaurants we frequent are all affected by our friends and acquaintances. However, some people affect us more than others. This influence stems mainly from their individual characteristics, so that someone with great charisma, who begins wearing excessively baggy pants, will influence others to follow suit. How much influence this "change agent" has is proportional to the number of people with whom he or she interacts.[31] Therefore, if a *cool* person

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I would, of course, welcome a more sophisticated and detailed test of my hypothesis that the courts were obligated to learn science partly because of the growing onslaught of DNA cases.

[30] *See* DOROTHY NELKIN & M. SUSAN LINDEE, THE DNA MYSTIQUE: THE GENE AS A CULTURAL ICON (1996).

[31] Professor Rogers defines a "change agent" as "an individual who influences clients' innovation-decisions in a direction deemed desirable by a change agency." ROGERS, *supra* note 4, at 335. He notes further that the "agent usually seeks to secure the adoption of new ideas, but he or she may also attempt to slow the diffusion process

pierces her nose, or he gets a tattoo, by following suit, we can be *cool* too. The more people this *cool* person knows, the more baggy pants and tattoos will be seen on the streets. In the law, science has become very cool.

A popular parlor game called "Six Degrees of Kevin Bacon" illustrates the basic premise of the law of the few. The objective of the game is to link any actor to Kevin Bacon by associating that actor with other actors who, through as few series of associations as can be identified, can be linked to a movie he or she appeared in with Kevin Bacon. For instance, Humphrey Bogart was in *The Wagons Roll at Night*[32] (1941) with Eddie Albert and Eddie Albert was in *The Big Picture*[33] (1989) with Kevin Bacon. Thus, Humphrey Bogart has only two degrees of separation. In contrast, Carole Lombard was in *Show Business in War*[34] (1943) with Mickey Rooney and Mickey Rooney was in *Silent Night, Deadly Night 5: The Toy Maker*[35] (1992) with Clint Howard: Clint Howard was in *My Dog Skip*[36] (2000) with Kevin Bacon. Carole Lombard has three degrees of separation.

"Six Degrees of Kevin Bacon" is a Hollywood version of a social science study conducted by Stanley Milgram in the 1960s.[37] Milgram was interested in seeing just how small a world we live in, so he sought to measure our interconnectedness. Milgram asked 160 people in Omaha, Nebraska to send a packet to someone whom they believed could get it to a particular stockbroker in the Boston area. The idea was that the Omaha resident would send it to someone they knew near Boston, and that person would send it on to someone else, and so on until the packet arrived at the stockbroker's home or office. Milgram found that most of the packets arrived after passing through five or six separate hands. Thus, the name of the game.

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and prevent the adoption of certain innovations with undesirable effects." *Id.*

[32] THE WAGONS ROLL AT NIGHT (Warner Bros. 1941).

[33] THE BIG PICTURE (Columbia Pictures 1989).

[34] SHOW BUSINESS IN WAR (Bridgestone Multimedia 1943).

[35] SILENT NIGHT, DEADLY NIGHT 5: THE TOY MAKER (Artisan Entertainment 1992).

[36] MY DOG SKIP (Warner Bros. 2000).

[37] Stanley Milgram, *The Small World Problem*, 1 PSYCHOL. TODAY 60 (1967). The Milgram study is discussed at length in GLADWELL, *supra* note 5, at 34-38.

The truly interesting discovery of Milgram's study was that about half of all the packets reached the stockbroker through just three people. Thus, it was not that all people are well connected through only six degrees of separation. We are all connected through a relatively small number of highly connected individuals. In the case of Kevin Bacon, for example, in a study conducted by Brett Tjaden, he ranked only 669th of all of the actors studied for the average number of degrees of separation.[38] Rod Steiger ranked number one.

Steiger's success as a "connector" is attributable to both the large number of movies he made and their great variety. The large number of movies increased the number of actors with whom he worked, and the variety exposed him to actors and actresses of varying genres. Connectors' success, therefore, depends on the number of people they know and the number of networks to which they belong. Connectors can be particularly effective if they create bridges between otherwise insulated groups. At the same time, however, it is not clear that Steiger made the best "change agent," because he did not have the charisma of a Bogart or a Grant. The game, after all, is not called "Six Degrees of Rod Steiger." The number of people someone knows is extremely important, but a good change agent must also have the power to persuade. In the law, this is especially true.

The most "connected" and, in formal terms, the most persuasive, legal institution is the U.S. Supreme Court. Although scientific evidence could have tipped without the Court, eventually the Court would either have to put its imprimatur on the phenomenon, or try and stop it. The Court opted to join the fray sooner rather than later. And when the Court granted certiorari in *Daubert*, there was little doubt that Justice Blackmun would write the opinion if he were in the majority.

Justice Blackmun was long known for his active interest in science. Before writing *Roe v. Wade*,[39] he spent a summer researching medical issues surrounding pregnancy at the Mayo Clinic, where years earlier he had been general counsel. In *Roe*, he used the medical concept of viability to set the time at which

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[38] GLADWELL, *supra* note 5, at 47. Tjaden's study and results, called the "Oracle of Bacon," can be found at http://www.cs.virginia.edu/oracle/.

[39] 410 U.S. 113 (1973).

the government's interest in the life of the fetus became compelling.[40] Five years later, Justice Blackmun authored *Ballew v. Georgia*,[41] an opinion that relied extensively on empirical research.[42] *Ballew* set the constitutional floor at six for the size of criminal juries.[43] Justice Blackmun, thus, was perfectly situated to give the final shove to fell a phenomenon that was already teetering and about to tip over. At first, however, *Daubert* did not constitute this final shove. Only later would it come to symbolize the tipping of scientific evidence. In the summer of 1993, just after the decision, *Daubert* was still a sign that pointed in several directions.

The Supreme Court might be the ultimate "change agent." But the pronouncements it hands down, though bearing great authority, need to be picked up by those in the field. The Court's will can be frustrated when those around it are hostile to its directives. Adding to this sometimes institutional inertia, or outright hostility, the *Daubert* opinion itself was maddeningly equivocal. The opinion spoke simultaneously of the liberality of the *Federal Rules of Evidence* and the pressing need to have judges screen scientific evidence as gatekeepers. Both plaintiffs' attorneys, who preferred liberal admissibility standards, and civil defense lawyers, who preferred the opposite, declared victory after the case was decided.[44]

The tipping of scientific evidence was assisted hugely, and largely ensured, by a relatively small number of judges devoted to handling scientific evidence who, together, represented an extraordinarily influential group of people. Early on, before *Daubert*, judges such as Jack Weinstein,[45]

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[40] *Id.* at 163.

[41] 435 U.S. 223 (1978).

[42] It should be noted, however, that, in *Ballew*, Blackmun's "treatment of the statistical literature [was], at best, careless." David H. Kaye, *And Then There Were Twelve: Statistical Reasoning, the Supreme Court, and the Size of the Jury*, 68 CAL. L. REV. 1004, 1008 (1980).

[43] *Ballew*, 435 U.S. at 239 ("[T]hese studies . . . lead us to conclude that the purpose and functioning of the jury in a criminal trial is seriously impaired, and to a constitutional degree, by a reduction in size to below six members.").

[44] *See* P. Kevin Castel, *Bye to "Frye": High Court Sets Standards for Admitting Expert Testimony*, N.Y.L.J., July 8, 1993, at 1.

[45] *See, e.g.*, Eliot Marshal, *New York Courts Seek "Neutral" Experts*, 272 SCI. 189 (1996); *see also* Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117 (1997).

Edward Becker,[46] and William Schwarzer recognized the impact science would have on the law, and shaped decisions to handle it. For example, brilliantly anticipating *Daubert*, the Federal Judicial Center, headed at the time by Judge Schwarzer, began compiling the *Reference Manual on Scientific Evidence*, which was published shortly after *Daubert* was handed down.[47] After *Daubert*, judges such as Robert Jones,[48] Samuel Pointer,[49] and Nancy Gertner[50] helped define *Daubert's* scope and direction. Also instrumental in sustaining the tipped state of scientific evidence was Justice Breyer, both for his opinion in *Kumho Tire Ltd. v. Carmichael*,[51] and his statements in favor of a liberal use of court appointed experts.[52] Combined with the influence of these and other judges, academics and the Federal Judicial Center contributed mightily to the sense of momentum that is an integral part of any tipping point.

III. THE STICKINESS FACTOR

The stickiness factor refers to how memorable or contagious the phenomenon is, in and of itself. Science does not exhibit a great deal of stickiness initially, especially among those without a background in the subject. Undoubtedly, this lack of stickiness contributed to the courts taking several centuries to join the scientific revolution. But science becomes sticky once it is learned. At that point, like gum on the bottom of your shoe on a hot summer day, it is impossible to get unstuck.

The stickiness factor probably was not highly instrumental in leading to the tipping point of scientific evidence. DNA profiling, however, might have contributed somewhat along this dimension. Just as the atom symbolized the mid to late twentieth century, the DNA helix is the symbol

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[46] *See, e.g.*, United States v. Downing, 753 F.2d 1224, 1242 (3d Cir. 1985) (cited in *Daubert*, 509 U.S. at 591).

[47] REFERENCE MANUAL ON SCIENTIFIC EVIDENCE (1994).

[48] *See, e.g.*, Hall v. Baxter Healthcare Corp., 947 F. Supp. 1387 (D. Or. 1996).

[49] *See, e.g.*, *In re* Silicone Gel Breast Implant Product Liability Litigation, MDL-926, Order No. 31E (Oct. 31, 1996).

[50] *See, e.g.*, United States v. Hines, 55 F. Supp. 2d 62 (D. Mass. 1999).

[51] 526 U.S. 137 (1999).

[52] *See* Stephen Breyer, *Introduction* to REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 1 (2d ed. 2000).

of our times.[53] DNA profiling was a component of a much larger and more profound revolution in biotechnology. The human genome, and all that it entails, is one of the biggest issues, as well as one of the most exciting and disturbing, confronting our society today. Undoubtedly, the new science of DNA and the biological science and ethical issues swirling around it—from cloning to stem cells—have a sticky quality to them.

Still, DNA was a relatively small part of the tipping that was happening across the law's frontier. A judge could, perhaps, learn enough biology and statistics to handle DNA profiling and possibly the occasional intellectual property dispute that might arise involving the subject. But what about all of the other scientific and quasi-scientific fields that could be seen along the horizon? There were many sciences, all rather less sticky, and many having the potential to overwhelm, either in their complexity or their great numbers. Toxicology, epidemiology, psychology and the forensic sciences had all been around for quite some time, and all had been readily ignored. Was it not possible to learn some science, without going all the way? It turns out that the answer is no. Science is just too sticky once it is understood.

Thomas Huxley, popularly known as "Darwin's bulldog" and a first-class scientist himself, referred to science as nothing more than "organized common sense."[54] But it is a common sense that is an acquired taste. Once that taste is acquired, however, it is difficult not to judge everything one tastes by it. That is what is happening in the law today. This sort of stickiness means that this is one tipping point phenomenon that will not wane like pet rocks or Hush Puppies. The phenomenon is something like what happens to generation after generation of first-year law students. In that first semester, they begin learning exciting new ways of thinking about car accidents, widget manufacturing, and criminal assault. Thinking like a lawyer is a new way of critical thinking and the young lawyer has been given a new pair of lenses through which to see the world. Soon, it is hard for them to avoid describing everything they see through these new lenses. In fact, at Thanksgiving get-togethers, it is not

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[53] *See* NELKIN & LINDEE, *supra* note 30.

[54] THOMAS HUXLEY, COLLECTED ESSAYS, THE METHOD OF ZADIG (1894-94) (quoted in THE OXFORD DICTIONARY OF QUOTATIONS 358 (4th ed. 1992)).

uncommon to see the first-year law student shunned into a corner because his or her family has heard enough. But it is impossible to disinvent the wheel. Once you have seen the world through Mrs. Palsgraf's eyes, your idea of causation is forever changed. In the same way, once you have seen the world through Richard Feynman's eyes, your idea of proof of causation is forever changed.

In 1989, at a forum on DNA profiling at John Marshall Law School, Senator Paul Simon called the new technology the greatest advance in crime fighting since fingerprinting.[55] Ironically, the revolution in scientific sophistication led by DNA profiling has caused a reexamination of fingerprinting.[56] A host of other forensic sciences are also under increased scrutiny.[57] The simple reason for this is the stickiness of science. A judge who understands elementary concepts, such as base rates in DNA profiling, is apt to question how they were derived for the points of identification in fingerprinting. It turns out that those base rates were never derived for fingerprinting. Although to date no published opinion has sustained an objection to fingerprinting, that day may not be far off.

The law is still in the initial stages of the tipping effect, and its dealings with science remain highly variable. As with other examples of the tipping point, the infection has not yet raged completely through the population. Indeed, it might never reach everyone or encompass all legal subjects. But there is little doubt that we are in the midst of an epidemic, and there are good reasons to expect it to continue to spread largely unabated. Although scientists use a wide variety of research strategies and statistical tests, most science conforms to certain basic logical principles. Moreover, most of the science, quasi-science, pseudo-science, and non-science proffered in American courtrooms is not complicated. Areas of expertise including psychology, sociology, toxicology, epidemiology, clinical medicine, engineering, biology, anthropology, and the forensic sciences are readily understandable to the average

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[55] Peter Gorner & Ronald Kotulak, *Police Fighting Crime with New DNA Weapon*, CHI. TRIB., May 26, 1989, 1989 WL 4588734.

[56] *See Fingering Fingerprints*, THE ECONOMIST, Dec. 16, 2000 at 89.

[57] *See, e.g.*, United States v. Hines, 55 F. Supp. 2d 62 (D. Mass. 1999) (handwriting identification analysis).

judge. More importantly, the failures of those sciences are easily identified if the average judge is paying attention. More and more, since the subject tipped, average judges are paying attention.

CONCLUSION

Scientific evidence has tipped. Symposia such as this one, as well as the myriad of programs on science being run by state, federal and private organizations for lawyers and judges, all reflect—and perpetuate—this phenomenon. The rage for science today can be traced to three factors prevalent at the end of the 1980s and the start of the 1990s which triggered it; these are the "power of context," the "law of the few," and the "stickiness factor." The context was ripe around 1990 because the courts were increasingly inundated with toxic tort cases and the new DNA profiling technology. It was becoming glaringly obvious that judges needed to develop an understanding of basic scientific and statistical methods to manage this onslaught. In addition, around this time there were a relatively small group of highly influential judges who believed that the law had to actively take control of the growing tide of science, pseudo-science, and bad science being proffered in court. These few were well-situated to greatly influence the many who doubted and fought the rising tide. Finally, as judges began thinking not just like lawyers but also like scientists, they began to exercise this new-found vision across the spectrum of experts vying to testify. Knowledge of the scientific method proved sticky, and lawyers and judges have begun sticking it to all sorts of experts ever since.

The law has joined the scientific revolution, largely as a result of the impossibility of it avoiding this fate. Not until around 1990, however, were the circumstances sufficiently conducive for this to occur. Now that it has, much still needs to be done to manage this new state of affairs. But it is worth pausing for a moment to welcome the new regime and to rejoice in the new enlightenment. Law, and possibly many scientific fields, will never be quite the same. For that, we should be grateful indeed.