Genome Editing and the Jurisprudence of Scientific Empiricism

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ABSTRACT

Humankind has reached, in tow by the hand of a scientific breakthrough called CRISPR, the Rubicon of precise genetic manipulation first envisioned over fifty years ago. Despite CRISPR’s renown in science and its power to transform the world, it remains virtually unaddressed in legal scholarship. In the absence of on-point law, the scientific community has attempted to reach some consensus to preempt antagonistic regulation and prescribe subjective standards of use under the guise of a priori scientific empiricism. Significant and complex legal issues concerning this technology are emerging, and the void in legal scholarship is no longer tolerable.

This Article shrinks the scholarly gap, and it is the first to introduce CRISPR to legal literature. By providing a resource for jurists, scholars, and practitioners, it challenges conventional notions concerning the false dichotomy frequently associated with mutually exclusive normative roles for science and law. The Article makes two independent contributions. First, it lays a robust and comprehensive epistemic foundation of genome editing suitable for legal audiences. This element is descriptive, but essential because a detailed and coherent understanding of the nuts and bolts of the science is requisite for a discussion of law and policy. Second, it advocates for a jurisprudence of scientific empiricism, namely, a normative legal framework that consolidates empiricism and technological—e.g., genome editing—applications into a uniform doctrinal structure unencumbered by common substantive impediments to constructive debate. These impediments consist of impractical and often

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sensationalist claims about issues raised by technological advances and are collectively characterized as “deceptive simplicity.” The proposed paradigm, which lays a blueprint for the legal community to combat the deleterious effects of scientific illiteracy, flows from the Supreme Court’s recent decision in Association for Molecular Pathology v. Myriad Genetics and is broadly adaptable to addressing questions of science in law.

Applying this framework, the Article reconsiders Buck v. Bell and argues that, contrary to long-held views, Buck is not a direct product of false science, but of unbridled deceptive simplicity. Lastly, the Article sets the stage for a series of forthcoming works that will analyze genome editing from regulatory, constitutional, international, egalitarian, ethical, and policy standpoints, which highlight pivotal synergistic roles for law, science, and public policy in the development of this remarkable nascent biotechnology.

TABLE OF CONTENTS

I. INTRODUCTION ................................................................. 605
II. GENOME EDITING—A SYNOPSIS ........................................... 617
   A. The Rise of Recombinant DNA ........................................ 621
III. THE GENOME EDITING TOOLBOX .......................................... 622
   A. Chemistry-Based Synthetic DNA Scission .......................... 622
   B. Viral-Based Editing ...................................................... 623
   C. Nuclease Genome Editing Based on Protein-DNA Interactions .......... 624
      1. Meganucleases ......................................................... 624
      2. Zinc Finger Nuclease ................................................. 626
      3. TALENs ................................................................. 627
   D. Programmable, RNA-guided, DNA Nuclease Genome Editing ............ 628
IV. CURRENT AND PROSPECTIVE APPLICATIONS OF GENOME EDITING .. 633
   A. Editing to Target Somatic Cells and Stem Cells .................. 633
   B. Gene Drives .............................................................. 638
   C. Transgenic Animals for Translational and Basic Research 644
      1. Mouse Pre-Clinical Models of Disease ........................... 645
      2. Large Animal Pre-Clinical Models on the Rise ................. 647
      3. Xenotransplantation—A Case Study ................................ 650
   D. Agriculture ............................................................... 654
      1. Crops and Biofuels ................................................... 654
I. INTRODUCTION

The most significant technological breakthrough of this generation, namely, a genome editing tool called “CRISPR,” has inconspicuously arrived. Only on rare occasions does a technology with such far-reaching implications lightly knock to announce its arrival while holding the power to forever change the world and humankind.

The world has heard that sporadic light knock before. Nearly eight decades ago, scientific inquiry conceptualized nuclear fission as a theoretical explanation for the recondite empirical evidence that $^{239}$U, an isotope of uranium produced by the neutronic irradiation of $^{238}$U, could have its nucleus split into highly radioactive fragments. That theory was ultimately supported by experimental observations showing the enormous release of ionization energy resulting from nuclear fragmentation, thereby confirming a decades-old relationship between mass and energy—$E = mc^2$—first formulated by Albert Einstein.

With remarkable speed, the newfound knowledge covertly


served as the basis for the Manhattan Project, the research program that ultimately developed the atomic bomb through nuclear fission.\footnote{For a historical account of the origins and development of the US atomic bomb program of World War II, see generally F.G. Gosling, \textit{The Manhattan Project: Making the Atomic Bomb} (U.S. Dep't of Energy ed. 1999).}


Unpredictably, the technology evolved into personal computers and smartphones, and enabled the ensuing development of the Internet.\footnote{See Barry M. Leiner et al., \textit{Brief History of the Internet} 1 (2012), http://www.internetsociety.org/sites/default/files/Brief_History_of_the_Internet.pdf [https://perma.cc/ZL6B-3TEP] (chronicling the origins and evolution of the Internet).} Other fundamental discoveries over the past few centuries—in mathematics, physics, chemistry, and biology—have facilitated our ability to harness the power of natural phenomena in space travel, wireless communications, medicine, and a myriad other applications.

The technological breakthrough of this generation, unlike many of its predecessors, holds the power to alter humankind from
within. A quantum leap in genome editing\(^9\) capabilities has led us to the Rubicon of precise, endogenous, genetic manipulation—one originally envisioned decades ago, yet methodologically beyond reach for prior generations of scientists. The protagonist of this genome editing revolution is an atomic, programmable, macromolecular machine comprising a pair of precision scalpels that shear DNA molecules and has been colloquially baptized as “CRISPR,” an acronym for the system of Clustered, Regularly Interspaced, Short Palindromic Repeats (CRISPR) and CRISPR-associated (Cas) proteins.\(^10\)

In the last four years, CRISPR systems—and CRISPR-Cas9 in particular—have been adapted in laboratories across the globe at an exponential rate. Astoundingly, more than 2,500 scientific publications\(^11\) feature theory, empirical observations, and descriptions of applications for this budding biotechnology. Stratospheric expectations for CRISPR systems have already attracted more than $1 billion in venture capital\(^12\) in a brief period of time. One of a few CRISPR-based companies became the first to file the requisite paperwork for an initial public offering with the Securities and

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9. See definition infra Part II; see also infra notes 53–55 and accompanying text.

10. See discussion infra Section III.D.


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Exchange Commission (SEC) recently, and rumors abound that other firms will follow suit in the near future.

Despite its renown in select scientific niches, CRISPR continues to be an arcane secret in the legal realm. Whereas scientific scholarship has produced thousands of publications on CRISPR, legal scholarship concerning this transformative biotechnology is virtually nonexistent. The gap is striking, notably on account of an ongoing, high-stakes, intellectual property battle over patent rights to CRISPR systems with multi-billion-dollar ramifications.

The neglect of CRISPR in legal scholarship poses grave uncertainty regarding how the law will treat this emerging technology going forward. Legal scholars have either largely ignored this field or kept a distance from it, presumably due, in part, to the challenges that complex scientific principles often pose to non-scientists in the legal


14. See, e.g., Chen, supra note 12. Between the time this Article was accepted for publication and its printing, other companies have filed for initial public offerings with the SEC. For instance, CRISPR Therapeutics AG filed for an initial public offering with the SEC on September 9, 2016. CRISPR Therapeutics AG, Form S-1 Registration Statement Under the Securities Act of 1933, U.S. SEC. & EXCHANGE COMMISSION (Sept. 9, 2016), http://www.nasdaq.com/markets/ipos/filing.ashx?filingid=11077159 [https://perma.cc/KM9L-9YEH].

15. CRISPR earned the 2015 “Breakthrough of the Year” accolade awarded by the prominent Science journal. Marcia McNutt, Breakthrough to Genome Editing, 350 SCIENCE 1445, 1445 (2015).

16. See supra note 11 and accompanying text.

17. An unfiltered search on the Westlaw database using the “CRISPR” acronym at the time this Article was completed in late 2015 returned zero hits for all primary—statutory and case law—sources, and only one hit for all legal scholarship journals. Westlaw Search for CRISPR, WESTLAW (search for all documents containing “CRISPR”) (last visited Feb. 1, 2016). The sole mention of CRISPR in all of legal scholarship was relegated to one sentence without explanation of what CRISPR is or even what it means. See Girard Kelly, Note, Choosing the Genetics of Our Children: Options for Framing Public Policy, 30 SANTA CLARA HIGH TECH. L.J. 303, 312 (2014).

18. A patent interference proceeding is underway, which challenges priority and validity of the first CRISPR patent. See Engineering and Optimization of Systems, Methods and Compositions for Sequence Manipulation with Functional Domains, U.S. Patent No. 8,993,233 (filed Dec. 12, 2013) (issued Mar. 31, 2015). In early 2016, the U.S. Patent and Trademark Office agreed to allow the interference proceedings to determine whether the Broad Institute of MIT and Harvard—on one side—or the University of California, Berkeley, the University of Vienna, and Emmanuelle Charpentier—on the opposite side—were first to invent CRISPR under US Patent Law. See Heidi Ledford, Bitter Fight over CRISPR Patent Heats up, 529 NATURE 265, 265 (2016), http://www.nature.com/polopoly_fs/1.17961!/menu/main/topColumns/topLeftColumn/pdf/nature.2016.17961.pdf [https://perma.cc/6MGY-TLNA].
and legislative arenas.\textsuperscript{19} A recent concurring opinion by the late Justice Antonin Scalia famously illustrated the degree of scientific antipathy among some members of the legal community.\textsuperscript{20} Exercising great candor,\textsuperscript{21} Scalia conceded his lack of knowledge of relevant scientific details in a case before him.\textsuperscript{22} At the same time, he disturbingly remarked he did not even believe in scientific facts that have been well established for decades.\textsuperscript{23}

\begin{itemize}
\item \textsuperscript{19} Consider, for example, the questions and commentary by Justices of the Supreme Court during oral argument in a recent case involving complex concepts in genetics and molecular biology. See generally Transcript of Oral Argument, Ass’n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107 (2013) (No. 12-398), http://www.supremecourt.gov/oral_arguments/argument_transcripts/12-398-amc7.pdf [https://perma.cc/8STG-PXJF].

\textquotedblleft I thought that maybe the cDNA was kind of an economy class gene, was—it wasn’t. . . That may be incorrect for the record, but that was my present understanding.	extquotedblright \textit{Id.} at 20:6 (Kennedy, J.).

I just didn’t understand, because I thought the . . . chromosome has the BRCA gene in the middle of it and it’s attached to two ends. But also in the body, perhaps because cells die, there is isolated DNA. . . . I probably misread it.

There’s a better chance that I’ve misread it. \textit{Id.} at 38:2 (Breyer, J.) (BRCA appears without emphasis in the original transcript, though proper scientific nomenclature requires the gene to be italicized).

My understanding is that here, . . . what’s involved, is snipping. You’ve got the thing there and you snip—snip off the top and you snip off the bottom and there you’ve got it. . . . I still don’t understand what—in what sense it’s different than just snipping along—along the line.

\textit{Id.} at 41:8, 42:22 (Roberts, C.J.).

To get back to your baseball bat example, which at least I—I can understand better than perhaps some of this biochemistry, I suppose that in . . . all of that time possibly someplace a branch has fallen off a tree and it’s fallen into the ocean and it’s been manipulated by the waves, and then something’s been washed up on the shore, and what do you know, it’s a baseball bat.

\textit{Id.} at 48:4 (Alito, J.).

\textquotedblleft [I]f I’ve read it correctly, that when you have an R—the messenger RNA does not have the same base pairs. There’s a U or something instead of an A or whatever it is.	extquotedblright \textit{Id.} at 18:5 (Breyer, J.).

\textsuperscript{20} See Ass’n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2120 (2013) (Scalia, J., concurring in part and concurring in the judgment) (\textquoteright{}I join the judgment of the Court . . . except Part I-A and some portions of the rest of the opinion going into fine details of molecular biology. I am unable to affirm those details on my own knowledge or even my own belief.	extquoteright{}).

\textsuperscript{21} To some extent, Scalia’s admission is commendable from the perspective that a person in a position of great power should not be afraid to admit knowledge gaps. After all, no human holds absolute knowledge in any area. On the other hand, it is worrisome that a powerful person may be called to decide pivotal questions with broad societal implications when that person makes no effort whatsoever to close self-perceived knowledge gaps. Expressing disbelief in science is not sufficient. Those with power to delineate the contours of what constitutes the rule of law ought to educate themselves about matters before them.

\textsuperscript{22} \textit{Myriad}, 133 S. Ct. at 2120.

\textsuperscript{23} See id.
That kind of scientific aversion has corrosive effects. It ultimately hinders the sort of interdisciplinary dialogue and insight required to fully understand and address significant problems in an increasingly interconnected world. In the near future, law- and policy-makers will be confronted with many questions related to CRISPR, and the legal community must proactively take steps to familiarize itself with this new technology. Given the rapid expansion of CRISPR-based applications, the void in legal scholarship concerning the technology is becoming increasingly problematic.

As a testament to this growing problem, Judge David Neuberger, President of the UK Supreme Court, recently published a commentary in Nature calling attention to the scientific community and arguing that scientific primers would be “hugely beneficial” for the legal community. Such primers, he contended, would save money and time, help assess the reliability of expert witnesses, and increase the proportion of cases that are settled without trial. Specifically, he singled out genetic engineering as an area in which a primer would be useful to jurists given that legal controversies in the field are likely to recur.

In the absence of on-point law, some in the scientific community are campaigning, in arguably self-serving ways, for a

25. David Neuberger, Stop Needless Dispute of Science in the Courts, 531 NATURE 9, 9 (2016).
26. Id.
27. Id.

First, CRISPR-based biotechnologies may pose an economic threat to Sangamo’s monopoly over genome editing using older Zinc Finger-based technologies. Although Sangamo has recently hopped on the CRISPR wagon, see, e.g., Screening Assays for Therapeutics for Parkinson’s Disease, U.S. Patent Application No. 14/647,732 (filed Dec. 2, 2013), it lacks the commanding foundational intellectual property it enjoys in the Zinc Finger field. Second, many of Sangamo’s gene editing biotechnologies, some of which are currently in clinical trials, see infra notes 188–
consensus to preempt antagonistic regulation and prescribe subjective standards of use under the misguided auspices of a priori scientific empiricism. This must give us pause. Einstein memorably remarked, “[T]he man of science is a poor philosopher.”\textsuperscript{29} Most scientists—by training—are unfamiliar with intricate legal principles, constitutional doctrine, regulatory processes, and policy making; likewise, most lawyers are oblivious to scientific theory, physico-chemical laws, and cellular and macromolecular processes. Given these vastly different realms of knowledge, it is understandable that many scientists and lawyers often pursue insularism by academic discipline. Surely, there is comfort in academic seclusion, but isolation is often dangerous to learning and the pursuit of knowledge. “People do not learn very much when they are surrounded only by the likes of themselves.”\textsuperscript{30} Interdisciplinary colloquy, therefore, is the most sensible approach to bridge the current chasm between science and law surrounding this momentous biotechnology.

Broadly speaking, this Article seeks to shrink the scholarly gap vis-à-vis genome editing and CRISPR-based technologies in legal literature. It is the first of a series of forthcoming articles\textsuperscript{31} that, collectively, propose a normative structural legal framework; namely, they conceptualize a jurisprudence of scientific empiricism that is broadly adaptable to addressing questions of science in law. The scientific empiricism referred to in this Article specifically concerns the natural sciences—e.g., physics, chemistry, biology—and not the

\textsuperscript{29} Albert Einstein, \textit{Physics and Reality}, 221 J. FRANKLIN INST. 349, 349 (Jean Piccard trans., 1936). Whether his assessment is correct is, of course, beyond the scope of this Article.


social sciences—e.g., sociology, psychology, economics, political science, etc. This distinction is mainly due to discrete research methodologies and analytical tools endogenous to each discipline. The paradigm proposed here originates from the Supreme Court’s recent decision in Association for Molecular Pathology v. Myriad Genetics, which this Article will refer to as Myriad.

This Article introduces CRISPR and the next generation of genome editing tools to legal scholarship. By providing a resource for jurists, scholars, and practitioners alike, it challenges conventional views regarding the false dichotomy frequently associated with mutually exclusive normative roles for science and law—the proximate cause driving laissez-faire attitudes of deference to elude questions of “law in science and science in law.”

32. In particular, this point revolves around the fact that, whereas the natural sciences rely extensively on quantitative methods, the social sciences depend, to a great extent, on qualitative research. The proposed framework in this Article is exclusively concerned with scientific empirical data that is reproducible and quantifiable. Hence, for example, a jurisprudence of scientific empiricism would seek to answer whether genome editing may lawfully be used to correct a genetic mutation associated with a monogenic disease as a consequence of a clinical trial, given the existence of empirical data demonstrating that such genetic corrections are feasible and reproducible (or not) under controlled experiments. The approach, however, would not apply to deciding the legal status by studying the decision making processes and attitudes toward genome editing of the patients undergoing treatment under the clinical trial. The primary empirical data acquired from social scientists in the former scenario largely depend on interviews and other qualitative research that may be considered ontologically subjective.


33. See, e.g., Craig v. Boren, 429 U.S. 190, 204 (1976) (“There is no reason to belabor this line of analysis. It is unrealistic to expect either members of the judiciary or state officials to be well versed in the rigors of experimental or statistical technique.”); ROBIN FELDMAN, THE ROLE OF SCIENCE IN LAW 37–48 (2009) (discussing lawyers’ proclivities to defer to scientific expertise).

34. See, e.g., Craig v. Boren, 429 U.S. 190, 204 (1976) (“There is no reason to belabor this line of analysis. It is unrealistic to expect either members of the judiciary or state officials to be well versed in the rigors of experimental or statistical technique.”). Technologies have advanced to the point where genome editing may be a viable therapeutic option for certain medical conditions. This Article thus adopts this phrase from the title of an article penned by Oliver W. Holmes, Jr. over a century ago. See Oliver Wendell Holmes, Jr., Law in Science and Science in Law, 12 HARV. L. REV. 443, 444 (1899). Interestingly, the same Holmes authored the infamous Buck v. Bell decision upholding the constitutionality of sexual sterilization for the mentally disabled relying on dubious science. See discussion infra Section V.C.
Although legal scholars need not become “amateur scientists,”\textsuperscript{36} this Article insists that law- and policy-makers must become engaged and proactively strive to grasp the core elements of significant technologies like CRISPR, which hold the power to transform the world. The Article’s overarching goals are to (1) ignite a measured and scholarly conversation about the current and prospective uses of select biotechnologies, stripped of illusory conjectures, and (2) provide the legal community with a primer on genome editing to facilitate an interdisciplinary exchange of ideas. There is much the legal community can contribute to this field.

In furtherance of these goals, the Article makes two independent but synergistic contributions. First, it provides a robust and comprehensive epistemic foundation of the history and current state of the scientific literature in the field of genome editing. It is descriptive and technical, but is intended to be suitable for both legal and scientific audiences. This work is precisely the type of primer for which Judge David Neuberger recently advocated.\textsuperscript{37} Notably, it faithfully tracks and explains primary scientific sources, something generally absent from legal scholarship construing scientific themes. This prologue is essential because, without a detailed explanation and coherent understanding of the nuts and bolts of genome editing, the audience may extrapolate unfounded notions of the immediate, short-term, and long-term prospects and limitations of the technology.\textsuperscript{38} Simply put, a solid foundation of key genome editing scientific principles offers the structural scaffolding—an insurance policy, so to speak—for a fruitful dialogue grounded in reason rather than baseless conjecture.

The second contribution propounds positive claims for prospective applications of genome editing that are firmly grounded in empirical evidence.\textsuperscript{39} One substantial predicament about powerful technologies is that they are often prone to manipulation by speculative agents who—knowingly or not—spread misinformation and oversell what is technologically feasible. By anchoring prospective technological applications in a jurisprudence of scientific empiricism, this Article advocates for a normative approach that consolidates genome editing applications into a uniform doctrinal

\begin{enumerate}
\item See Neuberger, supra note 25, at 9.
\item See discussion infra Parts IV and V.
\item A revolution is well underway in genome editing science with the potential to fundamentally reshape the way we approach agriculture, synthetic biology, ecosystems, bioterrorism, gene therapy, and biomedicine through law and policy. See discussion infra Part IV.
\end{enumerate}
structure unencumbered by common substantive impediments to constructive debate. These impediments consist of impractical and often sensationalist claims about issues raised by technological advances and are collectively characterized as “deceptive simplicity.”

This approach aims to cultivate and expand *Myriad’s* roots of scientific empiricism and is broadly applicable to other fields of law in which scientific inquiry may play important or dispositive roles.

The synergism between these two contributions underscores the importance of interdisciplinary efforts to prevent, mitigate, and resolve future “global problems” raised by technological progress. In essence, a jurisprudence of scientific empiricism is based on the notion that “[c]ritical thinking . . . cannot possibly be restricted to the examination of the concepts of [one’s] own specific field.”

This Article is divided into four sections. Part II begins by proposing a genome editing definition, a necessity for any applicable regulatory or statutory scheme. It introduces the reader to the manipulation of genetic material, explains how this concept of biotechnology is well rooted in popular and scientific history, and describes the discovery of two critical elements that facilitated genome editing.

Part III rummages through the genome editing toolbox and examines the development of modern, cost-effective, powerful, programmable tools that are democratizing researchers’ access to genome editing technologies.

Part IV examines current applications of genome editing in a number of fields ranging from stem cell research and agriculture to

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42. *Einstein*, supra note 29, at 349.

43. See also infra notes 53–55 and accompanying text.

44. The search for meaning in ambiguous statutory text lacking robust definitions has, in recent years, lead to increased use of dictionaries in judicial opinions. See, e.g., James J. Brudney & Lawrence Baum, *Oasis or Mirage: The Supreme Court’s Thirst for Dictionaries in the Rehnquist and Roberts Eras*, 55 WM. & MARY L. REV. 483 (2013) (pointing out that as many as one-third of statutory decisions in modern Supreme Court jurisprudence consult dictionaries in often highly subjective modes).
biofuels production and human pathophysiology. It meticulously acquaints the reader with prospective genome editing uses in each field, relying exclusively on primary scientific sources. Importantly, the Article deliberately contemplates genome editing from diverse viewpoints and recognizes that every technology endowed with awe-inspiring powers should be handled responsibly and with respect.45 This Part argues that, taken together, genome editing biotechnologies are not mere tools for basic research, but rather epitomize prolific mines for future significant medical and scientific breakthroughs. The goal is to engage the legal community in discussions about the technology’s potential for good and bad, including what should or should not be done to legally promote or hinder it.46

Finally, Part V concentrates on deceptive simplicity and implements the normative framework articulated in this preamble to delineate adequate contours for a discussion that avoids the squabbles frequently set forth by manufactured fears; the kerfuffle concerning “designer babies”47 is one example relevant to genome editing. To that end, it reconsiders Buck v. Bell48 and the indelible scar it left on

45. Consider the advent of the atomic bomb. Some argue that the technology changed the world for the better as it brought an end to the bloodiest conflict the world has ever witnessed. MICHAEL KORT, THE COLUMBIA GUIDE TO HIROSHIMA AND THE BOMB 8, 46–49 (2007); Winston Churchill, Leader of the Opposition, Where Do We Stand?, (Aug. 16, 1945), in 11 VITAL SPEECHES DAY 738 (1945), http://www.ibiblio.org/pha/policy/1945/1945-08-16c.html [https://perma.cc/7RS7-C76R]. Others decry the bomb as an instrument that led to utter destruction in two cities, nearly a half-million deaths, and political instability for decades after War World II. GOSLING, supra note 5, at 51, 54, (stating that the bombs dropped on Japan eventually killed an estimated 340,000); KORT, supra, at 76–78, 81 (describing political instability); Martin J. Sherwin, The Atomic Bomb and the Origins of the Cold War: U.S. Atomic Energy Policy and Diplomacy, 1941-45, 78 AM. HIST. REV. 945, 945 (1973). Computers and the Internet have changed—in both positive and negative ways—how humans communicate, access information, shop, and even perceive reality. See generally, e.g., Kaveri Subrahmanyam et al., The Impact of Home Computer Use on Children’s Activities and Development, 10 CHILD. & COMPUTER TECH. 123 (2000). Genome editing is no different in this sense. Although this Article highlights many potential benefits, it by no means argues that the biotechnology should be viewed as a panacea for all world problems.

46. To some extent, the scientific community has begun engaging in this debate. See, e.g., Scientists Debate Ethics of Human Gene Editing at International Summit, GUARDIAN (Dec. 1, 2015), https://www.theguardian.com/science/2015/dec/01/human-gene-editing-international-summit [https://perma.cc/FY62-EJCL]. However, the legal community has not assumed a leadership role to direct a pervasive discussion of legal issues framed by genome editing technologies.

47. See, e.g., Joan Mahoney, Genome Mapping and Designer Babies, 79 UMKC L. REV. 309, 313 (2010) (citing not a single primary scientific source for the proposition that new technology may presumably allow parents to decide eye color and sexual orientation of designed babies); discussion infra Section V.A.

American jurisprudence from a novel perspective—namely, to illustrate the dangers of unchecked deceptive simplicity.

Much has been written about Buck in legal scholarship and this Article will not belabor what has already been said about the case. The conventional view is that Buck’s holding is illegitimate because it rests on false, or pseudo, science and incorrect moral and ethical principles. This Article rejects that view and applies a jurisprudence of scientific empiricism to instead contend that Buck is a direct product, not of false science, but of rampant deceptive simplicity that permeated every aspect of elite circles at the time it was decided.

The distinction between false science and deceptive simplicity is crucial. Whereas false, or pseudo, science refers to a system of theories and rules configured to give the appearance of being grounded in scientific methodology, deceptive simplicity strips logic beyond a bare minimum using vague intuition born out of second-hand, reductive explanations that diminish a scientific concept to a deceptively simple catchphrase. To support this proposition, the Article studies Buck’s substantively porous decision, which cited not a single scientific source for the Court’s lending of credence to the notion that “heredity plays an important part in the transmission of insanity, imbecility, etc.”

Lastly, this Part sets the stage for a series of upcoming articles that aim to analyze the prospective benefits and risks associated with the use of genome editing biotechnologies from statutory, regulatory, constitutional, international, ethical, egalitarian, scientific, and policy standpoints. In so doing, it encourages scholarly debate and highlights the pivotal synergistic roles that law, science, and public policy will play on the development of this truly exceptional and transformative emerging biotechnology.

49. Pseudoscience is defined as “a system of theories, assumptions, and methods erroneously regarded as scientific.” Pseudoscience, MERRIAM-WEBSTER ONLINE DICTIONARY, http://www.merriam-webster.com/dictionary/pseudoscience [https://perma.cc/8FKP-4GVS] (last visited Feb. 23, 2017); see also discussion infra Section V.C.


51. See discussion infra notes 581–98 and accompanying text.

52. Buck, 274 U.S. at 206.