# SYSTEMS OF EVIDENCE IN THE AGE OF COMPLEXITY

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The global economy is transforming in unprecedented fashion. Persistent, exponentially advancing technologies[1] now rival the invention of the printing press in their importance to society.[2] Indeed, respected economists declare that what is happening is the biggest development in the history of economic activity.[3] The result? Complex systems will soon define reality and a new civilization is emerging. And what is happening in the legal realm? Our system of evidence now fails to comprehend the emerging complexity that may soon overwhelm us. Accordingly, the rule of law is in jeopardy.

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1. *See* George L. Paul, *Transformation*, 9 ABA SCITECH LAWYER, Winter/Spring 2013, at 2, *available at* www.lrrlaw.com/files/uploads/documents/Transformation,%20by%20George%20Paul.pdf (quoting Daniel Burrus' statements that exponential hard trends are transforming society in a way that is "bigger than the . . . printing press").

2. It is widely acknowledged that the invention of the moveable type printing press by Johannes Gutenberg, circa 1450 C.E., was the technology that more than any other helped usher in modernity. Its acceleration of the transmission of information enabled such things as the Renaissance, the Protestant Reformation, and the Scientific Revolution. Before Gutenberg's invention it took many months to make a single book, but after the printing press, people were able to print about 300 pages a day, with the rate up to 1,000 pages a day at the end of the Fifteenth Century. *See* Carlo M. Cipolla, BEFORE THE INDUSTRIAL REVOLUTION: EUROPEAN SOCIETY AND ECONOMY 1000–1700, at 106 (Christopher Woodall, trans., 3d ed. 1994). Because of the importance of his invention, Gutenberg has been proclaimed the most important person of the last millennium. *See* AGNES HOOPER GOTTLIEB, ET AL., 1000 YEARS, 1000 PEOPLE: RANKING THE MEN AND WOMEN WHO SHAPED THE MILLENNIUM (1998). Others state Gutenberg is one of the most influential people in human history. *See Johannes Gutenberg*, WIKIPEDIA, http://en.wikipedia.org/wiki/Johannes_Gutenberg (last visited Apr. 12, 2014) (further asserting that Gutenberg's invention stimulated the Renaissance and the Scientific Revolution).

3. The current changes are not only the biggest since the Industrial Revolution, they may well be the biggest changes ever in the history of our economy. *See* W. Brian Arthur, *The Second Economy*, MCKINSEY Q. (Oct. 2001), http://www.mckinsey.com/insights/strategy/the_second_economy.

Clearly, our system of evidence must become more realistic. The "observations"[4] in this article discuss why and will address the following issues:

1. *Inflation of Information*: How the three principal drivers in our economy—processing power, information storage capacity, and bandwidth—now push ever-increasing amounts of complex information through our technologies and minds in a process termed "information inflation."[5]

2. *Society's Cognitive Disconnect*: How, because of the exponential nature of information inflation, it is difficult to forecast future developments using everyday societal intuitions, and thus information inflation creates a cognitive disconnect that can be fatal to public policy.

3. *Complex Information Systems*: How our economy is now experiencing a proliferation of "complex information systems," which as a consequence of their complexity, defy understanding and thus make the testing of their actions either impossible or exceedingly difficult.

4. *The New Complex Evidence*: How such complex information systems sense events, record data, enter into transactions, and transform information in complex ways; and then state, decide, opine, and define our reality in written records, oral communications, and immersive experiences. These systems will become increasingly complex in the short-term future and already facilitate a mind control of sorts.[6] In the mid-term, there are implications that are staggering in their consequences.

5. *Failure of our System of Evidence*: How our evidentiary rules have no tradition of testing complex information systems, rendering existing jurisprudence outdated, inappropriate, and incapable of comprehending important evidence.

6. *The Common Law Function*: How the system of evidence must now acknowledge that complex information systems are a new type of "declarant" under the law of hearsay. Because of the pace of change, the system of evidence must now embrace a new "common law function," which will permit it to co-evolve with society in its new Age of Complexity.

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4. It is a privilege for the author to be permitted to express these ideas in the nature of *observations*. These are amplifications of the author's remarks, entitled "The Shopbook Rule of Wooden File Cabinets," made at a meeting of the Federal Evidence Rules Advisory Committee on April 4, 2014. Some observations may seem wide-ranging, but all of them are material to the underpinnings of a "New Technology"—an empiricism which will be *realistic* in its ability to guide social life and public policy for the citizens of our new Age of Complexity.

5. *See infra* note 96 and the Endnote (discussing the process of inflation in general).

6. *See generally* Carrie Leonetti & Jeremy Bailenson, *High-Tech View: The Use of Immersive Virtual Environments in Jury Trials*, 93 MARQ. L. REV. 1073 (2010).

## I. THE NEW LIFE OF INFORMATION

Seven years ago, I co-authored the article, *Information Inflation: Can the Legal System Adapt?*,[7] with Jason Baron. It has been cited over a hundred times in cases, articles, legal briefs, and in a decision by the Supreme Court of at least one nation overseas.[8] Some consider the article seminal because it forecast how the legal profession would evolve so as to comprehend the data created by the inflation of information. The technologies the article predicted have come to pass and have been commercialized. They are studied in institutes and discussed in federal court decisions.[9]

*Information Inflation* did more than predict how the legal profession would plumb vast new seas of information in discovery. It highlighted evidentiary concerns. Its second paragraph stated: "As problematic as quantity are the diverse new forms of writing which emerge constantly as a consequence of information inflation."[10] The article posed the conundrum posed by a complex system:

> In such a system, the whole exhibits an emergent behavior that is much more than the sum of the parts. Critically for law, such systems cannot be understood or explained by any one person. As a result, writing has now grown into something akin to a "new form of life."[11]

Consider the idea "a new form of life." Since *Information Inflation* was published seven years ago, digital information continued its inflation and

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7. George L. Paul & Jason R. Baron, *Information Inflation: Can the Legal System Adapt?*, 13 RICH. J.L. & TECH. 10, 12 (2007).

8. In *Global Yellow Pages Limited v. Promedia Directories Pte Ltd.*, [2013] 111 SGHC 7, the High Court of Singapore noted that "information inflation" was the result of "an evolutionary burst in writing technology." The author is pleased that the High Court of Singapore has cited his article, as Singapore's economy has been ranked as (1) the most open in the world; (2) the least corrupt; (3) the most pro-business and (4) having the third highest per-capita Gross Domestic Product (GDP). *See* Economy of Singapore, WIKIPEDIA, http://en.wikipedia.org/wiki/Economy_of_Singapore (last visited Apr. 21, 2014).

9. *See* Bennett B. Borden & Jason R. Baron, *Finding the Signal in the Noise: Information Governance, Analytics, and the Future of Legal Practice*, 20 RICH. J.L. & TECH. 7, 14 (2014) (discussing the principles at issue and the case law discussing such technologies as "predictive coding").

10. *See* Paul & Baron, *supra* note 7, at 17.

11. *Id*. *See also* GEORGE L. PAUL & BRUCE H. NEARON, THE DISCOVERY REVOLUTION: E-DISCOVERY AMENDMENTS TO THE FEDERAL RULES OF CIVIL PROCEDURE (2006). The author has the privilege of participating in ongoing research with his co-author Mr. Nearon, who in our book helped educate the legal profession about the complexity of information systems in a typical business. No one can agree on how such systems work, and no one person understands them. ROBERT W. RYCROFT & DON E. KASH, THE COMPLEXITY CHALLENGE: TECHNOLOGICAL INNOVATION FOR THE 21ST CENTURY 3 (1999).

catalyzed further transformations in our civilization. What was viewed as "writing" seven years ago has evolved into society-wide behaviors, implicating the dynamic of language capability.[12]

As an example, the devices we all carry have grown smaller and more powerful, and they are now "wearable" and designed to mesmerize with complex digital stimuli, and most critically, citizens are already addicted. Such behavior is new to Earth.[13] These devices are evolving exponentially. 3-D screens and eyeglasses? Devices tattooed into your throat? Yes, they are already here and it is only the beginning.[14]

In addition, cloud computing achieved dominance. Its business model revolutionized the economy. Among other things, it supports the societal addiction to the devices by means of "apps," of which there are now more than 1,000,000 kinds.[15] These apps query vast databases in real time and do amazing things.

This infrastructure, in turn, has enabled new species of "mind networks."[16] Such systems are so catalytic that a single message can network out so as to be read by 100,000,000 people in six days.[17] Minds on earth can publish far and wide, instantaneously, and in turn are constantly devouring designed channels of digital information. The networking of these separately powerful technologies—all built on a pre-existing Internet—triggered the emergence of a "technological complex,"[18] which snapped together soon after *Information Inflation* was published. The complex is global, and there are now more mobile devices than there are people on earth.[19]

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12. *See infra* note 98 (discussing technology, man's use of tools, the view of language as the sublime technology, and the concept that technology is now a *grand tether* of sorts). Human language has been described as a "form of life," a metaphor expressed by Ludwig Wittgenstein in the mid-Twentieth Century. *See* LUDWIG WITTGENSTEIN, PHILOSOPHICAL INVESTIGATIONS, at liii (2010).

13. *See* Paul, *supra* note 1, at 10 for an explanation of the use of and by such intimate device technology as an example of what technologists call "*technique*."

14. *See generally* U.S. Patent Appl. No. 13/462, 881 (filed May 3, 2012).

15. *See* Nathan Ingraham, *Apple Announces 1 Million Apps in the App Store, More than 1 Billion Songs Played on iTunes Radio*, THE VERGE, Oct. 22, 2013, http://www.theverge.com/2013/10/22/4866302/apple-announces-1-million-apps-in-the-app-store.

16. These mind networks are diversifying and networking together exponentially. Some such mind networks are currently called "social media," but there are many other kinds, such as crowd-sourced funding and crowd-sourced research and development. *See* Paul, *supra* note 1, at 10–11.

17. *See* Emily Heinz, *How 'Kony 2012' Went Viral*, HUFFINGTON POST, Apr. 12, 2012, http://www.huffingtonpost.com/2012/04/12/kony-2012-viral-infographic_n_1421812.html.

18. *See infra* note 64 (discussing the "technological complex").

19. The International Telecommunications Union (ITU) indicated that in 2014 there will be 7.3 billion mobile devices in use, or more than there are people on the planet. *See How Many Mobile Phone Users in the World*, HOWMANYARETHERE, Feb. 12, 2012, http://www.howmanyarethere.org/how-many-mobile-phone-users-in-us; Joshua Pramis, *Number of Mobile Phones to Exceed World Population by*

All the while, more and more types of *things* became increasingly intelligent. Things now incorporate tiny processors and other miniature devices which sense, decide, transmit, record, and then make both decisions and declarations. Cars, for example, are increasingly beginning to drive themselves. Tennis rackets and basketballs can be intelligent.[20] There are devices in bridges, roads, and agricultural fields, all in order to make those things intelligent. Might you want an information system to manage a beef production industry—for a designed, national "cow infrastructure?" Then imbed a miniature device in every cow living in the nation in order to monitor its activities from birth to death, as is currently being done in Uruguay.[21]

Almost anything can be made intelligent. Huge companies are just now rolling out new species of chips and devices to facilitate communicative intelligence in both animate and inanimate things that are not computers. The infrastructure is already here. It is currently estimated there are ten billion things on our Internet and that there will be many multiples of that number by the end of the decade.[22]

But what if a new Internet were to emerge? Some sort of awesome "ultranet," which would connect all such increasingly intelligent things with their ever-shrinking communicative devices? That too is already happening. Currently a new Internet protocol, called IPv6, is being refined. It will

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*2014*, DIGITAL TRENDS, Feb. 28, 2013, http://www.digitaltrends.com/mobile/mobile-phone-world-population-2014/#!EdUVC.

20. *See, e.g.*, Tom Perrotta, *The Racket of the Future*, WALL ST. J., June 2, 2012, http://www.online.wsj.com/news/articles/sb10001424052702303647004577434350145781454; Brett Zarda, *The Embeddable Coach: New Basketball's Built-In Sensor Tracks and Evaluates Players*, POPULAR SCI., Jan. 21, 2011, http://www.popsci.com/technology/article/2011-01/tracking-basketball-players-sensor-embedded-ball; *USDA Makes Implanted Computer Chips Its De Facto Standard for Controversial National Animal ID System*, ORGANIC CONSUMERS ASS'N, May 12, 2008, http://www.organicconsumers.org/articles/article_12268.cmf. The size of devices continues to shrink almost across the board. Researchers have glued tiny, manufactured tags to the backs of ants in order to study ant behavior. Hitachi now makes RFID tags as small as a piece of dust.

21. More than eighty percent of the eleven million Uruguayan cows have a microchip imbedded in their ears, and all are getting an ID number that keeps track of their health history, where they are from, and where they are at any given moment—from birth to the moment they are sold for beef production. *See* Patricia Rey Mallén, *Tracking System Keeps Uruguayan Cows Healthy*, INT'L BUS. TIMES, Nov. 20, 2013, http://www.ibtimes.com/tracking-system-keeps-uruguayan-cows-healthy-thriving-meat-industry-6th-world-1477576. The author is grateful to Reed Gelzer, M.D., for bringing Uruguay's efforts to his attention.

22. *See* R. Colin Johnson, *"Internet of Things" Roll Out Boosted by New Intel Chips, Gateways*, GOPARALLEL, Nov. 7, 2013, https://goparallel.sourceforge.net/internet-things-roll-boosted-new-intel-chips-gateways; *Technical Program Announced for TSensors (Trillion Sensor) Summit at Stanford University for October 22–25, 2013*, PRNEWSIRE, Sept. 23, 2013, http://www.prnewswire.com/news-releases/technical-program-announced-for-tsensors-trillion-sensor-summit-at-stanford-university-for-october-22-25-2013-224948032.html.

permit the number of potential IP addresses to exceed the number of atoms on the face of the planet.[23]

Such a backbone will allow all our increasingly intelligent things to be connected in a network the size and scope of which will be unimaginably profound. The nodes will connect devices already so small that some now approach the size of a piece of dust.[24] Most say the emergence of such a creature is now inevitable, and it is increasingly called the "Internet of Things" or "IoT." The network is already here to some extent and facilitative technologies currently are growing it by 100 new things each second and the pace is accelerating. Most say such a mind-blowing Internet of Things will be here ten to fifteen years in the future, but possibly sooner, as the Internet inflates from a few billion things to a number approaching a trillion things.

In addition, ever-increasingly complex arrays of digital information are now routinely fed into human minds. Are you using your 3-D technology, perhaps on eyeglasses simulating a virtual reality? Social science research in the jury context demonstrates that even primitive forms of such digital experiences alter memories, implant false memories, and fundamentally alter decision-making dynamics.[25] Powerful new forms of mind control have been commercialized and there is a nascent jurisprudence on the subject.[26]

Look in front of your face. It appears some sort of a "new mind" is looming up during our very lifetimes, when our species faces a great test of sorts. Should we take the timing for granted? Are there perhaps ethical implications—a call to action for the protectors of our liberties? Are there indeed fiduciary duties for the noblest of professions?

## II. CHALLENGE TO THE LAW OF EVIDENCE

The Law of Evidence faces the biggest challenge of its three hundred year history. Information systems are now complex. They constantly network to realize potentialities large and small, and emerge into new

23. *See, e.g., Internet of Things: How Cisco Defines the IoT*, CISCO, http://www.cisco.com/web/solutions/trends/iot/overview.html (last visited Apr. 22, 2014) (discussing exponential growth in intelligence in things, the exponential "miniaturization" of things, and the exponential growth in networks). There are now cameras and computers that are less than one cubic millimeter in size, and the new Internet protocol (IPv6) will in fact permit one-hundred IP addresses for each atom on the face of the planet.

24. *See* Perrotta, *supra* note 20; Zarda, *supra* note 20. *See also supra* notes 20–23 and accompanying text.

25. Leonetti & Bailenson, *supra* note 6, at 1076–77.

26. George L. Paul, *Canvassing the Emerging Law of Digital Information: Stephen Mason's* Electronic Evidence, 53 JURIMETRICS J. 467, 469, 480 (2013).

structures that defy understanding and testing. They sense things. They decide things. They make statements about their decisions. They make records. Soon they will be making declarations of all sorts as a new economy sweeps over the globe. Complex information systems will in some part even define our reality, as they are being used by and therefore are themselves using human minds in a "grand tether" of sorts.[27] Clearly, there is now a new type of "declarant" in society, which can be said to make "declarations of complexity."

How can society deal with evidence generated, recorded and then stated by declarants so complex that no one can understand their inner workings? How can we test such assertions? Shall we simply take a chance and assume for the remainder of civilization that all statements made by complex systems are always true and just? Shall we let them define our reality for all time?

### A. *The Dangerous Disconnect*

There is an additional challenge posed by our new reality. These new declarants are increasing their information powers, capabilities and complex networking dynamics *exponentially*. What does this say about reality? How fast is exponential? Human intuitions are linear and don't easily comprehend exponential growth. There is a cognitive disconnect we must come to terms with.

Take a chessboard example: If you put one penny on the first square of a chessboard, and then two pennies on the second and four on the third and so on moving along the board one square a minute, each time doubling the pennies, how much money will you have on the last square, only, after sixty-four minutes? Imagine the number and quantify your intuition but do not get overly analytical. Just do it. Everybody knows it must be a big number. But how big is this number and was your usually reliable, societal intuition correct? The answer: you will have one thousand times the global gross domestic product on that last square.[28]

That is a good investment of one penny and an excellent return in one hour. But how far off was your intuition? You may have been off by a factor of a million, but possibly you may have been off by more than a billion-fold. It is not prudent public policy to misjudge the results of a relevant process by one billion-fold.

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27. *See infra* note 98.
28. Paul, *supra* note 1, at 3.

Computer technology accelerates the same way. Assume[29] that digital information had a velocity of *one inch per minute* in 1955. If a power doubling time of two years is in effect, technology will pick up the pace of its ability to do "information work" as one moves through history. In 1969, if you tried to keep up with the velocity of digital information, you would be going about *ten feet per minute*. When the author graduated from high school in 1975, one had to walk *one mile per hour* so as to keep pace with the velocity of digital information. The year information was inflating at one mile per hour, 1975, was the year the Federal Rules of Evidence became effective.

The author began to practice law in 1982. Just then, the inflationary event and the structures it was spinning out were getting press. There were compact discs for our music, and vinyl records began to disappear. Toys called "personal computers" turned up, but they did not yet have the power to engulf a society. We still had to type on a typewriter back then—a machine that had captured the economy back in the 1870s.

By the late 1980s, digital information had picked up the pace, and around that time, many of us first had a personal computer on our desk. The trajectory of information by then had gone vertical and the diffusion of the personal computer was a transformation of society. By the early 1990s, we had to hop in a plane to keep up with the velocity of digital information, and by 1993 we were forced to board a jet and zoom *500 miles per hour* to keep up.

The year 1993 was the year the United States Supreme Court declared, in *Daubert v. Merrell Dow Pharmaceuticals*,[30] that our rules of evidence remain utterly empirical. They were declared scientific and held out as incorporating advanced and appropriate epistemologies. The rules of evidence would continue to dominate society as a state-of-the-art truth declaring technology. Most importantly, the venerable "testing function" was re-consecrated in *Daubert* to remain paramount in the law of evidence.[31]

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29. The Endnote, *infra*, describes this thought experiment exploring the accelerating velocity of digital information in our culture.

30. 509 U.S. 579, 589–95 (1993).

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> Ordinarily, a key question to be answered in determining whether a theory or technique is scientific knowledge that will assist the trier of fact will be whether it can be (and has been) tested. "Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry." . . . . See also C. Hempel, Philosophy of Natural Science 49 (1966) ("[T]he statements constituting a scientific explanation must be capable of empirical test"); K. Popper, Conjectures and Refutations: The Growth of Scientific Knowledge 37 (5th ed. 1989)

But just as *Daubert* was decided, the pent-up power of the ever-accelerating velocity of digital information began to network once again. It networked then as it always has and always will, and it only needs a small chance to network. Just as a seed of grass only needs a tiny crack in the sidewalk in order to spring up and live, so too will the seed of information life always find nooks and crannies in which to network.

Between 1989, when the District Court granted summary judgment to the Merrell Dow defendants,[32] and 1999, six years after the Supreme Court's decision in *Daubert*, civilization was transformed. The World Wide Web was conceived, born and then networked out exponentially. When *Daubert* was at the trial court level there was no World Wide Web and its chief inventor, Tim Berners-Lee, was just then writing a proposal for the Web we know today. In 1992, the World Wide Web comprised a meager twenty servers. But after *Daubert* was decided the Web grew to 200 servers in August of 1993; 100,000 servers in January of 1996; and then 4.3 million servers in 1999.[33] Today there are billions of users of the World Wide Web.

Going from no World Wide Web to billions in the world on the World Wide Web is a transformation of a civilization. Going from one server to 4.3 million servers in six years is something qualitatively different than doubling the velocity of information three times over the course of six years. The networking of an information ecosystem creates a new landscape. With networking, doubling times collapse and structures blast out in new, complex webs. Remember one mind to 100,000,000 minds in six days?

All this is because networking is the chief dynamic that makes a complex system more than the sum of its parts. Networking occurs both inside and outside of devices, and just as it is difficult to define the boundary of ecosystems, so too is it difficult to delineate the physical boundaries of information systems. All systems are constituents of other systems. Human minds are everywhere, including not only in the software code but also in the operators and users of a system and there may be thousands of operators and millions of users.

In networks, one can add nodes but after a certain threshold is crossed, something fundamentally different comes together. What complexity theorists call a "behavior" "emerges." It has a "phase." A rough analogy is that of a two-year old going through a phase and that phase will change

("[T]he criterion of the scientific status of a theory is its falsifiability, or refutability, or testability") (emphasis deleted).

*Id.* at 593 (first citation omitted).

32. *See* Daubert v. Merrell Dow Pharm., Inc., 727 F. Supp. 570, 578 (S.D. Cal. 1989).

33. *See* Paul & Baron, *supra* note 7, at 6 n. 24.

through time. These changes are called "phase shifts" or "transformations."[34] Both this article and the original *Information Inflation* article declare that complex information systems are behaviors. They are forms of life in the same sense that human language systems are forms of life.[35]

Accordingly, *Daubert*, which reaffirmed the promise of state-of-the-art empiricism in our legal system, was decided in 1993 before there was a World Wide Web. Over the next six years the Web emerged and by 1999, lawyers had to travel *4,000 miles per hour* to keep up with the velocity of digital information.

[1999 Citizen Onlookers]: "Help the law of evidence! Its authors need to get out of their jet plane and get into a rocket ship! They long ago went vertical on the graph of change and are still accelerating upwards."

[2011 Citizen Onlookers]: "In 2011, in order to keep up with the velocity of information, our lawyers must travel 250,000 miles per hour. Did our lawyers know back in 1975 when the Federal Rules of Evidence became effective—and they were travelling at one mile per hour— that in 2011 they would be travelling 250,000 miles an hour in order to keep up with the velocity of digital information? It seems unlikely in the extreme."

[2014 First Citizen]: "Don't panic! I am confident our jurists realize they will soon be racing at over *one million miles per hour*. They will be thinking such velocity through and through and it only takes a few years to write a new rule."[36]

[2014 Second Citizen]: "Years to write a new rule? Soon rule-makers will be traveling *4,000,000 miles per hour*. And the rules they are revising became effective when information was inflating at *one mile per hour*. And an important individual rule they must scrutinize was adopted as custom *four centuries ago*.[37] And when my kids reach my age the velocity of the

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34. These observations and technical terms are well-settled among complexity theorists, whether they be chemists studying far-from-equilibrium thermodynamics, climatologists, ecologists, or evolutionary biologists. The larger society does have a primitive understanding of "tipping points" and the "butterfly effect," which are not pop truisms, but instead important characteristics, grounded in science, of our complex systems. But society has not fully comprehended the more subtle and non-deterministic laws that govern our relevant world. *See generally* ILYA PRIGOGINE & ISABELLE STENGERS, ORDER OUT OF CHAOS: MAN'S NEW DIALOGUE WITH NATURE (1984); *see also* JOHN H. HOLLAND, HIDDEN ORDER: HOW ADAPTATION BUILDS COMPLEXITY (1995); ROGER LEWIN, COMPLEXITY: LIFE AT THE EDGE OF CHAOS (2d ed. 1999).

35. *See generally* WITTGENSTEIN, *supra* note 12.

36. At an April 4, 2014 meeting of the Federal Evidence Rules Advisory Committee, it was acknowledged that the fastest a new rule of evidence can be conceived, written and go into effect is three years. More typically, because of hearings and public comment, such rule-making takes five to six years.

37. See the discussion in the next section, *The Shopbook Rule of Wooden File Cabinets*, which was the title of the author's remarks at the April 4, 2014 meeting of the Federal Evidence Rules Advisory Committee in Portland, Maine.

Inflationary Event will be *one million times what it is today!* I think it is about time to get moving."[38]

[Final Citizen]: "We must be realistic. If we are to be the caretakers of the institution differentiating 'true' from 'false,' we must reexamine our empirical assumptions, and devise an updated, appropriate, and prudent state-of-the-art empiricism. It should be called *Realism*. It must exist for us to preserve the rule of law."

### B. *The Shopbook Rule of Wooden File Cabinets*

At the time a formalized system of evidence arose in the early 1700s, Europe was enthralled by a new scientific method. Starting primarily with Newton, there was a long succession of remarkable mathematical discoveries about the "laws of nature." Because nature could be described by mathematics, the future of events could be predicted with certainty.[39] This ability did much to shape what intellectual historians call the "Cartesian-Newtonian Paradigm."[40] It ruled the Western world for 350 years.

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38. *See infra* Endnote (demonstrating that in forty years of twenty doubling times of two years, the velocity of information will be one million times what it is today—if long-standing trends continue).

39. In any new empirical tradition, we must reexamine society's epistemological assumptions. Lawyers are concerned to a large extent with what is reasonable, and what is unreasonable, and it thus behooves us to examine the foundations of our systems of knowledge. To these ends, we must acknowledge that our society takes the ability of mathematics to describe and predict reality for granted as if it were only natural. However, philosophers of mathematics have concluded that the ability of man to describe the universe with mathematics is *unreasonable*. This is considered by philosophers to be a well-settled, profound insight regarding an unsolved conundrum of reality. There is no explanation for mathematics' effectiveness in the natural sciences. *See* Eugene Wigner, *The Unreasonable Effectiveness of Mathematics in the Natural Sciences*, 13 COMM. PURE & APPLIED MATHEMATICS (1960), *available at* http://www.dartmouth.edu/~matc/MathDrama/reading/Wigner.html. Accordingly, in establishing new empirical foundations for our Age of Complexity, we must attempt to understand what can be described and predicted by mathematics, why that is so; what cannot be predicted by mathematics; and what can be described by mathematics. This is necessary unless one takes the position that understanding reality, including its complex systems, is unnecessary in developing empirical traditions—the systems of thought that are used to differentiate true from false and what is real and what unreal. It does not appear to be prudent to take the position that we need not understand reality in order to design legal and other social systems designed to discover reality. Indeed, such a view is "unrealistic." And it is not prudent to be unrealistic.

40. It is well settled that beliefs, ideas, conventions and hierarchies of such organizing patterns envelop a society and its culture. Such organizing sets of ideas shape a scientific worldview. In his book, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS, for example, Thomas Kuhn roughly defined a scientific paradigm as recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners. But a paradigm can embrace more than science. Scientific paradigms interact with larger, cultural paradigms, given that culture is complex. The term "Cartesian-Newtonian Paradigm" refers to the broadest type of cultural paradigm. It refers to the mode of thought that emerged in the mid-1600s with Descartes' rationalism and mathematical coordinate system and then with Newton's towering deterministic laws and calculus, which beginnings were followed by a long series of mathematical discoveries and inventions exploiting the unreasonable effectiveness of mathematics in the

The law of evidence evolved within this paradigm. In its first, brilliant phase in the early 1700s, it embraced the new philosophy of John Locke, called "empiricism,"[41] which had swept Oxford, Cambridge, and the entire European continent by storm in a few short years. The law first used logical hierarchies to rank the authoritativeness of different types of writings in a best evidence rule. Lawyers wanted to exploit the empirical insight that writings were more reliable than testimony, and indeed some writings were more reliable than others. The law then turned to the concept of hearsay. That idea had existed for decades, but it was not venerated until the 1800s. As society lost faith in any guarantees provided by a sacred oath, it acknowledged that witnesses must be "examined" as to their reliability, and a rule against hearsay became increasingly enforced. This was the second triumph of empiricism in our evidence law.

Cross-examination of witnesses is a form of "testing." The scientific process of testing (roughly the experimental method) and the socio-legal process of testing (roughly the examination of witnesses) have the same dynamic and it is the essence of empiricism. The human mind is constantly comparing ideas, using a materiality dynamic to determine which ideas link up, and which are discordant. The mind is thus constantly synthesizing and lack of "credibility" can instantly shatter ideas. The modern understanding of the rule against hearsay and the practice of testing in cross-examination together constitute the great and most lasting technology in the law of evidence.[42] Such techniques of testing should never leave us, as they are how we learn the difference between true and false.

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natural sciences. These explorations of mathematics encouraged Western culture to view reality as atomistic, and subject to manipulation in ways which could be predicted by computation. Many say that the paradigm did much to enable the Industrial Revolution, and some go so far as to say that its manipulative view of reality contributed to the European colonization of less powerful peoples. In any event, the larger cultural paradigm was heavily influenced by the constituent scientific paradigm, and intellectual historians sometimes refer to the enveloping thought of the past 350 or so years as the "Cartesian-Newtonian Paradigm." It was a view of atomism, determinism, analytics, logic and predictability of relationships of parts, with vectors determining end states. It did not comprehend complexity. *See generally* THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS, (4th ed. 2012); *and* PRIGOGINE & STENGERS, *supra* note 34.

41. The English word "empirical" derives from the Greek word ἐμπειρία, which is cognate with and translates to the Latin *experientia*, from which we derive the word "experience" and the related "experiment." *Empiricism*, PRINCETON.EDU, https://www.princeton.edu/~achaney/tmv/wiki100k/docs/Empiricism.html (last visited Apr. 22, 2014).

42. This is hardly a radical concept and has previously been recognized by evidence scholars, including by the Federal Evidence Rules Advisory Committee:

> All may not agree with Wigmore that cross-examination is "beyond doubt the greatest legal engine ever invented for the discovery of truth," but all will agree with his statement that it has become a "vital feature" of the Anglo-American system. The belief, or perhaps hope, that

But even before the empirical revolution and any systematized law of evidence, our courts had customs. In pre-industrial Europe, tradesmen wrote down information about their dealings. A "Shopbook Rule" emerged in English courts in the late 1500s. Our Shopbook Rule is a great tradition of our courts and certainly it is one of the most long-lived. It evolved long before the Industrial Revolution and no doubt helped facilitate that revolution by giving legal force to the documentation of transactions, debts and payments.

United States courts enforced the Shopbook Rule before the Civil War, when our own legal customs were taking American shape. Books and records of businesses were in handwriting. After the war, what we know as the typewriter was invented in 1867. A company named Remington retooled after the war, and in 1873 started manufacturing the first commercial typewriter. It diffused throughout society in the later 1870s and 1880s.

The Shopbook Rule lived on, notwithstanding that records were sometimes typewritten. Its policy was one of practicality. The out-of-court statements were transactions and amounts; mathematics ensured there could be an order to things. If there were mistakes in any involved algorithms, they could be comprehended, since the algorithms were largely grade-school math.

The vertical file cabinet was invented in 1898 and thereafter diffused throughout the economy. It revolutionized the business world. Wooden file cabinets housed the business records of the 1920s and the Great Depression, and were used throughout World War II. Any idea about using steel for file cabinets was tabled because steel was needed for the effort in that total war. During all this time, the Shopbook Rule was the rule we used.

A 1922 snapshot into the policy behind the Shopbook Rule is *Radtke v. Taylor*.[43] *Radtke* was a dispute over a $64.83 entry in a "daybook."[44] The underlying sales slips were not in evidence.[45] Accordingly, the court was compelled to consider "the nature and effect of shopbooks considered as evidence."[46]

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cross-examination is effective in exposing imperfections of perception, memory, and narration is fundamental.

*Notes of Advisory Committee on Proposed Rules Introductory Note: The Hearsay Problem*, CORNELL U. LEGAL INFO. INST. (citations omitted), http://www.law.cornell.edu/rules/fre/article_VIII.

43. 210 P. 863 (Or. 1922).

44. *Id.* at 864.

45. *Id.* at 865.

46. *Id.*

The Court first noted the historical custom. In the late 1500s English Courts were receiving shopbooks to make their decisions.[47] And Parliament was concerned. An "evil" had appeared in the shopbooks.[48] It was described as "not crossing out sums."[49] Receiving shopbooks also violated the rule that one cannot utilize self-serving evidence. But what could one do really? Not use them? Accordingly, Parliament noted its concerns about inaccuracy and the self-serving aspects and limited the use of shopbooks as early as 1609.[50] The 1609 Act tolerated the consideration of shopbooks, but limited their evidence to a period not exceeding one year after any transaction.[51] Accordingly, starting in 1609, the use of shopbooks was perceived as an accommodation of necessity.

Courts in the United States adopted the 1609 policy of a compromise forced by necessity, in part because for a major portion of the 1800s, parties could not testify in their own lawsuits[52]:

> The American shopbook rule has been based upon the ground of necessity. There were many small merchants who kept their own books and did not employ clerks or a bookkeeper; and, since the parties to lawsuits were disqualified as witnesses, such merchants were nearly always without any available evidence to prove sales made by them on credit. Out of this necessity arose a rule permitting the use of a party's shopbooks as evidence of goods sold and services rendered. A rule allowing the reception of books of accounts as evidence was in effect in the early 1800's in nearly all of the American courts then in existence; and all the courts which recognized such a rule did so upon the ground of necessity.[53]

*Radtke* found there was no statute but there was a judicial tradition allowing use of shopbooks in Oregon courts.[54] The Court applied the longstanding custom, and held that the required foundations had not been satisfied for the admission of shopbooks into evidence.[55] It excluded Mr.

47. *Id.* at 866.

48. *Id.*

49. *Id.* at 867.

50. *Id.* at 866.

51. *Id.* at 866.

52. *See generally* GEORGE L. PAUL, FOUNDATIONS OF DIGITAL EVIDENCE (2008) (discussing the history of the law of evidence).

53. *Radtke*, 210 P. at 867.

54. *Id.* at 871.

55. *Id.* at 872.

Radtke's "daybook."[56] It is a testament to the quality of our profession that such meticulous historical research was done to inform an evidentiary ruling.

Accordingly, in 1922 our Shopbook Rule was well over three hundred years old and very much alive. Sixteen years earlier, there had been a national call to modernize and perhaps unify the chaotic, common law of evidence. People had been complaining about it for almost a century. This was a call to a codification of the law of evidence.[57] The Shopbook Rule was examined in the 1920s and five years after *Radtke*, it was codified in the Model Act for Proof of Business Transactions, which had been written by legal experts appointed by the Commonwealth Fund of New York. This "Commonwealth Fund Act" is cited as legislative history in the original Advisory Committee Note to FRE 803(6).[58] This 1927 codification was adopted by Congress in 1936. The codification of the 1920s customs became the evidence rule in our federal courts during the Great Depression, and has been utilized thereafter.

Shopbooks were conceived as hearsay. The Commonwealth Fund Act confirmed they would constitute an exception to a modern hearsay rule. The updated Shopbook Rule would apply not only to shopbooks but also to business records of a more general nature—records of "regularly conducted activity." This slightly updated, 1927-vintage Shopbook Rule, and all its minor variations since that time, roughly required: (1) records be made contemporaneously by *someone* with relevant knowledge; (2) records be regularly made by an organization as a regular practice of its business; (3) a qualified custodian must lay a foundation; and (4) there better not be something suspicious going on.

The policy was that accuracy could be presumed because *people* were recording information over and over again, and therefore generally refining accuracy in a methodology for their business processes. The 1920s rule was thus a codification of a long-standing decision dynamic in the law. The 1927 codification of the early Twentieth Century foundations, as adopted by the federal courts in 1936, was thus animated by the same public policy underlying the 1609 Act of England's Parliament.

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56. *Id.*

57. In 1906, botanist-turned-law professor-turned law school dean, and later Dean of Harvard Law School, Roscoe Pound, made an address at an American Bar Association meeting, entitled "The Causes of Popular Dissatisfaction with the Administration of Justice." Looking back at events two decades later, Professor John Henry Wigmore, who in 1904 had written his own magisterial TREATISE ON THE ANGLO-AMERICAN SYSTEM OF EVIDENCE IN TRIALS AT COMMON LAW, identified Pound's speech as the tipping point catalyzing the codification of the common law of evidence. *See* John H. Wigmore, *Roscoe Pound's St. Paul Address of 1906—The Spark that Kindled the White Flame of Progress*, 20 J. AM. JUDICATURE SOC'Y 176 (1937). The codification took decades to complete.

58. FED. R. EVID. 803(6) advisory committee's note (1972).

It was not until after World War II that metal filing cabinets appeared on the scene, but by then the *Shopbook Rule of Wooden Filing Cabinets* had reached its maturity. Its approach to records of business processes is now found in FRE 803(6). There is nothing comprehending complexity in the rule, and that is no doubt because, when it was re-codified in the early 1970s, other than human beings, there were generally no complex systems making "statements." There were no "declarations of complexity." Any complex system making a "statement" would be a "someone," as provided in FRE 803(6)(A). Our Shopbook Rule compromise is now four hundred years old.

### C. *The Paradigm of Complexity*

When the early 1970's re-codification of the Shopbook Rule became effective in 1975, the Cartesian-Newtonian Paradigm had recently enabled our travel to the moon and we were proud of that achievement.[59] Few paused to consider that deterministic laws, such as gravity, were of limited relevance for living systems. Such laws could be described by mathematics, but it began to dawn on society that while such laws were good for moon landings, they failed at comprehending systems like the atmosphere, ecosystems, economies and social systems. These were "open" systems. Critically, one could not apply deterministic mathematics to the initial conditions of such systems so as to predict the future.

Such systems are governed by a family of natural laws that are probabilistic in nature.[60] Matter, energy, and information flow into open

59. The ability to forecast the trajectories of spacecraft so they can land within a few feet of targets on distant heavenly bodies is a testament to the fact that the law of gravity is a deterministic law. Mathematics could be employed to predict future events in such circumstances, namely the movement of bodies of mass in space assuming certain velocities and equations.

60. The dissipation of matter, energy, and information on a macroscopic scale falls generally within the ambit of the Second Law of Thermodynamics, which summarizes a cosmological principle that in the aggregate, matter goes from an ordered state to a more chaotic state, and energy goes from a useable state to a less useable state. Things fall apart, and the entropy of the universe increases. Such processes are irreversible and this is why, if we see a film of shards jumping off the floor and instantly assembling into a wine glass, we know we are watching a film being shown in reverse, and we are watching time's progress shown backwards. Complexity theory recognizes that when energy or information flow into an open system, the Second Law of Thermodynamics is not violated. Total entropy always increases. However, since an open system takes in more energy or information than it uses, constituent elements of an open system can communicate to create "pockets of order" within the overall system. Such systems are sometimes called "dissipative systems" because they absorb energy and information and waste some of it in the mandated increase of entropy, but some segment of the flowing energy of information is used to create "behaviors" resident in the open system. Such behaviors are what you see in the awesome, ordered arms of a hurricane. This is what we see in the gigantic flows of heat, air, water vapor, and ocean currents that order our climate. This is how ecosystems become organized. This is what creates the "Invisible Hands" of an economy. This is what organizes the human mind. This too is the behavior characterizing

systems all the time, which then organize themselves so that an order can arise out of chaos. Such order, as a result of the relevant natural laws of nature, has certain general characteristics.

First, the order of such systems is what is termed "complex." This is a multifaceted term that cannot be described in a single sentence, but which nevertheless signifies recognizable attributes. Complex systems comprise many "communicating" lesser constituent parts, arranged in networks. Complex systems evolve and have a history and thus are characterized by irreversible processes. "Complexity" became a way to understand most processes scaled between the very large (interplanetary distances) and the very small (atoms). Complex systems thus are generally the systems of the macroscopic world. They are the systems whereby matter, energy and information are ordered by information flowing into open systems (the systems termed "*Oikos*," including ecosystems and their kin).[61]

Although one could never predict the future states of such systems with mathematics as one could in a deterministic system (where will all the planets be in 2273?), one could use mathematics to *observe* broad patterns of behavior of such systems. They generally behave similarly across different realms, at least in certain broad attributes. As an example, the behaviors of ecosystems would mirror, in their broadest elements, the trajectories of economies and civilizations.

Critically, complex systems have many lesser parts. But what makes them complex is that they are much more, and qualitatively different, than the sum of their parts.[62] In a complex system, the communicating energy and information flows permit a behavior to "emerge." Emergence is a key behavior in such systems. And once a system achieves complexity, it generally will suck in ever more information and thereafter become increasingly complex through time. As noted in the Endnote to this observation, complex systems do this by leaps and bounds so as to constantly transform.[63] Similarly, they may suddenly morph and experience "exponential decay." Such pulses, and fits and starts, happen both with ecosystems in their punctuated equilibrium and mass extinctions, and with civilizations in their rise and sudden falls.

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complex information systems. *See* Glenn Res. Ctr., *Second Law of Thermodynamics*, NASA, http://www.grc.nasa.gov/www/k-12/airplane/thermo2.html (last updated July 11, 2008).

61. *See* Paul & Baron, *supra* note 7 (referring to information ecosystems as *"Oikos"*).

62. *See* PAUL & NEARON, *supra* note 11, at 4. *See also* GRÉGOIRE NICOLIS & ILYA PRIGOGINE, EXPLORING COMPLEXITY: AN INTRODUCTION (1989); PRIGOGINE & STENGERS, *supra* note 34 (explaining the concepts of "emergence," "complexity," "behavior," and providing a general description of far-from-equilibrium thermodynamic systems).

63. *See* Endnote (discussing "saltations").

D. *Complex Information Systems*

The digital age emerged at the same instant in human history that complexity arose as a paradigm for comprehending the natural world. Digital technology started to build up power to catalyze an emergence of interlocking, digital information technological "complexes."[64] There is a now an emerging Paradigm of Complexity channeling human thought, and this is appropriate and moreover helpful, because we now live in an emerging Age of Complexity.[65]

Think of the many teams that write our interlocking software, in part responsible for running our multi-nested information systems. Think of the many teams that design and manufacture our devices. Think of the people tethered to their monitors and keyboards inputting and operating and programming and being programmed—all part of a larger system no one understands because of its many constituent elements and emergent properties.[66] Such systems do much more than "regularly record data" and certainly they do more than record data meticulously collected by "someone."[67] They *transform* information in complex ways that appear new on the scene on an almost daily basis. They make statements no single "someone" could ever make. As one example only, they employ opaque algorithms to analyze big databases, now routinely collected not only without the knowledge but also against the wishes of the populace.

Indeed, our information systems have grown so complex that society must now build *secondary*, complex information systems to *observe and comprehend* information systems and their databases, and then to analyze and create the "facts." Accountants now call such secondary, observational

64. A technological complex can be conceived as a behavior emerging from the networking of constituent technologies. With digital computing, a quick succession of advances were synced together to emerge into radically new and ever-more powerful technologies. These include digitization; real time computing; the microprocessor; the personal computer; e-mail; local and wide-area networks leading to the Internet; the evolution of seamless editing software; the World Wide Web; advanced, addictive personal devices; cloud computing; wireless connectivity; intelligence in objects; new forms of networks; immersive technologies; miniaturization; mobility; interactivity; globalization; convergence of technology and information flows; people and their ever-evolving "*techniques*"; and cultural evolutionary advances that connect humanity to all these technologies in a "grand tether."

65. *See* PAUL & NEARON, *supra* note 11, at 4–8 (discussing the "Age of Information Complexity"). *See also* Paul & Baron, *supra* note 7, at 7 (declaring that the emerging complexes of digital computing herald a "new phase of civilization").

66. ROBERT W. RYCROFT & DON E. KASH, THE COMPLEXITY CHALLENGE: TECHNOLOGICAL INNOVATION FOR THE 21ST CENTURY 3 (1999) (pointing out the challenge posed by complex systems stemming from the inability of any one person, or even small group of people, to understand a complex system).

67. FED. R. EVID. 803(6)(A).

and testimonial systems the "Expert Systems."[68] These are some of the systems now making statements in their role as "declarants of complexity."

As one might expect, things sometimes do not go as planned in complex systems. There is a good engineering argument and many publications that demonstrate the more complex a system, the more it is prone to errors of many types and sizes.[69] There are design defects taking years to uncover, which may suddenly manifest themselves in unpredictable fashion.[70] Or, one

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68. The author has the pleasure of communicating with many of the leading members of the information technology auditing profession, including those that write the standards of technology assurance. They are currently studying and attempting to define and characterize complex information systems. Such leaders in the Certified Public Accounting field ("CPAs") have been convened by Bruce Nearon, CPA.

As only one example of their insights, Deniz Appelbaum, Ph.D. candidate at Rutgers University, is currently researching the rise of "Expert Systems" in accountancy. Notwithstanding that they work with datasets that are generally structured and designed to keep track of financial information in orderly fashion, accounting systems have become so complex that secondary information systems must be designed to comprehend the financial data residing in the primary systems. These secondary, "expert" systems are the systems that *create* the "facts." Similarly, lawyers in large lawsuits now use systems that merge human minds and their language capacity with machine processes in a technology called "predictive coding." *See* Borden & Baron, *supra* note 9.

Finally, the realm of analytics uses complex algorithms to attempt to search through unstructured, "big" databases, to formulate and then declare "facts." This technique is still evolving. Appelbaum reports that "heterogeneity" is a significant problem in Big Data as most data mining algorithms do not like inconsistent data. Many forms of data end up as messy heterogeneous Big Data files, and data scientists are still trying to determine the best way to analyze this data and transform it into a format that algorithms can manipulate. Both Appelbaum and R.D. Gelzer report that only a handful of data scientists are discussing the *provenance* of Big Data, and no one at all is talking about *secure* Big Data provenance, or the authenticity or reliability of the data in the big data that is manipulated by the analytics, which then rob the human mind of its empirical function in order to create the mental constructs called "facts." *See* Kenneth Neil Cukier & Viktor Mayer-Schoenberger, *The Rise of Big Data: How It's Changing the Way We Think About the World*, FOREIGN AFF., June 2013, http://www.foreignaffairs.com/articles/139104/kenneth-neil-cukier-and-viktor-mayer-schoenberger/the-rise-of-big-data.

69. *See* STEPHEN MASON, ELECTRONIC EVIDENCE, ch. 5 (3d ed. 2012).

70. Three days after the April 4, 2014 Federal Evidence Rules Advisory Committee meeting, it was publicly disclosed there was a systemic, serious vulnerability in our nation's purportedly secure electronic commerce infrastructure. The "Heartbleed" vulnerability is registered in the Common Vulnerabilities and Exposures system as CVE-2014-0160. Security expert Bruce Schneier calls Heartbleed a "catastrophic" bug in OpenSSL. In his blog, *Schneier on Security*, Schneier states, "'Catastrophic' is the right word. On the scale of 1 to 10, this is an 11. Half a million sites are vulnerable . . . ." Bruce Schneier, *Heartbleed*, SCHNEIER ON SEC. (Apr. 9, 2014), https://www.schneier.com/blog/archives/2014/ 04/heartbleed.html. Catastrophic economy-wide failures like Heartbleed demonstrate that complex information systems are not only imperfect, they evolve in complex ways, such as in open source systems where many actors add to systems without a preset plan. Such complexity may facilitate error. *See* Ralph Losey, *Heartbleed: A Lawyer's Perspective On Cyber Liability and the Biggest Programming Error in History*, E-DISCOVERY TEAM (Apr. 22, 2014), http://e-discoveryteam.com/2014/04/22/heartbleed-a-lawyers-perspective-on-cyber-liability-and-the-biggest-programming-error-in-history/ (explaining that a simple error in one line of code submitted free of charge to open source software created the Heartbleed vulnerability). Less than three weeks after these Heartbleed revelations, Microsoft acknowledged that Microsoft Explorer contains a serious flaw that makes it possible for outsiders to gain control of users' information systems when they

of many interacting, constituent subsystems may malfunction—such as in an e-commerce or banking network—rendering the global, complex system unreliable. There may have been upgrades that were not done correctly by strangers somewhat unfamiliar with the system design (hired "consultants," often working under enormous time pressures). People frequently do not use systems correctly. People get adventurous and use systems in ways not intended. All these things happen daily. Systems may be unreliable for many reasons.[71]

And then there is misbehavior. There are viruses. There are hackers. There are crooks and they have been around a long time. And there are secret, evil armies given marching orders, among them, "botnets." The botnets have long exploited computers, but now they turn to our interconnected "things." In January 2014, a security firm discovered a botnet had taken over a *refrigerator*.[72] What was going on with the laptops at the Winter Olympics?[73] There is no "biological" life to the overarching whole, but there is definitely a new form of robust, unruly life incorporating multitudes of human minds. It is taking over the planet and it is increasing in complexity exponentially.

All these systems within systems are making declarations of complexity, which will hereafter define our reality. But these new species of declarants refuse to answer questions about how they formulated their testimonies—or how or why they decided to do what they did do. How can we test and ask questions, in the tradition of the rule against hearsay, when these behaviors are so complex they defy easy understanding, explanation, and most of all testing and examination?

## III. THE LEGAL FUNCTION NOW COMPELS A NEW COMMON LAW FUNCTION

Our system of differentiating true from false (the law of evidence), and therefore our system of differentiating right from wrong (the law of evidence) is in jeopardy. This is no exaggeration if one looks just a few years out. The rule of law hangs in the balance. What should we do?

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browse the World Wide Web. Clearly, the infrastructure of the Internet has reached a complexity that now draws into question its reliability.

71. Stephen Mason discusses the engineering evidence and presents literature documenting such malfunctions and exploring the theory of such malfunctions. *See* MASON, *supra* note 69.

72. *See* Michael Kassner, *Internet of Things Botnet May Include TVs and a Fridge*, TECHREPUBLIC, Jan. 21, 2014, http://www.techrepublic.com/blog/it-security/internet-of-things-botnet-may-include-tvs-and-a-fridge/.

73. *See, e.g.*, *Visitors to Sochi Olympics Can Expect to Be Hacked*, WASH. FREE BEACON, Feb. 4 2014, http://freebeacon.com/national-security/nbc-visitors-to-sochi-olympics-can-expect-to-be-hacked/ (journalists conducted experiments showing almost instantaneous hacking of their laptops).

Let us start at the beginning. In the United States we read about the "three co-equal" branches of our government. This separation of powers is supremely wise. But on a deeper level this "co-equal" idea is naïve and erroneous.[74]

Our government has an unwritten architecture. It has a necessary geometry. It has a design subject to a simple yet ineluctable logic that defines the "legal function." Ours is a government of the rule of law. The legal function requires we make and abide by rules, and the first such rule is that we follow the rules, and this first rule is the rule of law. Some institution must decide whether rules are being followed and must compel all citizens, without exception, to follow the rules. That institution must thereafter enforce its decisions, so that citizens are doing what they are told. In our system, the Judiciary discharges this function. The Judiciary is infinitely more powerful than the other branches of government—or our species of government will explode. And the key to its job, which above all else is to preserve the rule of law, is a system called the law of evidence, because without such a system one can't know true from false and therefore right from wrong.

Both the Judiciary of England and its descendant the American Judiciary have faithfully discharged the legal function for centuries. These judiciaries did their job when there were no specific rules governing ever-evolving fact patterns and when times were changing rapidly. They did it before statutes and the dynamic of codification swept over society in the Twentieth Century. A body of judge-created rules, which arose as a product of individual adjudications, emerged into an evolving network of sorts.

### A. *Lord Neuberger's Address on the Common Law Function*

Recently in the United Kingdom, Parliament created a new "Supreme Court." Since 2009 it has served as the highest court in the land.[75] Its first members were twelve Law Lords. The new court's chief officer is Lord Neuberger of Abbotsbury, previously Master of the Rolls.[76]

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74. *See* Marbury v. Madison, 5 U.S. (1 Cranch) 137 (1803).

75. The Supreme Court is the final court of appeal for all United Kingdom civil cases, and criminal cases from England, Wales, and Northern Ireland. It hears appeals on arguable points of law of general public importance, and concentrates on cases of the greatest public and constitutional importance.

76. The author corresponds with Stephen Mason, Barrister of the Honorable Society of the Middle Temple, about matters of policy and developments in other nations. Mr. Mason was so kind as to provide the author with materials on Lord Neuberger's recent address, as well as with other insights, including discussions about the common law function as it exists in Great Britain.

In a July 2012 paper delivered at the Max Plank Institute in Hamburg,[77] Lord Neuberger made important observations about the common law function that unites our countries. He began his observation by examining the judicial system of the German speaking countries, which the British consider to be slavish in their citation to academic works, and contrasted it to that of England, which has long had precisely the opposite tradition.

In Hamburg, Lord Neuberger painstakingly dissected a long-standing rule in England that judges cannot cite the works of non-judges in their opinions—certainly not as any kind of authority—until the non-judge is dead. The "Better Read When Dead" rule of the English courts caused judges to refuse to take note even of "books of high estimation" on the ground their authors were still alive. The rule has waxed and waned, is on its way out, and it is probably dead. But it was alive well into the Twentieth Century. This doctrine is still discussed today by an outstanding judge in Great Britain, when he gives notable addresses at prestigious institutions in foreign nations.

Lord Neuberger gave his thoughts on England's longstanding yet mysterious policy. The prolonged life of the "Better Read When Dead" rule stems from a judicial sentiment that it is the judiciary which declares the law. Lord Neuberger's thesis is that the odd rule arose in England because, as opposed to other cultures like Germany for example, England has a common law tradition.

Law evolves in individual fact patterns, and Lord Neuberger observed that some feel that "decided" law is "tough" law. The law is thus forged in the present moment, and fine-tuned to give justice in response to the disputes, crises, and technologies of the day. It should be a razor sharp instrument, honed not by a logic articulated in codes, but by the experience of society. In a somewhat elliptical way, we say such up-to-the-minute decision-making is animated by a "common law function," because such was the dynamic driving the law in our culture for centuries, when the legal function was given life by a common law.

But on the other hand, it could be possible to overreact. What if a person in his twenties makes some important points about the law, but he is not a judge? What if a technologist in her thirties wants to be heard? Do we not cite the ideas and solutions until such young people are dead?

Lord Neuberger is discussing the balance and why it is appropriate "Better Read When Dead" fades away into history. He acknowledges the

77. Lord Neuberger of Abbotsbury, Master of the Rolls, Address at the Max Planck Inst., Hamburg: Judges and Professors—Ships Passing in the Night? (July 9, 2012), *available at* https://www.judiciary.gov.uk/Resources/JCO/Documents/Speeches/mr-speech-hamburg-lecture-09072012.pdf.

second part of the common law function, which is the necessity of referring to others' observations so the judiciary can serve the legal function in ever-changing circumstances. Lord Neuberger is describing what makes a great common law tradition, but he also seems to be making an observation about codification schemes in general. It appears they can become senescent. Perhaps they are not tough law, but rather a flabby pool of concepts that can become seriously out of shape in short order. And in a time of exponential change, they can become counterproductive in the extreme, in the blink of an eye.

We are fortunate that Lord Neuberger framed the issue for us. Now is the time to fine-tune a modern theory of the common law function. What is *our* common law here in the United States, which undoubtedly has the most powerful judiciary on the planet? What kind of common law of evidence should we have in the Twenty-First Century?

### B. *The "Adjacent Possible"*

A new form of evidentiary common law can comprehend our systems of complexity—and even allow testing of declarations of complexity. But judges are not technologists. If it takes a time-consuming effort of a group of technologists to explain a complex system and its declarations, how then can one lawyer make judgments as to their reliability when doing the day-to-day business of the law? We need a simple approach.

First, we must understand the "position" any new, evidentiary common law will have in our ever-emerging, hyper-complex society. Such law is both a subject observing technology, and simultaneously it is part of the object being observed. It is part of the culture, but it simultaneously shapes the culture. It will be part of a new, societal wide *technique*[78] whereby we relearn how to differentiate true from false and right from wrong, and therefore understand what is functional and what is dysfunctional in service to the requirements and objectives of society. Is there an analogy for the context in which such a legal system has life?

There is. Ecologists and evolutionary biologists are analysts of complexity and theorists of the highest order. They teach that a constituent system in an ever-expanding network of systems is not only itself evolving, but it constantly communicates with, and is thereby influenced by, the other constituent systems—which are themselves

78. *See* Paul, *supra* note 1, at 10 (discussing the technological concept of "*technique*," a French word which has been taken up in the literature of global technological processes).

evolving. All elements co-evolve and thus the global system evolves as a function of all transformations.

Complexity theorists mathematically describe complex systems as existing in a multi-dimensional "space." As we have seen, such systems have behaviors with ever-unfolding phases, and thus their behavior is conceived as unfolding in a multi-dimensional "phase space." Complex systems, including the information ecosystems of the judicial function and its enveloping culture, unfold into what complexity theorists term the phase space of an "adjacent possible."[79]

Because of the irreversible processes and non-determinism of complex systems, it is not possible to predict the future.[80] But one can identify hard, technological trends and thus in a way "see into the future." By employing techniques and being ever vigilant, one can very roughly identify the potential universes of the next transformation—the geometry into which the system may next unfold. We can observe as we co-evolve into the adjacent possible.

In the next years modern legal systems will confront whether it is feasible to test the statements of complex information systems, which are today routinely admitted into evidence without much scrutiny and with trivial foundations. Such statements are defined outside the hearsay rule, and appear to be a sort of evidentiary "stateless person."[81] This lack of

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79. Evolutionary biologist Stuart Kauffman points out that both biological and cultural systems are *nonergodic*, meaning they exhibit a behavior that in certain crucial respects is incomprehensible through observation either for lack of repetition—for example, by involving only transient states which are unique, or for lack of stabilities—for example, when transition probabilities are so variable that there are not enough observations available to ascertain them. Kaufman notes that as a consequence of the symmetry breaking set in motion by the primordial inflation, complex systems resolve such nonergodicity by moving into a phase space of an *adjacent possible*. Complex systems do not have a deterministic path. By breaking symmetries, they "make choices" by moving into possible adjacent states, which often consist of two "choices" enabled by symmetry breaking. A complex system thus unfolds into an adjacent possible. It is this author's observation that the concept of an adjacent possible, in the cultural and human mind context, is closely related to the ethical concept *free choice*. *See* STUART KAUFFMAN, INVESTIGATIONS, ch. 7 (2000).

80. Reed Gelzer, M.D., notes that this also necessarily points to an irrevocable conclusion: If a particular "ecological" outcome is deemed desirable, necessary conditions must be anticipated and proactively maintained to create homeostatic mechanisms for preserving and protecting that desired outcome.

81. *See* FOUNDATIONS OF DIGITAL EVIDENCE, *supra* note 52, at Pt. III. There is significant jurisprudence holding that the statements made by machine systems are not hearsay because machine systems are not people; thus they do not make statements; and thus are not declarants under FRE 801. The conclusion is that the hearsay rule is not applicable.

This view has been adopted in constitutional adjudication. *See generally* United States v. Washington, 498 F.3d 225 (4th Cir. 2007) (holding that since the relevant evidence constituted facts asserted by machines, they were not out-of-court statements made by declarants, and thus there was no protection by the Confrontation Clause of the United States Constitution). *See also* United States v.

comprehension by the law presents a conundrum. It will be extremely difficult to test individual statements of particular complex systems, especially after they almost always come into evidence after trivial foundations. This will be difficult indeed, on a citizen's budget, when it takes a room full of technologists to begin to come to grips with how such declarants operate.[82]

Continuing our existing scheme regarding complex information systems may turn out to be feasible and if so, let us say "Bravo!" The empirical exercise examines all material evidence and in certain instances there will be circumstantial, extrinsic evidence that may be determinative of system reliability. But this will not always be the case, and we will never know to what extent, or degree, or in which circumstances there will be evidence extrinsic to the system that permits differentiation of true from false. It will be hit or miss and therefore not in accordance with a rule of law incorporating notions of due process. Would we have a rule that says sometimes one can cross-examine her accusers, but not always, and that we will toss a coin to determine in which cases?[83]

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Summers, 666 F.3d 192 (4th Cir. 2011) (expert's reliance on an instrument read-out did not violate the Confrontation Clause because such a read-out is not "testimony"); United States v. Moon, 512 F.3d 359 (7th Cir. 2008); United States v. Lamons, 532 F.3d 1251 (11th Cir. 2008) (holding the same and asserting that the best way to test the reliability of information systems is to consider whether any statements printed out are "authentic" under FRE 901(b)(9)). Such "authenticity" logic is defective in the extreme. Even if a statement is what it purports to be—the accurate result of a complex information system process—that does not make it true, or reliable, and most importantly it does not mean it is testable so as to gauge its truth or falsity.

82. This is of increasing concern, because if the committees in charge of updating our Federal Rules of Evidence intend FRE 803(6) to govern the admissibility of the statements of complex information systems, they just upped the ante. The Advisory Committee is now emphasizing, in an amendment to FRE 803(6)(E), that the default admissibility (trivial foundations) of statements analyzed under that Rule will continue to occur unless the *opponent* of the evidence can show a lack of trustworthiness. The burden is thus always on the opponent. Undoubtedly, judges will apply a rationality test of sorts and automatically declare that things "go to the weight," just as they do with troubling digital authenticity issues.

This is the current scheme notwithstanding that—reflective of its four-hundred year-old history—Rule 803(6)(A) talks about a "someone" making regular records. The law is thus contradictory. Sometimes a complex information system might be a "someone," but when the idea of cross-examination is presented, it is not a "someone," including not a someone in the constitutional context of preserving our liberties and due process. The law thus unthinkingly retreats to expediency, as it has for four-hundred years, to use an archaic rule that talks about someone with knowledge making records. It continues to put a pre-industrial peg into a Twenty-First Century complex hole.

83. This will remain the situation unless and until society begins applying reliability criteria methodically to new systems as they are developed, when they are deployed, or, in the specific instance of legal proceedings, as a part of normal evidentiary proceedings. Thinkers are now applying comprehensions of complexity to analyze enormously important segments of our national information infrastructure. *See, e.g.*, Reed Gelzer et al., *Electronic Health Records Systems: Testing the Limits of Digital Records' Reliability and Trust*, 12 AVE MARIA L. REV. 259 (2014) (forthcoming).

Certainly, our Shopbook Rule of Wooden File Cabinets will not serve as the test for whether to admit declarations of complexity into evidence. It is a default rule admitting evidence notwithstanding it is hearsay, applied after rudimentary foundations are laid. It is a four-hundred year-old decision dynamic designed for completely different purposes—the consideration of regularly recorded events. FRE 803(6)(A) talks about "someone" recording things. It was not designed to test the accuracy of the algorithms transforming information, occurring in systems of systems that incorporate thousands of fallible minds. Our system of evidence is at a crossroads, and we will likely decide that our four hundred year-old "Shopbook Rule" is even more outdated than Britain's two hundred year-old "Better Read When Dead" rule.

If we cannot thoroughly examine each declaration of complexity potentially at issue in adjudications, can we nevertheless devise techniques that permit us *to take a position* on complex systems at issue in adjudications? Can the judiciary continue to serve the legal function and its necessary evidentiary function? We must be realists. We must design something simultaneously simple and complex that can co-evolve into the adjacent possible. A possible scheme to initiate discussion consists of: (1) a *gatekeeping function of complexity*; (2) a new *trust function*; and (3) the *annihilation function*.

### C. *A New Gatekeeping Function of Complexity Utilizing Societal Trust*

#### 1. *The Gatekeeping Function*

We need practical solutions. There is an idea called a "gatekeeping function." This is something simple in logic. It is a yes/no/in/out/pass/fail binary function. If a system and its statements do not get pass the gate, they are not considered in the empirical dialogue. We can begin working on our new gatekeeping function. This one will be more encompassing, more important and more successful than the Article VII gatekeeping idea expressed in *Daubert*, which applies to people and not information systems. A new "gatekeeping function of complexity" can help save the policies behind the hearsay rule, which is our greatest rule of evidence. Such a function can help keep our system of true and false a realistic, empirical technique.

But if a new, simple common law is to comprehend complexity, it simultaneously must be an instrument of complexity. It must utilize complex thought and judgments, to make evidentiary judgments about complex phenomena. Societies do make judgments about technologies and

systems, just like people make judgments about complex systems, such as other people. We can incorporate the concept of *trust* into the new gatekeeping function.[84]

2. *The Trust Function*

Trust is very much discussed in both the world of technology assurance and the world of information security, and it can be a societal conclusion taking into account to the best of our ability the *accelerating wavefront of human knowledge*.[85] Let us at least examine a "complex trust function." If we cannot do it, then we are back to an inscrutable, exploitable and likely unworkable scenario of nearly automatically admitting into evidence the declarations and versions of reality generated by complex information systems which simultaneously both are and are not a "someone." The reality is that there are now declarations of complexity—and the law should recognize the evidentiary citizenship of our complex declarants.

3. *Our System of Annihilation*

There is a third function material to any new, evidentiary common law function. This is the "Annihilation Function" and it is the essence of our current system, which is an adversarial rather than an inquisitorial system. We will always have the issue of erroneous systems and their statements. These will hereafter proliferate like weeds in a garden, very soon springing up in the emerging Internet of Things. Some process must examine and test

84. This function will be new for trial courts—at least in this century. Judges will in a fashion need to return to their evidentiary responsibilities of earlier times—more like the powers they were to have in The American Law Institute's Model Code of Evidence (1942), which Professor Wigmore attacked, and defeated, because it gave the trial judge too much discretion in competency and admissibility determinations. In the new gatekeeping function, judges can't make decisions based on what is rational, or whether evidence *supports a finding*, as they currently do in our authenticity scheme. They will need to make a decision about societal trust. The architecture enabling this function already exists in the scheme provided in FRE 104(a), which United States District Court Judge Paul Grimm (Maryland) emphasizes is a misunderstood and far too infrequently used rule of evidence. It states that trial judges are not bound by the rules of evidence (other than privilege), when they make determinations of admissibility.

Whether the federal judiciary can implement such a complexity gatekeeping idea is debatable. It departs from the current, relative evidentiary powerlessness of trial judges, which began creeping into the law of evidence in the 1800s. There will need to be debate and development of new techniques. The problem is we may have no choice, if we are to be realistic.

85. The author is indebted to technologist Neil Jacobstein for introducing him to this idea. Jacobstein posits that we are approaching a time when real-time, crowd-sourced updates are made to human knowledge, which are then exploited in real time by members of a society, in selective "snapshots." The resulting waveform of information, constantly culled by citizens, is called "*the accelerating wavefront of human knowledge*."

the facts created by systems that get past any gate of trustworthiness. This is where "annihilators" come in. They will attempt to destroy the statements and decisions of information systems that get past the gate.

Just as we explain the three co-equal branches of government, so too are we fond of explaining to the civics class that we have an "adversary system." But the word "adversary" is not specific enough to explain our litigation system. An "adversary system" implies a contest. But the contest could be one of measurement. A runner might win a race, by a tenth of a second, and thereby triumph over his adversary. He is the champion but the runner-up still stands on the podium beside him. But certainly, a winner in such a contest is not elevated to the podium after having intentionally tripped his competitor. Such conduct would bring on ignominy because it is not playing by the rules.

But there is a different species of adversary system. Rather than determine who is first and who is second, in an adversary system with an annihilation function, each contestant attempts to destroy his opponent. The loser does not win second place. He is eliminated from the field entirely—much as in war, a gladiatorial contest, in a trial by combat, and most definitely in a lawsuit.[86]

Our empirical exercise, in its purest form, is the ability to approach truth by exposing what is false. Truth is hard to define. But one can surely identify what is false, and scientists do this by means of observations and the experimental method. So too do fact-finders in tribunals and courts of all sorts.[87]

And just as truth is elusive, so too is justice. It is hard to know what is "just." Such a notion is abstract and appears to be a subject for philosopher kings and spiritual leaders. But citizens can surely identify injustice when

86. The "annihilation dynamic" manifests itself throughout our economy, society and patterns of thought. It organizes reality in complex systems. Witness the behavior of warring factions in our "two party system" of government, where opposing powers ineluctably self-organize, and then seek not to cooperate but focus their energy and resources in order to annihilate one another, often irrationally and contrary to the public good. Witness the continued refusal of advocates in the discovery process to cooperate in gathering information from complex information systems. Thinkers throughout the ages have observed the annihilation dynamic in many milieus and patterns and the examples are far too numerous to list here but include modes of religious thought as well. The annihilation dynamic appears to be related to the primordial symmetry breaking. *See* discussion in *supra* note 79 and *infra* note 96.

87. *See generally* KARL POPPER, SCIENCE: CONJECTURES AND REFUTATIONS (1963). Scientists do not attempt to "prove truth" in conducting their experiments. They test and probe in an attempt to disprove, or do what is called "falsify." The court in *Daubert* discussed some of the literature, which should not be taken as a scientific treatise, but rather as an acknowledgement that truth comes from revelation of falsity. After successfully and repeatedly passing falsification tests, theories are increasingly accepted as true. Some theories are accepted for several hundred years, such as Newton's laws, until others, like Einstein, demonstrate that under certain circumstances such laws are inaccurate and untrue.

they see it. It is a big "not." "That's not fair!" This exercise of exposing what is false and unjust, rather than attempting to prove what is true and just, has profound roots in the theory of knowledge. We are fortunate that our system of true and false is a system of annihilation. Scientists surely would construct such a system for any system of evidence. They would certainly not want to measure truth by degrees, and tally up points. They would annihilate competing theories of truth by falsification.

So how does a system of annihilation operate? What do its practitioners do? They deal with open systems—with flows of information synthesizing ideas and concepts in the "mind of a tribunal." What dynamics must be present so that advocates—who must aspire to be triumphant heroes—can do their job to expose falsity and injustice? Are there dynamics facilitating falsification techniques, which also serve the critical social function of permitting discovery of what is false and therefore unjust?

Our system of annihilation is itself a system of complexity. Accordingly, its dynamics have similarities across realms just as most complex systems do, as we have seen. So let us take the original systems of annihilation as an intriguing starting point. These have long existed on the physical plane, and are illustrated in purest form at their earliest stages of evolution.

In the original warfare of ancient Greece, the Spartans learned that at certain moments in battle, the opposing phalanx[88] would march off course. This exposed a "flank," where the shields and lances of the opposing, rectangular formation, which were ordered and arrayed to protect its front, could not protect simultaneously against violence from both the front and the side. There was an asymmetry, which could be exposed in an attack from two sides at once, and it was always a latent weakness. And thus, the flank attack was born. Many say it was the original military tactic.

Once such an attack was launched, the integrity of the opposing force could be unraveled instantly. Soldiers dropped their gear and ran, and were often slaughtered from behind. The concept of "[Expletive]! We've been outflanked" is a cry of imminent disaster. The great generals have always sought to devise tactics that can quickly unravel opposing structures. The moderns have always influenced their opponents to expose fatal vulnerabilities. They seek to shatter integrity.

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88. This was a formation of soldiers in a rectangle, with long rows of soldiers arrayed in a file, and "ranks" of soldiers arrayed behind one another. The soldiers held shields with their left arm so as to cover the left half of their body and half of the body of the man to their left, and then attempted violence with swords and lances of the right arm. Because each soldier was dependent on the man to his right to protect the right part of his body from being stabbed with the sword of an opponent, phalanxes tended to drift to the right, and thus exposed their left flank.

Our system of annihilation works the same way. It is a far cry from any "adversary system" with a measurement function. Our system is awe-inspiring and often terrifying for its participants. It is the system not only of individual adjudications, but also of resolution of the great issues of the day. Once one comprehends the true dynamic of such systems, one is struck with even greater awe.

An annihilation contest in the legal realm takes place on a sort of information battlefield. There is an arena, and it is bounded in time and space and thus constrains information flows—the very type giving life to complex systems of many sorts. As a bounded arena of information flows, the legal battleground can be viewed as a sort of complex "phase space."

Two adversary minds are thus opposed in a "phase space of mind." It is a conceptual phase space in which flows of information create and destroy opposing information behaviors, roughly equated to "ideas," the concept that so intrigued Locke and was the centerpiece of his philosophy. The adversary minds are constantly jockeying for a fatal, upper hand. They observe so as to absorb all the information flowing in the arena. They aspire to miss no chance for annihilation.

Then the adversary minds, in their attempt to annihilate, use the information they have absorbed to *convey* two distinct species of information into the mind of the tribunal. The first builds a "case," a version of reality—a construct of information and ideas that will *catalyze the synthesis of information* in the mind of the tribunal. In order for the flowing information to organize into a behavior in the mind space, any proffered case must have what is called integrity. There is an entire literature on how to build a case. Best to be a little conservative there, however, as the main power in the phase space of mind is usually not the strength of one's own concept. A mind's main strength relates to the other species of information that is conveyed in a system of annihilation.

The second species of information adversary minds convey is designed to annihilate the opponent. This is their attack. Minds in a battle of annihilation seek to use an "empirical instrument," the tool catalyzing the synthesis of ideas in the psychological process lawyers have been studying since they began reading Locke. With the empirical instrument, minds expose untruth in the opposing concept. This, in turn, destroys credibility, which is the catalyst synthesizing the integrity of the opposing case in the phase space of mind. Once credibility has been sufficiently impaired, information structures fall apart just as physical structures do when compromised on the battlefield.

At the beginning of an annihilation contest, one side tries to arrange all the jigsaw pieces of a conceptual phase space puzzle into one story or picture

(a donkey for example), and the other side tries to construct an opposing story or picture (perhaps an elephant). The two conceptual phalanxes push back and forth like giant, bristling turtles, which are opposed in the mind of the tribunal. Things are usually at a stalemate so long as the *integrity* of both cases remains intact.

The annihilator's job is to exploit vulnerabilities. His job is to sense the tipping point that can destroy the credibility dynamic of his opponent, so as to unravel conceptual integrity, reveal falsehood, prove unreliability, expose injustice, and highlight a lack of authenticity. Once the organizing, credibility dynamic is sufficiently impaired the puzzle game is over. The mind of the tribunal instantly scrambles up the pieces of the losing side and fits them into the "triumphant mind's" proffered pattern—often when they do not even fit that well. Trial lawyers get great satisfaction doing such things to opponents in real time. Precisely the same process, however, happens in the vast majority of litigation now called "discovery," as advocates learn what will likely happen if they continue the annihilation game.

Without an annihilation function, we cannot use what is false to act as a trigger, or tipping point, that allows the tribunal to organize information so as to mete out justice. This is how society learns what is true, and what is unjust, and therefore what is righteous and how it should resolve disputes of all sorts. The meting out of justice depends on an implosion of one of the two opposing structures. What does this mean for hyper-complex systems embraced by a new, evidentiary common law function? Here are some preliminary observations.

First, in order for any annihilation dynamic to exist, information systems must permit and even facilitate *testing* of their relevant attributes. This is a matter of judicial and national information policy. Unless a system is testable, any revelation of falsehood is hit or miss and may not be possible. It is rather like attempting to do science without an ability to conduct experiments, or like fighting on a battlefield without a sword.

Accordingly, the new gatekeeping function of complexity must consider whether a complex system at issue is testable. No testing possible? Then probably its statements should not participate in the empirical exercise. Lack of transparency should raise great questions. There can be no "black boxes"[89] in our system of true and false. Such black boxes should be

89. *See* NATHAN ROSENBERG, INSIDE THE BLACK BOX: TECHNOLOGY AND ECONOMICS (1982). In science and engineering, a "black box" is a device, system or object which can be viewed in terms of its input, output and transfer characteristics without any knowledge of its internal workings. Its implementation is opaque (black). Many of the technologies now utilized in the discovery process in litigation are "black boxes."

unconstitutional under both the Fifth and Fourteenth Amendments to the United States Constitution. It is a violation of due process to be compelled by government to use a system of evidence that does not have ground-rules and techniques that permit demonstration of the falsity of assertions. Accordingly, at any moment, an advocate must be prepared to object and demonstrate that the statements of an opposing information system are not testable, and there will be counter arguments back and forth on this issue. This needs to be worked out.

Next, what should occur if a system is trusted, and is considered to be testable, and thus gets past the gate? Just because a system is generally trusted and testable does not mean any statement or decision is true or just. In such circumstances, annihilation practitioners must possess techniques. They must know what to discover about complex information systems and how to use that information to unravel the credibility of an opponent. This is no small requirement because of the nature of complexity. Unless one wants to proceed without any annihilation function, however, this simply must occur in some fashion and it is a challenge to the litigation profession that dwarfs the challenge of obtaining information from huge databases. We will soon learn whether mid-Twenty-First century advocates can emerge—those who can wield swords of annihilation in a context of complexity. Annihilation techniques will be among the most valuable techniques of our future Society. They are the empirical instrument. Such techniques are our best hope to reveal what is false and are necessary to keep society righteous.

Finally, among other things, careful consideration should be given by all actors in society—whether they be organizations or individual citizens—as to whether they have the ability to make their own records, which can *contradict* the records created by others' complex systems. Businesses whose dealings are being recorded and then restated as facts by complex systems under the control of others should in turn have their own systems, which can get past the gate, so as to contradict and even perhaps annihilate an opposing system. There must be layers of testability in one's own systems, and this is how one builds credibility. This is one of the great challenges to Information Governance. Such considerations are fertile areas for federal legislation, which will address our new national information infrastructures. The several branches of government must cooperate.

## IV. CONCLUSION

If the most powerful judiciary in the world cannot design a system that permits its citizens to reasonably approach truth by revealing untruth, then how can the larger society do so—when it seeks to resolve its larger, more

complex and more variegated disputes? Our law of evidence is thus a laboratory for all public policy. Given the small percentage of disputes tried before either a court or a jury, and given even the embarrassing inaccessibility of courts to the many, the view of the rules of evidence as an empirical laboratory for the rest of society makes such rules surprisingly relevant to hundreds of millions. Indeed, the law certainly exists as a system of rules that can be applied in disputes and decision-making, but its real force is that it guides actions, and understandings, as a controlling element in our construct of reality.

The issue is whether the larger society can devise a new empiricism that is *realistic*. As always, it is the lawyers who must lead the way into the future. Realistic information systems guide many sectors of the economy, and this can occur in justice systems as well. However, not only is the jury still out, the case has yet to even commence. Whether the noblest profession can design a new system of evidence will determine, in great respects, whether our larger governmental systems will continue to serve the rule of law. Whether lawyers can design a new empiricism will determine the future path of our culture.

## ENDNOTE: INFORMATION INFLATION TRIGGERS TRANSFORMATIONS IN CIVILIZATION

Some say what is happening is the biggest thing to occur since the invention of the printing press.[90] Is there a way to comprehend the speed at which information is inflating, and its effects on the economy? How should we view the dynamics currently transforming civilization and the human mind?

Many have heard of "Moore's Law." Briefly stated, this is an observation that the number of transistors on integrated circuits grows exponentially. The "doubling time" observed by Gordon E. Moore was that transistors double every two years. Other technologists, such as David House, observed that chip *performance* doubles every eighteen months, because not only are there increasingly more transistors on a circuit, but such transistors are performing tasks more quickly than previous generations of transistors. These observations have remained uncannily accurate since they were published in 1965.[91]

If one wants to be conservative, therefore, one should assume that microprocessors double in performance every two years. This exponential growth in computer processing power can be considered a "driver" of our technology networks.

But information processing power is not the only broad-based driver of our technologies. There is also the ability to store increasingly vast amounts of data more cheaply and in smaller devices. When the author was in college, sixteen gigabytes of storage cost $4,000,000 and required a room full of refrigerator-sized machines. Now one can buy that same storage for $9.99 and balance it on one's finger. What is sometimes called "Kryder's Law" is the observation that efficiencies in storage technology are accelerating faster than even semiconductor chip performance is accelerating. Some peg the doubling time at 13.5 months.[92]

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90. Paul, *supra* note 1. Daniel Burrus, CEO of Burrus Research Associates, Inc., states that "A transformation is unfolding. There are exponential hard trends. I say it is bigger than the diffusion of the printing press." *Id.* It is the author's observation that because of immersive technologies, and the fact that the new societal behaviors and *techniques* enabled by information inflation approach the dynamics of human language systems, our current transformation has the potential to approach the importance of the emergence of writing over 5,200 years ago.

91. *See generally Moore's Law*, WIKIPEDIA, http://www.en.wikipedia.org/wiki/Moore's_Law.

92. *See generally Kryder's Law, Encyclopedia*, PC MAGAZINE, http://www.pcmag.com/encyclopedia/term/64169/Kryder-S-Law; *see also* Chip Walter, *Kryder's Law*, SCIENTIFIC AMERICAN, Aug. 2005. Examination of storage capabilities and costs indicate that in the last thirty years, a typical PC has increased its information storage capacity by one million fold. This is faster than a doubling time of

But there is also bandwidth—a third major driver. Butter's Law of Photonics says that the amount of data coming out of an optical fiber is doubling every nine months.[93] Thus, the cost of transmitting a bit over an optical network decreases by half every nine months.[94] Remember the old fashioned modems? Perhaps you are too young. But now you can watch a streamed HD movie.

In short, exponential growth in *all these areas* drives our technology, and they all relate to the velocity of digital information flowing throughout society. Doubling times of nine months, thirteen and one-half months, and twenty-four months create mind-boggling accumulations of increased performance in the ability to do information work.[95] Bandwidth is currently increasing the fastest, and it can shoot information around the world ever more quickly and cheaply. Storage is currently increasing the next fastest. Increasingly inexpensive and ever-larger reservoirs of information can reside to be used instantly. And then there are our exponentially advancing processors, which transform information in complex ways. Information is pushing rather like an information tsunami, inflating outwards ever faster so as to shatter existing structures all while it builds up new landscapes. This accelerating, exponential growth in information power is one way to view *information inflation*.[96]

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every two years, which would require forty years to increase capacity by one million fold. Some have observed that hard disk performance doubles every 13.5 months; alternatively, "the doubling of processor speed every 18 months is a snail's pace compared with rising hard-disk capacity." *Id.*

93. *Butter's Law of Photonics*, MYBROADBAND, http://www.mybroadband.co.za/vb/showthread.php/122878-Butters-Law-Of-Photonics.

94. *Id. See also* DANIEL BURRUS & JOHN DAVID MANN, FLASH FORESIGHT: HOW TO SEE THE INVISIBLE AND DO THE IMPOSSIBLE (2011) (asserting that there is a Burrus Law of Bandwidth, an observation that digital bandwidth increases at a faster rate than processing power).

95. These doubling times should be taken with a grain of salt, because they are observations of broad trends caused by increases in networked technologies in a complex society. They are not mathematically derived. But there is strong support in the literature for the stability of all these doubling times, the best documented of which is Moore's Law.

96. The name of the article, *Information Inflation: Can the Legal System Adapt?*, was inspired by the primordial epoch of our universe, named "inflation" by cosmologist Alan Guth. This has received spectacular publicity quite recently. In a discovery that has been dubbed "one of the greatest discoveries in the history of science," telescopes observed physical artifacts of the cosmic inflation, which had been posited by Guth's mathematical theory of the late 1970s. *See generally* Dennis Overbye, *Space Ripples Reveal Big Bang's Smoking Gun*, N.Y. TIMES, Mar. 17, 2014, http://www.nytimes.com/2014/03/18/science/space/detection-of-waves-in-space-buttresses-landmark-theory-of-big-bang.html.

The publicity misses some important points. During the inflationary epoch the universe was born and accelerated out exponentially for an infinitesimally short time at many times the speed of light from a thing infinitesimally small to a thing approximately the size of a grapefruit. During this time the universe became *organized* by some sort of field, which existed for the briefest moment and which then disappeared. Cosmologists and others wanting to discuss the degree of organization of the grapefruit-sized thing sometimes say there is a "fine-tuning" of the universe, but that term fosters dispute because it

But we do not experience these drivers separately. They network. Our culture absorbs these evolutionary developments into all its technologies, which are networks connecting all advancements. In addition, society has transformed sufficiently so that much of the information in the world is accessible in real-time. We are approaching a time when real-time crowd-sourced updates of knowledge will network with real-time crowd-sourced utilization of such updates.[97]

This accelerating wavefront of human knowledge helps construct ever-more advanced, material objects. These constitute our technological "hardware." Technologists call the tools and know-how required to build technological hardware *Technique I*, which is a French term referring to the technological "software" utilized to construct technology. The *users* of technology then learn how to absorb new technologies into their own human mind "software." This user software is called *Technique II*, and it reflects how a society relates to technology as a constituent element of its culture.[98] Put a very smart 1969 person in front of computer linked to the

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suggests possible participation of entities or "tuners," which cannot be disproved, and it is indeterminate in its meaning. Other scientists, in order to avoid metaphysical debate, describe the incredible degree of the organization of the grapefruit-sized thing to be "*unreasonable*." *See generally* PAUL DAVIES, COSMIC JACKPOT (2007). Accordingly, we must acknowledge that mathematics now permits us to conclude that our universe is unreasonable. This has profound ramifications that will not be discussed here and the author refers the reader to Davies for appropriate background.

Why "unreasonable?" If the grapefruit-sized thing had been organized only slightly differently during its faster-than-light-speed inflation, digital technology would not exist. How slightly differently? One cosmologist says the grapefruit-sized thing was so unreasonably organized that the odds of it are akin to a person throwing a dart on one side of the currently sized universe—all the way to the other side of the universe many tens of billions of light years away—and hitting a target the size of an atom. It is hard indeed to conceptualize and the details are beyond the scope of this Endnote. The fantastically brief, original inflationary epoch helped shaped the way the "symmetries" of the grapefruit-sized thing continued to break thereafter ("symmetry breaking"), causing ever-increasingly larger amounts of interacting information to form structures such as atoms, carbon, life, ecosystems, mind, and then complex information systems. Accordingly, because it could not exist but for the unreasonably precise order of the grapefruit-sized thing, and the way its symmetries were trained to break by such unreasonable order, the inflation of information we see today can be viewed as caused by and a result of the unreasonable, primordial inflationary event and its organizing functions.

97. *See supra* note 85 (Jacobstein's notion of the "accelerating wavefront of human knowledge").

98. This ability to manipulate reality with tools evolved approximately three million years ago, long before our species, *Homo sapiens*, evolved several hundred thousand years ago. At an indeterminate time during this evolution, human language emerged—a *sublime technology* permitting human minds to cross the void between their conceptual universes. Ludwig Wittgenstein analogized this behavior to a *complex game*, structured by conventions. Technology, including the sublime technology of language, is thus used by human minds. *See generally* Ludwig Wittgenstein, *Philosophical Investigations*, and Kevin Kimble, *Revisiting Wittgenstein on the Nature of Religious Language*, ASIAN SOCIAL SCIENCE Vol. 6 No. 6, June 2010. But technology also very much uses human minds, and the relationship between Mind and Technology is a "grand tether" of sorts. Suffice it to say that the emerging techniques enabled by the information inflation of the Twenty-First Century have such profound implications that they exist on a level approaching language capabilities. Matters along these lines were recently discussed with U.S.

World Wide Web and ask her to go to Google Maps. Nothing would happen. There is no *technique*.[99]

Networks of increasingly powerful hardware and software are constantly communicating so as to form the ever-morphing structures in the economy. The devices which are continuously invented and then diffused throughout the economy are constantly shrinking in size (miniaturization) and using less and less matter (dematerialization). There are hard trends in computer technology other than the trends in increased performance of the three principal drivers.[100] The structures that emerge can be conceived as information flows, and they snap together into networks called "technological complexes."

Clearly, the emergence of such complexes is not exclusively the result of an increase in information power. Rather, a new technological complex is formed when the economy transforms. An existing, quasi-stable behavior snaps together in a new network. Complexity theorists say that the behavior has undergone a *phase shift*, and that a new behavior has *emerged*. Bits and pieces and then bigger bits and pieces aggregate and then communicate to network together and "SNAP!"—a new civilization appears piece by piece with some pieces networking inside other pieces, and so on, in an information ecosystem of sorts.[101] New technologists sometimes call this process by which civilizations emerge "saltation." Civilizations grow by leaps and bounds and that is also how they fall apart. Natural historians call this evolution.

To illustrate the concept of saltation, during the six-year diffusion of email and the World Wide Web, society transformed qualitatively differently than by "eight-fold," which is the multiplier of our hypothetical inflationary drivers over a six-year period (three doublings over the course of six years or 2 X 2 X 2 = 8). Certainly, a society-wide ability to send a letter with huge attachments anywhere in the world, instantaneously, is qualitatively different than eight times as "powerful" as sending a bundle of paper by United States mail. In fact, in the new phase, one can send pure information rather than a

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Magistrate Judge John Facciola. He and the author discussed that the best way to proceed was to "look in front of your face," and that when you did so, you would observe that the mind is changing, a phenomenon which can also be called "transformation of mind."

99. *See generally* ARNULF GRÜBLER, TECHNOLOGY AND GLOBAL CHANGE (1998) (an excellent introduction to global technologies, including their networking dynamics and the concept of *technique*). *See generally* Lewis Mumford, *Technics in the Nature of Man*, *in* PHILOSOPHY AND TECHNOLOGY: READINGS IN THE PHILOSOPHICAL PROBLEMS OF TECHNOLOGY 77–85 (Carl Mitcham & Robert Mackey eds., 1972).

100. BURRUS & MANN, *supra* note 94 (discussion of eight current information pathways in our inflationary economy).

101. Paul & Baron, *supra* note 7 (referring to information ecosystems as "*Oikos*").

physical artifact. How much more powerful is this than eight times as powerful? The question does not make sense, because society has been transformed by means of a *saltation*.

The same point is illustrated by the emergence of the societal technique of using advanced devices that communicate with the over-a-million apps, networked to the cloud and enabling fantastic data retrieval and freedom of choice. This technological complex diffused and enveloped us during a course of five or six years. Certainly, the ability to use a device to query the cloud and do the sorts of things apps do, including furthering the ability to interact on social media, is far more "powerful" than four or even eight times the reality of not being able to do such things. There is a new civilization.

Accordingly, for purposes of the didactic exercise set forth in the body of these observations, let us adopt a conservative approach. Remember that not only processing power but also storage and bandwidth (with asserted doubling times of two years, 13.5 months, and nine months) are all inflationary drivers, exponentially accelerating in performance. A conservative estimate of increase in processing performance alone is a doubling every two years. Accordingly, this observation has made a conservative and simplifying "mind experiment" assumption that the "*inflationary power of information*" is doubling every two years.

This is an abstraction, designed as a mind experiment attempting to get lawyers to understand what is happening. It does not attempt to derive a scientifically quantifiable concept of power, which in physics, is the rate of doing work. What it does do is take the concept of something doubling every twenty-four months, and metaphorically equate the exponentially growing product to a *velocity* of *miles per hour*. Surely more and more ever-increasingly complex information is flowing ever more quickly throughout our networks. In our mind experiment, we have lawyers trying to keep up with a velocity of information flowing throughout a society and its technologies, roughly analogized to a power of information, which is the rate of doing information work.

One final point should be noted before the calculations. There is a seeming problem with the analogy of information power represented by a velocity. If a velocity doubles every two years, in two years something will be twice as fast. But in some instances, when something doubles in velocity, it then has *four times its previous energy*[102]—not twice the energy—so are we underemphasizing or overemphasizing?

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102. JEFFREY W. SCHNICK, CALCULUS-BASED PHYSICS I, CH. 2, *Conservation of Mechanical Energy I: Kinetic Energy & Gravitational Potential Energy*, at 1011 (2008) ($k=1/2mv^2$, where k is kinetic energy; m is kilograms, and v is meters per second. This mathematical description of reality, in its primitive form, is often attributed to Gottfried Leibniz (1646–1716) and Johann Bernoulli (1667–1748)).

But let us remember what we have learned. The law that says that as velocity of mass doubles, it quadruples in kinetic energy is a deterministic law of motion. It depends on the movement of mass through space. It is not the power of information to transform a complex system. For all we know, if information has double a previous velocity flowing through a system, it may indeed lead to an increase in "power" of four-fold. Or it may be eight or twelve-fold or even more.

But as we have seen, such deterministic concepts of information "power" cannot be equated to the power to change a civilization, because information flows do not merely increase in velocity. The accelerating velocity builds up, and surges through systems, and such build-up is exponential and we are now speeding along at almost one million miles per hour with our velocity of information. This built-up velocity of information triggers transformations, when tipping points are passed which then cause cascades of reorganization. Doubling the hypothetical velocity of information flowing through a system can cause a phase shift, and a saltation in a civilization. So do not be misled by deterministic laws, and erroneously apply them to complex systems.

Finally, here is the easy math behind the mind experiment set forth in the body of these observations. Assume that information was inflating at one mile per hour (mph) in 1975, the year the Federal Rules of Evidence became effective. Information was thus inflating outwards at two mph in 1977, at four mph in 1979, and at eight mph in 1981. In 1983, we would project that information had a velocity of sixteen mph. In 1985 it was thirty-two mph. In 1987, it was sixty-four mph. In 1989, it was 128 mph. In 1991, it was 256 mph. In 1993, it was 512 mph but let us round down and say that in 1993, it was 500 mph. In 1995, we are up to 1,000 mph, and in 1997, information was pushing out at 2,000 mph. In 1999, information had 4,000 mph of power. In 2001, it had 8,000 mph of power. In 2003, it had 16,000 mph of power. In 2005, it had 32,000 mph of power. In 2007, it was 64,000 mph. In 2009, it was 128,000 mph of power. In 2011, it was 256,000 mph, and in 2013, it was 512,000 mph of power.

By 2015 our society will be experiencing an inflationary dynamic of one million mph.[103] And assuming such conservative doubling times describing

103. Continuing with the same math backwards, we have in 1973 information's velocity being 1/2 mph; 1971 being 1/4 mph; 1969 being 1/8 mph (eleven feet per minute); 1967 being 1/16 mph; 1965 being 1/32 mph and 1963 being 1/64 mph. In 1961 the velocity of information was at 1/128 mph, or less than a foot a minute. In 1959 it was at 1/256 mph, and in 1957 the power of digital information was at 1/500 mph. 1/500 mph is roughly the same as ten feet per hour. This is the same as 1/6 foot per minute, which is the same as two inches a minute. In 1955 digital information had a velocity of one inch per minute. Accordingly, in a simplified mind-experiment assumption, the velocity of information has risen from one inch a minute in 1955 to 500,000 mph in 2013, which would take one to the moon in thirty minutes.

the inflation of information hold into the future, if one has a child at age forty, information will have *one million times* its previous, time-of-birth velocity when the child reaches his parent's age.[104]

There is discussion about when doubling times might slow down. On this, it is impossible to predict the future. It is impossible to know for sure whether things will continue to increase in power exponentially but with slower doubling times, or whether they will in fact keep accelerating at the same pace or even accelerate at a faster rate. Raymond Kurzweil, noted futurist, observes that the current semiconductor foundation of digital computing is the "fifth paradigm" of computing, and that if one examines the earlier four paradigms (which include human beings, called "computers," doing the computing) the doubling dynamic in computing has remained roughly the same for over one-hundred years and there may be no end in the foreseeable future. Even as the shrinking components on existing chips butt up against the size of molecules new paradigms—such as three-dimensional computing—may come to the fore, and Kurzweil asserts there may be 3-D chips by the late "teen years" of this century.[105] These will allow doubling times to continue well into this century. Who knows what sort of doubling times will exist if quantum computing becomes commercialized?

But even if, against all predictions, the inflationary dynamic simply stopped today, the dynamic of networking in our complex economy would continue. All the drivers are catalysts—even if the gas pedal suddenly becomes stuck and henceforth pumps out information at a mere one million miles an hour. The drivers will continue to trigger saltations which will transform our world.

104. If someone became a parent when they were forty, they are forty years older than their child. Forty enables twenty doubling times under our mind experiment. Thus, when the child is the age of his parent, or forty, information will have doubled in velocity every two years, twenty times, in the following fashion: 2, 4, 8, 16, 32, 64, 128, 256, 500 (rounded down), 1,000, 2,000, 4,000, 8,000, 16,000, 32,000, 64,000, 128,000, 256,000, 500,000 (rounded down), and 1,000,000. When the child becomes forty, digital information will have 1,000,000 times the velocity it exhibited at the time of the child's birth.

105. RAY KURZWEIL, HOW TO CREATE A MIND: THE SECRET TO HUMAN THOUGHT REVEALED 268 (2013).