LOUIS D. BRANDEIS SCHOOL OF LAW
UNIVERISTY OF LOUISVILLE

JOURNAL OF ANIMAL AND ENVIRONMENTAL LAW

Volume 8- Symposium Edition Summer 2017

ARTICLES

JOURNAL OF ANIMAL AND ENVIRONMENTAL LAW
Volume 8, Symposium Edition

JOURNAL OF ANIMAL AND ENVIRONMENTAL
LAW
Volume 8, Symposium Edition

Published by the *Journal of Animal and Environmental Law*. Digitally published by the *Journal of Animal and Environmental Law*.

JOURNAL OF ANIMAL AND ENVIRONMENTAL LAW

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JOURNAL OF ANIMAL AND ENVIRONMENTAL LAW
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TABLE OF CONTENTS

SYMPOSIUM SUMMARY & THANK YOU

April 20, 2017, JAEL hosted its inaugural symposium in conjunction with the LBA. The goal was to provide an experiential education on agricultural issues facing Kentucky today.

The symposium was a huge success. A huge thank you to all those who spoke at the symposium including Jonathan Miller, Theresa Zawacki, Randy Strobo, Hank Graddy, and Ronald R. Van Stockum, Jr. An extra special thank you to Key-Note speaker, and the Founder and Executive Director of The Berry Center, Mary Berry.

Additional thanks to all those who helped plan and sponsor the event including Professor John Cross, Professor Tom Fitzgerald, the Louisville Bar Association, and The Mayan Café.

AUTHOR BIOGRAPHIES

Jonathan Miller, the Member-in-Charge of Frost Brown Todd's Lexington office, also leads the firm's Kentucky government relations practice as Principal of its public affairs affiliate, Civic Point. A former statewide elected official turned "recovering politician," Jonathan assists his broad client base – ranging from Fortune 500 firms, to aspiring entrepreneurs, to non-profit associations – in navigating complex local, state and federal government institutions through his counsel on legal, public policy, political and public relations matters. In his law practice, Jonathan brings to bear for clients his experience from the top levels of state government (elected two-term State Treasurer and Finance Cabinet Secretary), politics (former state Democratic Party chair and prime-time speaker at the 2000 Democratic National Convention); and Capitol Hill (senior aide to a Vice President, a U.S. Secretary of Energy and a U.S. Congressman.)

Nolan M. Jackson, an associate at Frost Brown Todd LLC in Lexington, Kentucky, practices in the Business Litigation group. Prior to joining Frost Brown Todd LLC, Nolan worked as a legal intern for the Attorney General of Kentucky and the Kentucky Department of Public Advocacy. Nolan also has extensive internship experience in government. In the parliament of the United Kingdom, he interned for a Deputy Opposition Whip in the House of Lords. In Congress, Nolan interned in the state constituency and Capitol Hill offices of a United States Representative. While in law school, Nolan was a member of the Moot Court Board National Team and *Kentucky Law Journal*. He also represented the University of Kentucky College of Law as a college senator in Student Government and as a University Supreme Court Justice.

Theresa Zawacki is Senior Policy Advisor to Louisville Forward, Louisville Metro Government's economic and real estate development authority. Ms. Zawacki coordinates Louisville Metro Government's local food initiatives and manages a range of cross-functional policy efforts, including the newly-formed Office of Redevelopment Strategies focused on targeted neighborhood redevelopment in Louisville's Russell neighborhood, a suite of community engagement strategies, and Louisville Forward's project management office. Ms. Zawacki is the primary author of the Louisville CARES revolving loan program, which provides gap financing for affordable multi-family rental housing development, and has experience in public and private sector finance. Ms. Zawacki spent 9 years practicing law in the private and public sectors, where she specialized in land use, planning and zoning, land conservation and environmental law. She served as an Adjunct Professor of Land Use Law from 2005-2006, and is a frequent national speaker on topics ranging from local food systems to brownfields redevelopment strategies. Ms. Zawacki received her undergraduate degree from Transylvania University in Lexington, Kentucky, and her J.D. and

Masters of Community Planning from the University of Cincinnati in Cincinnati, Ohio.

Randy Strobo is an attorney and an environmental professional. His primary areas of practice include environmental, civil, administrative, and appellate litigation across a range of issues including environmental damage, land use, planning and zoning, property, eminent domain, personal injury, permitting and regulation, industrial pollution, air and water quality, conservation planning, agricultural and historic preservation, and energy. In addition, Randy Strobo provides legislative and policy guidance, urban land use planning, and conservation planning with a focus on management, sustainability, ecosystem services, and green infrastructure to various state, national, and international clients. In this capacity, Randy has advised Karst Education and Environmental Protection (KEEP), the Kentucky Conservation Committee, Yale University, Diageo Inc., the Environmental Investigation Agency, and the Watershed Watch of Kentucky. Randy worked as a Coca Cola World Fellow at the Centre for Environmental Management at North-West University in Potchefstroom, South Africa, and he also has international experience advising clients during international climate change treaty negotiations.

Randy joined the faculty of Bellarmine University's School of Environmental Studies in 2012 teaching classes on environmental law and policy and environmental innovation. He also currently serves as Vice President of the ACLU of Kentucky's Board of Directors and as Legal Chair for the Sierra Club's Kentucky Chapter. Prior to opening Strobo Barkley PLLC, Randy Strobo practiced law at W.H. Graddy & Associates from 2008 to 2014. Randy also worked for the Kentucky Resources Council, a nonprofit based in Kentucky that provides legal, technical and policy assistance to community groups, conservation organizations, local governments, and low-income individuals on environmental issues. In 2011 Randy received a Master's degree in Environmental Management from the Yale School of Forestry and Environmental Studies after receiving his law degree from the Brandeis School of Law at the University of Louisville in 2008. He graduated from the University of Kentucky with a BS in biology in 2002.

Hank Graddy is a 1969 graduate of Washington & Lee University (Bachelor of Arts) and a 1975 graduate of the University of Kentucky School of Law (Juris Doctor). He practices law in Versailles, Kentucky. His primary areas of practice include land use planning and zoning proceedings, and environmental, civil, administrative and appellate litigation. He is admitted to practice in Kentucky, the Eastern and Western Federal District Courts in Kentucky, the Sixth Circuit Court of Appeals and the United States Supreme Court.

He was lead attorney in litigation that sought to require swine facilities to be regulated as CAFOs, concentrated animal feeding operations under the Clean Water Act in *Commonwealth v. Sharp*, 2012 Ky. App. LEXIS 189 *, 2012 WL 4035917 (Ky. Ct. App. May 25, 2012), and in related litigation that sought to recover tort damages from these swine facilities in *Powell v. Tosh,* 942 F. Supp. 2d 678 *, 2013 U.S. Dist. LEXIS 32231, 2013 WL 900789 (W.D. Ky. 2013)

He has presented continuing legal education programs on environmental law and land use law, including *Legal Issues Involving Local Government,* in Lexington, Ky., on 4/16/2009*, Legal Issues Involving Local Government*, Lexington, Ky., on April 10, 2008, *Practical Guide to Zoning and Land Use Law,* in Lexington, Ky., on 9/6/2007*, and 2007 Kentucky Environmental Law Update,* in Lexington Ky., on 8/24/2007. On October 10, 2011, he presented "NEPA In Kentucky Today and Tomorrow" to the Louisville Bar Association Environmental Law program. On June 4, 2013, he presented on three of six topics at the *Attorneys' Guide to Local Government,* on Land Use and Planning Issues, Zoning Considerations, and Eminent Domain. On October 9, 2015, he was a panelist at the American Bar Association Section on State and Local Government 2015 Fall Council Meeting in Louisville, on "Land (and how it gets that way)" with Dean Patricia Salkin as moderator.

Mr. Graddy, representing the Sierra Club, filed the challenge of the air quality permit issued by Kentucky to Peabody Coal's Thoroughbred Generating Station, and, with attorneys Betsy Bennett and Liz Natter and Robert Ukeiley, served as counsel for a portion of the Thoroughbred challenge through the favorable and groundbreaking opinion of the Administrative Hearing Officer in August 2005, and the unfavorable decision of the Cabinet Secretary in April 2006. He then served as local counsel for the Sierra Club appeal of that permit, ultimately resulting in a decision by Peabody Coal to withdraw the permit application and abandon plans to build that plant in late 2008.

Mr. Graddy has served previously on the Kentucky Agriculture Water Quality Authority for three terms from 1994. Mr. Graddy has served on the Kentucky Environmental Quality Commission. He has served on numerous special commissions authorized by the Kentucky General Assembly.

His family has lived and farmed in Woodford County, Kentucky since 1787. His mother, brother and sister are farming, raising cattle, including exclusively grass fed and finished, asparagus, eggs, tobacco, horses, corn, soybeans, and cut flowers. He is a member and current elder of Pisgah Presbyterian Church. He is married to Lisa Todd Graddy, and they have 2 daughters, Tevis Garrett Graddy-Lovelace and Lucy Hart Graddy.

Ronald R. Van Stockum, Jr. has academic degrees including a Bachelor of Science in Biology from Santa Clara University, California, May 1972; a Master of Science in Biology from the University of Louisville, May 1975; a Ph.D. in Biology from the University of Louisville, May 1979; and a Juris Doctor in Law from the University of Louisville, May 1979. Prior to entering the private practice of law, Mr. Van Stockum was an attorney for the Natural Resources and Environmental Protection Cabinet of the Commonwealth of Kentucky. He has been in the private practice of law as a sole proprietor since 1981.Dr. Van Stockum is published in the areas of biology, history, and environmental law, and creative writing, and has addressed these topics in numerous presentations and seminars. He is past Chair of the Kentucky Chapter of the Nature Conservancy and has served as Vice President of the Filson Historical Society. He is past Chair of the Environmental Law Section of the Louisville Bar Association and past Chair of the Kentucky Bar Association, Environment, Energy & Resources Law Section. He is also past President of the University of Louisville Alumni Association. Dr. Van Stockum practices from his office in Shelbyville, Kentucky.

The Evolving Law and Regulation of Industrial Hemp in the United States

Jonathan S. Miller
Nolan M. Jackson[1]

INTRODUCTION

This Article and its inclusion in this Journal are remarkably aligned. Our vehicle – the *Journal of Animal and Environmental Law* – is published at the University of Louisville Brandeis School of Law, just seventy miles from our practice in Lexington, Kentucky. And Kentucky, frankly perhaps more than any other state, has promoted and pioneered the modern industrial hemp movement – the focus of this Article. As the volume in which this Article appears supports the *Journal of Animal and Environmental Law's* inaugural symposium; industrial hemp is experiencing an inauguration of its own – into a clearer and friendlier legal landscape. This Article's appearance in this particular volume of this particular Journal is appropriate, and we are delighted to be included.

This Article addresses the legal development of the modern industrial hemp movement in the United States. Part I revisits the history of industrial hemp in the United States. Part II summarizes the legal permissions related to industrial hemp and its derivative products, including laws authorizing state pilot projects for the growth and cultivation of industrial hemp. Part III identifies niche legal and business considerations when advising clients on industrial hemp. Finally, Part IV identifies areas of uncertainties in the industrial hemp industry and proposes legislative and policy cures.

[1] Jonathan S. Miller, B.A., Harvard College, J.D., Harvard University School of Law. Jonathan was twice elected Kentucky State Treasurer and served as Secretary of the Kentucky Finance and Administration Cabinet from 2007-2012. Nolan M. Jackson, B.A., University of Kentucky, J.D., University of Kentucky College of Law. Jonathan serves as Counsel to the United States Hemp Farming and Business Roundtable, a broad, national coalition of hemp industry leaders focused on advocating for full legalization of the crop and developing a self-regulatory structure. In this capacity, Jonathan has played a critical role in the development of federal legislation that has propelled the industry forward. Jonathan and Nolan also advise dozens of clients on issues related to industrial hemp at the Lexington offices of Frost Brown Todd LLC, where Jonathan serves as office Member-in-Charge.

I. HEMP IN THE UNITED STATES

Industrial hemp is an agricultural commodity cultivated for "use in the production of a wide range of products."[2] Botanically, industrial hemp is categorized as *cannabis sativa L.*, a subspecies of the cannabis genus. Sixty-six unique, chemical compounds are extractable from hemp, including tetrahydrocannabinol (THC) and cannabidiol (CBD).[3] These cannabinoids are responsible for "a range of potential psychological and physiological effects."[4] Hemp grows "well as a rotational crop" and "requires few, if any, fertilizers and pesticides."[5] Kentucky is, perhaps, hemp's friendliest environment, where the crop has grown "luxuriantly" for two centuries.[6]

The history of industrial hemp in the United States is well documented.[7] The significance of hemp to the nation's economy predates our founding.[8] In fact, the Founders' draft declarations of American independence appeared on hemp paper.[9] For many Americans, including Kentucky's Henry Clay, hemp was a principal source of

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[2] Renée Johnson, "Hemp as an Agricultural Commodity," Congressional Research Service, FAS.ORG (available at https://fas.org/sgp/crs/misc/RL32725.pdf). Indeed, the Latin word *sativa* means "useful." Robin Lash, *Industrial Hemp: The Crop for the Seventh Generation*, 27 AM. INDIAN L. REV. 313, 316 (2003).

[3] Shelly B. DeAdder, J.D., *The Legal Status of Cannabidiol Oil and the Need for Congressional Action*, 9 BIOTECHNOLOGY & PHARMACEUTICAL L. REV. 68, 73 (2016); *see* "Defining 'Industrial Hemp': A Fact Sheet," EVERYCRSREPORT.COM, 1-3 (available at https://www.everycrsreport.com/files /20170306_R44742_7c860bf499276665a028f0dd0dfb817f45a4ad3e.pdf).

[4] "Defining 'Industrial Hemp': A Fact Sheet," *supra* note 3, at 3.

[5] Courtney N. Moran, LL.M., *Industrial Hemp: Canada Exports, United States Imports*, 26 FORDHAM ENVTL. L. REV. 383, 391 (2015).

[6] Jessica Firger, "The Great Kentucky Hemp Experiment," NEWSWEEK.COM (Oct. 11, 2015, 10:05AM), http://www.newsweek.com/2015/10/23/great-kentucky-hemp-experiment-381870.html.

[7] For a thorough recitation of the history of hemp in America, *see, e.g.,* Vanessa Rogers, *The Future of Hemp in Kentucky*, 4 KY. J. EQUINE, AGRIC. & NAT. RESOURCES L. 479, 481-83 (2012). For an appreciation of the early uses of hemp in the American colonies and elsewhere, *see, e.g.,* Lash, *supra* note 2, at 314-15.

[8] *See* Thomas A. Duppong, *Industrial Hemp: How the Classification of Industrial Hemp As Marijuana Under the Controlled Substances Act Has Caused the Dream of Growing Industrial Hemp in North Dakota to Go Up in Smoke*, 85 N.D. L. REV. 403, 404 (2009) ("Industrial hemp was introduced to America some-time around 1545 and was cultivated as early as 1611 in the Jamestown colony."). Robin Lash traces the growth and cultivation of hemp outside the United States to 8000 B.C. *See* Lash, *supra* note 2, at 313, 314.

[9] Lash, *supra* note 2, at 314 (internal citation omitted).

income.[10] Later, when used for its fibers, hemp proved critical to American efforts in World War II.[11]

Due to its versatility, the hemp plant has found use in several industries. The global market for hemp consists of thousands of products.[12]Among others, hemp has impacted "agriculture, textiles, recycling, automotive, furniture, food and beverages, paper, construction materials, and personal care."[13] Hemp has inspired settlers, too; commemorative cities and towns dot the Midwestern and Southeastern United States.[14]

Despite its economic impact, hemp became displaced – first by the cotton crop, then by government regulation.[15] "By 1890 the labor intensive hemp industry had been effectively replaced by the development of new technology in the cotton industry. This resulted in a dramatic decrease in domestic production of industrial hemp."[16] The federal tax on the marijuana plant rendered the domestic farming of hemp impractical.[17] Later in the Twentieth Century, falsely fearful of hemp as a psychoactive substance, states legally restricted growth and cultivation of the hemp plant.[18] Subsequently, federal legislation scheduled cannabis, from which hemp derives, as a controlled substance.[19]

The history of hemp in the United States is a tragic one. The hemp plant was, quite literally, used to declare the formation of our republic, and it supported early American industries in their infancies. At some point, between those times and these, mores evolved and suspicion of hemp grew. Government forgot about (or ignored) industrial hemp's economic and societal contributions and, until recently, federally

[10] "Hemp planted at Henry Clay Estate for first time since 19th century," LANEREPORT.COM, http://www.lanereport.com/63101/2016/05/hemp-planted-at-henry-clay-estate-for-first-time-since-19th-century/ (May 3, 2016); *see also* Lash, *supra* note 2, at 315 ("During the Colonial Era and Early Republic, Americans were legally bound to produce hemp crops.").
[11] *See* Rogers, *supra* note 2, at 482; Duppong, *supra* note 3, at 406.
[12] Johnson, *supra* note 2, at 2.
[13] *Id.*; *see* Rogers, *supra* note 2, at 480-81; Duppong, *supra* note 8, 405-06.
[14] Lash, *supra* note 2, at 315.
[15] *See* Duppong, *supra* note 8, at 405.
[16] *Id.*
[17] *See id.*
[18] *See id.*
[19] *See id.*

criminalized its domestic growth and cultivation. A tragic and turbulent history indeed.

II. LAWS PERMITTING THE GROWTH AND CULTIVATION OF INDUSTRIAL HEMP

Federal laws permitting industrial hemp growth and cultivation

Distinguishing between hemp and marijuana

To appreciate the development of laws permitting the growth and cultivation of industrial hemp is, in part, to understand the difference between hemp and marijuana. "There is a common, and unfortunate, misconception surrounding industrial hemp. The industrial hemp plant . . . is often confused with its cousin marijuana."[20] While both hemp and marijuana derive from the plant genus cannabis, unlike marijuana, hemp cannot produce a psychoactive effect.[21] Hemp contains trace levels of tetrahydrocannabinol (THC), a cannabinoid with the capability of producing a psychoactive high.[22] Marijuana, on the other hand, is used – medically and otherwise – precisely because of its THC content.[23]

Sometime between 1930 and 1970, Congress became incapable (or unwilling) to distinguish hemp from marijuana.[24] In 1937, Congress passed the Marijuana Tax Act, which taxed the trafficking of marijuana.[25] "The legislation "placed all *Cannabis* culture under the regulatory control of the U.S. Treasury Department . . . [and] required the registration and licensing of all hemp growers with the Federal Government in an effort to restrict production of marijuana in the United States."[26]

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[20] Nicole M. Keller, *The Legalization of Industrial Hemp and What It Could Mean for Indiana's Biofuel Industry*, 23 IND. INT'L & COMP. L. REV. 555, 556 (2013). Keller thoroughly discusses the agricultural and scientific differences between the hemp and marijuana plants.

[21] *See id.* at 556-57.

[22] *See id.* at 557; Lash, *supra* note 2, at 317.

[23] *See id.*

[24] One author attributes the association of hemp as marijuana to a bureaucratic preference for flax and cotton industries. *See* Susan David Dwyer, *The Hemp Controversy: Can Industrial Hemp Save Kentucky?*, 86 Ky. L.J. 1143, 1158-59 (1998).

[25] *See* Lash, *supra* note 2, at 319.

[26] USDA, "Industrial Hemp in the United States: Status and Market Potential," ERS.USDA.GOV, 3 (available at https://www.ers.usda.gov/webdocs/publications/ages001e/15867_ages001e_1_.pdf?v=42087).

The Marijuana Tax Act excluded industrial hemp from the definition of marijuana, an exclusion supported by bill's legislative record.[27] However, when Congress repealed the Act, in favor of the Comprehensive Drug Abuse Prevention and Control Act of 1970 (the "Controlled Substances Act" or "CSA"), it abolished the distinction between hemp and marijuana, but it distinguished the non-psychoactive parts of the cannabis plant from the definition of marijuana.[28] Currently, the federal definition of marijuana does not include the mature stalks of such plant, fiber produced from such stalks, oil or cake made from the seeds of such plant, any other compound, manufacture, salt, derivative, mixture, or preparation of such mature stalks (except the resin extracted therefrom), fiber, oil, or cake, or the sterilized seed of such plant which is incapable of germination.[29]

Accordingly, the United States has legally imported CSA-exempt, non-psychoactive cannabis products – known colloquially as hemp – for decades.[30] According to U.S. Customs and Border Protection ("CBP"), "[h]emp products such as paper, rope, and clothing (which contain fiber made from the cannabis plant) and animal feed mixtures, soaps, and shampoos (which contain sterilized cannabis seeds or oils extracted from the seeds), etc. may be imported into the United States."[31] The United States "imports all of its hemp from the approximately thirty countries, including Canada, Britain, Australia, Germany, and China, where industrial hemp cultivation is legal."[32]

In the early part of the new millennium, however, the Drug Enforcement Agency ("DEA") promulgated regulations that would have banned the manufacture and sale of edible products made from hemp seed and oil, citing provisions in the Controlled Substances Act.[33] In 2004, the U.S. Court of Appeals for the Ninth Circuit invalidated these

[27] Lash, *supra* note 2, at 319.
[28] *See id.* at 322.
[29] 21 U.S.C.A. § 802(16) (West).
[30] *See* Ann Hassenpflug, Ph.D., *Sixth Circuit Court Decision Expands Teacher's Role in the Classroom*, 171 ED. LAW REP. 679, 680 (2003)
("The products of the industrial hemp plant, such as fiber, seeds, and oil, are not illegal in the U.S.").
[31] U.S. Customs and Border Protection, "Importing hemp products into the U.S.," CBP.GOV, https://help.cbp.gov/app/answers/detail/a_id/1751/~/importing-hemp-products-into-the-u.s. (last updated Mar. 1, 2016, 7:45AM).
[32] Hassenpflug, *supra* note 30.
[33] *See Hemp Industries Ass'n v. Drug Enforcement Administration*, 357 F.3d 1012, 1084 (9th Cir. 2004).

DEA regulations.[34] The Court drew from the statutory language a clear mandate: affirming that non-psychoactive hemp products do not contain any controlled substance as defined by the CSA.[35] The Court's holdings included:

- "THC naturally-occurring within non-psychoactive hemp products did not fall under the DEA's regulation";[36]
- " …we conclude that Congress did not regulate non-psychoactive hemp in Schedule I";[37]
- "Appellants' products do not contain the 'synthetic' 'substances or derivatives' that are covered by the definition of THC, and non-psychoactive hemp is explicitly excluded from the definition of marijuana";[38]
- "Congress knew what it was doing, and its intent to exclude non-psychoactive hemp from regulation is entirely clear;"[39] and
- DEA "*cannot regulate* naturally-occurring THC *not* contained within or derived from marijuana – i.e., non-psychoactive hemp products – because non-psychoactive hemp is not included in Schedule I. The DEA has no authority to regulate drugs that are not scheduled, and it has not followed procedures required to schedule a substance."[40]

The Ninth Circuit's order enjoined the DEA from engaging in enforcement actions against these products.[41] Never overturned, the Court's ruling remains good federal law.[42] For this reason, U.S. companies have continued to import non-psychoactive hemp from overseas, to trade in it, and to use it in the manufacture of products.

The 2014 Farm Bill and Omnibus Law

Despite the Ninth Circuit's ruling that the sale of imported hemp products was legal, the *growth and cultivation* of industrial hemp remained illegal under the CSA. Invoking *Hemp Industries Association*, petitioners in the Eighth Circuit sought a ruling permitting the growth

[34] *See generally Hemp Industries Ass'n*, 333 F.3d at 1091.
[35] *See Hemp Industries Ass'n*, 357 F.3d at 1018.
[36] *Id.* at 1014 (*citing Hemp Industries Assoc. v. DEA,* 333 F.3d 1082 (9th Cir.2003)).
[37] *Id.* at 1016.
[38] *Id.* at 1017.
[39] *Id.* at 1018.
[40] *Id.* (original emphasis).
[41] *Id.* at 1019.
[42] *See id.*

and cultivation of non-psychoactive hemp in the United States.[43] In each case, however, the Eighth Court held that the growers were in violation of the Controlled Substances Act.[44]

More recently, however, the legal landscape for domestic industrial hemp growth, cultivation and sale has favorably developed. Particularly, "Congress has sought to further distinguish between industrial hemp and marijuana."[45] On February 7, 2014, the Agriculture Act of 2014 ("2014 Farm Bill") became law.[46] Section 7606 of the 2014 Farm Bill legalizes the domestic growth and cultivation of industrial hemp.[47] Under section 7606, state departments of agriculture and institutions of higher education are authorized to grow and cultivate industrial hemp for research conducted under an agricultural pilot program.[48] Section 7606 reads in whole:

(a) IN GENERAL.—Notwithstanding the Controlled Substances Act (21 U.S.C. 801 et seq.), the Safe and Drug-Free Schools and Communities Act (20 U.S.C. 7101 et seq.), chapter 81 of title 41, United States Code, or any other Federal law, an institution of higher education (as defined in section 101 of the Higher Education Act 8 of 1965 (20 U.S.C. 1001)) or a State department of agriculture may grow or cultivate industrial hemp if—

> *(1) the industrial hemp is grown or cultivated for purposes of research conducted under an agricultural pilot program or other agricultural or academic research; and*
> *(2) the growing or cultivating of industrial hemp is allowed under the laws of the State in which such institution of higher education or State department of agriculture is located and such research occurs.*

(b) DEFINITIONS.—In this section:

> *(1) AGRICULTURAL PILOT PROGRAM.—The term "agricultural pilot program" means a pilot program to study the growth, cultivation, or marketing of industrial hemp—*
>
> > *(A) in States that permit the growth or cultivation of industrial hemp under the laws of the State; and*
> > *(B) in a manner that—*

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[43] *See Monson v. Drug Enforcement Admin.*, 589 F.3d 952 (8th Cir. 2009); *U.S. v. White Plume*, 447 F.3d 1067 (8th Cir. 2006).
[44] *Monson*, 589 F.3d at 964-65; *White Plume*, 447 F.3d at 1073.
[45] Johnson, *supra* note 2, at 1.
[46] *See* 7 U.S.C. § 5940, Pub. L. 113-79, 128 Stat. 649.
[47] *See id.* § 5940(a)(1)-(2).
[48] *Id.*

> *(i) ensures that only institutions of higher education and State departments of agriculture are used to grow or cultivate industrial hemp;*
> *(ii) requires that sites used for growing or cultivating industrial hemp in a State be certified by, and registered with, the State department of agriculture; and*
> *(iii) authorizes State departments of agriculture to promulgate regulations to carry out the pilot program in the States in accordance with the purposes of this section.*
>
> *(2) INDUSTRIAL HEMP.—The term "industrial hemp" means the plant Cannabis sativa L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol ["THC"] concentration of not more than 0.3 percent on a dry weight basis.*
> *(3) STATE DEPARTMENT OF AGRICULTURE.— The term "State department of agriculture" means the agency, commission, or department of a State government responsible for agriculture within the State.*[49]

The 2014 Farm Bill mandate is both limited in its reach, and sweeping in its impact. It is limited to the extent that the production of industrial hemp is strictly restricted to agricultural pilot programs conducted by state departments of agriculture, institutions of higher education, and/or their contractual designees. The 2014 Farm Bill provisions do not apply to industrial hemp grown or used outside the context of an agricultural pilot program. It is sweeping to the extent that if industrial hemp is grown or cultivated within the context of a duly-registered agricultural pilot program, all federal laws, including the Controlled Substances Act, that would otherwise restrict, regulate, or prohibit the use or production of industrial hemp are "not-withstood."

It is important to note that the Farm Bill definition of "industrial hemp" is broader than the marijuana exemptions found in the CSA. While the earlier statute listed a number of parts of the plant that were exempt from the definition of marijuana – and therefore clearly not subject to CSA or DEA regulation – the Farm Bill explicitly refers to "all parts of the plant." As discussed earlier, the Ninth Circuit ruled that the CSA exempted all "non-psychoactive" hemp. The DEA has subsequently argued that certain parts of the plant not specifically mentioned in the CSA exemptions, such as the flowering top, still

[49] *Id.* § 5940(a)-(b).

remain under the definition of marijuana. This debate continues today concerning imported hemp; but the Farm Bill makes clear *that Congress' current intent is to define industrial hemp as all parts of the plant, as long as the THC level is less than 0.3%.*

In the months following passage of the 2014 Farm Bill, there were conflicting interpretations of the new hemp provision's meaning and application. Most prominently, the DEA initially raised objections to the importation of hemp seed for pilot programs and took the position that such importation, as well as the cultivation of industrial hemp, would remain subject to the CSA and would require licenses (permits) from DEA.

The Kentucky Department of Agriculture brought suit in federal district court to compel DEA to release a shipment of hemp seed without a license.[50] That litigation was settled informally in a manner that permitted seed importation and cultivation.[51] In 2015, 125 pilot programs were authorized in Kentucky.[52] Similar settlements have been reached between the DEA and departments of agriculture in other states that have legalized the growth and cultivation of industrial hemp.

Unfortunately, this ad hoc negotiation process has produced a patchwork of standards when it comes to federal regulation of industrial hemp. Additionally, other federal agencies –such as U.S. Customs and Border Protection and the Food and Drug Administration ("FDA") – have raised separate concerns and restricted the full development of state agricultural pilot programs.

To eliminate the existing confusion and provide clarity with respect to the legal status of the agricultural pilot programs authorized under the 2014 Farm Bill, Congress passed critical language in the Consolidated Appropriations Act for Fiscal Year 2016 (the "Omnibus Law").[53] The Omnibus Law protects agricultural pilot programs

[50] *See Kentucky Dept. of Agriculture v. U.S. Drug Enforcement Agency*, Civil Action No. 3:14cv-372-H (W.D.Ky.)

[51] Jonathan Miller and his partners at Frost Brown Todd LLC represented coalitions of hemp farmers and industry associations in this successful litigation.

[52] Kentucky Department of Agriculture, "Industrial Hemp research Pilot Program 2017 Policy Guide," KYAGR.COM, 1 (available at http://www.kyagr.com/marketing/documents/HEMP_Policy-Guide_2017.pdf) (hereinafter "2017 Policy Guide").

[53] *See* Pub. L. 114-113, 129 Sta. 2242, § 763.

established pursuant to the 2014 Farm Bill.[54] Section 763 of the Omnibus Law reads in whole:

> *None of the funds made available by this Act or any other Act may be used—*
>
> *(1) in contravention of section 7606 of the Agricultural Act of 2014 (7 U.S.C. 5940); or*
>
> *(2) to prohibit the transportation, processing, sale, or use of industrial hemp that is grown or cultivated in accordance with subsection section 7606 of the Agricultural Act of 2014, within or outside the State in which the industrial hemp is grown or cultivated.*[55]

Section 763 makes clear that no agency can expend monies authorized by federal law to interfere with or otherwise frustrate duly registered agricultural pilot programs. The prohibition against interference extends to intrastate and interstate transportation, processing, sales, and use of industrial hemp grown or cultivated pursuant to the 2014 Farm Bill.

State laws permitting industrial hemp growth and cultivation

Pursuant to section 7606 of the 2014 Farm Bill, thirty (30) states have authorized the growth and cultivation of industrial hemp for commercial or research purposes.[56] The extent of these states' permissions vary. For example, some states liberally permit the growth and cultivation of industrial hemp – for any legally permissible purpose. Many of their statutes recognize industrial hemp as a marketable, agricultural commodity.[57] Other states permit the growth and cultivation of industrial hemp more restrictively, designating only departments of agriculture and institutions of higher education, or their designees, as authorized growers.[58]

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[54] *See id.*

[55] *See id.*

[56] Frost Brown Todd LLC, "50-state survey on states' industrial hemp laws" (on file with authors).

[57] Alabama, California, Colorado, Indiana, Maine, Montana, North Dakota, Oregon, Rhode Island, South Carolina, Vermont, Virginia, Washington, West Virginia.

[58] Delaware, Hawaii, Illinois, Kentucky, Maryland, Michigan, Minnesota, Nebraska, Nevada, New Hampshire, New York, North Carolina, Pennsylvania, Tennessee, Utah.

Connecticut – the only state to ambiguously permit the growth and cultivation of industrial hemp – falls somewhere in between. Connecticut law removes industrial hemp from the definitions of "marijuana" and "cannabis-type substances."[59] Legislative summaries indicate that Connecticut intended these definitional distinctions to "legalize industrial hemp" and "allow industrial hemp to be grown, used, and sold under state law."[60] But, Connecticut has not outlined any licensure or registration procedures, or any state oversight of growing or cultivation. Those omissions dramatically depart from other states' industrial hemp schemes. To the extent that Connecticut's adoption of the 2014 Farm Bill definition of industrial hemp also adopts federal regulatory standards, Connecticut would permit "an institution of higher education or [the state's] agriculture department [to] grow or cultivate industrial hemp under a pilot program or other research programs that [complies with the 2015 Farm Bill]."[61]

Like Connecticut, many of the states permitting the growth and cultivation of industrial hemp define hemp as the 2014 Farm Bill defines hemp.[62] Accordingly, in these states, industrial hemp means "the plant Cannabis sativa L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis."[63] Kentucky ties industrial hemp to the concentration of THC permitted under federal law.[64] In addition to authorizing growth and cultivation, many states expressly exclude industrial hemp from their definitions of marijuana or exempt the cultivation and possession of industrial hemp from criminal penalties, or both.[65]

[59] Conn. Gen. Stat. Ann. § 21a-240(7), (29) (West).
[60] 2015 Connecticut House Bill No. 5780, Connecticut General Assembly - January Session, 2015 (West); Connecticut Bill Analysis, 2015 H.B. 5780.
[61] Connecticut Bill Analysis, 2015 H.B. 5780.
[62] Connecticut, Delaware, Maryland, Nebraska, Nevada, New Hampshire, New York.
[63] *Id.*
[64] *See* Ky. Rev. Stat. Ann. § 260.850(6)(a) (West).
[65] Alabama, California, Colorado, Indiana, Kentucky, Maryland, Michigan, Minnesota, Nebraska, Nevada, North Carolina, South Carolina, Tennessee, Vermont, Virginia, Washington, West Virginia. Hawaii (criminally exempted), Maine (criminally exempted), Minnesota (criminally exempted), Montana (criminally exempted), North Carolina (hemp extract criminally exempted), Pennsylvania (criminally exempted), Utah (hemp extract criminally exempted), Virginia (criminally exempted), West Virginia (criminally exempted)

Twenty states have yet to authorize the growth and cultivation of industrial hemp.[66] A handful of these states treat industrial hemp particularly unfavorably. Oklahoma, for example, prohibits growing industrial hemp "anywhere in the [s]tate."[67] Yet, industrial hemp may be shipped into Oklahoma for purposes involving the use of non-psychoactive cannabidiol to treat certain diseases and illnesses.[68] Moreover, Oklahoma law excludes industrial hemp from the definition of marijuana.[69]

Massachusetts treats hemp unusually too. The state has not established an agricultural pilot program for the growth and cultivation of industrial hemp.[70] It has not legalized the commercial production of industrial hemp.[71] Still, Massachusetts law excludes industrial hemp from the definition of marijuana.[72] And Massachusetts permits the humanitarian use of medical marijuana and the personal use of marijuana not medically prescribed.[73]

Most states, even most of the twenty states that do not mention hemp in their statutory language, define marijuana similarly to federal law – often using the precise language – exempting the non-psychoactive parts of the cannabis plant from the definition. Florida and Mississippi are the outliers, defining cannabis as all parts of the plant, a definition which captures industrial hemp and its derivative products. Both states, however, recognize the medical value of cannabis. Florida permits the regulated and supervised use of low-THC cannabis and cannabidiol to treat certain medical diseases and illnesses, including cancer.[74] Mississippi permits the regulated use and possession of CBD – the non-psychoactive cannabinoid in hemp – for treatment of a debilitating epileptic condition or related illness.[75]

Kentucky's agricultural pilot program

[66] Frost Brown Todd LLC, "50-state survey on states' industrial hemp laws" (on file with authors).
[67] Okla. Stat. Ann. tit. 63, § 2-101(23)(g) (West).
[68] *See id.* § 2-101(23)(e), (f), (g).
[69] Okla. Stat. Ann. tit. 63, § 2-101(23)(g).
[70] *See* state hemp summary, *supra* note 1.
[71] *Id.*
[72] Mass. Gen. Laws Ann. ch. 94C App. § 1(g)(1).
[73] *See generally* Mass. Gen. Laws Ann. ch. 94C App., §§ 1-1-17; Mass. Gen. Laws Ann. ch. 94G §§ 1-14. (West).
[74] *See* Fla. Stat. Ann. § 381.986(2) (West).
[75] Miss. Code. Ann. § 41-29-136 (West).

Some states' schemes regulating the growth and cultivation of industrial hemp are newer and nascent. Alabama categorizes industrial hemp as an agricultural commodity under state law. But has not enumerated growing regulations.[76] Other schemes preceded the 2014 Farm Bill and are more thorough in scope. By way of example, Kentucky adopted a regulatory scheme that promotes "industrial hemp production, development, and commercialization of hemp products in agribusiness, alternative fuel production, and other business sectors, both nationally and globally . . . to the greatest extent possible."[77]

In 2017, Kentucky again conducted "an Industrial Hemp Research Pilot Program (IHRPP) as authorized by . . . the 2014 Farm Bill."[78] Individuals and companies may participate in IHRPP as growers or processor/handlers.[79] Participants must apply, pay a $50 application fee, and undergo a criminal background check.[80] Approved participants must enter a Memorandum of Understanding and Participant Agreement with Kentucky Department of Agriculture (KDA).[81] The "documents set forth terms and conditions governing participation in [IHRPP]."[82] Failure comply with the terms and conditions may result in expulsion from IHRPP.[83] Among other activities, IHRPP regulates seed acquisition, planting, use of pesticides, laboratory testing, and transfer of hemp materials and products.[84] IHRPP authorizes research of industrial hemp by Kentucky institutions of higher education, too.[85] Such institutions must register and affiliate with KDA.[86] Similar restrictions on seed acquisition, planting, and laboratory testing apply.[87]

IHRPP enjoyed immediate, gradual success:

> To date over 40 processors have been admitted into [IHRPP] . . . and are developing infrastructure with sufficient capacity to process hemp grown by farmers all across Kentucky. In the first year of the program, farmers planted 33 acres and succeeded with a modest harvest. In

[76] Ala. Code § 2-8-381(4).
[77] Ky. Rev. Stat. Ann. § 260.8505(1) (West).
[78] "2017 Policy Guide," *supra* note 52.
[79] *See id.* at 2.
[80] *Id.* at 3, 4, 13.
[81] *See id.* at 6, 16.
[82] *Id.*
[83] *Id.* at 6, 11, 16, 21.
[84] *See id.* at 8-10, 18-20.
[85] *Id.* at 22.
[86] *Id.*
[87] *See id.* at 23-24.

> 2015, over 900 acres were planted and about 500 were successfully harvested.[88]

In 2016, IHRPP reported 2,300 acres planted. KDA expects an "even larger . . . growing season" in 2017.[89]

In early 2017, the Kentucky General Assembly passed Senate Bill 218, which brought the state closer in line with the federal legal regime, and codified the regulatory program established at the KDA. In House Bill 333, moreover, Kentucky took a large step toward the development of a CBD market, by exempting from the definition CBD products that were derived from hemp and/or products that have been approved by the Food and Drug Administration. These bills confirm that the Bluegrass State retains the most progressive and permissive industrial hemp laws in the country.

Kentucky's successes in this area are owed in large part to its political leadership on both the state and federal level. The revolutionary development of industrial hemp policy over the past few years was initiated by Kentucky's elected Agriculture Commissioner James Comer (R), who ran for office on a platform of legalizing the crop. While most political leaders in the state were initially opposed, Comer developed bipartisan support for state legislation that ultimately passed overwhelmingly in both houses of the General Assembly (with the strong assistance of state legislators such as Senate Agriculture Chair Paul Hornback (R) and then-House Majority Leader Rocky Adkins (D)). Comer has been followed into office by Commissioner Ryan Quarles (R), who has also been a resolute advocate of the industry, and developed the new, more transparent and comprehensive regulatory scheme summarized above.

Kentucky also is fortunate to have the strong support of its influential congressional delegation. United States Senators Rand Paul (R) and Mitch McConnell (R) were early congressional champions of industrial hemp, and Senator McConnell, while serving as Senate Majority Leader, was instrumental in the passage of the Farm Bill and the inclusion of section 763 in the Omnibus Law. Northern Kentucky Congressman Thomas Massie (R) has been one of the most vocal and passionate advocates for full hemp legalization in Washington, having introduced several pieces of legislation and amendments that would

[88] *Id.* at 1.
[89] *Id.*

move the crop toward full legalization, while Congressman John Yarmuth (D) has provided bipartisan support at both the state and federal level.

Summarizing the legal landscape for industrial hemp

When applicable state laws are read alongside the 2014 Farm Bill and Omnibus Law, the following legal regime for industrial hemp emerges:

- Federal law defines industrial hemp as the *cannabis sativa* plant and any of its products that contain 0.3% or less THC on a dry weight basis. Any product with more THC is not industrial hemp and is subject to the Controlled Substances Act.
- Industrial hemp grown or cultivated pursuant to a 2014 Farm Bill-authorized agricultural pilot program is not subject to the Controlled Substances Act. Such hemp, in any form, is legal to transport, process, sell, and/or use. Further, the Omnibus Law clarifies that as a matter of *federal* law, such hemp products can be transported, sold, and used in a state other than the state in which they were cultivated, even if the state in which they are sold, used, or transported has not established an agricultural pilot program pursuant to the 2014 Farm Bill. For example, if a hemp product is derived in Kentucky from hemp cultivated under Kentucky's agricultural pilot project, an agency could not use federal monies to prohibit the sale of that product in *any* other state.
- Industrial hemp that is grown or cultivated outside of a 2014 Farm Bill-authorized agricultural pilot program – grown in a state that has not adopted appropriate regulations, or on a farm that has no contractual relationship with a university or state department of agriculture – is not protected by federal law permissions.
- Federal law strictly prohibits agencies from using funds authorized by federal law to interfere with industrial hemp agricultural pilot programs. Accordingly, with regard to duly registered pilot programs, agencies, including Drug Enforcement Agency; Food and Drug Administration; and U.S. Customs and Border Patrol, cannot use federal funds to regulate or restrict the importation of hemp seed, the growth or cultivation of hemp plants, or the use or sale of hemp products.
- Instead, duly registered agricultural pilot programs are regulated

under their corresponding state laws. States have enacted different regulations and enforcement procedures.

- If applicable state law bans the sale, transport, or use of a particular hemp product in that state, that state law could still be enforced by the state authorities. For example, if a state's definition of marijuana included industrial hemp, a product derived from the non-exempt parts of the hemp plant may be unlawful to possess or sell in the state under state law.

III. NICHE LEGAL AND BUSINESS CONSIDERATIONS FOR INDUSTRIAL HEMP

Growing Pains, CBD and Confusion with Medical Marijuana

As new laws on industrial hemp have emerged, so too have growing pains. Agencies, while resituating under a federal scheme more tolerant of the cannabis plant and its industrial hemp derivatives, have occasionally encroached the 2014 Farm Bill and Omnibus Law. Most prominently, federal agencies have focused attention on scrutinizing CBD.

When the 2014 Farm Bill was being drafted, few in the emerging industrial hemp industry were familiar with CBD. In a series of CNN reports presented in 2013 by Dr. Sanjay Gupta, the concept and potential benefits of this compound were first introduced to a national audience.[90] Specifically, Gupta explored the potential application of CBD to treating severe cases of childhood intractable epilepsy, interviewing families that demonstrated persuasive anecdotal evidence of its benefits. At the time, however, CBD was discussed as a medical marijuana product, with no discussion of industrial hemp.

But industry leaders began to understand that CBD, which is a naturally occurring compound in all cannabis plants, could be infused in products that contained less than 0.3% THC. Accordingly, CBD products in such cases met the Farm Bill's definition of industrial hemp. With other health- and wellness-related applications of CBD for all people, not just those suffering from acute diseases, hemp farmers and companies saw that a hemp-infused CBD market could emerge to help

[90] Dr. Sanjay Gupta, "Why I changed my mind on weed," CNN (Aug. 8, 2013, 8:44PM), http://www.cnn.com/2013/08/08/health/gupta-changed-mind-marijuana/index.html.

propel the hemp industry immediately, without waiting the months or years necessary to develop the financial and physical infrastructure to produce hemp fiber products. Indeed, in 2016, fully 60% of all Kentucky Department of Agriculture pilot programs involved growing hemp for CBD products in one form or another.

While the Farm Bill and Omnibus Law provide protections for the sales of hemp-derived CBD – especially when the hemp is grown as part of a state-authorized pilot program – some federal agencies objected, and began to issue non-legally-binding statements that suggested that CBD was not permitted for sale under federal law.

FDA Web Posting

On May 13, 2016, the Food and Drug Administration ("FDA") posted on its web site a document entitled "FDA and Marijuana: Questions and Answers."[91] While most of the posting involved issues relating to marijuana, there were a few sections dedicated to CBD.

Most concerning to the hemp industry, the FDA concluded that CBD could not be marketed as a dietary supplement, and that the interstate sale of food products containing CBD was not legal. However, the FDA has left the question open to further input from the industry, and did not signal that any enforcement actions were imminent. Further, in that this is a posting concerning marijuana, it is potentially limited to marijuana-infused CBD (i.e, CBD with more than .3% THC).

Ultimately, no legally binding steps have been taken by the FDA to enforce or codify the statements made in this informal forum. Still, the never-retracted posting still has served to chill some CBD production and sales.

Joint Agency Statement of Principles on Industrial Hemp

On August 12, 2016, DEA, FDA, and USDA issued a joint "*Statement of Principles on Industrial Hemp* to inform the public how Federal law applies to activities associated with industrial hemp that is grown and cultivated in accordance with [the 2014 Farm Bill]" (the "Statement").[92] In relevant part, the Statement defined industrial hemp as the plant *Cannabis sativa* L. and any part or derivative of such plant,

[91] *See* U.S. Food and Drug Administration, "FDA and Marijuana: Questions and Answers," FDA.GOV, https://www.fda.gov/NewsEvents/PublicHealthFocus/ucm421168.htm (last visited Apr. 2, 2017).

[92] Federal Register, "Statement of Principles on Industrial Hemp," FEDERALREGISTER.GOV, https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp.

including seeds of such plant, whether growing or not, that is used exclusively for industrial purposes (fiber and seed) with a tetrahydrocannabinols concentration of not more than 0.3 percent on a dry weight basis. The term "tetrahydrocannabinols" includes all isomers, acids, salts, and salts of isomers of tetrahydrocannabinols.[93]

Other declarations included:

> The growth and cultivation of industrial hemp may only take place in accordance with an agricultural pilot program to study the growth, cultivation, or marketing of industrial hemp established by a State department of agriculture or State agency responsible for agriculture in a State where the production of industrial hemp is otherwise legal under State law.

and

> For purposes of marketing research by institutions of higher education or State departments of agriculture (including distribution of marketing materials), but not for the purpose of general commercial activity, industrial hemp products may be sold in a State with an agricultural pilot program or among States with agricultural pilot programs but may not be sold in States where such sale is prohibited. Industrial hemp plants and seeds may not be transported across State lines.[94]

The Statement sparked immediate consternation.

Hemp industry associations feared enforcement action by federal agencies and sought response as to specific concerns, including:

1. If the Statement purported to redefine the federal definition of industrial hemp, particularly in how it might limit the sales of hemp products that are not used for fiber and seed, such as CBD;
2. Why the Statement declared that sales of industrial hemp products could not be made "for the purpose of general commercial activity," a restriction not included in the 2014 Farm Bill; and
3. Why the Statement declared that "Industrial hemp plants and seeds may not be transported across State lines," a declaration

[93] *Id.*
[94] *Id.*

inconsistent with the Omnibus Law.[95]

Congressional leadership echoed the industry's concerns.[96] Senate Majority Leader Mitch McConnell wrote USDA worried that the Statement inappropriately narrowed the federal definition of hemp and limited marketing research for industrial hemp products.[97]

In its response to letters of concern, USDA admitted that its definition of industrial hemp exceeded the 2014 Farm Bill's definition.[98] First, it clarified, however, that it did not intend to treat as illegal a larger class of industrial hemp products.[99] Instead, the Statement legitimizes "research involving, in some instances, a greater universe of plants that is set forth in the [2014 Farm Bill]."[100] Second, USDA reassured that it did not jointly issue the Statement to "somehow restrict activities involving industrial hemp that are permissible under federal law."[101] The Statement does, however, reinforce a restriction against general commercial activity involving industrial hemp grown under the 2014 Farm Bill. The 2014 Farm Bill, according to USDA, contemplates sales involving industrial hemp, as marketing research, which the 2014 Farm Bill authorizes, necessarily involves sales.[102] The 2014 Farm Bill limits, if USDA be believed, sales and transport of industrial hemp to the purpose of marketing research.[103]

Ultimately, it is important to note, the Statement clearly notes that it "does not establish any binding legal requirement." So while it has raised concerns from the industry and Members of Congress, it does not have any impact on the law.

Unfortunately, a few jurisdictions, such as Pennsylvania, have relied on the Statement to limit pilot programs to exclusively seed and

[95] Frost Brown Todd LLC, Letter to Secretary Thomas J. Vilsack (Aug. 17, 2016) (on file with authors).
[96] For a summary of congressional concerns, *see* Johnson, *supra* note 2, at 24-25.
[97] Sen. Mitch McConnell, Letter to Secretary Thomas J. Vilsack (Oct. 6, 2016) (on file with authors).
[98] Inga Bumbary-Langston, Acting Principal Deputy General Counsel, United States Department of Agriculture, Letter to Senator Mitch McConnell, United States Senate (Mar. 6, 2017) (on file with authors).
[99] *Id.*
[100] *Id.*
[101] *Id.*
[102] *Id.*
[103] *See id.*

fiber production.[104] Worse, companies involved in the transport and sales of hemp end-products have expressed concern about the Statement's application, some refusing to do business with Farm Bill-compliant companies.

DEA Rule on coding "marijuana extracts"

On December 14, 2016, the Drug Enforcement Administration (the "DEA") published a final rule for the establishment of a new drug code for "marihuana extracts." The rule raised deep concerns in the hemp industry, particularly concerning the potential impact on CBD. The *International Business Times* reported the rule as "set[ting] new cannabis extract laws" and controlling "CBD and all other extracts derived from the cannabis plant (psychoactive or not)" as Schedule 1 substances.[105] Other articles suggested that the rule changed federal law, posing imminent exposure to criminal liability to those who sell or possess hemp products.

Industry activists and congressional leaders quickly sought clarification. The DEA confirmed that the rule preserved and did not fundamentally change the legal landscape for hemp products. Congressional representatives and their staffs were privately assured by DEA officials that introducing a scheduling code for marihuana extracts was merely intended to better catalogue and track substances in accordance with United Nations standards. Further, DEA spokesman Russ Bauer publicly stated to the *Denver Post* that "[the rule was] primarily an administrative move and does not reflect a change in any control status." According to Bauer, the rule, at its core, "allow[s] the DEA's internal accounting mechanisms to be more accurate to track elements such as scientific and medical research. Researchers use the codes to identify which substance is subject to the project."

The confusing nature and verbiage in the DEA Rule, however, continued to place a chill on the emerging hemp industry – already begun with the federal agency joint Statement – leading to more concern among farmers, processors, producers, and the businesses that hemp product sellers use to get their products to market. Accordingly, the Hemp Industries Association, filed suit, and a Motion to Show Cause,

[104] *See* 3 Pa. Stat. and Cons. Stat. Ann. §§ 701-710 (West).
[105] Seerat Chabba, "DEA Gives Cannabis Law Significant Tweak," YAHOO! NEWS, https://www.yahoo.com/news/cbd-now-schedule-drug-dea-083035386.html (Dec. 15, 2016).

which asks why the DEA should not be found in contempt of the Court's injunctive ruling.

The DEA's initial response assured the industry that the agency has not, and will not, enforce its regulation "with respect to products made solely from the parts of the cannabis plant excluded from the CSA definition of marijuana," including "the mature stalks of such plant" and "oil or cake made from the seeds of such plant." They added: "To the contrary, DEA has allowed products made solely from the parts of cannabis plant excluded from the CSA definition of marijuana to be sold throughout the United States without restriction . . . Any suggestion that the DEA has attempted to impede the sales of these products . . . is without merit." Finally, the DEA apologized for a quotation made in a national publication by one of its spokespeople that may have suggested otherwise.

Subsequently, the DEA confirmed this interpretation in a posting on its web site.[106] Specifically, the DEA states that "the new drug code…does not include materials or products that are excluded from the definition of marijuana set forth in the Controlled Substances Act (CSA)."

But there is also some confusing and contradictory language within. On the one hand, the web site posting includes verbiage about "botanical considerations" that suggests that certain cannabinoids such as CBD would only appear in "trace amounts" in the parts of the cannabis plant that are exempt from CSA control, and suggests that "if a product, such as oil from cannabis seeds, consisted solely of parts of the cannabis plant excluded from the CSA definition of marijuana, such product would not be included in the new drug code...even if it contained trace amounts of cannabinoids."

However, other language – citing two studies that are nearly two decades old – suggests certain parts of the plant such as "the flowering tops" and "leaves" do indeed fall within the CSA definition of marijuana. Again, the DEA is pontificating without legal authority: There is no mention of "flowering tops" or "leaves" in the Controlled Substances Act or the Ninth Circuit decision, meaning that the DEA's statement has no

[106] "Clarification of the New Drug Code (7350) for Marijuana Extract," DEADIVERSION.USDOJ,GOV, https://www.deadiversion.usdoj.gov/schedules/marijuana/m_extract_7350.html (last visited Apr. 2, 2017).

controlled legal authority. In the end, federal law remains that non-psychoactive hemp remains exempt from CSA and DEA regulation.

In the end, there remains a critical debate over the definition of "industrial hemp." In the Farm Bill, Congress mandated that it includes all parts of the plant, as long as the THC level was less than .3%. The Ninth Circuit in 2004 ruled that all non-psychoactive parts of the plant are not controlled as marijuana under the CSA. It would be logical to conclude that, taken together, that the Farm Bill definition provides the level for non-psychoactive composition, and accordingly, all parts of the plant under .3% THC should be considered non-controlled hemp. However, federal agencies, most prominently the DEA, seem to be arguing that the exemption is limited to only the parts of the plant that are explicitly exempted in the CSA, i.e., the fiber and seed.

The scope of the Statement and USDA's subsequent responses remains undefined and untested. The DEA Rule coding "marihuana extract" and the Statement are examples of federal encroachment on laws authorizing the growth and cultivation of industrial hemp. Despite government's growing tolerance of industrial hemp, federal agencies are poking ambiguities in federal laws authorizing growth and cultivation.

Developing niche guidance

By addressing and advising clients through these growing pains, we have developed niche legal and business considerations for industrial hemp. For instance, we addressed distributing industrial hemp products in states that do not distinguish hemp from cannabis or marijuana. Also, we advised Kentucky-charted depository institutions on assessing risk that might otherwise attach from accepting deposits earned from industrial hemp growth or cultivation. Finally, we organized interstate, collaborative associations for collecting state and federal lobbying.

Concern can arise where a company wishes to distribute a hemp to or within a state that does not distinguish hemp from cannabis or marijuana. For example, Florida defines cannabis as "all parts of the plant."[107] It controls cannabis for its hallucinogenic substances, unless specifically excepted.[108] Florida has not legalized the growth or cultivation of industrial hemp. On its face, Florida appears to control

[107] Fla. Stat. Ann. §§ 893.02(3), 893.03(1)(c)(7) (West); Miss. Code. Ann. §§ 41-29-113(c)(23)(A) (West).
[108] Fla. Stat. Ann. § 893.03(1)(c)(7); Miss. Code. Ann. § 41-29-113(c)(23)(A).

hemp, for its parts from the cannabis plant; we developed arguments to the contrary. The Controlled Substances Act excepts non-psychoactive hemp from the federal definition of marijuana. A company may choose to rely on this exception to pull industrial hemp products from the coverage of Florida's controls. Moreover, it could argue against the classification of industrial hemp as a hallucinogenic substance, which Florida's cannabis control expressly targets. Due to its federally-mandated THC levels, industrial hemp has no psychoactive effects. The loophole particularly favors companies whose products are topically applied or ingested, from which any hallucinogenic effects are remote. Of course, state law enforcement officials may disagree with this interpretation.

How a state-chartered depository institution with customers active in the hemp industry must observe federal banking laws is a second niche legal consideration we have encountered. The federal Bank Secrecy Act (BSA) and anti-money laundering (AML) "laws require all U.S. depository institutions to assist in the detection, prevention, and reporting of money laundering and terrorist financing."[109] Kentucky depository institutions worried that accepting deposits from IHRPP participants might cause them to run afoul of the BSA and AML laws. On behalf of clients, we sought guidance from the Kentucky Department of Financial Institutions (KDFI), which issued supervisory guidance.[110] The guidance clarifies that depository institutions need not assess accounts affiliated with IHRPP as high-risk.[111] So long as it maintains a copy of an IHRPP's memorandum of understanding with KDA, the institution need not diminish or terminate its relationship with an IHRPP participant. Solicitation of on behalf of uniquely-positioned clients – state-chartered deposit institutions with customers who participate in IHRPP – also helped grow our understanding of how industrial hemp impacts niche legal and business considerations.

Finally, we have become uniquely active in and familiar with organizing hemp stakeholders. We assisted the organization of the Kentucky Hemp Industry Council, which more recently has reconvened as the U.S. Hemp Farming and Business Roundtable. These entities gathered industry seed-to-sale stakeholders—growers, processors, distributors, marketers, and representatives from institutions of higher

[109] Kentucky Department of Financial Institutions, "Supervisory Guidance 2016-1" (on file with author).
[110] *See id.*
[111] *Id.*

education and state departments of agriculture. Associating has allowed for the facilitation of communication among industry representatives, instructive discussion of emerging industry issues, controlled dissemination of a uniform message, and pooling of resources to market and lobby for industrial hemp. For example, our associations collaborated with others for guidance on the DEA Rule and Statement; those concerted efforts elicited responses from USDA. Rather than advocating individually, clients might consider joining an association of concentrated voices—a niche strategy we have employed with great effect.

IV. CURING UNCERTAINTIES IN THE INDUSTRIAL HEMP INDUSTRY

Clearly, areas of uncertainty in the legal landscape for industrial hemp persist, particularly as to the federal status of chemical extracts from hemp such as CBD.[112] As the industry continues to grow, adaptive, thoughtful advice will remain paramount. In the meantime, immediate, organized, aggressive steps can be taken to color legal ambiguities related to industrial hemp.

First, state legislation can cure uncertainties. We encourage all American states and territories to establish pilot programs under the 2014 Farm Bill, and to pass legislation that clearly defines industrial hemp as all parts of the cannabis plant with THC levels under 0.3%, and that, like Kentucky's new law, explicitly exempts hemp-infused CBD from the definition of marijuana. Currently, while the Omnibus Law prohibits federal agencies' interference with the movement of industrial hemp across state lines, state enforcement agencies can cause impediments; the Omnibus Law applies only to agencies receiving *federal* appropriations. Transporting industrial hemp products into and out of all states without interference requires tolerant state schemes. For example, hemp compliantly grown or cultivated under Kentucky's pilot program, if transported to processors or distributors in states without 2014 Farm Bill pilot programs, is threatened by local enforcement action. What the Omnibus Law protects, some states could still prosecute. One way to ensure, with legal certainty, that industrial hemp may move interstate without interference – federal, local, or otherwise – is establishing 2014 Farm Bill pilot programs in all American states, and defining industrial hemp and CBD in a uniform national fashion.

[112] *See* DeAdder, *supra* note 3, at 72.

Second, legislation in Congress can cure uncertainties, too, as evidenced by federal agencies' rulings and statements that conflict with the 2014 Farm Bill and Omnibus Law. Accordingly, we implore Congress to cure uncertainties in the legal landscape for industrial hemp by passing the Industrial Hemp Farming Act.

Reintroduced in 2015 by Congressman Thomas Massie (R-KY) and Senator Ron Wyden (D-OR), the Industrial Hemp Farming Act ("IHFA") "is intended to facilitate the possible commercial cultivation of industrial hemp in the United States."[113] It amends the Controlled Substances Act to exclude industrial hemp from the definition of marijuana.[114] Also, IHFA defines industrial hemp as "the plant Cannabis sativa L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis."[115] If enacted, IFHA would permanently preempt enforcement of industrial hemp under the Controlled Substances Act, without regarding for whether an enforcement agency has been appropriated funds under the Omnibus Law. Most significantly, the debate over the definition of "industrial hemp" would be resolved, once and for all.

The IHFA is being re-introduced in the current Congress by Kentucky's newest U.S. Representative – but someone with a long history of leadership in the issue. Congressman James Comer (R-KY), formerly the Agriculture Commissioner who, as discussed above, got the hemp ball rolling a few years ago, will be the primary sponsor of a bill that would remove industrial hemp from the CSA's jurisdiction, and establish it clearly as an agricultural commodity.

At the time of the article's preparation, the bill had not yet been introduced, but current drafts would improve upon previous versions of the IHFA by (1) ensuring that Native American Tribal Councils can participate in hemp growth and cultivation; (2) providing a role for the USDA to assist the industry by developing new THC testing and seed certification standards; and (3) confirming that industry hemp is an agricultural commodity, not a controlled substance, and that all parts

[113] Johnson, *supra* note 2, at 26-27.
[114] "S. 134 – Industrial Hemp Farming Act of 2015," CONGRESS.GOV, https://www.congress.gov/bill/114th-congress/senate-bill/134/text (last visited Mar. 30, 2017).
[115] *Id.*

of the plant can be grown, transported, stored, and sold into interstate and international commerce, as long as the THC level is below 0.3%.

With Rep. Comer a rising star in the House, and hemp's most powerful supporter, Senate Majority Leader Mitch McConnell presiding in the Senate, the prospects for passage of IHFA have never been brighter. Given the interference of federal agencies into Farm-Bill sanctioned pilot programs, and the need for more certainty in the growing hemp industry, such passage has never been more timely as well.

CONCLUSION

It is quite likely that by the time of this Article's publication, Rep. Comer will have introduced the 2017 version of the IHFA. It is also quite possible that by the time you are reading these words, the IHFA may have passed through Congress and have been signed by the President.

Suffice it to say, industrial hemp law is moving at a lightning speed. And just as Martin Luther King, Jr. famously said, "the arc of the moral universe . . . bends toward justice," hemp law will in all likelihood continue to evolve in a way that supports the long-enduring and now rapidly-growing industry. The more states that adopt pilot programs, the more farmers that grow the crop, the more businesses that make expensive investments into infrastructure, the more political support will grow. While federal agencies may continue to set roadblocks against these developments, particularly regarding a product like CBD that is unfortunately and inappropriately linked with marijuana, we expect the federal laws to continue to expand the legal reach of this historical crop and its products.

Ultimately, there are hundreds of farmers and entrepreneurs who are taking a calculated risk that the future federal laws will transform the hemp industry into the kind of agricultural commodity that could provide needed jobs and opportunity, especially in areas that have felt the blow of the crash of the tobacco marketplace. Not ironically, it is in Tobacco Country, specifically Kentucky, where political leadership on the state and federal level is providing the framework for a future thriving industry.

Local Food Systems and Farmland Preservation in Kentucky

Theresa M. Zawacki[1]

The growth of the local food movement and the concurrent development of local food systems that source food for consumer and commercial use from nearby farms present a tremendous opportunity for Kentucky farmers and communities of all sizes. Kentucky is well-positioned to be a leader in local food systems development, in part because its history as a tobacco-producing state allowed the preservation of a network of small and mid-size farms that traditionally relied on tobacco as a base crop. Though market solutions are being developed to support local food production, and Kentucky is recognized as an innovator in local food, Kentucky communities interested in tapping into and supporting this work must use existing legal, planning, and policy tools to preserve farmland and protect it from potentially incompatible development so that it can be available for future generations.

Kentucky ranks sixth in the nation for the total number of farms in the state, with a whopping 76,000 farms as of 2016.[2] However, Kentucky agriculture is threatened by a loss of income potential, and most farmers are no longer employed in farming as a primary occupation. In fact, 44,927 of these farms are principally operated by a farmer who is employed in an off-farm occupation.[3] Equally concerning, farmers are aging, and in many cases have no clear succession plan or are reliant on the sale of their land to finance their retirement. The average age of a Kentucky farmer is 57.6, just under the national average age of 58.3.[4] Between six and ten percent of farmland is expected to transfer ownership in the next five years.[5] In many cases, these transfers will be for purposes of development, and not for purposes

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[2] Ranking of States with the Most Farms, http://beef2live.com/story-ranking-states-farms-0-113143, last visited 7/17/2017.
[3] USDA/NASS 2016 State Agricultural Overview for Kentucky, https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=KENTUCKY, last visited 7/17/2017.
[4] *Id.*
[5] 2012 Agricultural Census Highlights concerning farmer age, https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/TOTAL/TOTAL_Highlights.pdf, last visited 7/17/2017.

of continuing agricultural operations. Between 1982 and 2012, the United States saw a total of 24,498,500 acres of farmland converted to developed land.[6] Many farms are owned by individuals who do not themselves engage in farming; and indeed, in Kentucky there are four million acres of rented farmland.[7]

Compounding these challenges, Kentucky's rural communities have historically relied on tobacco farming as a primary driver of economic development. The tobacco economy, including aggregation, distribution, processing, and sales, is driven by a formally-codified system of checks, balances, rights, and responsibilities, the hallmark of which is a production quota system that guarantees participating farmers a predictable income while protecting the market from saturation. In 1998, following decades of suits filed by state attorney generals against the tobacco industry alleging deceptive marketing practices, particularly those targeting children, and conspiracy to cover up known health effects of tobacco usage, a Master Settlement Agreement was reached with for 46 states. The Agreement, which bound the four largest tobacco manufacturers in the nation, required the distribution of $206 billion for public health programs and other activities over 25 years, or through 2025, and a variety of other measures that cumulatively resulted in a substantial decrease in smoking and tobacco usage in the United States.[8] In response, tobacco production, which was directly tied to demand for tobacco products through a tightly regulated quota system in which each tobacco farmer had a guaranteed market and sale price for annually producing a certain amount of tobacco to sell to producers, decreased precipitously.

In 2002, two years before the United States Congress enacted the 2004 Fair and Equitable Tobacco Reform Act to codify the Master Settlement Agreement's order to decrease in the amount of tobacco produced in the United States by providing cash payments to farmers in exchange for the mandatory sale of their tobacco production quotas, there were 29,237 tobacco farms in Kentucky. In 2007, there were only 8,133 tobacco farms remaining, and in 2012, that number dropped to

[6] Statistics on farmland conversion trends, Farmland Information Center, http://www.farmlandinfo.org/statistics, last visited 7/17/2017.
[7] *Id.*
[8] *See generally*, Master Settlement Agreement (1998), http://www.naag.org/assets/redesign/ files/msa-tobacco/MSA.pdf, last visited 7/17/2017.

only 4,537 farms producing tobacco.[9] Many farmers were left without the ability to produce and guarantee the sale of a crop that had for decades ensured a base income that could be supplemented by other crops as needed to achieve a desired standard of living. The decline of tobacco has, in many cases, exacerbated challenges related to the aging farm population and the transfer of ownership of agricultural lands. This decline has left rural and urban communities alike wondering about the future of farming and farmers in the state.

Theoretically, farmers struggling to identify alternatives to tobacco production need look no further than the local food movement to identify potential high-value market opportunities. Increasing consumer awareness and concern for where and how food is produced, national food recalls and health alerts related to food handling practices, the rise of the locavore or "Farm to Table" movement and its prominence in food journalism and restaurant culture, and an ever-increasing consumer demand for organic food are creating new economic opportunities for farmers and incentivizing the preservation of working farms. The United States Department of Agriculture ("USDA"), the USDA's Natural Resources Conservation Service ("NRCS"), state departments of agriculture, and many local governments, including Louisville and Lexington, Kentucky, are funding programs and projects intended to recreate and augment local and regional food systems with the goal of sustaining the tradition of small- and medium-scale food production, preserving farmland, and attracting a new generation of farmers to replace those who are retiring.

Though market opportunities are evolving through consumer preference and external influence, there remains a need to complement the work with strategies to preserve land for farming. In Kentucky, there are a number of legal tools available to support farmland preservation. These include comprehensive land use planning, zoning laws and related land use strategies, including growth boundaries, conservation easements, including Kentucky's Purchase of Agricultural Conservation Easements ("PACE") program, and transfer of development rights. Given a supportive policy orientation, these solutions provide a framework for successful local food systems development, the preservation of rural communities and traditions, and

[9] 2012 Agricultural Census Volume 1, Chapter 1: State Level Data concerning trends in the number of tobacco farms operating in Kentucky, https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Kentucky/, last visited 7/17/2017.

the environmental and cultural benefits of retaining Kentucky's agricultural land.

Comprehensive planning, the development of a long-range vision for land and community development, is a prerequisite for land use regulation.[10] A community comprehensive plan must contain a statement of goals and objectives to guide physical development, as well as a land use planning element that shows the most "appropriate, economic, desirable and feasible patterns for the general location, character, extent and interrelationship of the manner in which the community should use its public and private land," including "public and private, residential, commercial, industrial, agricultural, and recreational land uses…"[11] A comprehensive plan may include additional components, such as conservation, natural resources, regional impact and "other programs which in the judgment of the planning commission will further serve the purposes of the comprehensive plan."[12] The manner in which these elements are addressed in a comprehensive plan varies from planning unit to planning unit, and sets the stage for how zoning laws relate to agricultural activities.

For example, Lexington, Kentucky's 2013 comprehensive plan includes Theme E, "Maintaining a Balance between Planning for Urban Uses and Safeguarding Rural Land," which describes goals intended to concentrate urban development patterns inside an Urban Services Area, discussed in more detail below. These goals are intended to protect agricultural uses in the Rural Services area, a portion of the community in which zoning laws promote the protection of farmland and natural resources and allow only very low density agricultural development and a handful of complementary uses.[13] Themes of agriculture, farmland preservation and urban/rural symbiosis permeate Lexington's comprehensive plan, and are found in plan elements pertaining to natural resources and land conservation, job creation and economic prosperity, and quality of life for residents and visitors. The plan considers additional research needed to ensure that agricultural lands are fully catalogued and classified, and that future land use decisions

[10] Ky. Rev. Stat. Ann. § 100.183 (West 2017).
[11] Ky. Rev. Stat. Ann. § 100.187 (1) – (2) (West 2017).
[12] Ky. Rev. Stat. Ann. § 100.187 (6) (West 2017).
[13] Lexington/Fayette Urban County Government's (Kentucky) 2013 Comprehensive Plan (final version), https://drive.google.com/file/d/0B0aBvWAKyfxaMnNTdmd1VXZBN2M/view, last visited 7/17/2017.

pertaining to urban and rural development recognize the intrinsic community value of the urban core's proximity to active farmland and severely restrict the types of activities that can occur in agricultural areas to keep those areas pristine.[14]

Similarly, the *2010 Boone County Comprehensive Plan* (Kentucky) contains an entire chapter dedicated to describing the current status of agriculture, the significance of farming, and the history of farming in the community.[15] Boone County's comprehensive plan outlines various non-planning resources available to support farming, including the establishment of agricultural districts and various technical assistance programs provided through the Boone County Soil and Water Conservation District.[16] The plan also incorporates survey work done to understand farm demographics, succession plans, views on agriculture, and willingness of farmers to participate in farm incentive programs ranging from farmland preservation and tax incentives to improving access to farmers markets and preservation of farming culture.[17] Recommendations and conclusions pertaining to land use include developing a purchase of development rights program, creating incentive programs and projects to retain and support the diversification of agricultural operations, and considering the infrastructure costs of developing farmland and the impact of development on agricultural operations.[18] But rather than creating a clear distinction between urban and rural areas of Boone County, the comprehensive plan treats agriculture as something that can and should, with proper safeguards, happen in conjunction with a variety of other types of development.

Whereas comprehensive planning is the conceptual embodiment or vision statement of a community's development priorities, zoning regulations are the legal framework that supports the realization of this vision. In Kentucky, agriculture is defined broadly to include "tracts of at least five (5) contiguous acres for the production of agricultural or horticultural crops, including but not limited to livestock, livestock products, poultry, poultry products, grain, hay, pastures, soybeans, tobacco, timber, orchard fruits, vegetables, flowers, or ornamental

[14] *Id.*
[15] 2010 Boone County, Kentucky, Comprehensive Plan, http://www.boonecountyky.org/planning_commission/2010_comp_plan.aspx, last visited 7/17/2017.
[16] *Id.* at 98-99.
[17] *Id.* at 99-100.
[18] *Id.* at 101-102.

plants.."[19] And agriculture receives special treatment under the Kentucky Revised Statutes. A local zoning ordinance may include provisions that eliminates nearly every land use regulation for agricultural land, with the exception of setbacks to protect existing and proposed streets; the regulation of buildings or structures in designated floodways and floodplains; the regulation of mobile homes and other dwellings; and provides that certain equestrian uses may be subject to regulation as conditional uses.[20] The inclusion of comprehensive plan elements pertaining to agriculture are therefore often aimed not at devising a system of land use regulations to guide the development of agricultural lands, but at ensuring, according to the community's vision, the preservation of farmland and rural character as development threatens to encroach on farmland, as is the case in Lexington, or grows to complement it, as is the case in Boone County.

Article 24 of Lexington's zoning ordinance establishes overlay zones for agricultural and rural areas of the community that establish a clear separation between agricultural uses and all other use. These overlay zones are intended to "promote the efficient use of existing and proposed agricultural lands, to minimize land use conflicts, and to respect existing and planned agricultural facilities," while simultaneously ensuring "a safe and efficient roadway system," and balancing traditional land use regulations with flexibility intended to address rural needs.[21] Overlay zones contain information about permitted, accessory and conditional uses, prohibited uses, and design standards intended to balance small-scale, minimally-intensive development that complements agricultural operations, including farm stands, small coffee shops, and livestock markets, with rural development patterns. Most residential, and nearly all commercial and industrial uses are prohibited. Large minimum lot sizes, deep building setbacks, and property management plans for larger agricultural uses are required for development in the overlays.[22]

In contrast, Boone County, Kentucky's zoning ordinance is substantially more inclusive of uses permitted in agricultural zones, including residential, recreational, tourism-related, and commercial

[19] Ky. Rev. Stat. Ann. § 100.111 (2)(a) (West 2017).
[20] Ky. Rev. Stat. Ann. § 100.203 (4) (West 2017).
[21] Article 24, Lexington/Fayette Urban County Government (Kentucky) zoning regulations concerning agricultural overlays, https://drive.google.com/file/d/0B0aBvWAKyfxaRUZBX0hNYkcye VU/view, last visited 7/17/2017.
[22] *Id*.

uses, including museums, bed and breakfast operations, commercial kennels, boat rentals, and garden stores.[23] Boone County's regulations additionally permit landfill construction in agricultural zones, subject to a conditional use permit and compliance with special site design standards. Minimum lot size, setbacks and density of residential uses ensure that rural character is preserved and that development does not encroach on agricultural uses.[24] Though design standards clearly favor preservation of rural design standards and agricultural operations, Boone County's regulations anticipate that agricultural operations will be supported by a variety of complementary uses intended to invite people to visit agricultural areas, and to provide necessary community services in areas where there will be minimal impact on adjacent property owners.

Complementary to comprehensive planning and the enactment of zoning regulations, communities interested in protecting farmland from development pressure and promoting agriculture have the ability to regulate where development occurs through the enactment of policy designed to limit where urban services and infrastructure are available. In 1958, Lexington, Kentucky became the first city in the nation to establish an "urban growth boundary" intended to limit where development could occur based on where city services such as sewers and water would be made available. Inside the "Urban Services Area," development is encouraged through the construction of needed infrastructure, including sewers and roads, and the provision of city services such as street cleaning and trash pickup. In the "Rural Services Area," infrastructure improvements and services are extremely limited and do not support higher-density development patterns.

The Service Areas operate independently from Lexington's zoning regulations, though they are very closely aligned. Agricultural and rural overlay zones occur only in the Rural Services Area, and traditional residential, commercial and industrial zones occur only in the Urban Services Area. As a result, Lexington has been highly successful in concentrating urban growth in its core and protecting large swaths of agricultural uses in a crescent around the city.

[23] Boone County, Kentucky, 2013 Zoning Regulations concerning agricultural uses, http://www.boonecountyky.org/document_center/PlanningCommission/2012ZoningRegs/Article06.pdf, last visited 7/17/2017.
[24] *Id.*

Land use regulations and related policies can establish and implement community priorities around farmland preservation and agriculture, but do not provide a direct incentive for the preservation of farmland. However, another tool, the conservation easement, can create direct incentives for landowners interested in preserving agricultural land in exchange for a possible tax benefit. Conservation easements are intended to impose limitations or obligations on property owners with the intent of "retaining or protecting natural, scenic, or open-space values of real property, assuring its availability for agricultural, forest, recreational or open space use, protecting natural resources, maintaining or enhancing air quality, or preserving the historical, architectural, archaeological, or cultural aspects of real property."[25] These easements restrict in perpetuity the development of the encumbered property. Generally, conservation easements cannot impair pre-existing interests in real property unless consented to by the owner, and must be recorded in the chain of title in order to impose rights and responsibilities on the parties thereto.[26] Conservation easements may be modified or terminated, but only under a very strict set of circumstances that must be well-documented to avoid potential negative tax consequences for the donor.

Kentucky's enabling legislation on conservation easements states that, with certain exceptions contained in KRS 382.810-382.860, a conservation easement may be "created, conveyed, recorded, assigned, released, modified, terminated, or otherwise altered or affected in the same manner as other easements."[27] Federal and state tax benefits can accrue to landowners who encumber their property through a conservation easement; these benefits are based on the difference between the pre-easement and post-easement land value as determined through an appraisal. Tax benefits are only allowed for donations of conservation easements made in perpetuity.[28] This rule is intended to prevent improper inurement to an easement donor who claims a tax benefit for the decreased value of the land following its encumbrance through the easement, and who, at some future date, realizes the profits of the development of that land following the termination or amendment of the easement.

[25] Ky. Rev. Stat. Ann. § 382.800 (West 2017).
[26] Ky. Rev. Stat. Ann. § 382.810 (West 2017).
[27] Ky. Rev. Stat. Ann. § 382.810 (1) (West 2017).
[28] 26 I.R.C. 170(h)(5)(A).

Conservation easements must be "donated" to, or written in favor of a "holder," an organization that intends to monitor compliance with the terms and conditions set forth in the document, and that can therefore protect the purpose for which the easement was given. In Kentucky, a variety of nonprofit organizations known as land trusts operate to hold conservation easements on land with scenic, conservation, agricultural, historic or cultural value. In Louisville, for example, River Fields, a private 501(c)(3) organization, and the Louisville/Jefferson County Environmental Trust, a quasi-governmental organization established by the Louisville/Jefferson County Metro Government are two organizations qualified to accept conservation easements, and that currently hold easements intended to protect agricultural land.

The donation of a conservation easement can be a fairly lucrative proposition for a landowner. However, many farmers are not interested in donating a conservation easement, as they lack the tax liability needed to capture the benefits associated with such a donation or view the future sale of their land as essential to their ability to retire. In order to incentivize farmers who may not be willing to donate a conservation easement but are interested in preserving their agricultural land, Kentucky offers a Purchase of Agricultural Conservation Easement Program ("PACE Program"), established in Kentucky Revised Statutes, Chapter 262.

The PACE Program ("Program") exists to "retain agriculture and enhance the contribution that agriculture makes" to Kentucky's economy.[29] The Program provides direct financial incentives for farmers to preserve their land, protects farming operations from incompatible uses, and protects farms from nuisance claims that may arise as development comes closer to agricultural operations.[30] A property owner may give any less than fee-simple interest, including an easement, life estate, covenant or contract, in exchange for compensation at less-than-appraised value. Payment can be made in a lump sum or over a period of time with interest.[31] During the term of the easement, the encumbered land can be used only for agriculture, and the landowner must prevent any acts to the contrary from taking place on the land. Participating landowners must implement a soil and water conservation plan on the property, and may not construct any improvements, cut

[29] Ky. Rev. Stat. Ann. § 262.902 (1) (West 2017).
[30] *Id.* at § 262.902 (3).
[31] Ky. Rev. Stat. Ann. § 262.904 (West 2017).

trees other than to maintain their health or prevent property damage, or make any changes to the configuration of the property through subdivision that were not previously contemplated as part of the transaction.[32] Properties are evaluated for eligibility to participate in the Program based on their soil type, agricultural use, proximity to other protected land, size and vulnerability to development for non-agricultural use.[33] The Program has purchased development rights on 108 farms since it was established in 1994, and has received donations of 61 additional easements. A total of 667 applications for participation in the PACE Program are currently under review.[34]

In 2000, Lexington established a related program through which landowners in the Rural Services Area can receive a payment in exchange for a permanent transfer of future development rights, creating an economic incentive focused on preserving farmland. Kentucky Revised Statutes Chapter 67A, pertaining to urban-county governments, of which Lexington is one, creates a local purchase of development rights program similar to the PACE Program. Included in this chapter is a section enabling the establishment of a program through which an urban-county government can, by referendum, levy taxes to be used for the purchase of development rights in certain areas of the community designated as agricultural.[35] Under this authority, Lexington created a Purchase of Development Rights Program ("PDR Program") to complement its growth boundary and to provide incentives for farm owners to preserve their land. The PDR Program is managed by a citizen board, and governed by Chapter 26 of the Lexington-Fayette Code of Ordinances.[36] PDR Program applicants receive a cash payment in exchange for the placement of a permanent conservation easement on their farmland. This easement prohibits future non-agricultural development on the land. Farms are selected using scoring criteria, including size, length of public road frontage, proximity to other protected land, soil quality, farm activity, and protection of natural, cultural and scenic resources.[37] Currently, there are 261 farms permanently protected by the PDR Program.

[32] Ky. Rev. Stat. Ann. § 262.910 (West 2017).
[33] 302 Ky. Admin. Regs. 100:010 (2017).
[34] Farmland Preservation/PACE, http://www.kyagr.com/marketing/PACE.html.
[35] Ky. Rev. Stat. Ann. § 67A.840, *et seq*. (West 2017).
[36] PDR Ordinance, https://next.lexingtonky.gov/sites/default/files/2016-07/PDROrdinance.pdf.
[37] *Id*.

Any city, county, consolidated local government, or urban county government which is part of a planning unit may also provide for a transfer of development rights from one parcel of land to another.[38] "Transfer of development rights" refers to a concept through which the right to develop a property is severed from the land to which it is attached and available to augment the development potential of another parcel of land. Communities interested in using this tool must enact an ordinance outlining the terms through which the transfer may be effectuated, allowing the reduction in development rights to be formally documented through an easement or other means, allowing the increase in development rights to be similarly documented, and establishing the areas of the community to and from which development rights may be transferred.[39] Though not intended explicitly to facilitate the preservation of agricultural land, a community could certainly choose to use it in this manner.

A great deal of work must be done to ensure that Kentucky farmland is preserved for future generations. Market opportunities for local food are still challenged by the small scale in which they operate, and until greater numbers of Kentucky farmers see food production as more economically viable than commodity crop and other non-food-crop production, this problem will persist. Resources are needed to ensure that all farmers know their options for succession planning, and creative strategies are needed to support the transfer of knowledge and access to land from seasoned farmers to those starting out in the profession. More communities must prioritize the preservation of agricultural land through their comprehensive planning and zoning processes, and the transfer of development rights through conservation easements or other means must be adopted more broadly. The tools needed to support the construction of a local food system in Kentucky exist, but must be more intentionally used and connected to be truly successful

[38] Ky. Rev. Stat. Ann. § 100.208 (West 2017).
[39] *Id.*

Commodity of the Future? Environmental Ethics and the Value of Water

Randy Strobo, JD, MEM[1]

I. INTRODUCTION

For the first time since 1939, less than 11 million tons of coal was mined in Kentucky.[2] Coal production in Kentucky, along with the prestige and significance of this "black gold," continues to decline in an increasingly diversified nationwide energy market. In the midst of this decline, the question many policy makers and government officials are now asking is what will replace it? For some, the answer is water.

Only two weeks after the Kentucky Energy & Environment Cabinet released its updated coal industry figures, Governor Matt Bevin of Kentucky spoke at the Annual Conference of the Kentucky Association of Manufacturers. In a day full of meetings and panels on costs of energy, workforce development, and Governor Bevin's "red tape initiative" to cut down on industry regulation, Governor Bevin insipidly, yet remarkably declared, "water is the commodity of the future."[3] This statement was amidst Governor Bevin's pontifications about his recent trips to Germany, the value of a liberal arts education, and how Kentucky would be the manufacturing hub of the United States.[4]

This is not the first time a government official has described water as a commodity, nor will it be the last. In fact, the regulation and policies behind the use and protection of water are often through the auspices of ecosystem services and other similar policy frameworks that seek to protect water by assigning water and the services it provides a monetary value. This push to rank natural resources such as water by

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[2] Erica Peterson, *Kentucky's Coal Employment Dips to Lowest Recorded Level Since 1898*, WFPL (May 2, 2016), http://wfpl.org/kentuckys-coal-employment-dips-lowest-recorded-level-since-1898/.

[3] Matt Bevin, Governor, Commonwealth of Kentucky, Keynote Address at the Kentucky Association of Manufacturers Annual Conference (May 11, 2016). *See also* Erica Peterson, *Bevin: Coal is Integral but Water is 'Commodity of the Future',* WFPL (May 11, 2016), http://wfpl.org/bevin-touts-kentuckys-low-electricity-prices-at-manufacturers-conference

[4] *Id.*

the quality of ecosystem services they provide for humans instead of protecting nature for nature's sake can be controversial for failing to acknowledge the intrinsic values of the natural world.

While water is plentiful in Kentucky, that water is also polluted, suffering from centuries of resource extraction, the industrialization of agriculture, and urban waste, among other attributable variables. Kentucky's Governor recognized the importance of water, but regarding water as a purely economic "commodity" is misguided. While the recognition of water's importance from any value perspective is encouraging from a state that has historically devalued water from a policy and environmental perspective, water is more than a commodity. Water provides Kentuckians with essential ecological services, holds cultural, religious, and social significance, and is imperative to the health and well-being of people and the environment. This article will explore those qualities and the environmental and ethical implications in the construction of water as a commodity.

II. KENTUCKY'S WATER WEALTH

Kentucky has a rich water supply. Kentucky averages about 49 inches of precipitation per year,[5] and that average has been increasing.[6] Kentucky consistently ranks in the top 15 among states in annual precipitation.[7] According to the Kentucky Geological Survey, about 40 percent of this water runs off into streams, and about 60 percent evaporates or is transpired by plants.[8] In fact, much of eastern Kentucky is considered a temperate rain forest because of forest composition, high biodiversity, and high annual precipitation rates.[9] Kentuckians use more than 4.3 billion gallons of water per day, of which 95 percent is surface water and five percent is groundwater.[10]

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[5] Mike Lynch, *Kentucky Geological Survey: Water Fact Sheet,* University of Kentucky (2014), https://www.uky.edu/KGS/education/factsheet_water.pdf [hereinafter KGS].
[6] National Oceanic and Atmospheric Association, *National Climate Report - Annual 2015*, https://www.ncdc.noaa.gov/sotc/national/201513 (last visited June 8, 2017) [hereinafter NOAA].
[7] Current Results, *Average Annual Precipitation by State*, https://www.currentresults.com/Weather/US/average-annual-state-precipitation.php (last visited May 20, 2017) (using data provided by NOAA National Climatic Data Center).
[8] KGS, *supra* note 5 at 1.
[9] C. Loucks *et al.*, *Appalachian Mixed Mesophytic Forests*, World Wildlife, https://www.worldwildlife.org/ecoregions/na0e402 (last visited June 8, 2017).
[10] KGS, *supra* note 5 at 1.

About 3.5 million Kentuckians are served by surface water sources, which include about 700 drinking water systems.[11] Surface water withdrawals total 489 million gallons per day for public supply. Of these withdrawals, 13 million gallons are used for domestic use, 167 million gallons are used for industrial/mining uses, 81 million gallons are used for agriculture, and 3,430 million gallons are used for cooling at thermoelectric power plants.[12] This surface water supply provides domestic water for 92 percent of Kentucky's urban population and about 50 percent of Kentucky's rural population.[13] Groundwater supplies provide the rest.[14]

Thirteen major river basins in Kentucky, containing upwards of 92,000 stream miles drain the state.[15] A vast majority of those are headwater streams, also called ephemeral or intermittent, and often sources of drinking water.[16] Kentucky has more navigable miles of water than any other state except Alaska and is the only state bordered on three sides by rivers.[17] There are 45 major lakes in Kentucky (only three of which are natural), including reservoirs, with 29 dams 50 feet tall or higher.[18] Reservoir storage in Kentucky totals 2.9 trillion gallons.[19]

III. LACK OF EXECUTIVE, LEGISLATIVE, AND JUDICIAL PROTECTIONS

Water quality has drastically improved since the Clean Water Act was passed in the early 1970s. Yet, the nation, including Kentucky, is far from attaining the original goal of the Clean Water Act, which is to eliminate discharges of pollutants into the navigable waters by 1985.[20] Thanks to the Clean Water Act, point source pollution from factories, commercial facilities, and sewage treatment facilities have been drastically reduced, although municipal sewage treatment plants account for 70 percent of point source pollution in Kentucky.[21] Now, Most of the water pollution is the result of non-point source discharges from farms, mines, construction sites, parking lots, and other land

[11] *Id.*
[12] *Id.*
[13] *Id.*
[14] *Id.*
[15] Tim Joice, "*Waters of the U.S.*", Kentucky Waterways Alliance (Apr. 3, 2013) https://kwalliance.org/waters-of-the-u-s/.
[16] *Id.*
[17] KGS, *supra* note 5 at 1.
[18] *Id.*
[19] *Id.*
[20] 33 U.S.C. 1251 (a)(1).
[21] KGS, *supra* note 5 at 2.

uses.[22] Of these, agriculture is the leading source of water impairment in the United States.[23]

Non-point source pollution is also "the primary contributor to water pollution in Kentucky."[24] Non-point sources pollute about three and a half times as many miles of streams as point sources in Kentucky.[25] The primary non-point sources of pollution are mining (31%), agriculture (29%), land disposal/septic systems (20%), and urban storm water runoff (10%).[26]

Despite great efforts to improve the water quality in the United States and Kentucky, Kentucky's water resources are still taken for granted.[27] There is evidence of this in Kentucky's current tendency to opt against the protection of water resources. In the past two years, the Kentucky has joined federal lawsuits to challenge the Stream Protection Rule,[28] and "Waters of the United States" (WOTUS) Clean Water Rule.[29]

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[22] JAMES SALZMAN & BARTON H. THOMPSON, ENVORNMENTAL LAW AND POLICY, 175 (Foundation Press, 4th ed. 2014).

[23] Edwin D. Ongley, *Control of Water Pollution from Agriculture*, Food and Agriculture Organization of the United Nations (1996), http://www.fao.org/docrep/w2598e/w2598e00.htm#Contents.

[24] Kentucky Energy and Environment Cabinet, *Integrated Report to Congress on the Condition of Water Resources in Kentucky*, 43 (December 4, 2014), http://water.ky.gov/waterquality/Integrated%20Reports/KY%20IR%20VI-2014.pdf.

[25] KGS, *supra* note 5 at 2.

[26] *Id*.

[27] Ashley R. Osborne, *Saving Water at Home*, Kentucky Department of Agriculture (Oct. 2012), https://www.uky.edu/bae/sites/www.uky.edu.bae/files/henv601.pdf.

[28] The Stream Protection Rule strengthened water resource protections around coal mines by preventing damage to the "hydrologic balance" outside mining permit areas. The rule also established a 100-foot buffer around streams, and called for the restoration of streams that had been damaged from coal mining operations. The Stream Protection Rule was disapproved H.J. Res. 38, which was signed by President Trump on February 16, 2017. 81 F.R. 93066 (Dec. 20, 2016).

[29] The Clean Water Rule was necessary because the "[p]rotection for many of the nation's streams and wetlands has been confusing, complex, and time-consuming as the result of Supreme Court decisions in 2001 and 2006." Environmental Protection Agency, *What the Clean Water Rule Does*, https://19january2017snapshot.epa.gov/cleanwaterrule/what-clean-water-rule-does .html. (last visited June 8, 2017) [hereinafter EPA] (referencing to a website containing historical material reflecting the EPA website as it existed on January 19, 2017, before the "Trump administration" removed these records from the current EPA website), *see generally* 80 F.R. 37053 (June 29, 2015).
The Clean Water Rule attempted to more precisely define and more predictably determine waters protected under the Clean Water Act. *Id*. More specifically the Clean Water Rule: clearly defines and protects tributaries that impact the health of downstream waters; provides certainty in how far safeguards extend to nearby

Kentucky's Governor, the vast majority of state legislators, and all but one federal legislator (Congressman John Yarmuth) also support the rollback of these regulations. These two regulations would have positive impacts on water quality across Kentucky and provide better guidance on when certain statutes and policies related to water protection apply.

Kentucky appellate courts have not decided many cases related to water protections. However, in cases where they have, Kentucky Courts have been indifferent to protecting Kentucky's waters. Reversing the Franklin Circuit Court's decision requiring a concentrated animal feedlot operation to obtain a Kentucky Pollution Discharge Elimination System (KPDES) permit, the Kentucky Court of Appeals reversed despite a Kentucky statute that is more protectionist of waters than the federal statute,[30] stating "It seems axiomatic that, where no federal NPDES permit would be required, any KPDES permit would necessarily be more stringent, and thus in conflict with KRS 224.16-050(4)."[31] Pursuant to KRS 224.16-050(4), the Cabinet's imposition is restricted under "any permit issued pursuant to this section any effluent limitation, monitoring requirement, or other condition which is more stringent than the effluent limitation, monitoring requirement, or other condition which would have been applicable under federal regulation if the permit were issued by the federal government."[32] As a result, and despite the Kentucky legislature's preference for broader water

waters; protects the nation's regional water treasures; clarifies that ditches not constructed in streams and flow only when it rains are not covered; maintains the status of waters within Municipal Separate Storm Sewer Systems, but encourages the use of green infrastructure; reduces the use of case-specific analysis of waters. *Id.* The Clean Water Rule was set to go into effect in August 2016. However, the Rule was stayed by the U.S. Court of Appeals for the Sixth Circuit in October 2016. On February 28, 2017, President Trump issued an Executive Order directing the U.S. EPA and Department of the Army to review and rescind or revise the 2015 Rule. EPA, *About Waters of the United States*, https://www.epa.gov/wotus-rule/about-waters-united-states (last visited June 8, 2017).

[30] "No person shall, directly or indirectly, throw, drain, run or otherwise discharge into any of the waters of the Commonwealth, or cause, permit or suffer to be thrown, drained, run or otherwise discharged into such waters any pollutant, or any substance that shall cause or contribute to the pollution of the waters of the Commonwealth in contravention of the standards adopted by the cabinet or in contravention of any of the rules, regulations, permits, or orders of the cabinet or in contravention of any of the provisions of this chapter." KRS § 224.70-110. The Franklin Circuit Court interpreted this statute to be "far broader and more inclusive than the federal act." Adams v. Sharp, 2012 Ky. App. Unpub. LEXIS 1058, 37 (Ky. Ct. App. May 25, 2012).

[31] *Id.*

[32] KRS 224.16-050(4) *(emphasis added).*

protections than the federal statute, Kentucky courts default to the less stringent provisions of KRS 224.16-050(4), effectively limiting Kentucky's jurisdiction over its own waters to the federal statute. This is an ironic position, especially in light of the state's dedication of time and resources to overturning federal environmental statutes, rules, and policies.

In a more recent case, *Commonwealth of Kentucky, Energy and Environment Cabinet v. Kentucky Waterways Alliance et al*.,[33] the Kentucky Supreme Court reversed a decision of the Kentucky Court of Appeals requiring more stringent water pollution limits for facilities that discharge in Kentucky waters. In this case, the body of water at issue was the Ohio River, a drinking water source for over five million people.[34] The Supreme Court held it was reasonable for Kentucky's Energy and Environment Cabinet to not require the permit applicant (Louisville Gas & Electric) to filter harmful contaminants, such as mercury, arsenic and selenium, from its discharges into the Ohio River.[35]

These judicial decisions are not surprising. While the judiciary often expresses a notion that judges are not influenced by non-legal factors, many also express a contrary view that non-legal factors, such as their own value preferences or their sense of changing values in society, often do affect judicial decision making.[36] Professor Cannon notes, "decades of empirical studies confirm that a judge's ideologies or values preferences can make and often do make a difference in how he or she decides cases."[37] In analyzing hundreds of environmental U.S. Supreme Court cases, Cannon developed an interpretive guide based on how the environment is valued by different influencers in society. This provides critical insight to how courts, in this case the U.S. Supreme Court, values environmental issues. This also provides an opportunity to review how environmental ethics are used to determine those values

[33] Nos. 2015-SC-000461 (Ky. Apr. 27, 2017), *see also* Commonwealth of Kentucky, Energy and Environment Cabinet v. Kentucky Waterways Alliance *et al*., 2015-SC-000462 (Ky. Apr. 27, 2017).
[34] James Bruggers, *Environmentalists Lose in Kentucky Supreme Court on LG&E Pollution Permit*, The Courier-Journal (Apr. 27, 2017), www.courier-journal.com/story/tech/science/environment/2017/04/27/environmentalists-lose-kentucky-supreme-court-lg-e-pollution-permit/307083001/.
[35] *Id*.
[36] JONATHAN Z. CANNON, ENVIRONMENT IN THE BALANCE: THE GREEN MOVEMENT AND THE SUPREME COURT, 38 (2015).
[37] *Id*. at 39.

and the ethical considerations the court uses to make decisions. That interpretive guide[38] in diagram form is below:

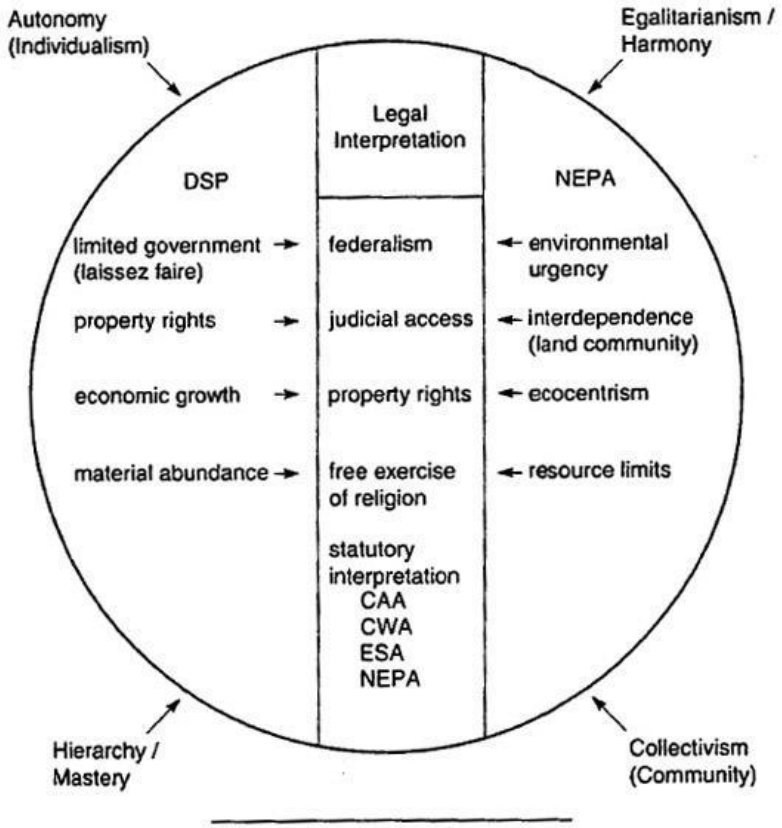

Figure 2.1
Interpretive Guide to the Cases

This diagram shows the competing value and ethical interests and the roles they play in judicial decision making. The New Environmental Paradigm (NEP) encompasses the values associated with environmentalism (egalitarianism, harmony, and collectivism). Environmental urgency, interdependence, ecocentrism, and resource limits are the elements linked to the NEP. On the opposite side are the competing values of the Dominant Social Paradigm (DSP) (autonomy, mastery, and hierarchy) and the elements linked to DSP (limited government, property rights, economic growth, and material abundance). The DSP is not the most popular, but is generally held by

[38] *Id.* at 48.

dominant groups and perpetuated by prevailing institutions, including the Supreme Court.[39]

Cannon also explores decision making in which the rights of the "other"[40] conflicts with human use and benefit.[41] Analyzing *Sierra Club v. Morton*,[42] *Tennessee Valley Authority v. Hill*,[43] and *Lying v. Northwest Indian Cemetery Protective Association,*[44] Cannon demonstrates how competing ethical values and interests such as ecocentrism, religions, and the protection of species without consideration to cost or value to humans compete against each other. In these instances, the Court either dismisses or belittles the ecocentric perspective, and the majority of justices remained oriented to Cost Benefit Analysis (CBA) and human utility.[45] However, Cannon recognizes that aspects of these cases, particularly the dissents, "represent the potential of ecocentric views to enter cultural discourse and practice."[46] These cases, despite their "anthropocentric cast," contribute to the ongoing process of deliberation, which would include the changing environmental ethic.

Why do Kentucky's government officials continue to take Kentucky's water resources for granted? Based on the Governor's newfound admiration for water, this may seem surprising. After all, even from a business perspective, would one not want to protect Kentucky's "commodity of the future?" The answer may lie in how water is valued and understanding those values beyond economic terms like "commodity."

IV. ETHICS AND THE VALUE OF WATER

A. THE EVOLUTION OF ENVIRONMENTAL ETHICS – A HISTORICAL PERSPECTIVE

Ethics "pertain to the tacit rules of behavior and consequences that regulate people's lives, activities, and decision making."[47] Water ethics "reflect importance water plays in people's lives and provide guidance in

[39] *Id.* at 47.
[40] The other being non-human considerations such as the intrinsic value of nature.
[41] *Id.* at 80.
[42] 405 U.S. 727 (1972) (standing).
[43] 437 U.S. 153 (1978) (Endangered Species Act).
[44] 485 U.S. 439 (1988) (eco-religion).
[45] CANNON, *supra* note 35 at 108.
[46] *Id.*
[47] Gabriel Eckstein, *Precious Worthless, or Immeasurable: The Value and Ethic of Water*, 38 Tex. Tech L. Rev. 963, 967 (2006).

decision making related to the use, management, allocation, and protection of freshwater resources."[48] Water is also valued in relation to what a community defines as morally appropriate or correct – in effect, how water should be managed.[49]

The value of water has evolved with the changing ethical and environmental visions throughout the history of the United States. Toward the last half of the 19th century, after centuries of the providential vision to conquer lands West to the Pacific Ocean, where there was a "national mission" to turn "the continent into private property" through labor and settlement,[50] a new ethical vision emerged – the Romantic. Popularized by literary and early conservation icons like Henry David Thoreau, Ralph Waldo Emerson, and John Muir, this vision viewed the most inspiring and beautiful nature as sublime and advocated that such places should be preserved for their own sake. Nature gave "insight into the order of things and one's place in it."[51] Muir in particular raised the level of awareness of the monuments of nature such as the Yosemite Valley and water resources like the Tuolumne River. He called on government and citizens to preserve these resources. The Romantics worked to ensure that American law drove the massive reservations of public land for recreation and preservation.[52]

As western expansion was completed at the end of the 19th century, ethical perspectives over wilderness, nature, and natural resources began to change. Seeing that the seemingly infinite expansion west was now finite, including the natural resources those lands possessed, the federal government began to be concerned with natural resource management and use. The government also became concerned with the loss of wilderness, especially "sublime" wilderness, and instituted the first of many public parks and preserves. The ethical considerations in finding a balance between natural resource use and extraction and the preservation of lands were the beginning of the modern environmental laws we have today.

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[48] *Id.*

[49] *Id.*

[50] After Nature gives a detailed historical perspective into what Purdy calls the "four pictures of the natural world:" the Providential, the Romantic, the Utilitarian, and the Ecological. JEDIDIAH PURDY, AFTER NATURE, 23-24 (2015) [hereinafter AFTER NATURE].

[51] *Id.* at 888.

[52] *Id.* at 889.

One of the first environmental legal and ethical tests that garnered national prominence involved the Hetch Hetchy Valley in Yosemite National Park in 1913. Gifford Pinchot, the first head of the U.S. Forest Service and founder of the Yale School of Forestry, called for the damming of the Tuolomne River in Hetch Hetchy Valley to supply San Francisco with water a hydroelectric power. John Muir, the founder of the Sierra Club and consummate preservationist, opposed the dam as a wasteful destruction of the "sublime" Hetch Hetchy Valley. Although the preservationists lost and the dam was built, the battle to protect the Hetch Hetchy laid the groundwork for future challenges against unwanted government management of natural resources.

From the time of the Hetch Hetchy Valley controversy to the 1950s, came an explosion in conservation groups and membership. This led to the first major victory for preservation in 1954, when preservationists mounted opposition to the construction of a dam in Echo Park, Utah, that would destroy parts of the Dinosaur National Monument.[53] As a result of efforts to oppose the dam, the dam supporters eventually gave up after a compromise was reached to build a dam on other unprotected lands.[54]

As the conservation movement began to make strides, industrialization and the "green revolution was wreaking havoc on the nation's waterbodies. In addition to the pollution from industrial factories and processes, innovation in the first half of the 20th century led to the proliferation of synthetic fertilizers, pesticides, plastics, radioactive compounds, and other pollutants across the country. In places like Louisville, public sewage and water systems became a necessity, and local ordinances to limit the burning of coal to heat homes and transition to natural gas instead were passed and enforced. Many of these issues came to a head when *Silent Spring*[55] was published in 1962. Written by Rachel Carson, *Silent Spring* documented the public health and environmental impacts of the pesticide DDT. This resulted in a media and political frenzy, including Congressional studies and investigations on DDT and other pollutants. This led to the first Earth Day in April of 1970, where over 20 million people marched in support of a clean and healthy environment.[56]

[53] John D. Leshy, *Legal Wilderness: Its Past and Some Speculations on Its Future*, 44 Envtl. L. 549, 562 (2014).
[54] *Id.*
[55] *See generally* RACHEL CARSON, SILENT SPRING (1962).
[56] CAROLYN MERCHANT, AMERICAN ENVIRONMENTAL HISTORY, 199 (2007).

Congressional action followed suit. The 1960s and 1970s saw passage of landmark laws to protect water resources such as the Wilderness Act of 1964 (identifies and protects wilderness areas on public lands),[57] the National Wild and Scenic Rivers System (preserving rivers with outstanding natural, cultural, and recreational values),[58] the Clean Water Act,[59] Safe Drinking Water Act,[60] the Resource Conservation and Recovery Act,[61] and the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund),[62] among others.

In passing these laws, Congress took an ecological position, the likes of which we have not seen since. Senator Muskie of Maine, one of the strongest environmentalists in the Senate when the Clean Water Act was passed, called the Clean Water Act a "decision to recognize fundamental principles of ecology."[63] Likewise, Senator John Sherman Cooper of Kentucky stated that the Clean Water Act "asserts the primacy of the natural order, on which all, including man, depends."[64] Senator Cooper went on to assert the "'underlying theme' of the Clean Water Act was to 'rely on the natural order.'"[65] In restoring the "natural order," Senator Muskie announced that "streams and rivers are no longer to be considered part of the waste treatment process," and "the use of any river, lake, stream, or ocean as waste treatment system is unacceptable. In other words, no one has the right to pollute."[66] The nation was now fully within what Jedediah Purdy[67] describes as an ecological vision, "an ecological view of the world as being formed of complex and interpenetrating systems, in which both sustenance and poison may travel through air. Water, and soil, and in and out of flesh, as each thing becomes something else."[68] For a short period of time, these were the new values of an emerging ecological politic, but those values soon waned.

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[57] 16 U.S.C. §§ 1131-1136 (1964).
[58] 16 U.S.C. §§ 1271-1287 (1968).
[59] 33 U.S.C. §§ 1251-1388 (1972) (amended 1977, 1987).
[60] 42 U.S.C. §§ 300f-j (1974) (amended 1986, 1996).
[61] 42 U.S.C. §§ 6901-6908(a) (1976) (amended 1979, 1984).
[62] 42 U.S.C. §§ 9601-9628 (1980).
[63] AFTER NATURE, *supra* note 49 at 211.
[64] *Id.*
[65] *Id.*
[66] *Id.* at 213-14.
[67] Purdy, a Duke law professor and environmental law scholar has written extensively on the politics of nature and the environment. *See*, for example, A□TER NATURE, *supra*.
[68] AFTER NATURE, *supra* note 49 at 8.

After the proliferation of environmental laws and regulations in the 1970s, the victors of progressive environmental regulation witnessed a sea change in the early 1980s. Environmental laws and the enforcement of those laws were scaled back. Technocrats and politicians started relying more on biased and outmoded versions of the CBA, its utilitarian application, and other methodologies that fail to incorporate a more complete view of the values, morals, and ethics of a particular issue and the populations that are impacted by them. Political partisanship had led to no significant development or improvement of environmental laws in almost three decades when the 1996 Safe Drinking Water Act was amended.[69] That Congressional inaction has led to unneeded destruction and contamination of water resources.[70]

These historical and ethical perspectives, and how those perspectives have changed over time, help to characterize the value of water in light of the Governor's proclamation that water is the "commodity of the future." Should we view water from a preservation perspective and seek to protect it for water's intrinsic value, which should be "priceless or even incalculable,"[71] or should we take a conservation approach and conserve water for the benefit of humans? If we opt for the latter approach, we must determine whether conservation should be for existing humans or whether we should also consider future generations. Further, if we go beyond a purely preservation and intrinsic perspective, then how do we place an economic value on water, and what ecological, social, and societal values do we consider? "For some, water is an integral component of the natural environment; for others, it is a property right and a commodity that is subject to the free market; still others regard water as a heritage of cultural, religious, and societal significance."[72]

B. VALUING WATER AS A BASIC HUMAN RIGHT

Before Kentucky begins to outsource its water supply to other states, regions, and countries as a commodity, it must ensure that its own citizens have access to clean water for domestic use. Access to clean water should be a basic human right a government affords its citizens.[73]

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[69] SALZMAN & THOMPSON, *supra* note 22 at 15.
[70] Again, in light of Congressional inaction, the Obama Administration and the U.S. EPA took regulatory action to clarify what water resources could be harmed by mining, and what waters of the U.S. were covered under the Clean Water Act. KGS *et al.*, *supra* note 26, 27.
[71] Eckstein, *supra* note 46 at 967.
[72] *Id.*
[73] *Id.* at 963.

Americans level of concern for water pollution is at its highest since 2001.[74] Streams, lakes, and reservoirs have provided a source of water for about 2,870,000 Kentuckians, and wells, springs, mines, cisterns, and other sources provided water sources for the remaining one million residents.[75] More than 450 million gallons of treated water is produced each day by public water systems, about 90 percent is from surface-water sources, and 10 percent from groundwater sources.[76] According to the Kentucky Water Resource Development Commission, "[p]roviding safe drinking water has been the single most significant improvement in the protection of the health of Kentucky's citizens in this century."[77]

In 1999, only 85 percent of the Commonwealth's residents received water from public drinking-water systems.[78] Of the remainder, about 420,000 (11 percent of the total population) used private domestic wells, and 175,000 (4 percent) relied on cisterns, hauled water, or other sources.[79] To address this problem, former Kentucky Governor Paul Patton's Executive Order 96-1339 directed the Water Resource Development Commission (WRDC) to prepare a strategic plan for water-resource development in Kentucky.[80] The goal of the plan is to provide the best available water and sewer service to every Kentuckian by the year 2020.[81] As of 2015, more than 95 percent of Kentuckians now have access to serviceable water, a direct result of the water resource development plan.[82] Kentucky has made strides to provide clean drinking water to its citizens, and is slated to continue improving access.

Despite improvement in water service, Kentucky remains wasteful regarding how it distributes water to its citizens. Water loss is

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[74] Justin McCarthy, *In US, Water Pollution Worries Highest Since 2001*, GALLUP (March 31, 2017), http://www.gallup.com/poll/207536/water-pollution-worries-highest-2001.aspx.
In the Gallup Poll taken March 1-5, 2017, the percentage of Americans who are worried "a great deal" about the pollution of drinking water is 63% and of rivers, lakes and reservoirs is 57%, the highest levels since 2001. *Id*.

[75] Kentucky Water Resource Development Commission, *Water-Resource Development: A Strategic Plan*, Kentucky Infrastructure Authority, 13 (Oct. 1999), http://kia.ky.gov/nr/rdonlyres/45387bda-b7f2-4cff-8df5-c129844ba678/0/wrdcplan.pdf.

[76] *Id.*

[77] *Id.* at 18.

[78] *Id*. at 12.

[79] *Id.*

[80] *Id*. at 9.

[81] *Id*.

[82] Kentucky Infrastructure Authority, *Kentucky Water Management Plan*, 12 (Feb. 2015), http://wris.ky.gov/downloads/wmp/2015_WMP_Executive_Summary_Final.pdf [hereinafter KIA].

also a concern Kentucky. Much of the drinking water infrastructure in the United States, including Kentucky, has been in service for decades and can be a significant source of water loss through leaks, unauthorized consumption (theft), administrative errors, data handling errors, and metering inaccuracies or failure.[83] The Environmental Protection Act (EPA) estimates the average water loss in the U.S. to be 15 percent per month.[84] However, at least one county in Kentucky, Martin County, has recently been under investigation by the Kentucky Public Service Commission (PSC) in recent years for water loss rates greater than 60 percent.[85] Other reports indicate that some water districts have a reported water loss of over 90 percent.[86] While Kentucky's Division of Water and Public Service Commission have begun to address these water loss issues, they will require substantial funds and resources to correct and control. The inefficiencies of Kentucky's water systems reinforce the notion that water, as a resource, is not properly valued.

C. VALUING WATER AS AN ECOSYSTEM SERVICE

John Grim and Mary Evelyn Tucker are Senior Lecturers and Research Scholars at Yale University and the founders of the Forum of Religion and Ecology at Yale. In their book, *Ecology and Religion*, they explore, among other issues, the intrinsic values of nature, and how religions interpret and apply those values.[87] Pertinent to the issue of water, and the value of water, Grim and Tucker described an experience they had studying the historical relationship between the Yamuna River in India and the people who use and worship it. The Yamuna River is considered a "living goddess," yet it is extremely contaminated.[88] Grim and Tucker describe it as a "vibrant example of the confluence of religion and ecology that joined together the natural and the sacred. But now it is a dying river."[89] Curiously, religious leaders are having difficulty reconciling the contamination with the sanctity of the river, "that a goddess can be deified with religious devotion and defiled with

[83] EPA, *Water Audits and Water Loss Control for Public Systems*, 1 (July 2013), https://www.epa.gov/sites/production/files/2015-04/documents/epa816f13002.pdf.
[84] Story Hinckley, *The place in America where (almost) no one drinks their tap water*, Christian Science Monitor (May 18, 2017), https://www.csmonitor.com/USA/Politics/2017/0518/The-place-in-America-where-almost-no-one-drinks-their-tap-water.
[85] *Id.*
[86] KIA, *supra* note 79 at 40, 65, 78, 189.
[87] JOHN GRIM AND MARY EVELYN TUCKER, ECOLOGY AND RELIGION (2014).
[88] *Id.* at 142.
[89] *Id.*

industrial development and waste," and are thus "reluctant to confront the dangers of river pollution."[90] It is a cautionary tale - the same incredulity can be found in viewing water solely as a "commodity." This is assuming that this blind valuation of water – as a commodity – will be a savior to Kentucky's economy, despite continued opposition to regulations and policies designed to protect it.

But, of course, water has other values. "As dynamic and complex systems of interaction between living organisms and non-living environment, 'ecosystems provide basic life support for human and animal populations and are the source of spiritual, aesthetic, and other human experiences that are valued in many ways by many people.'"[91] Water has been essential for the maintenance and operation of Earth's life support system for the past 2.7 billion years.[92] Freshwater ecosystems deliver many services essential to the support of human life and well-being when water is available in both quantity and quality.[93] In Kentucky, these services include domestic use for consumption and waste, agriculture and food production, fisheries and aquaculture, industrial use, pharmaceutical and biotechnology, instream uses such as recreational aesthetics, and include non-material benefits such as cultural, religious and artistic benefits.[94] However, delivering these services that are critical to supporting life, welfare and economic growth, and nature requires a "holistic approach, aligning social and economic development with protection of natural ecosystems."[95] Ecosystem service analysis is an example of monetizing nature,[96] and Kentucky's economy cannot function without water's provision of economic goods and services.[97] Still, there needs to be a "fuller means of valuing nature beyond economics alone" that includes the "intrinsic, aesthetic, and relational value of nature."[98] Viewing water solely as a commodity underestimates the benefits it provides to Kentucky and its citizens by not fully incorporating these other ecosystem services and values.

[90] *Id.*
[91] Keith H. Hirokawa, *Disasters and Ecosystem Services Deprivation: From Cuyahoga to the Deepwater Horizon,* 74 Alb. L. Rev. 543, 550 (2010).
[92] *Id.*
[93] *Id.*
[94] *Id.*
[95] *Id.*
[96] GRIM AND TUCKER, *supra* note 84 at 169.
[97] Hirokawa, *supra* note 86 at 550.
[98] GRIM AND TUCKER, *supra* note 84 at 169.

D. WATER AS A COMMODITY – ENVIRONMENTAL VALUES THROUGH ETHICAL EXPERIENCE

In his article, *Our Place in the World: A New Relationship for Environmental Ethics and Law*,[99] Purdy outlines five themes in the ethical experience that environmental values have engaged: not harming others; the ethics of solidarity; personal ethics; aesthetic response and ethics; and virtue ethics.[100] Evaluating, to the extent practicable the idea of water as a commodity through the lenses of these ethical considerations is valuable to understand the ethical complexities involved in the management of water.

From an environmental value perspective, not harming others focuses on the "suffering of other individuals and species."[101] "Trees, rivers and mountains, species, and ecosystems have all achieved some status as entities that (some) people recoil from harming."[102] Thus, polluting a waterbody could "trigger the deep-seated aversion to causing harm."[103] Viewing water as a commodity reduces water to a product that can be bought or sold. It ignores the many non-economic values outlined above, and could result in the de-personalization of harm that this ethical perspective suggests. Solidarity is "the sense of obligation connected with group membership, including the willingness to make sacrifices to benefit other members and vigilance against betrayal of the group from within."[104] An example of this is the regulation and administration of parks, forests and other natural resources.[105] The reduction of water to a commodity could have a chilling effect on an individual's willingness to make sacrifices to protect it for the benefit of others.

Personal ethics focuses on dignity and authenticity. Historically, dignity was associated with people making productive use of land resources. This would also apply to making productive use of water resources. Authenticity is "being oneself."[106] Here, "the experience of value in nature has been inseparable from the sense that nature puts

[99] Jedediah Purdy, *Our Place in the World: A New Relationship for Environmental Ethics and Law*, 62 Duke L. J. 857 (2013).
[100] *Id*. at 891.
[101] *Id*. at 894.
[102] *Id*.
[103] *Id*.
[104] *Id*.
[105] *Id*. at 895.
[106] *Id*. at 896.

one in touch with a clearer experience of oneself..."[107] Separating water from non-economic values would not result in an authentic effect of being oneself. The commodification of water is a detachment from nature.

Aesthetic response speaks to "the value of nature, and the human relation to it."[108] Like authenticity, a detachment from nature would make it difficult for one to experience an aesthetic response. Environmental Virtue ethics emphasize virtues, or moral character, and how we should rightly live with nature. From this viewpoint, a virtuous person would not likely value water from a purely economic perspective because of the detachment from ecological values and systems.

While not definitive, this analysis shows the difficulty in justifying the commodification of water through the lens of environmental ethics. Water is more than a commodity, and limiting it as such leaves behind values imperative to the holistic valuation of water as a resource for humans and the environment. This was a common view of our legislators and government officials when many of our most important environmental laws, such as the Clean Water Act, were passed in the early 1970's, including legislators in Kentucky.[109] It is time for our government leaders to take a step back and once again govern holistically, regulating through a diversity of values, rather than through the myopic lens of commodity.

V. CONCLUSION

There is some truth to the Governor's statement designating water as the commodity of the future in Kentucky. Water is now viewed as much as a commodity as a public good.[110] Most people purchase their drinking water from a municipal water utility, and beverage companies have grossed billions of dollars in the bottling of water throughout the world. Our conception of how water should be understood and managed will continue to change over time.[111]

Yet, water provides essential ecological services, holds cultural, religious, and social significance, and is imperative to the health and

[107] *Id.*
[108] *Id.*
[109] *See* fn. 63-68, *supra.*
[110] JAMES SALZMAN, DRINKING WATER: A HISTORY, 23 (2012).
[111] *Id.*

well-being of people and the environment. Despite these important qualities, Kentucky officials continue to fight against regulations and policy that protect water resources. That is wrong. From an ethical and values based perspective, Kentucky officials should embrace the protection of water to the fullest extent of the law and beyond for the future of the Commonwealth and its citizens. Like coal, water is a finite resource. We should protect water while we still have it.

IF CAFOS ARE POINT SOURCES, WHAT WENT WRONG?

Hank Graddy

Agriculture has changed dramatically over the past fifty years. This period includes the enactment of the Clean Water Act in 1972 and the publication of the seminal *Unsettling of America,* by Wendell Berry in 1977.[1] The legislative history of the Clean Water Act (set forth below) anticipated the changes. These changes were already having devastating impacts on rural America as Berry lamented in 1977 and has consistently lamented to the present.[2] For the purpose of this article, I will summarize these changes as the shift from an agrarian agriculture to an industrial agriculture.

The change to industrial agriculture has caused wide-ranging adverse impacts including the destruction of the local economies and the emptying of rural communities, the inhumane treatment of livestock and poultry, the rise of antibiotic-resistant bacteria associated with the overuse of antibiotics in concentrated animal feeding operations (hereinafter CAFOs) and the epidemic of obesity caused by an unhealthy diet.[3]

The adverse environmental impacts include "dead zones" – areas without dissolved oxygen necessary to sustain aquatic life (hypoxic) in most of our bays and estuaries with an upstream industrial agricultural economy.[4]

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[1] Berry, Wendell, *The Unsettling of America: Culture and Agriculture* (Sierra Club Books, 1977).

[2] *Id*; Chapter 5, "Living in the Future: The "Modern" Agricultural Ideal."; Berry, Wendell, *Our Only World* (Counterpoint, 2015), including Chapter 8, "Our Deserted Country" and Chapter 9, "For the 50-Year Farm Bill."; *The Essential Agrarian Reader* (Norman Wirzba, Ed., The University Press of Kentucky, 2003) Wendell Berry, Chapter 1, "The Agrarian Standard."

[3] Eubanks, William S. II, *A Rotten System: Subsidizing Environmental Degradation and Poor Public Health Wins Our Nation's Tax Dollars,* 28 Stan. Envtl. L. J. 213 (2009).

[4]US Environmental Protection Agency, Mississippi River Hypoxia Task Force, Hypoxia 101 (accessed at https://www.epa.gov/ms-htf/hypoxia-101); US Environmental Protection Agency, 2013 Reassessment of the 2008 Action Plan, pages 43-47 (accessed at https://www.epa.gov/sites/production/files/2015-03/documents/hypoxia_reassessment_508.pdf); US EPA Science Advisory Board 2007 Update on Hypoxia in the Northern Gulf of Mexico, pages 85-88, page 111, and pages 168-173, (accessed at:

They include harmful algae blooms (HABs) in United States lakes, causing loss of drinking water supplies in places like Toledo Ohio, and the unprecedented seven-hundred-mile blue-green algae outbreak in the Ohio River in 2015.[5]

And they include the unreported toxic air emissions of ammonia and hydrogen sulfide and other waste product air emissions along with nuisance odors. Public health associations have called for a precautionary moratorium on CAFOS.[6]

The distinction between the adverse environmental impacts and the other negative impacts is that the adverse environmental impacts were preventable – they were and are against the law, as will be discussed below.

The failure of the Clean Water Act and the Clean Air Act and the other landmark federal environmental protection laws to prevent water and air pollution from industrial agriculture cannot be excused on the grounds that Congress could not have foreseen these problems – Congress did foresee these problems and acted to prevent them as set forth herein. What went wrong?

In this article, I will examine the language and legislative history of the Clean Water Act to show that Congress sought to regulate CAFOS to prevent water pollution. I will examine federal and state requirements intended to prevent CAFOs from causing odors and nuisance conditions. I will review what went wrong by following the permitting process for nine proposed swine barns in Western Kentucky and my own subsequent tort litigation that involved the same type of

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https://yosemite.epa.gov/sab/sabproduct.nsf/C3D2F27094E03F90852573B800601D93/$File/EPA-SAB-08-003complete.unsigned.pdf).

[5]Draft ORSANCO Harmful Algae Bloom Monitoring, Response and Communication Plan, June 2016 (accessed at http://www.orsanco.org/wp-content/uploads/2017/03/HAB-Monitoring-and-Response.pdf).

[6]The American Public Health Association, *Precautionary Moratorium on New Concentrated Animal Feed Operations* (2003), policy number 20037 (accessed at https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/24/11/17/precautionary-moratorium-on-new-concentrated-animal-feed-operations); National Association of Local Boards of Health, *Understanding Concentrated Animal Feeding Operations and Their Impacts on Communities* (2010) (accessed **at:** https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf).

swine and swine barns[7]. I was counsel for Western Kentucky residents who lived within a mile and a quarter of these Tosh Farms Standard Hog Barns in two types of litigation: an administrative appeal of the Kentucky No Discharge Operating Permits (KNDOPs), and a tort action against the hog farmers and their related business entities. I share my cautionary tale that has taught me the following lessons:

1. Despite a clear legislative intent in 1972, the environmental protection laws and regulations in Kentucky have not protected people from industrial agricultural pollution.
2. If victims of uncontrolled industrial agriculture pollution try to use tort remedies, (the remedies that were available but inadequate before the passage of the above-referenced federal environmental protection legislation) they will likely encounter the same inadequate protection that preceded passage.
3. Thus, advocates and victims in Kentucky, alike, must remain patient and persistent in the pursuit of the full and effective implementation of the Clean Water Act and other environmental protections requirements, knowing that this progress will depend upon citizen action.

1. AGRICULTURE IN KENTUCKY IS CHANGING, BUT REMAINS UNIQUE.

The national changes in agriculture that Senator Robert Dole and Wendell Berry recognized in the 1970s have taken place in Kentucky, about 20 years later, supporting the end-of-the-world observation attributed to Mark Twain.[8]

However, I believe these changes are different when compared to the grain belt in the Midwest, the older poultry and swine CAFOs in the Mid-Atlantic and Missouri and Iowa, the feedlots in the Great Plains, and the dairies in the West.

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[7] The swine barns discussed herein are "Tosh Farms Standard Hog Barn." The swine barn houses and "finishes" up to 2,490 swine and most swine farms have two barns. The slatted floor allows manure and urine to collect in an eight (8) foot concrete "deep pit" under the barn. Annually, one swine barn would produce 1.78 million gallons of liquid manure, urine and other swine waste. KNDOP Permit Application, 2006.

[8] *"I want to be in Kentucky when the end of the world comes, because they are always 20 years behind.*" Widely attributed to Mark Twain, but without any proof. *See:* https://en.wikiquote.org/wiki/Talk:Mark_Twain#End_of_the_world.3F.

These changes are evidenced in the United States Department of Agriculture (USDA) agricultural census statistics, at:

TOTAL AGRICULTURAL PRODUCTS SOLD
In 1982, the market value of all crops sold in Kentucky was $1.358 billion and the market value of all livestock (excluding equine) sold was $1.018 billion.
In 2012 (the last census), the market value for all crops was $2.280 billion and the market value for all livestock (excluding equine) was $2.786 billion, down from $3.4 billion in 2007.

CATTLE INVENTORY
In 1982, there were 60,183 farms in Kentucky with a cow/calf inventory of 2,524,964 head. In 2012, there were 40,141 farms in Kentucky with a cow/calf inventory of 2,270,871 head.

SWINE INVENTORY
In 1982 there were 11,436 farms in Kentucky with a swine inventory of 869,727 head. In 2012 there were 1,284 farms in Kentucky with a swine inventory of 313,360 head.

POULTRY SOLD
Poultry inventory data is not available before the 1997 census. In 1982, there were 99 farms in Kentucky that sold 2.4 million broilers or other meat chicken. By 2012, there were 826 farms in Kentucky that sold an estimated 305.3 million broilers or other meat chicken.

CORN PRODUCED
In 1982, there were 31,301 farms in Kentucky that raised 1.342 million acres of grain corn, producing 131.668 million bushels.
In 2012, there were 8,899 farms in Kentucky that raised 1.530 million acres of grain corn, producing 104.894 million bushels

TOBACCO
In 1982, there were 74,166 farms in Kentucky that raised 256,619 acres of tobacco, producing 538.759 million pounds. In 2012, there were 4,537 farms in Kentucky that

raised 87,931 acres of tobacco, producing 183.904 million pounds.

EQUINE VALUE
Data on horses including Thoroughbreds is not included in the USDA Census but is found within the USDA data base for Kentucky. The Kentucky Equine Report includes the following survey data:
The Equine Total of 242,400 horses in 2012 is estimated to have a total value (including land value) of $6.292 billion dollars.[9]

The above statistics support the following general observations: Beef Cattle and Grain Corn have been stable agricultural products in Kentucky over the 30-year period from 1982 through 2012. Tobacco has collapsed with the end of the USDA Tobacco Program.[10] Poultry has exploded and the explosion has been in concentrated animal feeding operations - CAFOs.[11] Swine has declined as a statewide agricultural product, but the smaller numbers of swine are much more concentrated on a much smaller number of farms - also CAFOs.[12]

This data is important to make the point that it is not too late to return to less intensive and more agrarian farming model. Kentucky agriculture is not completely captured by the industrial agriculture model. There is an opportunity for a better agricultural model, with greater emphasis on pasture and reduced emphasis on corn.[13]

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[9] *Table 1. Historical Highlights: 2012 and Earlier Census Years,* USDA National Agricultural Statistics Service (2012) (accessed at https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Kentucky/st21_1_001_001.pdf).
[10] Patton, Janet, *With the End of Tobacco Buyout Checks Looming, Kentucky Farmers have had to Make Changes,* Kentucky Herald Leader (28 Sept 2014) (accessed at http://www.kentucky.com/news/business/article44512536.html).
[11] *Table 1. Historical Highlights: 2012 and Earlier Census Years,* USDA National Agricultural Statistics Service (2012) (accessed at https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Kentucky/st21_1_001_001.pdf).
[12] *Id.*
[13] Berry, Wendell, *Our Only World* (Counterpoint, 2015), including Chapter 8, "Our Deserted Country" and Chapter 9, "For the 50-Year Farm Bill." Page 165, "XVIII – And so one of the most important results of the perennialization of agriculture would be the movement of farm animals out of the wretched confinement factories where they don't, and can never, belong, back onto the pastures and into the open air where they do belong."

Part of this opportunity will require holding industrial agriculture fully accountable for its environmental costs.

2. INADEQUATE COMMON LAW REMEDIES WERE A REASON FOR ENACTING THE LANDMARK FEDERAL ENVIRONMENTAL PROTECTION ACTS IN THE 1970S.

The Clean Water Act (CWA), 33 U.S.C. § 1251 (2017) and Clean Air Act (CAA), 42 U.S.C.A. § 7400 and the Resource Conservation and Recovery Act (RCRA) 42 U.S.C.A. § 6901 and the other major federal laws were enacted during the 1970s. One of the reasons they were enacted was because common law remedies for pollution were inadequate. This inadequacy was compounded by state level environmental protection statutes that were wildly inconsistent and invited a "race to the bottom" among legislators trying to lure businesses into their states or local government to their county.[14] [15] I believe other weaknesses of common law remedy include:

1. Inconsistent results;
2. Exacerbated environmental injustice;
3. Difficulty of proof of causation where multiple contributors; and
4. Focus on "reasonable man" and "ordinary health" and "ordinary sensibilities" limited remedy for those most

[14] A "race to the bottom" is "a situation characterized by a progressive lowering or deterioration of standards especially as the result of pressure of competition." Google Dictionary "race to (or for) the bottom", (accessed at https://www.google.com/search?q=race+to+the+bottom&oq=race+to+the+bottom&aqs=chrome..69i57j0l5.3370j0j4&sourceid=chrome&ie=UTF-8).

[15] The Kentucky General Assembly has already codified a version of the "race to the bottom" at KRS 224.16-050(4), that provides:

> The cabinet shall not impose under any permit issued pursuant to this section any effluent limitation, monitoring requirement, or other condition which is more stringent than the effluent limitation, monitoring requirement, or other condition which would have been applicable under federal regulation if the permit were issued by the federal government.

This statute strips agencies of the Commonwealth of their discretion to impose stricter limits when faced with the unique facts of every permitting application.

> sensitive and most in need of protection – youth, elderly impaired immune systems.[16]

Importantly, the recognition that common law tort remedies were not adequate was shared by Democrats and Republicans. See legislative history below. The unfairness of "inconsistent results" cuts both ways.

Similarly, a system that depended upon each municipality or county enacting local nuisance ordinances or that depended on each state enacting statewide water quality or air quality standards meant that a business that might be operating legally in one county could be found to be operating illegally when it crossed the county or state boundary.

These general observations about the weaknesses of the common law remedies, as well as inconsistent and often ineffective state statutes to address environmental protection, were recognized to apply to agriculture operations – at least those agriculture operations that were more like an industrial operation than a farm by many, including Senator Robert Dole.

3. THE CLEAN WATER ACT AND THE RESOURCE CONSERVATION AND RECOVERY ACT HAVE WORKED TO REDUCE INDUSTRIAL AGRICULTURAL POLLUTION, AT LEAST IN WASHINGTON STATE.

The Republican Senator from Kansas, Robert Dole testified in 1972 in support of the Clean Water Act, as follows:

> **Animal and poultry waste, until recent years, has not been considered a major pollutant.... The picture has changed dramatically, however, as development of intensive livestock and poultry production on feedlots and in modern buildings has created massive concentrations of manure in small areas. The recycling capacity of the soil and plant cover has been surpassed.**

[16] *See*: Hribar, Carrie, MA, *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities*, (National Association of Local Boards of Health 2010) (accessed at www.cdc.gov/nceh/ehs/docs/understanding_cafos_Nalboh.pdf)

> ....
>
> **The present situation and the outlook for future developments in livestock and poultry production show that waste management systems are required to prevent waste generated in concentrated production areas from causing serious harm to surface and ground waters.**[17]

Judge Edward F. Shea, United States District Court Judge for the Eastern District of Washington, after quoting Senator Dole, expanded on the changes in agriculture and legislative attempts to regulate these industrial farming operations.

> In the years following Senator Dole's remarks, the number of dairies adopting intensive confinement procedures for the production of milk increased. One article observed, "the character of livestock production in many parts of the world, however, is changing rapidly and dramatically. Economies of scale, specialization, and regional concentration in all major livestock production sectors have fueled a trend toward fewer, larger operations that confine thousands of animals on limited acreage." Larry C. Frarey and Staci J. Pratt, *Environmental Regulation of Livestock Production Operations*, 9 NAT. RESOURCES & ENV'T. 8, 8 (1995); see also U.S. General Accounting Office Pub. No. GAO/RCED-95-200BR, Animal Agriculture: Information on Waste Management and Water Quality Issues 60 (1995).
>
> In 1977, the Senate Committee on Environment and Public Works in Senate Report 95-370, discussed a variety of amendments to the 1972 legislation. See S. REP. No. 95-370 (1977), reprinted in 1977 U.S.C.C.A.N. 4326. These ultimately became the Clean Water Act of 1977. As enacted, the CWA contained an exemption for permit requirements for discharges composed entirely of return flows from irrigated agriculture. See 33 U.S.C. § 1362(14).

[17] Testimony of Sen. Robert Dole as part of the legislative history (S. REP. No. 92-414, at 100 (1972), reprinted in 1972 U.S.C.C.A.N. 3668, 3761. of the Clean Water Act as set forth in the case of *CARE v Henry Bosma Dairy*, 65 F.Supp.2d 1129, 1135-6 (E.D. Wa. 1999)

> No permit was required under the NPDES IF discharges were composed *ENTIRELY* of return flow from irrigated agriculture. See 33 U.S.C. § 1342(1)(1) (*emphasis added*).
>
> In 1995, there was an effort in the House of Representatives to amend the Clean Water Act by adding to Section 319 the following: "(Q) AGRICULTURAL INPUTS. - FOR THE PURPOSES OF THIS ACT, ANY LAND APPLICATION OF AGRICULTURAL INPUTS, INCLUDING LIVESTOCK MANURE, SHALL NOT BE CONSIDERED A POINT SOURCE AND SHALL BE SUBJECT TO ENFORCEMENT ONLY UNDER THIS SECTION" (as a non-point source). See H.R. 961, 104th 12 Cong. (1995) (unenacted) (parenthetical added). The 104th Congress took no action on House Bill 961. Had this amendment passed, land application of manure would have been regulated as a non-point source in 33 U.S.C. § 1329. Though the CWA has been amended since its enactment in 1972, Congress' goal remains the same--to eliminate the discharge of pollutants into the navigable water so the United States. See 33 U.S.C. § 1251.

CARE v Henry Bosma Dairy, 65 F.Supp.2d 1129, 1135-6 (E.D. Wa. 1999) (emphasis added).[18] The 9th Circuit Court of Appeals affirmed the decision on appeal. *Cmty. Ass'n for Restoration of the Env't [CARE I] v. Henry Bosma Dairy,* 305 F.3d 943, (9th Cir. 2002). *See also*: *Cmty. Ass'n for Restoration of the Env't [CARE II] v. Cow Palace, LLC*, 80 F. Supp. 3d 1180 (E.D Wash. 2015), where C.A.R.E. challenged the manure management practices of the dairy as a violation of RCRA where the manure management constituted open dumping of solid waste that posed an imminent and substantial danger to public health and the environment.

[18] A point source is defined as any "discernable, confined and discrete conveyance" of pollution. 33 U.S.C. § 1362(14). A non-point source does not come from any identifiable source but runs into waterways from a variety of locations. Brehm, Susan M., *From Red Barn to Facility: Changing Environmental Liability to Fit the Changing Structure of Livestock Production*, 93 Cal. L. Rev. 797, 824 (May, 2005).

4. LESSON ONE: IF CAFOS ARE POINT SOURCES, WHAT WENT WRONG: WE TRIED TO BRING THE LAW OF *CARE I AND HENRY BOSMA* TO KENTUCKY BUT WE GOT THE WORST OF *WATERKEEPER* 2005

I will now discuss my experience seeking to apply the Clean Water Act to swine CAFOs in the administrative appeal of the permits for nine swine farms in Western Kentucky. While reading, remember that this is my recollection of events and occurrences and I do not cite to the case all of the time.

The first threat of industrial swine farms coming into Kentucky began in 1997. The Governor enacted emergency administrative regulations that would have helped insure compliance with the Clean Water Act. The Kentucky Farm Bureau and swine and poultry producers challenged the regulations. See *Kentucky Farm Bureau Federation et al., v. Commonwealth of Kentucky, Natural Resources and Environmental Protection Cabinet*, Franklin Circuit Court, Civil Action 00-CI-00706.

Affected county attorneys sought an opinion from the Attorney General concerning local ordinances to regulate industrial swine facilities and received this:

> Nor do we believe that such operations are, in this state, accepted and customary. We have observed a high level of community opposition to these massive hog operations. Already one altercation has resulted in bloodshed. The dispute is not between farmers and suburbanites; many farmers are as much opposed to industrial-scale hog operations as other residents. A recent news article quoted one farmer as saying, "People are packing guns. It's got everybody tensed up."
>
> Subsection 1 of KRS 413.072 states, "It is the purpose of this section to reduce the loss to the state of its agricultural and silvicultural resources . . . ." The placement on a former strip mine of an industrial-scale hog operation with its obligatory lagoon does not qualify in our view as an agricultural resource. It is rather an industrial operation producing industrial waste."

The above reference to an altercation with "bloodshed" and the local ordinances that were enacted following this opinion helped end this earlier threat.[19]

In 2005, the second industrial swine farm invasion began. Jimmy Tosh had established a large-scale swine operation in Tennessee south of Murray, Kentucky. He already had several swine barns in Carlisle, Graves, and Marshall Counties. He announced that he wanted to make a major expansion of operations to Western Kentucky and he assured residents and local officials that he would use newer methods to raise his swine so that residents nearby would not even know that his pigs were there. Nine farm owners in Hickman, Carlisle and Fulton Counties applied for permits to construct the Tosh Farms Standard Hog Barn for about 2,490 pigs each, with manure storage in an eight (8) foot "deep pit" below the swine.[20]

Initially, the Kentucky Division of Water required these nine farm owners to apply for KPDES, Kentucky Pollutant Discharge Elimination System permits, as CAFOs, concentrated animal feeding operations as per the CWA Section 509(14) definition of point source.

> (14) The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, *concentrated animal feeding operation*, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.[21]

[Emphasis added.] The four words emphasized above within the Clean Water Act definition of a point source are the basis for the acronym, "CAFO." Despite this Congressional definition, today in Kentucky and in many other states, most "concentrated animal feeding operations" have managed to escape compliance with the Clean Water Act point source requirements.

[19] See Opinion of the Attn'y Gen., OAG 97-31, 1997 Ky. AG LEXIS 65 (Aug. 21, 1997)
[20] 2006 Permit Application.
[21] 33 U.S.C. § 1362(14).

These draft KPDES permits were withdrawn after the public hearing.[22] In 2006 the nine farmers applied again, but they argued they were exempt from the Clean Water Act based upon *Waterkeeper Alliance v. EPA*, 399 F.3d 486 (2d Cir. 2005). [*Waterkeeper* 2005] The Energy and Environment Cabinet, Division of Water (EEC, DOW) agreed and issued Kentucky No Discharge Operating Permits (KNDOP).[23] Initially over 60 residents of Hickman, Fulton and Carlisle Counties challenged these nine KNDOPs.[24]

Significant features of these KNDOP permits included the following:

1. Jimmy Tosh, as the owner of the swine, was not required to sign the permit application or be bound by permit conditions – meaning no "integrator liability."[25]

2. The permits required the swine barns to be setback from another person's residence, or church, schools or business a distance of 1,500 feet.[26]

3. The permits did not require a setback from the property line.[27]

4. The permits required the following compliance with the Kentucky ambient air quality standard for odors at 401 KAR 53:010, Appendix A:

> Section 1. Ambient Air Quality Standards. The primary and secondary ambient air quality standards for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, lead, hydrogen sulfide, gaseous fluorides, total

[22] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI-1413, Opinion and Order of Judge Phillip Shepherd, November 16, 2009 at 4.
[23] *Id.* at 4, 10.
[24] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI_1415, Complaint and Appeal filed in Franklin County Circuit Court on September 5, 2007 (accessed at www.kyrc.org/webnewspro/118931213737164.shtml).
[25] *Id.* at 4.
[26] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI_1415, Complaint and Appeal filed in Franklin County Circuit Court on September 5, 2007 (accessed at www.kyrc.org/webnewspro/118931213737164.shtml).
[27] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI_1415, Complaint and Appeal filed in Franklin County Circuit Court on September 5, 2007 (accessed at www.kyrc.org/webnewspro/118931213737164.shtml).

fluorides, and odors are specified in Appendix A of this administrative regulation. Measurements shall be made by methods and frequency specified in Section 2 of this administrative regulation.

Odors. A mixture of one (1) volume of ambient air and seven (7) volumes of odorless air shall have no detectable odor at any time.[28]

5. The permits did not require compliance with the Kentucky Air Toxics regulation at 401 Ky. Admin. Regs. 63:020 which states:[29]

401 KAR 63:020. Potentially hazardous matter or toxic substances.

RELATES TO: KRS Chapter 224
STATUTORY AUTHORITY: KRS 224.10-100
NECESSITY, FUNCTION, AND CONFORMITY: KRS 224.10-100 requires the Natural Resources and Environmental Protection Cabinet to prescribe administrative regulations for the prevention, abatement, and control of air pollution. This administrative regulation provides for the control of emissions of potentially hazardous matter and toxic substances.

Section 1. Applicability. The provisions of this administrative regulation are applicable to each affected facility which emits or may emit potentially hazardous matter or toxic substances as defined in Section 2 of this administrative regulation, provided such emissions are not elsewhere subject to the provisions of the administrative regulations of the Division for Air Quality.

[28] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI-1413, Opinion and Order of Judge Phillip Shepherd, November 16, 2009 at 4.
[29] *Id.* at 5.

> Section 2. Definitions. Terms used in this administrative regulation not defined herein shall have the meaning given to them in 401 KAR 50:010.
>
> (1) "Classification date" means April 9, 1972.
>
> (2) "Potentially hazardous matter or toxic substances" means matter which may be harmful to the health and welfare of humans, animals, and plants, including, but not limited to, antimony, arsenic, bismuth, lead, silica, tin, and compounds of such materials.
>
> Section 3. Control of Potentially Hazardous Matter and Toxic Substances. Persons responsible for a source from which hazardous matter or toxic substances may be emitted shall provide the utmost care and consideration, in the handling of these materials, to the potentially harmful effects of the emissions resulting from such activities. No owner or operator shall allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals and plants. Evaluation of such facilities as to adequacy of controls and/or procedures and emission potential will be made on an individual basis by the cabinet. (5 Ky.R. 512; eff. 6-6-79.)[30]

6. The permits require the preparation of a Comprehensive Nutrient Management Plan (CNMP). The CNMPs calculated that each swine barn would generate 1.78 million gallons of liquid swine manure, urine and swine waste per year.[31]

7. The CNMPs require that the swine waste be land applied to crop land at rates that will not exceed the Nitrogen fertilizer needs of the crop, but the CNMPs do not manage for Phosphorus crop needs.[32]

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[30] 401 KAR 63:020

[31] *Barry Sharp, et al. v. Energy and Environment Cabinet, et al.*, 07-CI-1413, Opinion and Order of Judge Phillip Shepherd, November 16, 2009 at 5.

[32] *Id.*

The Citizens objecting to these nine new swine facilities retained a real estate appraiser to provide testimony about potential damage to property values caused by these proposed swine facilities. Mary Clay, MAI reviewed property sales in six (6) Kentucky counties. Calloway, Graves, Carlisle/Hickman, Warren and Davies Counties, proximate to seven (7) existing hog facilities, including two (2) that raise Tosh Farms swine using "deep pit" animal waste handling facilities. This review compared sales of unimproved building lots and unimproved farms within one (1) mile of a swine barn and lagoon (or swine barn over a "deep pit") with sales of similar properties over two (2) miles from the facility. This review included the existing swine facility of Cannon. In all six counties, Clay found a significant loss of property in the sale of lots and farms within one (1) mile of the facility compared with the sale of lots and farms over two (2) miles from the facility:

County	1.0 to 10 acres	10 acres and more
1. Calloway Co:	**-43.96%**	**-25.88%**
2. Graves Co:	**-32.29%**	**-45.15%**
3. & 4. Carlise/Hickman:	**-67.04%**	**-38.89%**
5. Warren Co:	-45.05%	-48.36%
6. Davies Co:	-30..11%	-35.00%
AVERAGE	-43.69%	-38.66%

The Administrative Hearing officer recommended that the nine permits be vacated to require compliance with the Kentucky Air Toxics regulation, 401 KAR 63:020, set forth above, and to address deficiencies in the CNMPs. The Cabinet Secretary rejected these recommendations. The Franklin Circuit Court agreed with the Hearing Officer regarding 401 KAR 63:020, and, in addition, held that these facilities were subject to the Clean Water Act notwithstanding *Waterkeeper* 2005.

5. *Commonwealth v. Sharp*, 2012 Ky. App. LEXIS 189 (Ky. Ct. App. May 25, 2012)

The following quotes from the Court of Appeals opinion summarize the issues raised, and the conclusions of Franklin Circuit Court, most of which were reversed by the Court of Appeals. These quotes also set forth the status of the *Waterkeeper 2005*[33] decision in Kentucky:

[33] *Waterkeeper Alliance, Inc. v. U.S. E.P.A.*, 399 F.3d 486 (2nd. Cir. 2005).

> Subsequently, after briefing, oral argument, and additional submissions by counsel, Judge Phillip Shepherd entered an opinion and order on November 16, 2009, which reversed in part and affirmed in part the Secretary's order, and remanded the case to the Cabinet for further action consistent with its holding. On four of the issues, the circuit court reversed the ruling of the Secretary, finding that the Cabinet erred: (1) in failing to require Farmers to obtain KPDES permits rather than No-Discharge permits; (2) in failing to require Tosh Farms to sign Farmers' permit applications as co-permittee; (3) in failing to exercise discretionary "special condition" authority to perform an air emissions risk assessment and/or impose conditions relating to air emissions in connection with Farmers' permits; and (4) in failing to exercise discretionary "special condition" authority to impose effluent or other limitations relating to pathogens in the permits. On the remaining issue raised by Petitioners, which was a challenge to the propriety of the permitted setback distances, the circuit court affirmed the Secretary's ruling.

Commonwealth v. Sharp, 2012 Ky. App. LEXIS 189 a 12-13

> The circuit court held that because the Secretary ultimately found that the Farmers' operations would produce large volumes of manure, and would result "in a considerable potential for water pollution," the operations should have been deemed CAFOs per se, thereby requiring KPDES permits. In so finding, the circuit court stated as follows:
>
> > "The [Circuit] Court finds that it was erroneous as a matter of state law for the Cabinet to change its legal interpretation in response to the Waterkeeper decision's interpretation of federal law. The Cabinet's adoption of the Waterkeeper decision on the issue of how to interpret the regulatory definition of CAFOs was erroneous, because the statutory authority under state law significantly differs from the federal act interpreted in the *Waterkeeper* case. The

> Cabinet's decision to reinterpret the regulatory definition of CAFO and exempt CAFOs from KPDES permits is clearly erroneous because Kentucky's water pollution statute is broader than the federal Clean Water Act on the crucial issue of whether a direct discharge into water is required to trigger the permit requirement. The Kentucky statute, unlike the federal Clean Water Act, prohibits both "directly and indirectly" any discharges that "cause or contribute to the pollution of the waters of the Commonwealth." KRS 224.70-110. As the Waterkeeper Court noted, the federal act provides that '[e]xcept as in compliance [with all applicable effluent limitations and permit restrictions], the discharge of any pollutant by any person shall be unlawful.' 33 U.S.C. § 1311(a)."
>
> In arguing on appeal that the circuit court erred in requiring an NPDES permit instead of a No-Discharge permit, the Cabinet notes that in *Waterkeeper Alliance v. EPA*, 399 F.3d 486 (2d Cir. 2005), the United States Court of Appeals for the Second Circuit held that the EPA's CAFO regulations violated the Clean Water Act (CWA) because they authorized NPDES permits for discharges from CAFO land application areas without requiring that those permits incorporate (subject to EPA approval and public participation) restrictions on the land application of waste. However, the Cabinet notes that the Waterkeeper court went on to vacate the regulations at issue to the extent that they required CAFO operators to seek NPDES permit coverage for "potential" discharges. The Cabinet argues that the fallacy with the circuit court's position is that the "potential to discharge" cannot be presumed, and that Kentucky's authority to prevent direct and indirect discharges does not give it the authority to presume that there is a "potential to discharge," even if that discharge is an indirect discharge.

Id. at 21-23.

> Accordingly, we cannot agree with the circuit court's determination that *Waterkeeper* is inapplicable to the issues presented herein. To the contrary, it is directly on point. *Waterkeeper* clearly provides that an operation only needs a NPDES permit if that operation is a point source discharge. It seems axiomatic that, where no federal NPDES permit would be required, any KPDES permit would necessarily be more stringent, and thus in conflict with KRS 224.16-050(4).

Id. at 37-38.

The Court of Appeals said the following about the Kentucky Air Toxics regulation at 401 KAR 63:020:

> Below, Petitioners alleged that in issuing No-Discharge permits to the Farmers, the Cabinet failed to properly apply 401 KAR 63:020, a Kentucky regulation relating to "potentially hazardous," or "toxic" air emissions. Specifically, the Petitioners alleged that prior to issuing the No-Discharge permits to the Farmers, the Cabinet was required to make an evaluation or assessment of the farms' potential emissions of air pollutants covered by 401 KAR 63:020, and to impose conditions in the Farmers' water permits relating to compliance with that regulation.
>
> The Hearing Officer's initial report contained approximately twelve pages of factual findings on this issue, supporting two recommendations that the permits be remanded for failure of the Cabinet and the Farmers to comply with 401 KAR 63.020.

Id. at 55.

> In response to the arguments made by the Cabinet, the Petitioners argue that the circuit court properly found that the Cabinet failed to fully enforce its own regulatory requirements regarding protection of the public from air toxins. They assert that (1) the Cabinet cannot excuse, without acting in an arbitrary manner, the failure to have conducted an individualized review of the potential of the Farmers' facilities to generate air toxins on the basis that

> it is a "water permit" because it already utilized another air quality regulation to address and regulate odors from the storage of animal waste at these same facilities; (2) Farmers are incorrect in their assertion that because the EPA has yet to determine if animal feeding operations emit potentially hazardous matter or toxic substances as required under 401 KAR 63:020, then it was not necessary for the Cabinet to require implementation of the statute pursuant to its special condition authority; and that it is the responsibility of the Cabinet, and not the EPA, to implement 401 KAR 63:020.
>
> First, Petitioners argue that 401 KAR 63:020 is a regulation promulgated pursuant to KRS Chapter 224, and that it is thus within the ambit of the regulations to be applied under 401 KAR 5:005 Sections 24 and 25. They thus assert that the argument that the facility is permitted under a "water permit" is flawed because the Cabinet clearly utilized an air quality regulation to address and regulate odors from the facilities' storage of animal wastes. They argue that the Cabinet clearly had an obligation to conduct an individualized review of the adequacy of controls and/or procedures implemented by the Farmers to control emissions at their particular facilities, and that it failed to do so. Petitioners assert that 401 KAR 63:020 clearly requires that the Cabinet make an individual evaluation where a facility "may emit" potentially hazardous material or toxic substances, and that in the face of admitted knowledge of emissions of ammonia and hydrogen sulfide, they are required to do so.

Id. at 60-62.

The Court of Appeals rejected Petitioners arguments, finding that:

> the Cabinet was required to impose a special permit condition only when, in the Cabinet's "best professional judgment," a "special" permit condition was "necessary" to implement 401 KAR 63:020. The Cabinet's authority in this regard is highly discretionary, and, thus, entitled to great deference. The Petitioners were required to show, by a preponderance of the evidence, that the Cabinet was required to exercise its discretionary authority to impose a

> "special" condition in Farmers' permit relating to toxic air emissions. Upon review of the record, we do not believe that burden was met in this instance.
>
> Further, and we believe, importantly, Petitioners do not dispute that the Cabinet can, at any time, enforce the provisions of 401 KAR 63:020, whether or not its provisions are specifically restated and implemented in an individual permit.[34]

Lesson one is clear. Despite a clear legislative intent by Congress in 1972, the Clean Water Act and other environmental protection laws and regulations in Kentucky have not protected people from industrial agricultural pollution. Part of the failure is the impact of *Waterkeeper* 2005. But another important consideration is political. The change in administrations from Governor Patton 1997 to Governor Fletcher in 2005 is part of the explanation. In addition, as will be seen below, when we discuss *Waterkeeper* 2017, agencies at every level do not seem willing to distinguish between the older rules that exempted an agrarian agriculture from the newer rules that were intended to apply to industrial agriculture.

Will common law tort remedies come to the rescue?

6. THE SECOND LESSON: IF VICTIMS OF UNCONTROLLED INDUSTRIAL AGRICULTURAL POLLUTION TRY TO USE TORT REMEDIES TODAY, THEY WILL LIKELY ENCOUNTER THE SAME INADEQUATE REMEDIES THAT TORT LAW PROVIDED BEFORE PASSAGE OF THE CLEAN WATER ACT.

Our experience in Marshall County taught us the second lesson.[35] Again, the discussion below is a recall of my personal litigation experience in the *Powell* litigation, cited in footnote 35.

When Jimmy Tosh told the folks in Marshall County that they would never even know his pigs were in the county, they believed him.

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[34] *Id.* at 63-64.

[35] *Terry Powell, et al. v. Jimmy Tosh, et al.* Initially filed in Marshall Circuit Court as Civil Action No. 09-CI-00249 and then removed to Federal District Court for the Western District of Kentucky as Case No. 5:09-cv-121-R. Specific opinions in this case are cited as they are discussed.

No one challenged the KNDOP issued to Ron Davis until the barns were built and the swine odors started on July 4th, 2007.

Terry Powell and his family and neighbors lived within a 1.25 mile circle around the Ron Davis barns. They filed suit in Marshall Circuit Court. Jimmy Tosh asserted the Class Action Fairness Act and removed the case to Federal District Court before Judge Russell. Powell asserted the Local Action exception but was not successful in getting the case remanded to the Marshall Circuit Court.

Plaintiffs retained Dr. Eric Winegar as their odor scientist. As discussed below, he prepared a report that measured the adverse odor impacts within the 1.25 mile radius around the Ron Davis barn, and he expressed his opinion that these would be the same impacts within a 1.25 mile radius around the other Jimmy Tosh Standard Hog Barns in Western Kentucky. This opinion was submitted to support the motion to designate this action as a class action for all residents and property owners surrounding these barns.

Judge Russell agreed to certify the action as a class action around the Ron Davis barn but not the other Jimmy Tosh barns in Western Kentucky.

On July 7, 2011, Dr. Winegar was given the discovery opportunity to measure actual emissions from the Ron Davis swine barns. His Supplemental Report of October 11, 2011, included his Emission Rate Calculations. Dr. Winegar concluded that the two Ron Davis swine barns, each with about 2,490 swine, were emitting 61,555 pounds per years of air emissions, including 47,097 pounds of Ammonia, 4995 pounds of Acetic Acid and 2,427 pounds of Hydrogen Sulfide.

Plaintiffs retained Mary Clay, MAI as their real estate appraiser to testify concerning damage to property value from the Ron David swine barns. On January 11, 2011, she submitted her report that the Plaintiff property owners had suffered $755,000 in lost market value from their proximity to the Ron Davis hog barns.

Subsequently, Plaintiffs retained another real estate expert to calculate the total property damages for the entire class of owners around the Ron David swine barns. Dr. Robert Simon submitted his report in May 2013. His conclusion included It is my opinion that these properties have suffered property value diminution aggregating approximately $8.74 million as of May 13, 2013, due to the noxious and

offensive odors resulting from Defendants' swine raising and waste disposal operations at the Ron Davis Hog Barns.

The case was settled six months later, so he was never deposed. However, his report has been published. See: *The Effect of a Large Hog Barn Operation on Residential Sales Prices in Marshall County, KY,* Dr. Robert Simons, The Journal of Sustainable Real Estate, Volume 6, Number 1, 2014. The Abstract is as follows:

> In this paper, we examine the economic impact of a tightly clustered complex of hog barns, a type of concentrated animal feeding operation (CAFO) on residential property in a rural area near Benton, Kentucky. The operation creates noxious and offensive odors associated with swine-raising and waste disposal activities. Theory and practice indicate that buyers would avoid purchasing a property believed to be contaminated or subject to effects of unsustainable environmental disamenities. Using hedonic regression analysis, the results show price reductions of 23%–32% for residential properties sold within 1.25 miles of the facility, and much larger losses northeast (downwind) of the facility.

6. *Powell v. Tosh,* 942 F. Supp. 2d 678 (W.D. Ky. 2013)

In 2013, this case was settled by a confidential settlement agreement.

This article will cite to the part of the case that is public, to help answer the question – will Common Law Remedies Come to The Rescue? The following are quotes from several orders by Judge Russell that apply Kentucky tort law to the facts of that case as he determined them.

a. Order Granting class action for a 2nd time (3.2.2012)[36]:

> By Order dated December 21, 2011 (DN 276), this Court vacated its Order partially granting Plaintiffs' motion for class certification (DN 245) in order to further review the appropriateness of class certification in this action. That matter has been fully briefed. On January 6, 2012,

[36] *Powell v. Tosh*, 280 F.R.D.296 (W.D. Ky. 2012).

> Plaintiffs' moved for leave to amend their motion to certify the class (DN 281). The Tosh Defendants have responded to Plaintiffs' motion (DN 282), and Plaintiffs have replied (DN 283). For the following reasons, Plaintiffs' motion to certify the class (DN 178) is GRANTED and Plaintiffs' motion for leave to amend their motion to certify the class (DN 281) is DENIED. Page 1.
>
> The Plaintiffs' Complaint sets out common law claims for temporary nuisance, permanent nuisance, trespass, negligence, negligence per se, product liability, gross negligence, civil conspiracy, negligent encouragement, and battery against each defendant. Plaintiffs ask for their claims to be certified as a class action and proposed the following class definition:
>
> All residents and property owners within a 1.25 mile radius of the Ron Davis Tosh Farms Standard Hog Barn subject to the Tosh Swine Services Agreement and all residents and property owners within such radius of all other Tosh Farms Standard Hog Barn subject to the Tosh Services Agreement in Marshall, Hickman, Fulton, and Carlisle Counties, Kentucky as identified in the December 12, 2010 Report by Dr. Eric Wineger, subject to the provisions to opt out of such class and opt into such class as the Court may approve, and excluding the Defendants and their agents, employees, and related legal entities, in Marshall, Hickman, Fulton, and Carlisle Counties, in Kentucky. Defendants oppose the certification of a class. Page 3.

b. Order Granting Partial Summary Judgment (3.8.13)[37]

1. Agency v independent contractor

> Rather, the Tosh Defendants collectively argue that under those facts, no Tosh Defendant should be held liable for the Davises' operations at the Brewers Highway barns.
>
> Though the question of agency is a close one, after a full review of the record, the Court finds that the Davises may be considered agents of certain Tosh Defendants. The

[37] *Powell v. Tosh*, 929 F. Supp. 2d 691 (W.D. Ky. 2013).

parties' relationship is governed by the SSAs between the Davises and Tosh Farms GP and, subsequently, Tosh Pork.10 As the Tosh Defendants point out, the SSAs specifically state that the Davises (called "Growers" in the SSAs) are independent contractors… However, weighing these factors against the remaining facts in the record, the Court still finds it appropriate to consider the Tosh parties employers of the Davises. Page 9.

2. Nuisance – temporary and permanent

First, in their motion for summary judgment, Defendants Ron and Heather Davis argue that Plaintiffs' nuisance claims are barred by Ky. Rev. Stat. § 413.072, more commonly known as the "Right to Farm Act." Page 15.

The Right to Farm Act does not bar the instant suit. Page 17.

3. Temporary Nuisance

All Defendants argue that any claim under temporary nuisance fails because Plaintiffs have provided no evidence quantifying the loss of use of their property due to the barns' operation. A permanent structure that can be changed, repaired, or remedied at reasonable expense to abate the nuisance is temporary. *Lynn Mining Co.*, 394 S.W.2d at 758 (citing *City of Ashland v. Kittle*, 305 S.W.2d 768, 769 (Ky. 1957)). Page 17. Plaintiffs only have offered proof of the diminution in the market value of their properties. Page 18.

[S]ome Plaintiffs previously have testified as to how the odors have affected their use of their properties: fewer family gatherings, friends do not visit, children cannot play outdoors as often, Plaintiffs cannot enjoy outdoor investments such as swimming pools or patios, and the odors prevent Plaintiffs from opening their windows or remaining outside. "While the diminution in the value of the use of property is a rather elusive concept, it has been recognized that discomfort caused by this type of injury may be considered as an element of damages." *Radcliff Homes, Inc. v. Jackson*, 766 S.W.2d 63, 66 (Ky. Ct. App.

1989) (quoting *Price v. Dickson*, Ky., 317 S.W.2d 156, 157 (Ky. 1958) (internal quotation marks omitted)); but see Ky. Rev. Stat. § 411.560(3) Page 18,

However, this Court has also granted Defendants' motion to exclude Plaintiffs' expert testimony regarding biofilters, which Plaintiffs contend would reasonably abate the nuisance alleged in this case. Page 19.

4. Permanent Nuisance

A permanent nuisance is any private nuisance that (1) cannot be corrected or abated at reasonable expense to the owner and (2) that is relatively enduring and not likely to be abated voluntarily or by court order. *Rockwell Int'l Corp. v. Wilhite*, 143 S.W.3d 604, 625 (Ky. Ct. App. 2003) (citing Ky. Rev. Stat. § 411.530(1)). Page 19.

Defendants' motion for summary judgment on Plaintiffs' temporary nuisance claim is granted, but summary judgment is denied as to Plaintiffs' permanent nuisance claim. Page 20.

5. Battery

In Kentucky, battery is any unlawful touching of the person of another, either by the aggressor, or by any substance set in motion by him or her. See *Vitale v. Henchey*, 24 S.W.3d 651, 657 (Ky. 2000) (quoting *Sigler v. Ralph*, 417 S.W.2d 239, 241 (Ky. 1967)). In a May 3, 2011, Memorandum Opinion and Order, (DN 200), the Court recognized that the issue of whether particulate touching can result in a battery is an issue of first impression under Kentucky law and noted that other courts have allowed a battery claim to proceed under similar circumstances. See, e.g., *Leichtman v. WLW Jacor Commc'ns, Inc.*, 634 N.E.2d 697 (Ohio Ct. App. 1994). The Court allowed Plaintiffs to amend their Complaint to add the claim of battery, concluding that "if Plaintiffs can prove that the acts in question were intentional . . . , Plaintiffs will have a valid claim for battery." (DN 200.) Page 21.

Likewise here, the record does not indicate any defendant raises hogs or ventilates the barns with the purpose of releasing odors into the surrounding community. Although defendants may have knowledge that odors could reach neighboring properties, like the courts in the aforementioned cases, the Court finds such generalized knowledge is insufficient to satisfy the intent requirement for battery. Plaintiffs can point to no authority, and the Court has found none, that supports holding a defendant liable for battery with proof of only such generalized knowledge as to intent. Defendants are entitled to summary judgment on Plaintiffs' battery claim. Page 23.

6. Negligence, Negligence Per Se, and Gross Negligence

Plaintiffs assert actions in negligence, negligence per se, and gross negligence. Negligence requires that the defendant owe the plaintiff a duty, a breach of that duty, and that the breach cause the plaintiff's injury. *Dickens*, 631 F. Supp. 2d at 864 (quoting *Pathways, Inc. v. Hammons*, 113 S.W.3d 85, 88 (Ky. 2003)). Failure to establish any of these elements is fatal to Plaintiffs' claim. *M & T Chems., Inc. v. Westrick*, 525 S.W.2d 740, 741 (Ky. 1974). "[N]egligence per se is merely a negligen[ce] claim with a statutory standard of care substituted for the common law standard of care." *Pile v. City of Brandenburg*, 215 S.W.3d 36, 41 (Ky.2006). Indeed, "the only discernible difference between common-law negligence and negligence per se is 'how they are proved.'" *Stivers v. Ellington*, 140 S.W.3d 599, 601 (Ky. Ct. App. 2004) (quoting 57A Am. Jur.2d Negligence § 687 (2004)). Therefore, just as in ordinary negligence claims, causation and injury must still be proven in negligence per se claims. Id. Page 23-24.

Defendants argue that the injury requirement of negligence is not satisfied by injury to real property and that Plaintiffs must show some form of physical personal injury. In support of this contention, Defendants cite to a case from this district, which noted that in Kentucky, "actions for damages to real property caused by another's negligence sound in trespass, not negligence." *Dickens*, 631 F. Supp. 2d at 864 (quoting *Wimmer v. City of Ft. Thomas*,

733 S.W.2d 759, 760 (Ky. Ct. App. 1987)) (internal quotations omitted); see also *Rockwell Int'lCorp*., 143 S.W.3d at 609-10. Page 24.

Plaintiffs argue that *Wood v. Wyeth-Ayerst Labs*., 82 S.W.3d 849 (Ky. 2002) supports a negligence claim where a plaintiff shows damage to real property. *Wood*, which addressed whether a plaintiff's increased risk of future bodily injury supported a negligence claim, cited approvingly to the Restatement (Second) of Torts' definition of physical harm. "The words 'physical harm' are used to denote physical impairment of the human body, or of tangible property . . . ." *Wood*, 82 S.W.3d at 855 (quoting Restatement (Second) of Torts § 7, cmt. e(1965)). Defendants note that any reference to property damage in *Wood* was dicta, and thus nondispositive. In any event, Plaintiffs point to no evidence in the record evidencing a physical injury or impairment of their property resulting from the odors. Rather, the only real property damages Plaintiffs allege are a decrease in their properties' fair market value as a result of odors from Defendants' barns. Such does not support a claim of negligence. Page 24-25.

Plaintiffs have also failed to present personal injuries to support a negligence claim. First, all but one Plaintiff acknowledge they have suffered no physical harm as a result of the odors from the Defendants' barns. Although some Plaintiffs recount mental or emotional distress as a result of the odors,13 none have sought or received treatment or counseling and none present medical proof in support of their distress claims. This is insufficient to support a negligence cause of action in Kentucky. See *Osborne v. Keeney*, 2012 WL 6634129, at *9 (Ky. Dec. 20, 2012). Page 25.

7. Trespass

Next, all parties have moved for summary judgment on Plaintiffs' claims for trespass. A person trespasses if he or she "enters or remains upon land in the possession of another without the possessor's consent." *Bradford v. Clifton*, 379 S.W.2d 249, 250 (Ky. 1964); see also *Carbide & Chems. Corp*., 226 S.W.3d at 54. "Kentucky law allows

> recovery under trespass in either of three instances: (1) the defendant was engaged in an extra-hazardous activity, (2) the defendant committed an intentional trespass or (3) the defendant committed a negligent trespass." *Rockwell Int'l Corp*., 143 S.W.3d at 619. Plaintiffs base their action in trespass on the hog odors emanating from the Brewers Highway barns. However, particles that are visibly undetectable and transient, such as odors, are not sufficient to state a claim for trespass under Kentucky law. See *Brockman*, 2009 WL 4252914 at *5; *Dickens*, 631 F. Supp. 2d at 865. Plaintiffs cite *Smith v. Carbide & Chems. Corp*. in support of their claim. 226 S.W.3d at 56. However, in *Carbide*, the defendants did not contest the plaintiffs' characterization of groundwater and soil contamination through imperceptible particles as an intentional trespass, and thus the court did not address that issue in its analysis. Id. at 54. In Kentucky, "a trespass only occurs when an object or thing enters a person's property and interferes with his or her possession or control." *Brockman*, 2009 WL 4252914 at *5 (emphasis added) (citing *Bartman v. Shobe*, 353 S.W.2d 550, 555 (Ky. 1962) (Trespass is "more visible and tangible" than a nuisance)). Plaintiffs' alleged injuries center on the odors' interference with the use and enjoyment of their property, not their right to exclusive possession. The evidence does not support a claim for trespass. Page 27-28.

c. Order Regarding Motions in Limine (3.8.13)[38]

Both Dr. Eric Winegar and Mary Clay were challenged under *Daubert*, and both were permitted to testify. See Memorandum Opinion and Order on Experts, DN 537, dated 3/8/2013, starting at Page 3.

> In *Daubert v. Merrell Dow Pharm., Inc*., "the Supreme Court established a general gatekeeping obligation for trial courts to exclude from trial expert testimony that is unreliable and irrelevant." *Conwood Co. v. U.S. Tobacco Co*., 290 F.3d 768, 792 (6th Cir. 2002) (alteration and internal quotation marks omitted) (quoting *Hardyman v. Norfolk & W. Ry. Co.*, 243 F.3d 255, 260 (6th Cir. 2001)

[38] *Powell v. Tosh*, 942 F. Supp.2d 678 (W.D. Ky. 2013).

> (applying *Daubert*, 509 U.S. 579, 597 (1993); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 147-48 (1999))).

d. Order decertifying class action for the second time. (8.2.13)[39]

On August 2, 2013, Judge Russell entered his second order to decertify the class action, page 7, as follows:

> The narrowing of the Plaintiffs' causes of action brings focus to the particular questions of law and fact necessary to resolve their sole remaining claim for permanent nuisance. Specifically, the Court's review of Kentucky nuisance law compels the conclusion that the question whether the Tosh Defendants' conduct amounts to a permanent nuisance requires an individualized inquiry and is not capable of determination on a classwide basis. That is, the common question of whether the Tosh Defendants' conduct amounts to a permanent nuisance—and, thus, are liable to a given Plaintiff—cannot adequately be resolved by a common answer.

The opinion continued on page 8:

> The Kentucky nuisance statute can be broken down into several parts. First, it lays out what a claimant must experience: a defendant's use of property must either (1) cause unreasonable and substantial annoyance to the claimant, or (2) unreasonably interfere with the claimant's use and enjoyment of his own property. Each of these possible showings has both a subjective and an objective component. In the former, the subjective component asks whether the claimant was in fact "substantially annoyed," and the objective component asks whether that annoyance was unreasonable. In the latter, the subjective component asks whether there was in fact an "interference with the claimant's use and enjoyment of his property," and the objective component asks whether that interference was unreasonable.

As noted above, the *Powell* litigation was settled by a confidential settlement agreement. Without risking breach of that agreement, it would be reasonable to conclude that the Plaintiffs recovered some

[39] *Powell v. Tosh*, 2013 U.S. Dist. LEXIS 120448.

benefits from the litigation in return for their agreement to the settlement. I do not suggest that tort litigation against industrial agricultural pollution is futile. However, the overarching conclusion of this attorney in the above tort litigation is unavoidable – the Clean Water Act and the other federal and state environmental protection requirement must be made more effective to address the pollution from industrial agriculture.

7. THE THIRD LESSON: WE MUST REMAIN PATIENT AND PERSISTENT IN PURSUIT OF THE FULL AND EFFECTIVE IMPLEMENTATION OF THE CLEAN WATER ACT AND OTHER ENVIRONMENTAL PROTECTION REQUIREMENTS, AND WE MUST REMEMBER THAT THIS CHANGE WILL BE THE RESULT OF CITIZEN ACTION.

Following the *Waterkeeper* 2005 opinion, the U.S. Environmental Protection Agency (US EPA) responded with revised regulations in 2008. The 2008 regulations were challenged by "Farm Petitioners" and decided in *National Pork Producers Council et al. v. U.S. E.P.A.*, 635 F.3d 738 (5th Cir. 2011). That court summarized *Waterkeeper* 2005, and disapproved parts of the 2008 regulations, as follows:

> Under the 2003 Rule, all CAFOs were required to apply for an NPDES permit whether or not they discharged. 68 Fed. Reg. 7176, 7266 (Feb. 12, 2003). Specifically, every CAFO was assumed to have a "potential to discharge" and had to apply for an NPDES permit.
>
> The Farm Petitioners asked the Second Circuit to vacate the 2003 Rule's "duty to apply" because it was outside of the EPA's authority. The court agreed and held that the EPA cannot require CAFOs to apply for a permit based on a "potential to discharge."
>
> The EPA's response to this part of the *Waterkeeper* analysis is the 2008 Rule's requirement that CAFOs that discharge and CAFOs that "propose" to discharge apply for a permit.
>
> Because the issues presented in *Waterkeeper* are similar to the issues presented here, we find the Second Circuit's

> analysis to be instructive and persuasive. Accordingly, we decline to uphold the EPA's requirement that CAFOs that propose to discharge apply for an NPDES permit.

From my review, it appears that neither Congress nor EPA has effectively applied the suggestion in Footnote 22 of *Waterkeeper*, 2005:

> We hasten to note, however, that if Congress were to amend the Clean Water Act to permit the imposition of a duty-to-apply, we believe the EPA would have ample reason to consider imposing this duty upon Large CAFOs. In our view, the EPA has marshaled evidence suggesting that such a prophylactic measure may be necessary to effectively regulate water pollution from Large CAFOs, given that Large CAFOs are important contributors to water pollution and that they have, historically at least, improperly tried to circumvent the permitting process. *See, e.g.*, Proposed Rule at 2976-77 (noting that, according to the 1998 National Water Quality Inventory, the agricultural sector was the leading contributor to identified water quality impairments in the nation's rivers and lakes); *id*. at 3008 ("since the inception of the NPDES permitting program in the 1970s, a relatively small number of larger CAFOs has actually sought permits); *see also* Preamble to the Final Rule at 7180 (describing a rise in the excess manure nutrients produced by animal feeding operations); *id*. at 7181 (detailing the ecological and human health impacts caused by CAFO manure and wastewater), *id*. at 7237 (noting the pollutants present in manure and other CAFO wastes and describing how they contribute to the impairment of water quality).
>
> We also note that the EPA has not argued that the administrative record supports a regulatory presumption to the effect that Large CAFOs *actually* discharge. As such, we do not now consider whether, under the Clean Water Act as it currently exists, the EPA might properly presume that Large CAFOs - or some subset thereof - actually discharge.

Today, the above discussion of the opportunities for Congress or EPA to more effectively regulate CAFOs under the Clean Water Act is an academic exercise. More effective regulation of CAFOs under the Clean Water Act will depend upon the ability of citizens to prove existing

CAFOs are *actually* discharging. That is exactly what citizens did in the *CARE I* case discussed above. That is the most important lesson of this article.

The Clean Water Act has other avenues. On September 13, 2013, Judge Sylvia Rambo decided, *American Farm Bureau Federation, et al. v US EPA*, USDC, MD Penn., Civil Action No. 1:11-cv-067, approving the TMDL – total maximum daily load - for the Chesapeake Bay, as promulgated by EPA, rejecting all of the industrial agriculture arguments. The Third Circuit has affirmed and on February 29, 2016, the US Supreme Court declined to hear the case.[40]

On August 2, 2017, NOAH announced that the "dead zone" in the Gulf of Mexico

A report issued at the same time placed much of the blame for such increase on industrial meat producers like Tyson and Smithfield.[41]

When the August 2, 2017 announcement of the largest "dead zone" in the Gulf of Mexico in history is seen in conjunction with the 2015 seven-hundred-mile harmful algae bloom in the Ohio River, referred to above, along with the Chesapeake Bay TMDL, it appears we are surrounded by nutrient water pollution caused largely by uncontrolled industrial agriculture. When the problems of uncontrolled industrial agriculture pollution surround you, it becomes harder to "look the other way."

This article began with a reference to the problems of industrial agriculture as described by Wendell Berry in 1977, and to the language

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[40] *Am. Farm Bureau Fed'n v. United States EPA*, 792 F.3d 281, 300 (3rd Cir. 2015), as follows:
"Because TMDLs only relate to bodies of water for which point source limitations are insufficient, they must take into account pollution from both point and nonpoint sources. We believe the congressional silence on how to promulgate a TMDL and the congressional command that a TMDL be established only for waters that cannot be cleaned by point-source limitations alone (necessarily implying that, whatever form the TMDL takes, it must incorporate nonpoint source limitations) combine to authorize the EPA to express load and waste load allocations. To be sure, the statute does not command the EPA's final regulation to allocate explicitly parts of a load among different kinds of sources, but we agree with the EPA that it may do so."

[41] http://www.mightyearth.org/

and legislative of the Clean Water Act that sought to address the water quality problems.

The recent of the U.S. Court of Appeals in DC – *Waterkeeper* 2017 – is a reason for renewed optimism that our federal environmental protection acts will become more effective as citizens complain and as courts lose patience with the agency deference to look the other way.

> **WATERKEEPER ALLIANCE, ET AL., PETITIONERS v. ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT U.S. POULTRY AND EGG ASSOCIATION, ET AL., INTERVENORS.**
> **United States Court of Appeals FOR THE DISTRICT OF COLUMBIA CIRCUIT Argued December 12, 2016 Decided April 11, 2017**
>
> WILLIAMS, Senior Circuit Judge: Anyone with a pet knows firsthand that raising animals means dealing with animal waste. But many of us may not realize that as the waste breaks down, it emits serious pollutants—most notably ammonia and hydrogen sulfide. While those emissions are miniscule for pet owners, they can be quite substantial for farms that have hundreds or thousands of animals.
>
> Two provisions of federal law—sections of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA") and the Emergency Planning and Community Right-to-Know Act of 1986 ("EPCRA")—require parties to notify authorities when large quantities of hazardous materials (such as ammonia or hydrogen sulfide) are released into the environment. See 42 U.S.C. § 9603 (CERCLA); id. § 11004 (EPCRA). On learning of such a release, the EPA has broad powers to take remedial actions or order further monitoring or investigation of the situation. See id. § 9604. In 2008 the EPA issued a final rule that generally exempts farms from CERCLA and EPCRA reporting requirements for air releases from animal waste.
>
> The parties here focus on two of the hazardous substances emitted by animal waste as it decomposes—ammonia and hydrogen sulfide. (There are other such substances (e.g.,

> nitrous oxide, methane, volatile organic compounds), see 73 Fed. Reg. at 76,950/2-3; see also NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES, AIR EMISSIONS FROM ANIMAL FEEDING OPERATIONS: CURRENT KNOWLEDGE, FUTURE NEEDS 50-56 (2003) ("National Research Council Report"), but we need not address them.) The EPA has classified ammonia and hydrogen sulfide as both CERCLA "hazardous substances" and EPCRA "extremely hazardous substances"; the EPA set the reportable quantity for each at 100 pounds per day. See 40 C.F.R. § 302.4(a) (CERCLA); id. pt. 355 App. A (EPCRA). None of the parties contends that the daily emissions of commercial farms fall below that threshold.

That opinion found that EPA acted in violation of Congressional mandate where it adopted a regulation in 2008 that exempted farms from having to report hazardous air emissions such as ammonia and hydrogen sulfide from animal waste. The Court of Appeals concluded:

> Because the EPA's action here can't be justified either as a reasonable interpretation of any statutory ambiguity or implementation of a de minimis exception, we grant Waterkeeper's petition and vacate the Final Rule. That necessarily moots Pork Producers' challenge to the CAFO carve-out; we therefore dismiss their petition. So ordered.

The parallels between EPA in *Waterkeeper* 2017 and the Kentucky Energy and Environment Cabinet "looking the other way" to avoid seeing the data and smelling the consequences of uncontrolled swine facility odors are very close. We will patiently pursue a better agency response.

We will also look to writers like Wendell Berry to help point us in the right direction. Again from "For the 50-year Farm Bill" at page 165, *id.*:

> XIX – Besides an immense kindness, this movement [of livestock from confinement barns to pasture] would be a return to ecological health. It would transform vast tonnage of so-called "animal waste" from the water courses, where it is a pollutant, to our food-producing acreage, where it is an indispensable fertilizer.

THE WONDROUS JOURNEY OF FOOD

Ronald R. Von Stockum, Jr.

I. A NECESSARY JOURNEY

I am lost. Somewhere in the world, I am lost. Is it in that jungle of forest in Eastern North America? I suspect so. But not of modern time, not my time. Maybe long ago? Or perhaps sometime in the future?[1] What has happened?

From the constellations at sunset, I surmise it must be late summer.[2] Tea is steaming above the scorpion's tail, and trees are

[1] **E. Lucy Braun envisioned an ancient forest complex that survived the glacial ages in the Appalachian plateaus**. She believed that its greatest complexity was developed in the Cumberland Mountains of Eastern Kentucky and Western Virginia. Dr. Braun characterized this mountain assemblage as the "Mixed Mesophytic Forest." She described it as, "...the most complex and the oldest association of the deciduous forest formation. It occupies a central position in the deciduous forest as a whole, and from it or its ancestral progenitor, the mild Tertiary Forest, all other climaxes of the deciduous forest have arisen." (Braun, 1950).

On December 10, 1998, "Kentuckians for the Commonwealth" (KFTC) filed a "Lands Unsuitable for Mining" petition with the Kentucky Natural Resources and Environmental Protection Cabinet (NREPC). KFTC was represented by Kentucky Resources Council Environmental attorney, Tom FitzGerald. The petition sought to prevent mining on all land on Black Mountain above 3,000 feet in elevation, approximately 10,000 acres. Black Mountain was the type of location of Dr. Braun's Mixed Mesophytic Forest and supports the highest summit in Kentucky at 4,139 feet.

The petition was filed pursuant to Kentucky Revised Statute (KRS) 350.610, "Designation of Lands Unsuitable for Mining." For additional case law in Kentucky on this provision, see *Laurel Mountain Resources, LLC v. Commonwealth*, 360 S.W. 3d 791 (2012). The KFTC petition was resolved by agreement as referenced in an April 19, 1999 letter of agreement between the parties.

[2] **Few have looked up during summer and not recognized the star asterisms depicting a Teapot pouring tea on the tail of a Scorpion**. In Greek mythology, the Teapot is the constellation Sagittarius the Archer. It is in the Zodiac, an area of the sky through which the sun appears to move. The early Mesopotamians thought of the constellation as a centaur. I just see a teapot. No dispute over the next constellation, however. This grouping of stars looks like a scorpion and was seen as

modeling their fall fruit adornment. Leaf brittle trails release a musty scent as I pass.[3]

I am clothed and cloaked and alone. And I am hungry.

My thirst is slaked, however, for there is an abundance of water here.[4] But it is wild water, full of living forms consciously removed or

such by the Babylonians of the Middle East as well as the Mayans of Central America.

Much popular culture revolves around the astrological portent of one's birth sign. It is determined by the constellation that appeared behind the sun as it rose on the day of one's birth. These dates and signs were fixed by astrologers perhaps 1,000 years ago. Take a look at an inexpensive star application on a smart phone and set it back to your birthday. Run it for sunrise. You may be surprised by which astrological "House" you really belong. Your birth sign may have been changed by the wobble of the earth, precession. And that is a phenomenon that may also play into climate change!

[3] **A poem entitled "Steaming Tea."** It goes like this: "To Greeks the claws that Mayans saw, that Romans tore and set afar, to hold the lunar scales for we, placed Scorpion on solar sea. Antares runs bright red like Mars, an archer aims a rising star, stinger poised yet barb restrained, it's only teapot pouring steam. Sagitta the Archer be, hunting Zuben Chimeli, the steam a Milky Way of stars within our world of spiral arms. A million more of galaxies expand our strings reality, yet only three from our world seen, grasp the Arab Genube. Xibalba Hades Hero Twins, the road beneath inflamed in sin, foolish men you dream to see, it's only teapot steaming tea." (Van Stockum, personal communication, 2004).

[4] **In fact, there are more miles of running water in Kentucky than any state other than Alaska**. At normal flow, there is more water from the Ohio River joining the Mississippi River at Cairo, Illinois than is in the Mississippi River itself at that point. Eastern North America is a verdant watery jungle!

Water is not so abundant everywhere else. California, which produces more than $50 billion in agricultural product, has only recently come out of a drought requiring statewide water rationing. And part of the genesis of the Syrian conflict in the Middle East was drought-driven human migration. As climate continues to change, those areas already stressed for fresh water are going to find obtaining sufficient supplies even more tenuous. And water is the stuff of life.

The Aral Sea, now lying between the Central Asian nations of Kazakhstan and Uzbekistan, was once the fourth largest inland sea. It is fed from the Amu Darya and the Syr Darya Rivers out of the mountains of Kyrgyzstan, the Tian Shan

killed from the previous water supplies of my people.[5] But my people are gone, or I have left them somehow, for there are no treatment plants here. No buildings of any sort. But I care not now. I am hungry. And those living things now living in my gut are hungry too.[6]

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range. Cotton and rice irrigation has robbed the Aral Sea of more than 60% of its volume.

Nearby Lake Balkhash at the border of China and Kazakhstan faces a similar fate. It is the world's 15th largest lake and the one that travelers on the Silk Road reached through the Dzungarian Gate as they traveled west from the deserts of China into the grassland of the Semirechye and the seven rivers feeding the lake.

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[5] **The 1970s was a decade when powerful federal environmental laws were promulgated.** In 1974, the United States passed the Safe Drinking Water Act (42 U.S.C. § 300(F) et seq.). Amended numerous times (including 1977, 1984, 1996, 2005, 2011, and 2015), this law seeks to protect the human population from nature, its own waste, and toxicity. It is expensive, however, and costs are generally borne by the taxpayers. As a result, legislation and enforcement is often reactive to crises in the water supply (e.g. Milwaukee, 1993, *Cryptosporidium*; Flint, Michigan, 2014, lead). For an example of this regulatory dilemma, see the findings of Congress in the 1996 Amendments (partially reproduced):

> "The Congress finds that –
> (1) safe drinking water is essential to the protection of public health;
> (2) because the requirements of the Safe Drinking Water Act (42 U.S.C. 300f et seq.) now exceed the financial and technical capacity of some public water systems, especially many small public water systems, the
> Federal Government needs to provide assistance to communities to help the communities meet Federal drinking water requirements; ..." (Pub. L. 104-182, Sec. 3, Aug. 6, 1996, 110 Stat. 1614-15).

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[6] **Fresh water is not fresh, not necessarily clean, nor as clear as its cool silvery look imparts.** In the wild, animals contaminate the water with their use. And animals are often reservoirs for human pathogens. The parasitic flagellate protozoan *Giardia* is widespread in the fresh waters of the world. Microscopic and unseen, it survives in cysts after passing through human or animal feces. One who drinks from contaminated water may have unexplained weight loss, massive flatulence, nausea, and abdominal cramps. No fun. That is why the Boy Scouts at Philmont, their high adventure camp in the Sangre de Cristo Mountains of New Mexico, disinfect the creek water there, careful to treat their bottle caps also. The treatment for elimination of the parasite from your body is no fun, either.

Where should I look? Where would you look?

There, a snake. What kind? I have to act quickly as it is sidling away. Smelled me before I him.

I begin the chase, quickly going over the characteristics of a poisonous snake.[7] Probably a pit viper. A bounding leap brings my boot down on its head.

It is bad enough that fresh water can be contaminated in the wild. But it can be even more dangerous if it is contaminated with the water-borne diseases of humans. Untreated sewage, faulty septic tanks, "straight pipes," and ineffective wastewater treatment is widespread. *Salmonella*, *Entamoeba*, *Cryptosporidium*, *Giardia*, fecal coliform bacteria, cholera, dysentery, nematodes, flukes, and viruses (such as those causing hepatitis and polio) are only some of the risks. On that Silk Road into Central Asia, travelers drank boiled tea for water. (Lattimore, 1928).

Life is all around us. It is within us, also. There is a flourishing microbiota in our guts. These organisms consist primarily of anaerobic bacteria in a symbiotic relationship with our bodies, either mutualistic or commensal, along with fungi, protozoans, Archaeans, and viruses that prey on the bacteria. Our gut flora contributes vitamins (e.g. vitamin K and biotin) and can ferment organic compounds that we cannot break down. And what we eat and how much we eat changes the makeup of our intestinal passengers. Recent research has demonstrated that "... Americans consuming unrestricted diets maintained less diverse fecal microbiota than those of individuals adhering to a plant-rich diet with restricted caloric intake." (Griffin, et al., 2017).

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[7] **There are three genera and four species of poisonous snakes in Kentucky:** 1) Copperhead (*Agkistrodon contortrix*); 2) Western Cottonmouth (*Agkistrodon piscivorus leucostoma*); 3) Timber Rattlesnake (*Crotalus horridus*); and 4) the Western Pigmy Rattlesnake (*Sistrurus miliarius streckeri*). You can identify all four of these snakes through characteristics that they share in the family *Viperidae*, subfamily *Crotalinde*. The Pit Vipers. That group also includes the deadly Bushmasters (*Lachesis sp.*) of Central and South America.

So here is how you can identify a native poisonous snake in Kentucky. First, they have vertical pupils, "cats' eyes" so to speak. Secondly, they have a pit between the nostril and eye. This is a heat-sensing organ for finding prey, the "pit" in Pit Vipers. Now, if you don't want to look close enough to see those two characteristics, you can always reach under and tickle the snake on its belly. You will probably get bitten, but in the off chance that the snake rolls over laughing, you will see that its belly plates (scutes) are entire below its anal plate. In a nonvenomous Kentucky snake, the scutes are entire above the anal plate and in two distinct rows below. So, here is a research assignment. If you are canoeing in Western Kentucky and a snake

Good, I still had my boots. I fumbled in my pockets. No wallet, no money. Who cares! I am hungry. There, in my right pocket, is my small penknife dangling from a tiny flashlight.[8] Great, it works. But this blade is too small and would be awkward in use to dispatch the snake.

I carefully bend down, keeping pressure on the snake's head. I will need to examine that head to make the snake identification,

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comes swimming by with its head held elevated out of the water, is it the poisonous Water Moccasin or the nonpoisonous, but incredibly ornery, Black Water Snake (*Natrix sipedon*)?

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[8] **A flashlight. A wondrous object.** In this case, not a fancy halogen lamp with halogen gases and a hotter burning tungsten filament. Its emission peaks are in the red spectrum (approximately 800 nanometers). The flashlight in question is an LED (Light Emitting Diode) lamp. These diodes are electron-energized semiconductors, emitting photons of different energies. Original LED applications produced photons energized in the red spectrum. The Nobel Prize in Physics for 2014 was awarded to three Japanese scientists (I. Akaskai, H. Amano, and S. Nakamura) for the invention of blue-emitting diodes. This enabled mixture with other diodes and a luminescent phosphor coating to produce white light. The efficiency of these new forms of artificial light, and the energy savings resulting therefrom, resulted in Congress phasing out the production of incandescent bulbs. See the Energy Independence and Security Act of 2007 (EISA), Pub. L. 110-140). The Act describes itself as:

> An act to move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the federal government and for other purposes.

With a resurgence of opposition to the incandescent bulb phase-out after the 2010 Congressional elections, Congress passed the Consolidated Appropriations Act, 2012 (Pub. L. 112-74, H.R. 2055, 125 Stat. 785, December 23, 2011), which cut funding for the program. The *New York Times* reported that:

> The bill stipulates that no federal money can be used to 'implement or enforce' new energy efficiency standards for light bulbs. Republicans said the government had no business telling people what sort of light bulbs they could use. (Steinhauer, 2011).

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although I can tell by the arrangement of its anal scutes if the darn thing will just stop squirming.[9]

There, I have it! I pinch my thumb and forefinger and tightly squeeze just below its head. As I raise up the snake, it writhes wildly, lashing and wrapping its body around my forearm. I bring its head up to my face for a closer view.

Round eyes–not slits like cats' eyes–fearfully looking at me. There is the nose slit and I see no heat-sensing pit between the eye and the nose. Non-poisonous.

The snake is almost 20 inches long, and thin. Not much of a meal, I think. I can identify its species, but will not identify it to you. I am somewhat displeased at what I am going to do next.

Grasping its tail, a third of the way up with my free hand, I release the snake and swing it furiously against a tree. Over and over I swing, smashing it against the tree until I am certain that I have crushed all life from its small head. I am very hungry.

I examine its now limp length. I run my fingers along its thin form. Slim pickings, I think, literally so. I could filet it with my little penknife, but my stomach wretches at the thought of chewing through those slippery, tawny fibers of muscle. Would they twitch in my mouth?

I decide to cook it first. Matches?

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[9] **Many states prohibit or regulate the killing of snakes without a permit** (see non-game code provisions in Georgia, Louisiana, Mississippi, Tennessee, and Virginia). In Arkansas, a "depravation" permit is required to "take any game or fur-bearing animal damaging crops or personal property ..." Non-game wildlife, including snakes, can be taken without such a permit if they "... pose a reasonable threat to persons or property ..." (Ark. State Game and Fish Commission Code Book, Chap. 05 - General Hunting and Fishing Regulations, Section 05.10 - Depravation Permit Required). In addition, Kentucky prohibits the use of reptiles in religious services or gatherings; "Any person who displays, handles or uses any kind of reptile in connection with any religious service or gathering shall be fined not less than fifty dollars ($50), nor more than one hundred dollars ($100)." (KRS 437.060, Use of Reptiles in Religious Services (1942)).

I fumble through my pants and coat pockets. None. In fact, nothing at all. How did I end up in this place with only a penknife and tiny flashlight?

Now how was I going to make a fire to cook that snake meat?[10] Come to think of it, a little warmth would be good, too. And maybe there

[10] **Food is not just about taste.** We also know, of course, that it is about nutrition and, in great bulk, calories. The history of food is the story of how our ancestors obtained that food, lots of it, and efficiently. And it is that consideration of efficiency in which cooking plays a part. Your brain uses about 20% of your caloric intake, but for young children at rest it may be two or three times that amount. There are, after all, about 100 billion cells in the brain. So maybe more calories, more easily obtained, meant an evolution of bigger brains, human brains? One hypothesis surrounding this aspect of our evolution is called the "Cooking Hypothesis." It is described by Harvard Biologist Richard Wrangham in his 2009 book, "Catching Fire," and suggests that cooking prepares the energy stores in food so that less chewing is required and a quicker digestion provided. For example, if cooked food results in more quickly available absorption by the stomach and small intestine, then more nutrition will enter the bloodstream than would otherwise be absorbed by the flora in your colon. Wrangham believes that cooking may increase digestibility by at least 10% and perhaps as high as 25-50%. As he points out, no aboriginal peoples exist without a cooking tradition, and that in the wild it would be difficult for a human to survive long on raw foods. Thus, it is possible that fire was tamed by our ancestors, and helped facilitate our brain size to begin its spectacular increase 1.8 million years ago. Cooking also renders food softer so less energy would be lost on chewing and tearing at it. That may explain the change in hominoid tooth structure and have provided longer life spans for the toothless elders.

Homo erectus, "Java Man" or "Peking Man" as the early skeletal assemblages were named, was the first truly human-like creature adapted to walk and live on the ground. The earliest fossil evidence for the creature is about 1.9 million years old. They appear to be the first of our kind to develop advanced stone, bifacial hand axes, and tools (Acheulean), and to have tamed fire in cooking hearths. They were the longest lasting species of the genus *Homo*, surviving almost ten times as long as our species has been extant. And they were still around 150,000 years ago!

Now, if cooking is what triggered larger brain size in the genus *Homo*, what is the earliest evidence for it in the archaeological record? The oldest data that we have is from two South African caves, Swartkrans and Wonderwerk. At those locations, there is sound evidence of our hominoid ancestors using hearth fires more than 1 million years ago. So the search for the origin of cooking fires continues to reach back toward the evolutionary origins of our bigger brains. And by the way, was human flesh on the menu for *Homo erectus*?

are animals out here hunting me for food just like I am hunting snakes. I spin around quickly at a sound behind me. Nothing. A shudder runs across my back. Yes, fire would be good.[11]

Charles Darwin said it best, maybe said it first, in his 1879 work, "The Descent of Man, and Selection In Regard to Sex." For him, language and fire were the most important of human discoveries.

He has discovered the art of making fire, by which hard and stringy roots can be rendered digestible and poisonous roots or herbs innocuous. This discovery of fire, probably the greatest ever made by man, excepting language, dates from before the dawn of history. (Darwin, 1871).

Cooking can also often render bitter and toxic foods palatable and can destroy disease vectors and pathogens. And that has been examined and legislated at both the federal and state levels.

The United States Food and Drug Administration (FDA) has since 1993 published a "Food Code" for the protection of the public.

The Food Code is a model for safeguarding public health and ensuring food is unadulterated and honestly presented when offered to the customer. It represents FDA's best advice for a uniform system of provisions that address the safety and protection of food offered at retail and in food service. (FDA Food Code, 2013, P.i).

The legal status of the "Food Code" is described as follows:

> The model Food Code is neither federal law nor federal regulation and is not preemptive. Rather, it represents FDA's best advice for a uniform system of regulation to ensure that food at retail is safe and properly protected and presented. Although not federal requirements (until adopted by federal bodies for use with federal jurisdictions), the model Food Code provisions are designed to be consistent with federal food laws and regulations. ... (FDA Food Code, 2013, Preface iii).

The Food Code is updated by the FDA every four years and includes input from the Centers For Disease Control. The Food Code is more than 750 pages long and references estimate that "... food-borne diseases cause approximately 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths in the United States each year. The occurrence of approximately 1,000 reported disease outbreaks (local, regional, and national) each year highlights the challenges of preventing these infections." (Scallan, 2011). Kentucky adopted and enforces the 2005 version of the Food Code as legal requirements in Kentucky through 902 KAR 45:005 entitled "The Kentucky Food Code."

Now on to the history and regulation of fire found in the next footnote!

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[11] **Oxygen is life-giving stuff.** Breathe the air. The liquor of life. Heady. But it is also the agent of fire. Well, actually, it is fire itself. No oxygen, no fire. And we breathe oxygen in! And oxygen is a very mischievous atom. Eight protons, eight

neutrons and eight electrons in two energy level clouds around the nucleus. Two electrons in the first level "S" orbital, two in the second level "S" orbital, and four in the second level "P" orbital. And therein lies the attraction of oxygen to other atoms, other matter. Oxygen needs two more electrons to complete that second "P" orbital. And it is aggressive in its desire to fill them. We call its action in doing so oxidation, rust, respiration, and fire!

Our ancient atmosphere did not contain oxygen in any appreciable quantity. All of the free oxygen had been tied up in the minerals and matter on this planet. Oxygen's appetite had been sated. Then early life evolved in our seas, evolved the ability to trap sunlight energy in its photosynthetic furnaces wherein carbon dioxide was forced into six-carbon storehouses of sunlight's fusion-generated energy; sugar glucose.

That early life form, hidden in the seas, generated a waste product. Most life does. In this case it was oxygen. Into the water it went, eating up (oxidizing) that with which it collided until an excess was able to escape to the atmosphere. We know when this occurred, about 2.4 billion years ago, because of the oxidation of iron sediments. We call these sediments, compressed into rock, the Banded Iron Formation (BIF) and the time of their creation, the Great Oxygenation Event. Go to Minnesota, you can see those rocks there.

About 21% of the atmosphere on Earth is now free oxygen. And that oxygen has risen to the stratosphere, where it intercepts deadly radiation, forming an invisible shield of ozone (O_3). This ozone layer protects the future evolution of complex life forms that sprung from those early photosynthetic cells. That's how we got here. Life terraforming Earth, preparing it for our arrival. Cool. Can we do that on Mars, too? Mars does not have an appreciable magnetic field like Earth. Even ozone might not be enough protection!

It turns out that there is a lot of oxygen around. I mean everywhere. It is the third-most abundant element in the universe. Eighty-six percent of the weight of Earth's oceans is oxygen and it is as much as half of the Earth's crust by weight. It is the most plentiful element on Earth.

And so now life has coated Earth's landscape with its organic paste and buried its carbon residue in coal, oil, and gas beds underneath. What difference does it make? Well, that residue will burn when ignited in the presence of oxygen and release that trapped carbon into the atmosphere. Will it warm the planet? That will be a discussion for another footnote. This footnote is ultimately about the controlled fire that we make through our enzymatic process of cellular respiration. There, oxygen and sugar are burned in the citric acid cycle, where it is converted to pyruvate and fuels the energy locomotive of our cells, adenosine triphosphate (ATP).

But what we colloquially call "fire" is the immediate goal of discussion herein. Fire, as Darwin noted in a previous footnote, is one of humanity's greatest discoveries. It cooks food, detoxifying some and making it easier to eat and digest. It provides heat on cold nights, scares off predators, clears fields, and is a weapon. But like the flooding that led to the English doctrine of Strict Liability, one wonders why law courts have not applied that doctrine to the most mischievous and wanton

My options are limited but not as sparse as those available to my ancient ancestors. They had probably first captured fire from lightning-induced grass flames. Some may have even learned to spin a reed between their hands or in a bowstring and created those first friction fires on a piece of wood. And surely, after learning to exploit flint rock for weapons and tools, they noted the sparks when that rock was truck.[12]

behavior of fire. Those characteristics were addressed in that seminal 1868 British Case, *Rylands v. Fletcher*, (LR3, HL 330 (1868) UKHL1):
We think that the true rule of law is, that the person who, for his own purposes, brings on his land and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril; and if he does not do so, is *prima facie* answerable for all the damage which is the natural consequence of its escape...

[12] **So what is the history of fire?** How did we tame it and how do we regulate it? As we have seen in the previous footnote, fire appeared on Earth when free oxygen became available, and a sufficient biomass had developed for which to burn. Plants began to spread on the land surfaces in the Silurian Period (approx. 440 mya). These conditions existed sufficiently in the Devonian Period (approx. 400 mya) for evidence of charcoal to have been found. As biomass on the land expanded later in the Paleozoic Period (approx. 345 mya), evidence of fire becomes more widespread. Fire became so common that many plants developed "serotiny," whereby seed germination occurred only after a fire. The concentration of oxygen in the Carboniferous Period (approx. 350 mya, the age of our great Coal Forests) was as high as 31%, much higher than today's levels. A source of ignition was also necessary and could have been provided by lightning, volcanic activity, or even meteorites.

There are mythological tales describing the gift of fire to humanity. The Greek version involved Prometheus, the Titan who stole fire from Mt. Olympus by lighting a torch in the sun and smuggling out charcoal to the humans below. For this and other transgressions, he suffered mightily the wrath of Zeus. In revenge, Zeus chained a naked Prometheus to a cliff in the Caucus Mountains where by day vultures ate out his spleen. At night, his spleen regrew to extend his torment. More about vultures in another footnote. In order to save Prometheus, Pandora's Box was opened, releasing the Spites of Man, including old age, disease, jealousy, and hatred.

Undoubtedly, the first hominoids captured fire from wildfires and perpetuated it through hearth fires. Eventually, our ancestors learned to start friction fires with a wooden drill or by striking fine-grained stone (e.g. flint, chert, or obsidian) against a stone containing iron (such as the iron pyrite used by the Italian "Iceman" more than 5,000 years ago). Fire meant much to these early peoples. Cooking made food more nutritious and digestible. Fire-softened foods could be used to feed the elderly without teeth. Society formed around communal fires maintained for nighttime protection. So the early hominoids could finally abandon trees and sleep on the ground. And fields could be burned to maintain pastures, thus attracting game. Trees could be felled by girdling them with fire. And fire was a

weapon that could be used against other humans. It continues in use today through the slash and burn agriculture of many undeveloped countries.

Hearths have been continuously maintained since those earliest of times. As braziers, they have long been essentials for travel:

> The poorer passengers seek shade or warmth, by burying themselves amongst the bales and other cargo, and sit patiently, almost in one position, until they reach their destination. They carry with them an earthen *mangal*, or chafing-dish, containing a charcoal fire, which serves to light their pipes, and to cook their coffee and food. ... (Layard, 1882).

In the Middle Ages, villagers were instructed by the ringing of evening bells to curb their nightly fires by covering them with what the French called "Couvre-feu" (cover fire). In 1068, William the Conqueror ordered the bells to ring the "Curfew" (modern English) at 8 PM and the population to bed.

In 1974, the United States Congress passed the Federal Fire Prevention and Control Act. 15 U.S.C. § 2201 et seq. Amended in 1990, the Act created the National Fire Prevention and Control Administration, the National Academy for Fire Prevention and Control, and the National Fire Data System. The 1974 law stated, in part:

That Congress finds that - ... (3) fire is an undue burden affecting all Americans, and fire also constitutes a public health and safety problem of great dimensions. ... Fire-fighting is the nation's most hazardous profession. ... (11) The unacceptably high rates of death, injury, and property loss from fire can be reduced if the federal government establishes a coordinated program to support and reinforce the fire prevention and control activities of state and local governments. (15 U.S.C. § 2201, Public Law 93-498, § 2, Oct. 29, 1974, 88 Stat. 1535). (See also 40 CFR Part 257-3.7(a) entitled Federal Regulation of Open Burning of Solid Waste).

In Kentucky, the Energy and Environment Cabinet, Department for Natural Resources, regulates forest fire hazard seasons at KRS 149.400.

(1) The periods commencing on February 15 and ending on April 30 and commencing on October 1 and ending on December 15 of each year are hereby declared to be and established as the fire hazard seasons. During the fire hazard seasons, even though the precautions required by KRS 149.375 shall have been taken, it shall be unlawful for any person to set fire to, or to procure another to set fire to, any flammable material capable of spreading fire, located in or within one hundred fifty feet (150') of any woodland or brushland, except between the hours of 6:00 p.m. and 6:00 a.m., prevailing local time, or when the ground is covered with snow. (KRS 149.400)

Open burning is also regulated by the Department for Environmental Protection, Division for Air Quality, and the Division of Waste Management. See 401 KAR 63:005. In addition, the Kentucky State Fire Marshall also regulates open burning. See KRS Chapter 227.220. Local ordinances also apply.

I have an advantage. I have a steel knife blade. It is small, but large enough to strike flint against.[13]

Yes, flint will work on my blade. Now where to find it?[14]

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[13] **When you attempt to start a fire by striking flint against rock, the type of rock you strike will determine your success**. For it is not the flint that gives off the ignition spark. It is the tiny speck of iron from what is struck that becomes incandescent. With the advent of Iron Age "fire steels," metal-striking strips were carried against which flint or chert was struck. The flint, fire steel, and "char cloth" were often kept in a "tinderbox." A flintlock works on the same principal, with the flint hammer snapping down against a steel "frizzen" plate. The resulting impact sparks into a small pan of gunpowder whose flame burns through a small hole, further igniting the powder charge within the barrel. "Half-cocked" is a colloquial phrase relating to its operation.

Matchsticks have their own interesting history; the first ones being dipped in sulfur. Other chemically soaked fibers produced the "slow" or "quick" match for guns, cannons, and fires.

Magnesium (atomic number 12, electron orbitals complete through the third level "S" orbital) is exceptionally flammable. It was the powder used for the photographic flash that you see in old westerns. In 1955, at the LeMan's Automobile Race in Monaco, more than 80 people died when a car with magnesium metal crashed and exploded into fire.

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[14] **Flint is composed of silicon dioxide (quartz).** In sedimentary stone, it can be precipitated out of calcium carbonite (limestone). It is a mixture of ultra-fine grains of opal (colloidal silica) or chalcedony (cryptocrystalline). The silica may have come from the spicules of sponges, but flint formation is not well understood. Flint can be found as nodules in limestone beds, where it forms a characteristic patina when exposed to air. Since it lacks a regular crystalline structure, it fractures like glass to a sharp edge. It is hard enough to scratch glass. Obsidian, a volcanic form of quartz, lacks even the microcrystalline structure of flint. Its structure causes it to fracture even more like glass, forming edges so sharp that they can be used to slice objects thin enough to be used in electron microscopy. Obsidian is not native in Kentucky and was a prize import from the west for Native Americans making knives, scrappers, spear points, and arrowheads. Flint used by Native Americans in Eastern North America can often be linked to quarries in specific geographic locations. Corydon, Indiana is one such location, and the Flint Ridge in Ohio, another.

Obsidian begins to form crystals and hydrate over time, so its structure will eventually change. What we commonly call glass is made by heating sand (again quartz, silicon dioxide), limestone, and soda ash at temperatures greater than 3,000 degrees F.

Caves? Flint nodules can be found in limestone and I do have the tiny light. No, that light is a most limited tool. Useless after the battery is exhausted. I shall defend its light zealously.

Maybe other people came here before me. Maybe many people have found themselves mysteriously deposited here to live out a primitive life and expire. Maybe they made tools and used flint. And maybe some of those tools washed and rolled into the streams draining this valley. I will need to find a stream-cut bank to look at the exposed layers of soil. Maybe, just maybe, I will get lucky and find flint rock washed down and now exposed in the soil column sliced open by the stream.

Downslope, I move. The dead snake is slung over my back. I am still hungry. Here I go. There is a floodway adjacent to the creek.[15] There should be good pickings in the opposite stream bank.

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[15] **Flood plains are special places.** Fertile soil. Flat. Take the Nile, for example, before the Aswan Dam**.** Excellent building site. Wonderful water views. Except for the flooding. Some of our nation's most productive agricultural lands lie in the lower Mississippi River Valley, often flooding past the floodwalls. So here are competing forces; floods, and agriculture. And thus the need for laws and regulations to protect agricultural interests, especially when states and the federal government provide expensive disaster relief. More competing forces. This time, private property rights versus the police power of government bodies to regulate risks.

In 1965, a hurricane hit Louisiana, killing 75 people and causing more than $1 billion in damage. In 1968, the United States Congress passed the National Flood Insurance Act of 1968 (NFIP) (P.L. 90-448), 42 U.S.C. § 4001 et seq., which states in part:

> (a) Necessity and reasons for flood insurance program– The Congress finds that (1) From time to time, flood disasters have created personal hardships and economic distress, which have required unforeseen disaster relief measures and have placed an increasing burden on the nation's resources; ... (3) As a matter of national policy, a reasonable method of sharing the risk of flood losses is through a program of flood insurance which can compliment and encourage preventative and protective measures. (42 U.S.C. § 4001).

By 2010, the NFIP had sustained losses of almost $20 billion (this included costs associated with Hurricane Katrina in 2005). In 2010, there were 5.5 million

properties insured by NFIP, with residential homes insured at $350,000, and non-residential properties at $1,000,000. In 2010, 50% of the homes insured were in Texas and Florida. And more than 25% of the residents of Florida and Louisiana participate in the program. Approximately 5.5 million properties are currently insured in the program.

Climate change with global warming is threatening coastal regions with increased flooding. In January of 2017, the National Oceanic and Atmospheric Administration released its report, entitled, "Global and Regional Sea Level Rise Scenarios for the United States," which includes the following partial statement in its Executive Summary:

> The projections and results presented in several peer-reviewed publications provide evidence to support a physically plausible GMSL [Global Mean Sea Level] rise in the range of 2.0 meters (m) to 2.7 m [approximately six feet, seven inches to eight feet, ten inches], and recent results regarding Antarctic ice sheet instability indicate that such outcomes may be more likely than previously thought. To ensure consistency with these recent updates to the peer-reviewed scientific literature, we recommend a revised upper-bound scenario for a GMSL rise of 2.5 m [approximately eight feet, two inches] by the year 2100 ... (NOAA Technical Report Nos. CO-OPS 083; page vi).

The Federal Emergency Management Agency (FEMA) maintains maps of the nation's floodplains, which have a one-in-one-hundred chance of a flood every year. These 100-year floodplains are defined as Special Flood Hazard Areas (SFHA). FEMA will provide flood insurance to states that adopt regulations that are at least as stringent as FFIP requirements (see 44 CFR Chapter I, Subchapter B - Insurance and Hazard Mitigation, §§ 59-80):

> *Base flood* means the flood having a one percent chance of being equaled or exceeded in any given year. (44 CFR § 59.1)
> *Flood* or *Flooding* means:
> (a) A general and temporary condition of partial or complete inundation of normally dry land areas from:
> (1) The overflow of inland or tidal waters;
> (2) The unusual and rapid accumulation or runoff of surface waters from any source.
> (3) Mudslides (i.e., mudflows) ...
> (b) The collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water ... or by an unanticipated force of nature, such as flash flood or an abnormal tidal surge ...
> (44 CFR § 59.1)

Kentucky's Division of Water requires flood plain development permits. KRS 151.250. The Division of Water Flood Mitigation Program has a 65-page "Quick

But wait–what is this? The grasses in this meadow are unnaturally aligned. And they are similar in appearance. Have they been planted? Some in primitive rows, some in mounds. People did this!

I crouch low in the adjacent patch of tall prairie grass and look around for danger. Nothing moving. I wait a long time, listening for the return of the gardeners. There must be other humans, banished here like me.

They too would have been hungry. So hungry that they had desperately turned to growing plants with tiny seeds for nourishment. They will never realize that those tiny seeds will raise up great civilizations with even greater numbers of people.[16] And those people

Guide to Flood Plain Management in Kentucky" (2009; http://www.water.ky.gov). $206 million in insurance payments were made in Kentucky between 1978 and 2009. The highest numbers of flood claims are in Eastern Kentucky.

FEMA also produces a 585-page guide entitled, "National Flood Insurance Program (NFIP) Flood Plain Management Requirements; A Study Guide and Desk Reference for Local Officials." (FEMA 480, February 2005).

[16] **This was the beginning of the great agricultural revolution** with the maturation of part-time gardening into deliberate selection of favorable plant characteristics, breeding, and cultivation. But it still took that silly visionary to convince those big game hunters that these little seed grasses held the key to their future survival, expansion, and power. It happened at different times in different places around the globe. Its effects came later to Eastern North America, arriving in force only around 500 A.D. with the development of temperate hardy corn from Central America. Those crops led to the development of the Great Mississippian civilizations like that at Cahokia on the Mississippi River across from St. Louis, or Wickliffe mounds in Western Kentucky near the junction of the Ohio and Mississippi Rivers.

Here, we will focus on Mesopotamia, the "Fertile Crescent" where, during the Neolithic Period 12,000 years ago, complex agriculture began. There, grasses led the way. Barley (*Hordeum vulgare*), and wheat (*Triticum spp.*), combined with various legumes such as lentil (*Lens culinarus*) and chickpea (*Cicer arietinum*, also known as the garbanzo bean).

The lands of Mesopotamia are fertile and need only irrigation to sprout great quantities of these foods. Large villages soon formed, generating significant disputes between its inhabitants. Enter Hammurabi. He wasn't the first "law giver," but he was an early one. He engraved his laws on a basaltic stele around 1780 B.C. in Babylonia, where he was King. There are 282 laws inscribed on the stele. The first

will come to reproduce beyond the carrying capacity of the land. But that will come much later. For now there would be a more primitive competition for calories.[17]

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one states, "1. Any person convicted of proffering charges against another person which he cannot substantiate shall be put to death." Number 282, the last law, states, "If a slave says to his master, 'you are not my master' and is proven guilty of this, his owner may cut off his ear." (Records of the Past, 1903, Vol. 2, Part 3). The Lillian Goldman Law Library at the Yale Law School has posted an online translation by L.W. King as part of their "Avalon Project, Documents in Law, History and Diplomacy." That translation mentions "corn" 55 times.

"Aye, there's the rub" (Shakespeare's Hamlet contemplating suicide). Corn was not available in the Old World until it was "discovered" in the New World by Columbus more than 3,000 years after Hammurabi lived. What gives? Examine the original Oxford English Dictionary (OED). My copy is a single volume with four pages reproduced on one page and sold with a magnifying glass. It appears that the original translators of Hammurabi's stele were British. Here is the OED definition of the word, "corn:"

> Corn ...
> I. *gen.* a grain, a seed ...
> II. *gen.* Spec. the fruit of cereals ... (OED, 1971)

The same confusion (at least to Americans, where corn is corn) appears in Arabic, where the word for corn is the same word as that for grain, sonbol.

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[17] **"Lebensraum," living space, as Adolf Hitler defined the term.** It was one of the prime objectives of Nazi Germany in World War II. Unlike the United States with western lands and its "manifest destiny," Germany only became a single nation in the late 1800s. By then, western nations had already established their expansive colonies. What African colonies Germany had in Africa, it lost in World War I. In the 1930s, Germany was unable to produce enough food for its population and mobilize for war. According to one author (Snyder, 2015), this led to desire for the fertile agricultural lands of the east and the demonization of the Jews and Slavs located there. "For Germany ... the only possibility of a sound agrarian policy was the acquisition of land within Europe itself ... I need the Ukraine ... in order that no one is able to starve us again, like in the last war." (Citing Hitler in Snyder, pp. 15, 18, 2015). Although convinced of the power of science in the development of his war machines, Hitler did not believe, or want to believe, in the power of science to improve food production and yield. That "Green Revolution" was just around the corner and would have removed the need for calories as an argument for war.

It would be easy to see them killing me, an unwelcome resource invader. Killing me like a snake. Would they cook and eat me, too? Lots of calories, and all of the essential amino and fatty acids.[18]

That cold shudder returns to my body, but this time runs down the sinewy tendons along my spine. Tendons that they would gently strip off my back, soak in water, and bind wooden shafts to their stone tools and weapons.[19]

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[18] **The human body cannot manufacture all of the organic compounds that it needs to function.** All too often we think of food only in the context of our caloric needs (energy) or the impact of various types of food on disease (e.g. saturated fats, and added sugars). But there are also essential organic compounds that we must ingest in our food and cannot manufacture in our body. Proteins are composed of amino acids. The essential amino acids needed from our diet are: 1) Arginine (youth); 2) Histidine; 3) Isoleucine; 4) Leucine; 5) Lysine; 6) Methionine; 7) Phenylalanine; 8) Threonine; 9) Tryptophan; and 10) Valine. Kwashiorkor is a disease of malnutrition caused by a deficiency of protein in the diet. There are also two essential fatty acids: 1) Linoleic; and 2) Alpha-Linolenic.

Essential vitamins obtained in our diet include: 1) Vitamin A (beta-carotin); 2) Vitamin B1 (thiamin) (prevents the disease Beriberi); 3) Vitamin B2 (riboflavin); 4) Vitamin B3 (niacin); 5) Vitamin B5 (pantothenic acid); 6) Vitamin B6 (pyridoxine); 7) Vitamin B7 (biotin); 8) Vitamin B9 (folic acid); 9) Vitamin B12 (cobalamin) 10) Vitamin C (as ascorbic acid) (prevents the disease scurvy); 11) Vitamin D (ergocalciferol, cholecalciferol) (prevents the disease rickets); 12) Vitamin E (tocopherol); 13) Vitamin K (naphthoquinoids). In addition, the following fifteen minerals are needed from the diet, either as electrolytes or as trace minerals: 1) Calcium (Ca) (atomic #20); 2) Chloride (Cl) (atomic #17); 3) Chromium (Cr) (atomic #24); 4) Cobolt (Co) (atomic #27); 5) Copper (Cu) (atomic #29); 6) Iodine (I) (atomic #53); 7) Iron (Fe) (atomic #26); 8) Magnesium (Mg) (atomic #12); 9) Manganese (Mn) (atomic #25); 10) Molybdenum (Mo) (atomic #42); 11) Phosphorus (P) (atomic #15); 12) Potassium (K) (atomic #19); 13) Selenium (Se) (atomic #34); 14) Sodium (Na) (atomic #11); and 15) Zinc (Zn) (atomic #30).

[19] **The Stone Age was hardly primitive.** The progression from chipped stone tools to the sharp slicing edges of obsidian was magnificent. The development of uniface edge stones (Oldowan) through the beauty and utility of bifacial hand axes (Acheulean) and composite blade tools (Microlithic) led to the Neolithic Period (New Stone Age). Small-grained rocks like flint and obsidian were worked into use as blades, spears, darts, and arrowheads. The evolution from hand axes, full groove axes, the larger and later three-quarters grooved axes, through to the smooth celt, gave early North Americans command over their environment. Along with fire, they felled trees, cleared fields, made housing material and boats. You should be so lucky to have such tools and weapons if you were found alone and abandoned.

Yikes!

I got up. Hunger made me do it. I headed to the creek bed. My path led directly through the garden. I hesitated, but for a very short time, just long enough to recognize the species cultivated. That told me of their nutritional needs.

As I passed through the garden–that term is not really accurate by our definition–I was able to catalogue the plants. College does that to its students, exposes them to science and the arts of which they are otherwise ignorant. College raises the lid on the treasure chest. The chest of knowledge. I had lifted that lid and feasted on the glowing jewels within.

But I would have spent too much time in college, learning and teaching. Delightful. Eventually I had to choose a degree and leave. So biology it was, and law for a living. I wonder what would have happened if I had chosen English? Hah! A better storyline perhaps! Tighter syntax, better use of phrases, and greater exploitation of rhetorical devices. But as spontaneous?

I had been exposed to the plant kingdom and I was aware of the historical development of these primitive gardens and their contents. Here was tall goosefoot, and the even taller marsh elder. And off to one side, in an area burned clean by fire, grew numerous clumps of little barley, its clusters of tiny seeds bouncing atop its short stems as though fruit baskets waiting for the plucking. I looked around further. I knew what this assemblage was. Words have power and these plants were part of an assemblage we call the "Eastern Agricultural Complex" of the early Native Americans.[20]

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[20] **Agriculture is the topic of this paper.** And for each of its elements, there is a history. Better law through history. We are now people of the corn, the potato and of the tomato. And all three of these crops are from Central and South America. Line out a graph of population growth against time. Is it just a coincidence that population on the planet exploded after the spread of these plants across the globe?

Corn was finally bred to succeed in temperate climates and arrived in Eastern North America as "flint" corn around 500 A.D. The impact of this temperate

hardy corn was immediate and fed the furnace of population growth that archaeologists call the Mississippian Period. This was the time of the great civilization at Cahokia in Missouri, across the Mississippi from St. Louis, where 10,000-20,000 people lived. Cahokia is listed as a World Heritage Site by the United Nation's Educational Scientific and Cultural Organization (UNESCO). It is also protected by state law. (See the Archaeological and Paleontological Resources Protection Act, 20 Illinois Compiled Statutes 3435, 1990, and 17 IAC 4190; and the Human Skeletal Remains Protection Act, 20 Illinois Compiled Statutes 3440, 1989, 17 IAC 4170 (31); and 20 Illinois Compiled Statutes 3420, 199, IAC 4180). In 1985, the Illinois Historic Preservation Agency (IHPA) was created.

But I digress. It is the agricultural practice in Eastern North America prior to the arrival of temperate hardy corn that is the topic of this footnote. That nascent agriculture is called the Eastern Agricultural Complex. It was a gardening practice adjunct to hunter-gatherer societies. The plants cultivated were, for the most part, seeded, with the exception of squash (*Cucurbita pepo*), which was grown for gourds and seeds. The seed plants were harvested for two different nutritional requirements. Sunflower (*Helianthus annuus*) and sumpweed (marsh elder, *Iva annua*) were grown for oily edible seeds. Starchy seeds were collected from maygrass (*Phalaris caroliniana*), erect knotweed (*Polygonum erectum*), little barley (*Hordeum pusillum*), and goosefoot or lamb's quarters (*Chenopodium berlandieri*). These gardens were supplanted by the arrival of The Three Sisters, temperate hardy corn, beans, and squash from Central America. Look on the back of the American Sacagawea dollar. There they are, The Three Sisters.

Beans are an important nutritional companion in corn diets. Corn is deficient in the essential vitamin, niacin (Vitamin B3, $C_6H_5NO_2$, precursor of NAD and NADP). Without niacin, the symptoms of the disease pellagra develop. Beans are relatively high in niacin. The "nixtamalization" of corn is a process developed in Mesoamerica. It makes the bound niacin in corn more available. It involves soaking corn in lime (calcium hydroxide) and ash (potassium hydroxide). Hominy grits are nixtamalized corn, as is the "masa" flour sold in grocery stores. Nixtamalization allows corn to form a dough.

Corn is also deficient in the essential amino acids, lysine and threonine, which are readily available in beans. Amino acid deficiency in primarily corn diets can lead to the disease Kwashiorkor. Corn provides good sources of the two essential amino acids, methionine and tryptophan, which are deficient in beans. The two crops complement each other.

And what of those garden plants of the Eastern Agricultural Complex that were being grown in Kentucky before the arrival of The Three Sisters? Wild birds and humans still eat sunflower seeds, but the original gourd species has vanished. The other seed species have also vanished or can only be found as roadside weeds. The cousin of one is now the trendy health food, quinoa (*Chenopodium quinoa*), a native of the Andes.

Now where were they growing sunflower? Those bright yellow petals with the dark dotted center of seeds. Surely, with such a loud display, they would announce themselves. I was caught up in the hunt. Again, the search for knowledge. So captivating is the effect of learning. I had forgotten my concern about the return of the gardeners!

I probed the edge of the field near the creek. The dead snake body brushed off my shoulder. It fell lifelessly across my shoe. As I reached down and picked up its limp body, I again felt both hunger and revulsion. I tucked its body under my belt.

Need to find flint, I remembered. Into the woods by the stream I went.

Bingo.

Sunflower!

No, wait. This flower is smaller, growing in a copse of sunlight penetrating to the stream bank.

It's the Earth Apple! How did it ever come to be called the Jerusalem Artichoke?[21] I grasped one of its stout stems–tugged, twisted, and pulled. Pop! Out came its roots and tubers. Those beautiful, swollen, maggot-looking tubers. My mouth squirted shots of starch-breaking enzymes onto my tongue. Oh, I was hungry.

But I knew better. The sugar in this plant's storage center was in the form of inulin, a polysaccharide of fructose for which humans have no enzyme sufficient to break out the sugar. Left to ripen, these tubers

[21] ***Helianthus tuberosus*, the Jerusalem artichoke.** A sunflower. Wild, native to North America and full of the polysaccharide inulin, a polymer of the simple sugar, fructose. Delicious. Like a nutty potato. Sweeter if you let the inulin breakdown to fructose in storage. If not, it will just pass through. We lack the digestive enzyme to break down inulin, hence it acts as a fiber. But bacteria in our large intestine can digest it. Hence the gas. Low glycemic index, too. The name is probably of Italian origin, "girasole," meaning sunflower.

break down into sugars naturally. Fructose. Very tasty. I wondered if cooking accomplished the same thing.

The stream was dry and I hopped down onto the flat limestone rock bed of the watercourse.[22] I could see several banks of exposed soil cut by the watercourse in its meanderings.

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[22] **As noted in footnote 4, there is a lot of water in Kentucky.** That is a precious statistic in a country rife with massive population concentrations living on what are essentially deserts. Certainly many populations exceed the carrying capacity of their land. Take Denver, Colorado and Beijing, China, both which capture water from distant watersheds and divert or pipe it into their cities. Los Angeles survives on water from the eastern mountains and the Colorado River, 242 miles distant (think Jack Nicholson in the movie Chinatown). And, of course, the diversion of Hetchy Hetchy Valley water from the Sierra, Nevada Mountains to San Francisco broke John Muir's heart. Fly over the Hetchy Hetchy and look down at the dams. It was the gorge just north of Yosemite.

The Kentucky Water Resources Research Institute (KWRRI) was established by the Federal Water Resources Research Act, 42 U.S.C. § 10301 et seq. The KWRRI is housed at the University of Kentucky. Its website lists the following projects: Floyd Forks watershed, stakeholder involvement, water distribution system, security projects, Kentucky Storm water, Virtual Observatory Ecological Informatics System (VOEIS), Kentucky Total Maximum Daily Load (TMDL), Paducah stakeholder engagement, the Bayou Creek metals study, the Kentucky Nutrient Model, and the Pride Water Quality Project.

The Kentucky Division of Water administers water resources legislation in the Commonwealth of Kentucky through KRS Chapter 151. KRS Chapter 151.110 is entitled, "Water Resources Policy - Duties of Cabinet." KRS 151.140 is instructive in its regulation and exceptions thereto. It is entitled, "Withdrawal of Water from Public Waters, Permit Required -- Exceptions."

> No person, business, industry, city, county, water district, or other political subdivision shall have the right to withdraw, divert, or transfer public water from a stream, lake, ground water source or other body of water, unless such person, business, industry, city, county, water district or other political subdivision has been granted a permit by the cabinet for such withdrawal, diversion, or transfer of water. Provided, however, no permit shall be required for and nothing herein shall interfere with the use of water for agricultural and domestic purposes including irrigation; and no permit shall be required if the amount of water withdrawn, diverted or transferred is less than the amount established by regulation and no permit shall be required for water used in the production of steam generating plants of companies whose retail rates are

I squatted, careful not to step on my future snake meal dangling from my belt. I could see round rocks and smaller pebbles protruding from the opposite cut bank. None appeared like the unnaturally "flaked" surfaces of rocks worked by Native Americans. I stepped over the creek bed and crossed to the other bank. As I probed the clay with a stick, I thought of what else I hadn't seen. Corn.[23]

> regulated by the Kentucky Public Service Commission or for which plants a certificate of environmental compatibility from such commission is required by law, or water injected underground in conjunction with operations for the production of oil or gas. (KRS Chapter 151.140).

[23] **Corn. So much to talk about.** We know where it came from, both geographically and genetically. Its progenitor was native to the Highlands of Mexico, where its descendants still grow it today as a weedy grass called Teosinte. I have grown Teosinte in Kentucky. It grows tall and looks like a cornstalk. I planted it in early spring but never saw a cob forming. I figured that it needed a longer growing season when one week before frost, I saw short, scraggly looking silks seeming to float out of joints. Little faith I. When I pulled back the base of the corn leaf clasping tightly to the stem, I found it! The earliest form of a corncob. A single row of six or eight little triangular kernels tucked neatly together in a tight line. That was a pretty cool moment. I was holding in my hand the history of my people. People of the corn.

Corn is a grass, as are the other significant food grains. As a student, it was important to learn that grasses were monocots, more modern evolutionary descendants of the dicots. As with so much of our plant and animal taxonomy, the science of genetics is discerning new and surprising evolutionary paths of life's development and progress. But there is something else fun and interesting about corn. It is a C4 plant, not a C5 one. That is a big deal. Really.

Photosynthetic plants create glucose, a six-carbon simple sugar, from carbon dioxide, water, and sunlight energy. There are three pathways that different types of plants utilize to feed carbon dioxide into the photosynthetic Calvin Cycle through use of the rubisco enzyme. Rubisco is considered the most abundant protein in the world. The resulting three-carbon intermediate (glyceraldehyde 3-phosphate) can then be converted to sugar and starch. The three types of pathways that can feed carbon dioxide into the photosynthetic system are C4, C5, and CAM (crassulacean acid metabolism). The differences involve the cellular location of the photosynthetic steps, the build-up of oxygen, and the loss of water through the plant leaf's stomata. Most plants are C5 plants. CAM is used by desert plants and is efficient in its use of water. C4 plants, including corn and sugarcane, are more efficient in water use relative to sugar production, but more importantly, can photosynthesize at a faster rate in high sunlight, high oxygen-generating conditions. About 1% of the world's

If I could date the time period within which I now found myself by agricultural practices, I might obtain a more certain knowledge of my predicament. I saw no corn being grown in that garden. No mounds of soil with bean trailers crawling up a cornstalk and squash vines smothering out weeds competing at its base and acting to retain moisture. That practice involved the "Three Sisters." Those Sisters were Mesoamerican cultivars that spread into North America after more temperate hardy corn strains were developed. And that didn't arrive here until about 1,500 years ago. So, if I was right, and these were Native American gardens, I was now living in what our anthropologists call the Middle Woodland Period. There I go. Convenient phrases used to encapsulate loose knowledge. Freud again.[24]

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plants use the C4 method of metabolism. It is this difference in plant photosynthetic mechanisms that makes for an interesting consequence of global warming and increased levels of carbon dioxide in the atmosphere.

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[24] **Freud and food. Totem and taboo.** Sigmund Freud developed intricate and surprising theories of psychoanalysis. One of them involved the eating, or prohibition thereof, of a "totem animal" in primitive societies. Of course, what is old is new so to speak, and Freud was interested in how these basic or primitive instincts persisted in modern culture. He described the "totem" as a sacred object that must not be killed or eaten. Yet, at important times, according to Freud, a "totem meal" performed an important function within a clan.

> The clan is celebrating the ceremonial occasion by the cruel slaughter of its totem animal and is devouring it raw - blood, flesh and bones. The clansmen are there, dressed in the likeness of the totem and imitating it in sound and movement, as though they are seeking to stress their identity with it. ...
> Psychoanalysis has revealed that the totem animal is in reality a substitute for the father; and this tallies with the contradictory fact that, though the killing of the animal is as a rule forbidden, yet its killing is a festive occasion - with the fact that it is killed and yet mourned. The ambivalent emotional attitude, which to this day characterizes the father-complex in our children and which often persists into adult-life, seems to extend to the totem animal in its capacity as substitute for the father. (Freud 1918, pp. 193, 202).

Food, therefore, at least in the "totem meal" sense, may serve an important cultural and psychological function in our society beyond nutrition.

But I was really hungry. I thought of taking a bite out of the raw snake.

Yee Gads! What of its intestines? And would it bleed into my mouth? On to the next clay bank I went.

I had better luck there. Infrequent slivers of flint flakes were embedded in the bank. Someone upstream had been knapping a core ball of flint, making points, edges, and tools. If I could only find one of those larger flint cores, I would be able to hold it tight enough to strike sparks off with my knife blade.

There you are! I see a knapped edge protruding from the clay. I pull it out, wiggling it as I do. It is gorgeous. A beautifully worked flint knife. The tip is broken off, but the edges are still sharp. I drag them across my palm. Ouch! Very sharp. A new tool. I pocket it and continue searching with excitement.

Night is coming. I don't like that. I jump onto the bank and start making a small pile of tinder for a fire. Strips of bark, small twigs. Out with my tiny blade. Strike against the flint. Wow, this is not working. Hard to call these things sparks. I am not going to start a fire this way.[25]

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[25] **We have evidence of fire pits at the Old Bear Site in Shelby County, Kentucky.** These remains are part of the Newton Phase of the Late Woodland Period (ca. 510 A.D.). The remains found there might give you an idea of what's available to eat should you find yourself in the predicament described at the beginning of this book.

> The many fractured animal bones that were found probably represent marrow extraction. Remains of twenty-five animal species were found, including seven white-tailed deer, three black bear, five raccoons, two wild turkeys, and one individual each of gray squirrel, woodchuck, skunk, wolf or dog, beaver, soft-shelled turtle, and terrapin. Plant remains in the pits included squash, honey locust, butternut, shagbark hickory, walnut, and acorns. The presence of the broken bones of one adult human near the site is intriguing.
> (Van Stockum, Jr., 2003)

Becoming a little desperate, and perhaps somewhat foolish, I consider trying to create a friction fire by spinning a small shaft of wood between my palms. I certainly do not have the patience to succeed at that practice, nor had I ever learned the elements of such a fire-starting technique. I look around in the dimming light, and then again at the dead snake in my belt. And there, beyond the snake, I see it. A rattlesnake fern! It is funny how mental association works. That fern might be of some help, but it gets me thinking of other primitive plants; ferns, fungi, and algae. Then it hits me–lichens! Dry tree lichens!

I quickly scout around, careful to look on the north side of tree trunks–at right angles to the setting sun. They were there, of course. Algae, cyanobacteria, and fungal symbionts living entirely in self-sufficient lichen harmony. I wonder if I can eat them too?

No time. I finger the fructose and foliose forms and tear off a handful of dry, crusty growths. Wasting no time, I hold them against one side of the flint core and begin to furiously strike my steel blade against its surfaces. Sparks are sent into the vegetative mass, which flares up and then quickly dies out.

Back to the rattlesnake fern. I get down and look closely at its short pinnately dissected frond. You might think it was a young poisonous Hemlock plant but for the realization that it will grow no taller. It is a European import anyway. Socrates, etc. Not here yet.

What I want now are the fern's tight collection of sporangia on an upright fertile frond. Dry, oil-rich spores. The stuff of magicians, witches, and wizards. Throw a handful in a fire and, pop, a disguising column of smoke will rise.

I run the stalk of spores through my fingers, collecting a small group in my palm. Then, carefully, I sprinkle them within the crevices of the lichens held against the rock with my other hand.

Out again with my penknife. Scratch, scratch, strike, strike.

Pop! The spores begin to catch hold of the sparks.

I began striking and blowing. In a short time, using longer, softer breaths, I had a promising flame in the bed of dry lichens. I gently laid the pile in the tinder of the fire pit that I had built. As darkness filled the spaces within the streamside forest, I lay back against a fallen log, roasting my fileted sliver of snake meat.

It was delicious. Tasted like chicken. But, of course, there are no chickens here.[26] They would first have to be brought from Southeast Asia, where they developed, into Europe and then here, as part of the Columbian Exchange. Same for the Poison Hemlock.

I was not cold that night. My jacket was warmed by the fire and, like our planet, reradiated heat into my sleeping body.

Yes, I slept. You would have too, if you had been through what I had. Tummy full, my mesentery was feeding. Not enough blood for both

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[26] **The wild turkey is native to North America.** Not so the chicken (*Gallus gallus domesticus*). The chicken is native to Asia and reached us through India.

Let us "talk turkey" and not be "chicken" to address the truth. Let us make a wish on a turkey's "wishbone." Turkey is an American bird and it's getting bigger all the time. Come on, you recognize their "carnucles," "snoops," and "wattles." How else would you separate the common American wild turkey (*Meleagris gallopavo*) from the other American species, the ocellated turkey (*Meleagris ocellata*)? True, the ocellated turkey is only found today around the Yucatan Peninsula. That is why it is represented in ancient Mayan drawings. And did you know that, other than the wild turkey, there was only one other bird domesticated in the New World; the Muscovy duck (*Cairina moschata*). That one never made it big on the world food table, but it is still popular with tropical farmers. I will let you figure out the "Muscovy" name for yourself.

By the way, do you know how much bigger the turkey on your table is today compared with 1960? Well, then it was 16.8 pounds in average weight. In 2014, it had risen to 30.4 pounds! A breeder tom is even bigger, between 50 and 70 pounds. For comparison, in 1960 the average American man weighed 166.3 pounds. In 2015, 195.5 pounds. Women in America now average 166.2 pounds, an 18.5% increase from 1960. And both sexes are about one inch taller.

digestion and muscular activity. Sleep came without my awareness of it.

The next morning, however, I was hungry again. Snake meat is good for stocking up on amino acids, but I now wanted base energy–the explosive kind found in sugars and carbohydrates, or the richer load of fat and oil stored for life's energy needs.[27] I could taste the sugars dissolving in my mouth.

I warmed up by the fire and, after the sun rose, heated up in its microwave radiation as I headed back out to the meadow.[28] I added

[27] **Humans describe the use of energy in different ways.**
In food, we use kilocalories (1,000 small calories) but call them Calories (KCALS). Check out any food label. Here is what it means. There are 4.2 joules (international unit of energy) in each small calorie. A small calorie is the energy needed to raise the temperature of water 1.8° F (1° C). In one sugar molecule there are about 680 KCALs of which respiration retrieves 37-50% and traps it in the phosphate bond of adenosine triphosphate (ATP). That is approximately 288 KCALs contained in 36 ATPs per sugar molecule (glucose). That is about 8 KCALs per ATP molecule in the last phosphate bond. About 8.8 ounces of your body weight at any one time is in ATP and represents about the energy in one "AA" battery. But every day you will convert and recycle your body weight in ATP. One alkaline based "AA" battery contains about 9360 joules (or 2.2 KCAL equivalents).
(Van Stockum, Jr., "Human Ecology," footnote 27, 2016).

[28] **We commonly refer to light as those frequencies interpreted by our eyes and brains as sight.** Yet visible light is just a small slice of the wide spectrum of electromagnetic radiation of excited photons, all moving at the "speed of light." These photons carry varying amounts of energy, thus accounting for the different attributes of different frequencies within the full spectrum of electromagnetic radiation. This spectrum, and energy transfer within it, explains in part the "greenhouse effect" on Venus and the current global warming phenomenon on Earth. More on that later, but in the classic model, this radiation is described as continuous waves of various wavelength, frequency, and amplitude. Our world is permeated by these wavelengths and they are passing through your brain and body in floods of

some wood to the fire. I didn't want to go through the difficulty of fire-starting again. I had "captured" my fire and I intended to keep it.

As I rose up on the small hillock, I found the field covered in beautiful white snakeroot. It is interesting to note that when one is hungry in the woods, with no hope of home and safety or cupboard and icebox, plants look different to you. Deliciously different. And I could have just reached down and grasped a handful of the snakeroot's white flowers, rolled them up in one of the plant's green spatulate leaves and chewed on it like a fat, soft sausage. But I didn't.

Some things used to be taught in families. The danger of white snakeroot is still taught by farmers of my time, especially at dairies. But there were no dairies here–farms neither. I had learned the danger of that plant in class.[29]

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frequencies right now. If your brain was so configured, you could watch television, listen to the radio, and sense changes in far away objects. Are they dangerous? Reality is full of field perturbations, so who really knows? Concern, reasonable or not, has been expressed over the use of handheld cell phones.

Here is a summary of the electromagnetic spectrum from longer wavelength, lower energy radiation to the shorter wavelength, higher energy (these are dangerous ones) frequencies. At the low end of the spectrum, wavelengths can be as long as one-quarter the distance between the Earth and moon. The distance shortens to subatomic distances on the other end of the spectrum. The low-end, long wavelength spectrum moves to shorter wavelength power and telephone bands, radio waves, microwaves and then through infrared to visible light. Then, as the wavelength shortens and energy increases, you move through the ultra violet, x-rays, and gamma rays. Much of the sun's energy penetrates through the Earth's atmosphere on visible wavelengths, only to be absorbed by the planet and reradiated as heat in the longer wavelength infrared band. Therein lies much of the story of global warming. Greenhouse gases can more easily "trap" the re-radiation as heat.

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[29] **Snakeroot, *Eupatorium regulon* (now *Agertina altissima*), is a native Eastern North American perennial plant.** It contains tremetone, a chemical that is toxic to horses and concentrates in the milk of cattle. It is this "milk sickness" that may have killed Abraham Lincoln's mother in Indiana in 1818. The disease causes weakness, stiffness, severe constipation, bad breath, and then coma. It is listed in the "FDA Poisonous Plant Database," which states "white snakeroot can be eliminated from pastures by persistently pulling the plant each year." (FDA #: F04968). Lucy Braun (see footnote #1) has a snakeroot named for her (*Agertina lucide-brauniae*) that is restricted to the Cumberland Plateau.

If plants look nutritious in the wild, then slow fat animals look even more so. No tinier oil-rich seeds eaten to obtain those energy-rich fatty acids. Animals like the acorn-plump squirrel and chubby round groundhog look like perfect meals. Lots of extra energy to store up, and surely those two fatty acids that we cannot manufacture ourselves. Ones we must get from our diet. And, of course, in the animals' muscles we would find the twenty amino acids that we use in our body's structure and metabolism, including the nine that must also be obtained in our diet.

I kept walking as I thought. Thinking of food. That is all you do when you are hungry. Fantasize about it.[30]

Whoa! Huge birds sluggishly lifted off and hovered above me. Bald heads. Vultures! Carrion! Fatty meat!

I quickly crossed the hillcrest and saw it. A dead deer, deflated it appeared, by the birds tearing at its innards. Lovely birds. They clean up the mess. We protect them so.[31] But away now, it was my turn. I raced over to the carcass.

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31[30] **Guam is the largest (210 sq. miles) of the Mariana Islands, a chain of isolated sea mounts in the Western Pacific Ocean.** It was the scene of fierce battles in World War II between Japanese forces and United States Marines. My father was there and has written about his harrowing experience (Van Stockum, Sr., 2013). The Japanese invaded Guam (then a U.S. territory) in December 1941. The United States Marines recaptured it in July 1944. Japanese Lance-Corporal Shoichi Yokoi eluded detection and capture, and for 28 years lived in isolation and in a cave dug out in the ground. In January 1972, two fishermen discovered him and he was finally brought out of the wild. What and how he ate during those long years is the subject of this footnote.

Yokoi often dreamed of food, stewed meat, broiled eel and snake. But there were no feasts in his dreams. Maybe such dreams warn the sleeper of famine and propel action. At one point, Yokoi stole a chicken and ate it raw. First he cut off the head and drank the warm blood. Then he threw away the intestines, eating the raw flesh and gnawing at the bones. The dreams worked.

Initially no fire was made for fear of being discovered. Any meat he could store was wrapped up in banana leaves. It soon became maggot-infested but he dug out the maggots with a stick and chewed through the rotting meat.

Yokoi had to be careful for he suspected that two other refugees had died from food poisoning, perhaps from eating the fruit of the palm-like Fredeico Nut Cycad Tree (*Cycas micronesia*). The seed, although nutritious, is rife with cyanide and must be split and soaked many times to leach out the poison. It has been linked to Lytico Bodig disease. Still, it was until recently a traditional food of the island. There are also poisonous toads on the island. Yokoi learned to avoid these. So much for the kindness of nature.

When he did use a fire, Yokoi at first used a flashlight lens to focus the sunlight into an ignition source. The lens broke, and he resorted to spinning a stick on a board to create fire. Then he devised a length of twined palm fiber rope, which smoldered when lit. This "slow match" was also soaked in oil for a lamp. From the fumes of the lamp, he discovered that he could smoke and preserve meat.

Breadfruit (*Artocarpus alilis*) was available from May to October. The large tubers of wild yams (*Dioscorea spinosa*) could be dug in December and January. The coconut tree (*Cocos nucifera*) bore fruit year-round.

Yokoi was able to capture wild pigs periodically with a noose, and even stoned pigs from a tree. He had greater success digging and camouflaging five-foot deep pits. He caught fish in a bamboo basket with coconut meat as bait, which he placed in local streams. He would harvest his baskets at midnight so as not to be seen. Yokoi also fashioned a coconut-baited mousetrap and would fry snails, lizards, and eels. One of his delicacies was the plump liver of a field mouse. He never used salt, fearful of going to the beach for saltwater and being discovered. (Smith, 1972).

After 28 of years hiding on Guam, Shoichi Yokoi returned to Japan in 1972. He died in Japan in 1997, aged 82. He was never introduced to Emperor Hirohito.

Turkey vultures (*Cathartes aura*, which means "cleansing breeze") and black vultures (*Coragyps atratus*) are both native to Kentucky. I have a multi-generational turkey vulture family living in the upper floor of my old dairy barn. My children were raised with them. Hear the strange "ssss" of a juvenile and you will think about having been transported to another planet. But friends they are to you and me. The Cherokee called turkey vultures "peace eagles" because they did not kill their prey. Black vultures do feed off small livestock afterbirths and still-borns, but they lack the talon strength to lift and fly away with food like hawks. My family is always pleased to see a vulture atop our broken-down silo or old dead behemoth oak tree with wings outstretched to the wind (the horaltic pose). They look like priests preaching to their flock, but I suspect that they are desiccating any parasites that found their way into their wing feathers.

They are like that. Fussy about cleanliness. That is why they have no feathers on their heads. They don't want to pick up anything extra when they are rooting around in the abdominal cavity of a dead animal. Did you know that they vomit on their legs? Same reason. They will sometimes urinate on their legs to kill and clean any hitchhikers they may have picked up down there. And vultures will vomit corrosive stomach acid in defense. Groovy.

Yup, plenty of muscle and fatty tissue left. A gold mine! I sat down and tore off some tissue. The odor of that spot was pretty rank, but I factored in that the animal had been dead for a while and moved forward in my mission. I clamped down on a dry, greasy piece of meat and jerked it around until it tore off in my mouth.

Yuk! Yee gads! It tasted slimy and rancid and sour at the sides of my mouth.

Bad! I thrust it out of my mouth and rose up spitting.

It was disgusting and now the odor made me want to retch.[32]

I headed back downslope to the good air. Plant food it would have to be. Though I did wonder in passing if I might snare one of those fat

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It is against Kentucky law to kill a vulture without a permit. That is because both species of vultures in Kentucky are protected by the Federal Migratory Bird Treaty Act of 1918. (16 U.S.C. § 703-712). The law incorporates portions of treaties with Canada, Mexico, Japan, and Russia. The Supreme Court reviewed the implications to state law in upholding the treaty in *Missouri v. Holland*, (1920), 252 U.S. 416. The list of migratory birds protected by the Act can be found at 50 F.R. 1013. A description of listing history can be found in the March 1, 2010 *Federal Register*, 75 F.R. 9281, entitled "General Provisions; Revised List of Migratory Birds." The list now encompasses 1,007 species of birds.

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[32] **The Roman Empire had an affinity for meat and fish.** Unfortunately, much of that food tended to rot in the hot Mediterranean sun. Age, shall we say. So even though it might still be nutritious, a lingering odor was not especially attractive. Enter the Roman's favorite sauce, liquamen or garum. Same stuff probably. Better ingredients in one versus the other. Have you ever smelled Thai Fish Sauce? That is all you will smell. That is probably the smell of liquamen. Yuk. But as a measured ingredient, an unbelievably tasty addition. The Romans put it on everything.

Here is how they made it. Scrape out the pieces of fish from your net, and cover them with salt. Then put the mixture out in the sun for several months. You will then have an awful, rotten liquid mess. Strain out the bits of tissue left and pour it on your favorite not-so-fresh food. Viola! (As the later Gauls might say).

There is another great food additive of Roman times, but it is a bit more of a mystery. Actually, it is a complete mystery. Silphium. Another one for you to research. From North Africa and then gone. You search for it.

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squirrels. The flint blade that I pulled from the bank would skin them quickly.

I shift again to the thought of carbohydrates and the enzyme amylase squirts from the sides of my mouth. Sugar, that's what I want. Maybe some greens, too. I look around. Maybe some dandelions or chicory greens. I love their yellow and blue flowers.

But there are none, of course. Wherever I was, I at least knew *when* it wasn't. It wasn't after Columbus "discovered" America. Dandelions and chicory plants are not native to the New World. They had probably been brought in as hitchhikers. Travelers within the Colombian Exchange.[33] And they were not here now. Day lily bulbs? Same thing. European in origin. None here.

Nope, definitely not modern times.

Back to the stream. I walk among the floodplain flora and see the carpet-like expanse of may apples. Maybe there are some of those singular, dangling, red-ripe fruits hanging from the green parasol of leaves spreading out on top.

I know, I know, they must be completely ripe or they are toxic. The fruits are gone anyway. Gone in a mid-summer ripeness. I want to bite into one of those meaty-looking leaves brushing against my face as I look underneath. Just like a box turtle, I want to nibble away. Hunger makes you like an animal, but I had learned not to eat that leaf. School again.

Maybe there were some Paw Paws within the understory of this streamside forest. Paw Paws are also known as Kentucky Bananas! Maybe there is a persimmon tree. No, better to wait for winter for those

[33] ***Brassica oleracea*** **is known as wild cabbage and is native to Europe.** Humans have cultivated and selected traits for consumption using all parts of the plant. The following foods all derive from this plant: Brussels sprouts, cabbage, broccoli, cauliflower, collard greens, kale, kohlrabi and rutabaga.

fruits. They need to be soft and ripe to avoid that bitter taste. More squirting mouth juice. So sweet and tasty.[34]

Look, a new puffball. I reach down and squeeze it. Fresh. Don't eat the mushrooms, I say to myself. You don't know them well enough to avoid the poisonous ones, and many species look alike.

Dagnabit! I was hungry. In frustration, I grabbed the leaves of one of the greenish herbs nearby and stuffed them in my mouth.

Ugh! My mouth twisted up like roasted chestnut skin. My tongue withdrew into my throat, and I gagged as I expelled the bitter mass that swelled up with my forsaken saliva.

What toxic defense had that plant raised against ingestion? It could have warned me like the monarch butterfly. I knew better than to eat that lepidopteron![35]

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[34] **Drupes, nuts, fruits, vegetables, and tubers. Herbs.** Colloquial terms with a botanical basis. But the law sometimes applies a more practical definition. See *Nix v. Hedden*, (1893), 149 U.S. 304. In this interesting case, the Supreme Court was required to determine whether a tomato was a vegetable or a fruit under the Tariff Act of March 3, 1883. The lower court found that, for the purpose of the Act, (which excluded fruits), the tomato was a vegetable.

> Botanically speaking, tomatoes are the fruit of a vine, just as are cucumbers, squashes, beans, and peas. But in the common language of the people, whether sellers or consumers of provisions, all these are vegetables which are grown in kitchen gardens, and which, whether eaten cooked or raw, are, like potatoes, carrots, parsnips, turnips, beets, cauliflower, cabbage, celery, and lettuce, usually served at dinner in, with, or after the soup, fish, or meats which constitute the principle part of the repast, and not, like fruits generally, as dessert. (Nix, Supra).

[35] **The Monarch Butterfly (*Danaus plexippus*) feeds on milkweeds (*Asclepius spp.*)**. The butterfly concentrates cardenolides, heart-attacking steroids. So you see, there is a reason to reject bitter-tasting foods. Butterfly-eating birds have figured this out.

I went to the creek to wash and cleanse my palate. Minnows! Now what would it take to eat those little beasties?[36] Saliva ran again as I thought of plopping that piscine into my mouth. I was over the squiggle fear. I was hungry. One bite with my teeth and a swallow. That's all it would take. A delicious thought.

Back on the stream bank. I pulled down a sapling. Its spring pulled me up and over the root-bound grass clumps bordering the stream. It was easy to traverse the riverside hardwoods swept clean of underbrush by frequent freshets.

I climbed up the slope behind the creek. Now, how did those Kentucky Bananas get up there? I saw the distinctly ovate understory leaves upslope. I know of no native animals with large enough guts to allow passage of their gigantic seeds. No matter. I could see the thick, oblong fruits. I was in time. The pulp thieves, animals like me who

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[36] **The Federal Water Pollution Control Act Amendments of 1972 (FWPCA) were a direct outgrowth of President Richard Nixon's expansion of the permit authority available under the Rivers and Harbors Act of 1899 (the Refuse Act, 33 U.S.C. § 407).** Although President Nixon vetoed the Act as too expensive, his veto was overridden and the law continues to protect the nation's waterways as the Clean Water Act (33 U.S.C. §1251(a) et seq.). Here are some of the goals and policies set out in the Act:

> (1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985; ...
> (3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited; ...
> (7) it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this chapter to be met through the control of both point and nonpoint sources of pollution. (33 U.S.C. § 1251(a))

That's where fathead minnows (*Pimephales promelas*) and water fleas (*Ceriodaphnia dubia*) come into play. Bio-monitoring. Looking for toxicity in whole effluent. See 40 CFR 136.3. It is a tribute to our people that the nation continues to pursue the lofty goals set out in the 1972 FWPCA. Maybe fathead minnows and water fleas are found in the stream described in this story.

would feed on that exotic, aromatic custard flavored fruit, had yet to tear them apart.[37]

The mind is a great thing, and imagination even greater. A flood spilled out of the corner of my mouth as I reached the understory cathedral of Paw Paw clones that represented this forest all linked together as one individual.

I grabbed a low-hanging fruit. I squeezed and snapped and soon had one in the palm of my hand. My penknife quickly sliced it open. I pried out some of its yellowish flesh and swept it into my waiting, open mouth. Oh, how wonderful. Is this how the Pharaoh felt when he tasted the first orange? I kept scooping, but it immediately became obvious that the seed took up almost all of the room inside the casing. I grasped one and it slipped between my fingers. It was almost the size of a half dollar and swollen in width like a thick black tick. I rolled it around my teeth, scraping off the titillatingly tasty, aromatic pulp.

I was fearful of catching the seed in my throat. My God, how big were the animals that evolved to ingest and disperse these seeds?

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[37] **The Pleistocene Geologic Epoch of the Quaternary Period is the period of glaciers in North America.** We date its beginning at approximately 2.5 million years ago, concluding with the retreat of the glaciers about 12,000 years ago. We call the next Epoch that followed the Holocene. We like to call it the Age of Humans.

In the Americas during the Pleistocene, there were giant creatures extant on the land. Mammoths, mastodons, gomophotheres, ground sloths, toxodons, and glyptodonts. These creatures are gone now. Whether due to human hunting, climate change, or both, they are extinct. But they leave behind memories of their majestic presence. Trees with special fruit and seeds upon which they fed. Those trees have continued to reproduce, even though their dispersal agents have vanished. They are a shimmering mirage of what once was, but is no more. Few animals can eat the large fruits, large seeds, and sometimes bitter contents. In Kentucky, they include the Kentucky Coffee Tree (*Gymnocladus dioicus*), Honey Locust (*Gleditsia triacanthus*), Paw Paw (*Asimina triloba*), Persimmon (*Diospyros virginiana*), and Osage Orange (*Maclura pomifera*). Those big Paw Paw seeds were meant to travel through the gut of large creatures, dispersing far and wide in their already fertilized bed of dung. Now the creatures that feast on the Paw Paw fruits steal the pulp and leave the seed. A sad fall for once so mighty trees and their praetorian guards!

I ravaged five of the fruits right there, and pocketed more that I could reach. Those remaining would not last long on the tree, but I would return the next day and collect again. I headed back to my campsite and its fire.

Just in time, too. I raced over when I saw no flames. Just embers.

I quickly knelt before that religious portent and gently blew life into it until flames returned. Then I slowly placed dried leaves, one at a time, blowing each one aflame until I felt safe enough to leave it and get more twigs and small branches. Eventually, a teepee of dried logs surmounted the tiny basket of tinder barking out shouts of tiny flames. Soon enough my log temple was all aflame in my honor. I curled up near it, relaxing in the carbohydrate metabolism of Paw Paw pulp.

It does not take your digestive enzymes long to dispatch the various carbohydrate packages into glucose. And it mostly happens in the small intestine, thereby quickly emptying out the stomach.[38] There I go. Hungry again!

I remembered the logs that I brought to the fire. One of them had a peanut-sized grub under it. A dull, whitish, plump accordion with a bushy head and busy mouthpiece.

Come to think of it, the groundnut is like a peanut and surely grew around here. I saw the winding vines and pinnate leaves with lancelet leaflets in my mind. And also in the vine category, did I see any wild grapes? I would need to be careful with those and not eat a similar-looking moonseed. Its leaves are like those of grape but its delicious-

[38] **The Vagus nerve, Latin for "wanderer," runs from the cerebellum down to your abdomen.** It is your stomach talking to you. "Gut instinct," "gut reaction," "listening to your gut," "visceral feelings." Who hasn't felt "butterflies" in their stomach and become "sick to their stomach" with anxiety and fear? Hunger involves the vagus nerve, hypothalamus, the hormone ghrelin, neuropeptide Y, leptin, and pro-opiomelanocortin. But in the absence of a meal, I find that it is the shrinking of the stomach that fires up the vagus nerve the most. Have you ever sneezed when you were hungry?

looking berries are very toxic. I pictured both in my imagination for later investigation.[39] I was off after that grub.

I reached the spot where I had removed the log and brushed aside the leaf mull. There he was. Wriggling like he knew dinner was on my plate. I gently lay down sideways on the forest floor and reached over to pluck out the beast. I grabbed it by its fat little body, which began testy movements, writhing at my touch. I knew what I would do, even though I had never done it before.

I inserted that little black head between my front teeth, snapped off the primitive cerebral center, and spit it out before it could grasp onto my tongue with its mandibles. It couldn't, of course. It had no significant biting parts. It was a grub, after all. But I was not going to dab its head with my tongue tip to verify that fact.

I was quick to return to that still-squirming, fat little body. I placed its headless shoulders to my lips and half squeezed, half sucked the colloidal suspension of fluids that flowed into my mouth. I threw down the exhausted casing and licked my lips.

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[39] **Groundnut is *Apios americana*, a perennial vine also known as hopniss.** Native Americans relied on hopniss for nutrition, especially in the winter.

There are six native species of wild grape in North America: summer grape (*Vitis aestvalis*); sand grape (*Vitis rupestris*); frost grape (*Vitis riparia*); fox grape (*Vitis lubrusca*); mustang grape (*Vitis mustanensis*); and the muscadine (*Vitis rotundifolia*). Most wine is made from cultivars of the European species, *Vitis vinifera*, which leaves only one other species to be accounted for, that being *Vitis amurensis* in Asia.

In Kentucky, wines are made from native *Vitis lubrusca* grape; American-French hybrids between *V. vinifera*, *V. ruprestris*, and other European cultivars. In Kentucky, small family wineries are licensed through KRS 243.155 and defined at KRS 241.010 (5).

Moonseed is the poisonous climbing vine, *Menispermum canadense*. All of the plant contains toxicity, including the seeds. They are crescent shaped, unlike the round seeds of the wild grape. Also, grapes have tendrils, which moonseeds lack. Be careful what you eat in the wild!

Now, where had I learned to do that? I think hunger remembers more than we do. Anyway, the slime tasted smooth, savory. Umami! Glutamic acids and nucleotides, no doubt.

But it was rather bland tasting. I looked around for something to spice up my meal. The adjacent prairie meadow seemed promising. There had been no fields of waving yellow mustards this fall, I knew. European plants again. But I had seen some native species up there.[40] Soon I was chewing a pepper-green mash of leaves, cutting into and wiping up the grub mixture of intestines, organs, muscle, and slime from my mouth. My stomach had shrunk some after the Paw Paw orgy. It would take more time to digest the grub paste.

Satisfied, I put more wood on the fire. That would be a primary occupation of mine in the days to come. I began to consider hunting. Killing animals. That would take tools and weapons. I thought back on my archaeological studies. Rocks and sharpened sticks. Spears with ligament sinew tying on flint points. The incredible rapid-fire weapon of the Native Americans, the "Atlatl."[41]

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[40] **1. Native dandelions (*Taraxacum spp.*);** 2. The common blue violet (*Viola sororia*); and 3. Wild leeks (ramps) (*Allium tricoccum*).

[41] **This is the atlatl, the one Aztec weapon feared by Cortez.** Its efficiency was recorded by Conquistador Bernal Diaz Del Castillo in 1520 A.D. He wrote of the atlatl, the Aztec word for the weapon in their native Nahuatl language, in his book, *A True History of the Conquests of New Spain* (published posthumously in 1632). The atlatl is a spear thrower capable of repetitive fire and sending an obsidian-tipped dart through chest armor. That's why Cortez feared it. Arrows bounced off their metal cuirass, but atlatl darts penetrated into the flesh below. Eskimo hunters still use them and they are featured in the opening scenes of the movie, "Apocalypto," by Mel Gibson. The atlatl is composed of a two-foot hand-held launching stick (the spear thrower), a long arrow-like shaft, and a short detachable dart with a sharp, flaked spear point hafted at its end. The use of this spear thrower developed after the demise of the megafauna at the close of the glacial ages 12,000 years ago, and before the use of the bow and arrow in Kentucky around 500 A.D. What most artifact collectors call "arrowheads" are actually atlatl points or the blades from earlier, true spears.

I drifted off into a warm nap, wondering if I would be there long enough to crossbreed some of the plants in the garden.

But those plants had already been selectively bred. And well hidden behind the bank and the brush were those planters who were determining my future.

Snake meat or adopted tribal member? The planters had not yet decided my fate.

From behind the stream bank, one of the warriors rose up quietly and cocked his spear thrower directly to the back of his shoulder. He then let the dart fly, the swoosh of its movement muffled by the winged banner stone weight on the throwing shaft.[42]

Accordingly, I did not hear of its passage until it collided with its target.

II. AUTHOR'S NOTE

So, my dear readers, I choose to begin this study of food in a short work of fiction. An adventure story, yes, but one rooted in fact.

I hope this unconventional beginning will catch your attention as you, my protagonist, progress through the time sequence of culture, food, and regulation that I present in this work.

I endeavor to write in an engaging, informative style, making use of grub-like footnotes hidden beneath the text and full of savory detail.

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[42] **The throwing stick, or spear thrower portion of the atlatl has a stone weight tied to its middle.** The advantage of weight to the physics of the throw is debated, but in the Southeast, it developed further, changing shape. Here a winged form, the "banner stone," developed. These flat, wide stones had holes hand-drilled through the middle of the stone's axis through which the spear thrower slipped. These bannerstones appear to add a noise-cancelling effect when swung. "Atlatl Bob" Perkins made an authentic reproduction of a southeastern atlatl for me. Its sound in operation is much quieter than those with the more linear banner stones used out west. So, not only is it a rapid-fire, high-caliber firing mechanism, it is a stealth weapon!

That is where you will find the supporting science, law, and society that feed this work.

This exercise in educational exploration moves forward as an intact, entire vehicle within the text alone. Therein lies the adventure in learning of this fascinating subject. Storyline and data too!

The footnotes may be laborious, but I hope rewarding each unto itself. Few readers will perhaps exhaust those references, so I feel safe in indulging my interests. For example, the lack of a magnetic field on Mars is a sobering reality for those seeking Elysian Fields for the expansion of humankind on that planet (see footnote 11). Likewise, a discussion of the Milankovitch Cycles might upset your standing on this "Terra Firma" (see footnote 84). What would you eat if you were stranded on a tropical island for 28 years (see footnote 30)? Maybe the unthinkable (see footnote 52). And maybe you will miss the humor that I am otherwise able to bury within the footnotes.

But the story itself is a good read, I think. For those who read it, pleasant steps. For those more adventurous souls who will sail within the footnotes, fair wind. I will see you in class!

III. INTRODUCTION

You would think that your experience with a variety of foodstuffs is vast. So you might consider that describing that from which you draw your daily enjoyment and sustenance would be a relatively simple topic to set out. Outside of exotic foods and unusual dishes of ordinary foods in our diet, there do not seem to be so many different foodstuffs in our daily lives. And within them all there is only a small subset of organic chemicals in four general categories.[43] Of the 118 natural elements now listed on the periodic table, only a handful is utilized by the human body in any great amount.[44]

[43] **Carbohydrates (simple sugars); lipids (fatty acids); proteins (amino acids); nucleic acids (nucleotides).**

[44] **Major Elements in the human body by mass and relative percentage:** 1) Oxygen - 65%; 2) Carbon - 18%; 3) Hydrogen - 10%; 4) Nitrogen - 3%; 5) Calcium -

Yet when you think of food, it is probable that you do not think of it like an organic chemist. You don't analyze it in a way that a biochemistry student might explore the backbones of carbon atoms peppered with hydrogen highlights that make up the great variety of life's "hydrocarbon" products. If you did, you might muse, momentarily, about the wondrous diversity of sugars and carbohydrates produced in the varied plant life on the planet.[45] You might even hesitate long enough to consider that almost all of life relies on the creation, consumption, and metabolism of one simple sugar, glucose–six carbons, twelve hydrogens, and six oxygens.

And in your assessment of food, it will not take long for your personal history with the subject to surface. It is a subject, the memory of which is triggered by the many tastes, hungers, and odors that you have picked up from your living environment. Original survivor skills.

The sense of smell is itself a wondrous ability of humans to catalogue the great diversity of organic compounds in nature, some food and some poison. But we will not begin the history of food in civilization through smell. We will start with the examination of taste. Taste does, after all, more immediately drive what we ingest, and as we will see,

1.5%; 6) Phosphorus - 1.0%. Water (H_2O) ranges around two-thirds of the weight of the human body and that accounts for the high mass of oxygen. Life is based on carbon-based compounds. But why don't we have skeletons made of silicon? Some sponges do, and that may be one of the sources of silicon found in flint nodules of sedimentary rock. You know, the ones early Native Americans "knapped" into tools and weapons.

[45] **And carbohydrates are everywhere.** They come as monosaccharides of simple sugars such as glucose, galactose, and fructose; disaccharides such as sucrose (glucose and fructose; table or grape sugar), lactose (glucose and galactose; milk sugar) and maltose (glucose and glucose; malt sugar); and polysaccharides of many simple sugars joined together such as starch (e.g. potato) and glycogen ("animal starch," a storage reservoir in animal liver and muscle). The exhaustion of glycogen is often referred to as "hitting the wall" by runners. Plants also produce a polysaccharide we call cellulose, which humans can't digest. Microflora in the guts of horses and cattle can do so and they enable those animals to forage and eat hay. Insects also produce a polysaccharide, chiton (insect shell), for their exoskeleton. We can't digest that either, but it is rather crunchy, and insects can be quite nutritious!

why we eat. Thus, I begin this descriptive journey, hoping to elicit your own memories of taste, and perhaps even spice them up with long-held whiffs of familiar scents.

IV. TASTE

Humans are a species of the genus *Homo*. Carl Linnaeus gave us that name in 1758. We are members of the family *Hominidae* in the order of Primates. We are all designated as part of the class, *Mammalia*, in the phylum *Chordata* of the kingdom *Animalia*. Although as *H. sapiens*, we are the only living species of the genus *Homo* extant, there have been at least seven others before, and in some cases, with us. They have colorful names such as Handy Man, Java or Peking Man, the Hobbit. The most recent of our sister species was called Neanderthal Man, *Homo neanderthalensis*.

It turns out that *Homo sapiens*, modern humans as we like to call ourselves, interbred with the older species, Neanderthal Man. That species is now extinct, which may have had something to do with the competitiveness and violence of our species. But we can still track the presence of Neanderthal Man through his genetics. And our genetics. For you see, on average, modern humans contain between 1-4% of DNA that was contributed from the Neanderthal genome.[46] In fact, about 20% of the total Neanderthal genome survives in different populations of our people.

Neanderthals gave us varying skin and hair characteristics, some of which are found in more than 65% of our European population. Modern humans also received some deleterious genes from Neanderthals. Their contributions may impact the occurrence of Type II Diabetes, Crohn's Disease, Lupus, smoking and depression in our species.

[46] **Except certain areas in Africa.**

But what did these ancient species of the genus *Homo* eat? There is a lot of colloquial fantasy, and some scientific investigation, on the subject. And surely much of what they ate was determined by taste.

We have identified five elements to the sense of taste, and they are not just pleasure principles.[47] There are even more elements to the sense of smell, and smell may be just as important as taste to our eating habits.[48] Indeed, when breathing through our nares, we are "tasting" the air. But back to our tongues.

Taste is flavor data, rewarding us for eating some foods and warning us away from others. We are all familiar, for example, with the power of sugar. Sweetness. Addicting. Our body bases its energy metabolism on just one type of hexose, the six-carbon simple sugar glucose. Other sugar units (there are sixteen six-carbon hexoses and fructose, a six-carbon ketose) are converted in the glucose oxidation cycle when we burn them for energy. We call that process respiration. Breathing. Oddly, glucose is not the sweetest tasting of these simple sugars. That is fructose, which is present in high quantities in honey and also in the indigestible polysaccharide inulin (think Jerusalem artichoke).

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[47] **Democritus was a Greek philosopher who lived around 400 B.C. in Abdera Thrace.** He expounded on the theory of atomism. He also related his theory to explain the sense of taste. For Democritus, taste was related to the basic shapes of atoms freed up by chewing; sweet was due to round atoms; sour, jagged atoms; pungent, fine, round, angular atoms; salty, large, twisted, two equal sided atoms; bitter, small, curved, smooth ones; and oily, small and round atoms. (Robinson, 1968).

[48] **Mixing ingredients that stimulate the five senses of taste leads to the diverse foods, and cultures, found in our societies.** But how many truly different tastes can you make? Not so limited with the sense of smell. The human nostril contains four hundred different smell detectors. One laboratory performed tests that indicated that humans can detect at least one trillion odors! (Bushdid, 2014). That is what makes fine dining truly a garden experience.

But here is a curious condition. Perhaps 4.5% of the population has a variety of "Synesthesia," where senses are merged. Seeing colors when tasting or smelling, for example. Creativity runs with this condition and many who have it are artists.

So we are addicted to sweets because we are addicted to energy and the plants that trap it and the animals that concentrate it and convert it to other important human building blocks in their bodies. When you are hungry, you can dream of sweetness and crave the taste. It is a survival mechanism.

The taste of sour is protective. It is the warning of decaying, rotting food. Such matter may contain dangerous pathogens, causing sickness and even death. Nevertheless, in the cuisine culture of certain societies, sour is intentionally added to enhance food dishes. And then there is the enticingly sweet, and very sour, lemon!

Bitter is another defensive taste. Many plants and animals produce toxins as a warning to predators. Another survival mechanism of the tongue. Stay away.

Salt is integral to the operation of our cells and movement of materials across its membranes. It also aids in preserving foods in longer storage, preventing them from rotting. The taste for salt is a powerful urge. A powerful need. But salt can be overwhelming. Try drinking saltwater. You will die of thirst cast adrift on an ocean.[49]

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[49] **See this quote from a 1958 article in *Natural History*, a journal founded by New York's American Museum of Natural History.**

> At the beginning of dehydration there is thirst and discomfort. Succeeding symptoms, in order, are lassitude, loss of appetite, sleepiness, rise in body temperature and, at about 5 per cent dehydration, nausea. At from 6 to 10 per cent dehydration, the victim will experience dizziness, headache, tingling in the limbs, dry mouth, difficulty in speaking, and inability to walk. At more than 10 per cent dehydration, delirium is common, and the senses fail. Dehydration of 25 per cent is probably fatal at any temperature. At air temperatures above 90 degrees F., 15 per cent dehydration is the theoretical fatal limit. ...
> ... as dehydration increases, the victim's will to resist the desire to drink sea water weakens until finally he succumbs to the temptation and death is caused by the ingestion of sea water. ...
> ... There is immediate slaking, followed quite soon by an exacerbation of the thirst, which will require still more copious draughts. The victim then becomes silent and apathetic, with a peculiar fixed and glassy expression in the eyes. The condition

Perhaps the most curious taste of all is the fifth one, umami. Discovered and described just over 100 years ago in Japan, it detects a "savory" smooth, enticing flavor. Its discovery was the reason for the addition of monosodium glutamate (MSG) as a flavor enhancer to foods. It informs the palate of the presence of amino acids, many of which we cannot manufacture and must ingest.[50] Melted cheese is high in umami. Is that why we love pizza and cheeseburgers?

V. THE PALEO DIET

Then there is the question of what foods our distant forbearers digested. Were they meat eaters? Herbivores? Or were they just opportunistic feeders, consuming whatever was in season or that they

> of the lips, mouth, and tongue worsens, and a peculiarly offensive odour [sic] has been described in the breath. Within an hour or two, delirium sets in, quiet at first but later violent and unrestrained; consciousness is gradually lost; the color of the face changes and froth appears at the corners of the lips. Death may take place quietly: more often it is a noisy termination, and not infrequently the victim goes over the side in his delirium and is lost. (Allen, 1956).

[50] **Umami, delicious, yummy, savory.** The French chef Auguste Escoffier may have been cooking to it in the late 1800s. But Kikunae Ikeda, a Japanese chemist, discerned its essence in "dashi," a Japanese savory soup of seaweed. He discovered that it was based on the presence of glutamic acid. Ikeda was the one to name it in a chemical journal more than 100 years ago. It is the "L" form of glutamate that is most powerful. Anchovies are packed full of it. Why else would you eat one? Okay, maybe you like salt, too. Fermented soy sauce gets you there, also. Ikeda also pioneered the use of monosodium glutamate, MSG, as a flavor enhancement. Or you can just eat a ripe tomato. Mouth-watering. A subtle pleasant after-taste will remain. Umami. Have another!

There are receptors on your tongue for L-glutamate. But why? Your body needs to ingest amino acids that it cannot manufacture itself. Free glutamate acid, whether from cooked meat, aged cheese, fermented soy, or ripe tomato, tells the body that digestible protein is available. Amino Acids. Your tongue encourages you to continue to feast. And Umami is enhanced by the presence of certain nucleotides. The building blocks of our genetic system, its transcription and translation, and energy transfer. The sensation of taste is not for your pleasure. It is for your survival. Enjoy!

could catch? Is it our teeth that give it away? Our digestive system? What did Neanderthal Man eat?

There are conflicting theories concerning our ancestors' diets. It is probable that they were omnivorous, eating the wide variety of foods available at different times of the year. And there is some evidence of possible cannibalism.[51]

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[51] **Cannibalism.** A shocking word. Dangerous, too, as we will see. We have recorded it in nature. Black widow spiders and preying mantises. But it appears that cannibalism is a widespread strategy in the animal kingdom. See for example the lace-weaver spider (*Amaurobius ferox*), or tiger sharks. Better for you to research that for yourself. And debate has surrounded Peking Man and Java Man (*Homo erectus*) and whether associated bones are evidence of cannibalism. It appears that cannibalism may have been widespread at different times (Chong, 1990). It occurred in Asia, Europe and the Americas. See the famous discussion of the Donner Party in Western North America, or the stranded Uruguayan rugby team. (Read, 1974).

Some primitive tribes of New Guinea are also believed to have engaged in the practice. That practice involved funerary cannibalism where relatives ate the rotted meat of the corpse. In addition to the meat, the brains of the deceased were mixed with ferns and roasted in bamboo tubes. Women were sometimes primary consumers because it was believed that they could better control the powerful spirits of the dead. In the 1950s, it was discovered that many in the population were dying of a mysterious ailment. They called it "Kuru," laughing death. In 1976, a researcher won a Nobel Prize for demonstrating that the disease was transmitted in brain tissue. Only later was that agent of disease discovered to be the prion, a "proteinaceous infectious particle." Think "Mad Cow Disease" in England, "Wasting Disease" in American deer populations, and Creutzfeldt-Jakob Disease in humans. About One in a million humans in the United States may contract the disease.

What would you do if you were stranded in a lifeboat at sea? Draw straws? It is called the "Lifeboat Strategy."

Cannibalism is not addressed by law in the United States. It is, however, covered by the criminal statutes regarding "corpse abuse." In Kentucky, corpse abuse is addressed in KRS 525.120, entitled "Abuse of Corpse," partially reprinted below:

> (1) A person is guilty of abuse of a corpse when, except as authorized by law, he intentionally treats a corpse in a way that would outrage ordinary family sensibilities ...
> (2) Abuse of a corpse is a Class A misdemeanor, unless the act attempted or committed involved sexual intercourse or deviate sexual intercourse with the corpse or the deliberate failure to prepare, bury, or cremate a corpse after the acceptance of remuneration

We do know that grass grains and cereals had yet to be cultivated and animals had not yet become domesticated. Humans were foragers, gatherers beginning to develop tools for hunting. Roots, tubers, and fruits would have provided complex carbohydrates with honey, perhaps, providing the infrequent and exceptional taste of sweetness. But how would they get the necessary essential amino and fatty acids from their diets? Animal tissue was surely important. And genetic selection for tool and weapon-making traits accelerated the capture of game. But it may have been the taming of fire that provided the most important innovation in hominoid nutrition.

Fire, of course, provides light and warmth. It can also be a weapon. And it inaugurated a new occupation for our hominoid ancestors. Cooking. And cooking is not just for the benefit of taste. It is argued that cooking provides new, more easily obtained sources of nutrition, allowing for a surplus of calories to feed the evolution of larger brains. Cooking can also change the composition of foods available for absorption, releasing essential nutrients not otherwise available. It is also important in preparing mixtures of different foods that combine to provide essential nutrition. And boiling can leach out poisons, making available new sources of nutritious food previously thought too toxic to eat.[52]

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into any contract negotiated, in which it is a Class D Felony.

For a discussion of Ohio's corpse abuse statute, see *Condon v. Wolfe*, 310 Fed. Appx. 807 (6th Cir. 2009). The famous 1884 English criminal case, *Regina v. Dudley and Stevens*, is perhaps the most instructive legal and cultural case published on the matter.

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[52] **Cassava (*Manihot esculenta*) is a South American carbohydrate-rich tuber.** Yet it is little known in the United States. We see it here mostly in the form of tapioca. Yet it is, after rice and corn, the third greatest source of carbohydrates in the tropical nations. More than 900 million people rely on it. And it is poisonous. Cyanide. *Time Magazine* labeled it as one of "the 10 most dangerous foods." Cassava must be significantly processed to remove the toxins. Then there is the delicacy of sliced fugu (blowfish). More cyanide. Yet 10,000 tons are eaten annually. Yikes!

But the biggest nutritional development of our species was the increase in the availability of calories created through agriculture. That development required, however, the counter intuitive realization that small grains and kernels, if gathered in sufficient quantity, can produce an excess of caloric needs for a family. Intentional gardening and selection of larger, more nutritious strains of plants produced even more calories per plant. The agrarian revolution had begun. Family structures changed, populations increased, and civilization, at least as we describe it, began. But some of the best soils for growing crops were arid and needed irrigation, and others flooding. That effort required coordination and group effort. Society and order. Bingo!

VI. CIVILIZED BEGINNINGS

Hammurabi's stele was erected in Babylon almost 4,000 years ago. The stone stele sets out 282 laws carved in cuneiform, including the principle of "an eye for an eye" (Lex Talionis) and many provisions dealing with contract as well as domestic relations. The provisions of interest to us here deal with "corn." The problem is that "corn" is native to the Americas and was not introduced into the "Old World" until after Columbus' voyages to the "New World" in the 1400s A.D. What gives?

Here is an example of an early translation of the cuneiform on Hammurabi's stele; "If he gives a cultivated cornfield or a cultivated sesame field, the corn or the sesame in the field shall belong to the owner of the field..." (The Avalon Project, Yale Law School; avalon.law.yale.edu). Even Austen Henry Layard describes "corn" in his description of Assyrian Bas-Relief sculptures excavated in Nineveh.

The explanation can be found in the Oxford English Dictionary. When Hammurabi's stele was translated into English in the early 1900s, the translator used an old agricultural term for whatever grain was being grown in the field. That word in England's English was, and still is, "corn." But it is not what we Americans definitively identify as "corn," the Native American maize (see footnote 16).

Now why was Layard thinking about food as he was digging into the ruins of Nineveh in 1845? Romantic, yes, but terrifying, times. They still are.

VII. THE EXCHANGE OF PEOPLES AND FOOD

We call it a revolution in food, but it took much time and experiment to establish. And after its development, it took even more time to distribute across continents and within populations. Sometimes it even came back from where it started with new, even more popular food. Two examples are instructive. One involves the spread of agriculture and animal husbandry into Western Europe. The second is what we describe as the great "Columbian Exchange" of animals, plants, and people between New and Old Worlds.

The migration of agriculture into Western Europe from the east brought along a sophisticated culture of animal husbandry in addition to seed crops. And it was a culture that embraced the consumption of milk and milk derivatives. Milk contains a sugar, actually a two simple sugar combination called lactose, a "disaccharide." But enzymes that are present in infants necessary to breakdown that lactose in their mother's milk are lost after weaning. So a milk-based culture required the expansion of a gene continuing to produce through adulthood the enzyme capable of breaking down the lactose in milk. More than 60% of the world's human population is lactose intolerant. But in Europe, the agricultural revolution was accompanied by an increase of lactose tolerance in the population. And a great proportion of American citizens are descended from this European culture. We drink a lot of milk here.

The Columbian Exchange had an even greater impact on the world. It is defined by trade between New and Old Worlds. Where would the planet's population find the calories for growth without corn and the potato?[53] They are not native to the Old World. And what would

[53] **The great diversity of the natural potato stock can be seen at the Potato Park (Parque de la Papa) in Peru.** It is an indigenous Bio-cultural Heritage Area

American farms look like without pigs, cattle, and horses? They are not native to the New World. No cattle drives, no dairy farms, no "Old Kentucky" horse farms, and no "beasts of burden." Only the llama was available in the Americas and could only be used for small loads.

With the advent of trade through the Columbian Exchange, the availability of foodstuffs exploded. The world's population did too. The potato, whose many varieties still populate its land of origin in the Andes Mountains of South America, is a power pack of energy-rich carbohydrates.

Americans are well-versed in the Irish diaspora to America after the failure of that country's population-supporting potato crop. And potatoes were a life-saving crop during winter European wars. Armies, like locusts, consumed all foodstuffs within their reach. They were rarely interested, however, in digging further in the ground looking for potatoes! China is now the number one producer of "spuds."

The Columbian Exchange created a change in world culture and order. The American lands received new, larger animals capable of greater work, meat and dairy production. The Old Worlds, which included Asia and Africa, obtained high calorie crops of great yield. The populations in both areas surged. And what would Italian dinner dishes look like without the tomato? Another American import. And Asian dishes? No heat without these American chilies!

Yet there had been earlier trade between disparate human populations. The famous Silk Road, traversed or imagined by Marco Polo in 1271 A.D., had to cross a continuous, 3,000-mile long barrier of mountains from Manchuria to Afghanistan. Imagine the wonder of traveling from China along a 4,000-mile long trail, crossing the Gobi and

(IBCHA) where 600 varieties of potatoes grow. The Peruvian International Potato Center is even studying how to grow potatoes on Mars!

Taklamakan deserts around a chain of oasis, and standing before the great defile of the Dzungarian Gate.[54]

Into the fertile grasslands you would walk. Past the site of the 751 A.D. Battle of Talus, where the Muslim Abbasid Caliphate defeated the Chinese forces of the Tang Dynasty, eventually converting most of Central Asia to Islam. Then onto Samarkand, now in Uzbekistan, the "door" to trade on the Silk Road, and eventually the seat of power of Tamerlane and the Timurid Empire.

An even earlier route of trade between Asia, India and the Middle East (and hence Europe) involved coastal sailing from the southern tip of Saudi Arabia to India and its Asian trade connections. Eventually, Arab sailors developed navigational tools to cross the Indian Ocean directly. Yemen was more important than just a source for frankincense and myrrh then. It was a bustling center in this Asian trade. And the description of coffee as "Mocha" comes from the name of one of its ports. Both this trade route and that of the Silk Road would traverse Iraq, making Bagdad and the Abbasid Caliphate wealthy in trade.[55]

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[54] **A 46-mile long gash through the mountains, 6 miles wide at its narrowest,** where one could walk along a deep fault line past snow-capped mountains 13,000 feet above her.

[55] **Thirty years ago, California produced 40% of the world's raisins.** Prices have dropped 25% from their 10-year average. As a result, only 165,000 acres are currently in raisins in California's Central Valley. In 2000, there were 280,000 acres in raisins. Many farmers are tearing out the grapevines and replacing them with almond trees at a cost of $7,000 per acre. Turkey and Iran are also significant producers of raisins, with Turkey expected to be the number one producer in the world.

Horne v. United States Department of Agriculture, No. 12-123, 569 U.S. _____ (2013), and No. 14-275, 576 U.S. _____ (2015) are cases dealing with the USDA's National Raisin Reserve. The Reserve is an outgrowth of Depression Era price collapse in the raisin industry. Congress authorized the USDA to obtain excess raisin production so as to buoy market prices. The plaintiff barred the government from gathering his raisin crop, thus engendering a legal review under the "Takings Clause" of the Fifth Amendment to the Constitution.

Writing for the majority, Chief Justice Roberts stated, in part:

> ... The Fifth Amendment applies to personal property as well as real property. The Government

To a great extent, the Portuguese voyages of Vasco da Gama, which reached India in 1497, changed the flow of trade from the east to the west. And we cannot leave the global trade in foodstuffs without discussing the triangular trade in African slaves, Caribbean sugarcane and molasses, and New England rum.[56]

> has a categorical duty to pay just compensation when it takes your car, just as when it takes your home. ... This principle, dating back as far as Magna Carta, was codified in the Takings Clause in part because of property appropriations by both sides during the Revolutionary War. This Court has noted that an owner of personal property may expect that new regulation of the use of property could "render his property economically worthless. ... But there is still a "longstanding distinction" between regulations concerning the use of property and government acquisition of property. ... When it comes to physical appropriations, people do not expect their property, real or personal, to be actually occupied or taken away. ... The reserve requirement imposed by the Raisin Committee is a clear physical taking. Actual raisins are transferred from the growers to the Government. Title to the raisins passes to the Raisin Committee. The Committee disposes of those raisins as it wishes, to promote the purposes of the raisin marketing order. The Government's formal demand that the Hornes turn over a percentage of their raisin crop without charge, for the Government's control and use, is of such a unique character that it is taking without regard to other factors that a court might ordinarily examine. (Horne at _____).

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[56] **Triangular trade can apply to a number of transoceanic shipping schemes.** One of the most infamous involved the "Middle Passage," carrying African slaves packed in the holds of sailing ships headed for the Caribbean Islands. It began in various forms in the 1500s, extending into the 1800s. Here is one way it worked in regard to sugarcane (*Saccharum sp.*). Sugarcane is native to Southeast Asia. It was imported into the Caribbean Islands by Christopher Columbus, where it flourished. Sugarcane cultivation is labor-intensive, however, and disease reduced the number of Native Americans available to work on the sugarcane plantations. Soon, European traders were sailing the first leg of the Triangular Trade, bringing

America was also the recipient of foods carried in by migrants from Central and South America. A three-part plant complex called the "Three Sisters," spread into Eastern North America around 500 A.D. The assemblage was grown together in a single mound with each species complementing the other by providing favorable growing conditions. Eaten in combination, they provided nutrients that one alone lacked. We even honor the "Three Sisters" on the back of the Sacajawea Dollar.

As would happen later when New World corn reached the Old World, the new corn arriving in Eastern North America provided

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manufactured goods to West Africa where they purchased slaves for the next leg to the Caribbean Islands, the Middle Passage.

In the Caribbean, African slaves grew and processed the sugarcane into refined sugar. Because of the nature of the trade winds, the next leg of the trade brought the products of sugarcane processing, sugar and molasses, to New England. There, molasses would be made into rum. These ships would then carry rum, sugar, tobacco, cotton, and finished goods back to Europe or directly to Africa.

Rum was made from molasses. Molasses was the concentrated dregs left after the sugar was removed from sugarcane syrup. It became a product to which value could be added through fermentation. A lower weight good with concentrated alcohol and enhanced profitability. This rum was prized in the Americas, Europe, and Africa as an essential trade ingredient. African slaves, Caribbean molasses, New England rum. A profitable, punishing example of the Triangular Trade.

The transatlantic slave trade, including that to Brazil, lasted approximately 366 years. The trade in North American slaves lasted approximately 250 years. There were as many as 12.5 million Africans enslaved and transported to the Americas. Twelve generations of families. In 1750, one male slave was valued at six ounces of gold; or two muskets; or forty pounds of gunpowder; or 8.5 gallons of Danish brandy; or twenty cowrie shells. In 1860, North American slaves were valued at approximately $3 billion in today's dollars. In 1850, one plantation owned 1,092 slaves, and produced four million pounds of rice each year. The rice was sent to the Caribbean to feed slaves working on the sugar plantations. One slave was expected to tend five acres and produce two thousand pounds of rice each year. (Civil Rights Museum Exhibits, Memphis, Tennessee, 2017).

In the 1760s, one slave was expected to produce 200 pounds of sugar, or 3.5 "hogs heads" per year on the Caribbean sugar plantations. Molasses was the residue of sugar processing. 110 gallons of molasses were converted in New England to 73 gallons of rum. Rum would then be transported to Africa where it would be used to purchase more slaves. In 1767, slaves could be bought for the following trade goods: one male for 130 gallons of rum; one female for 110 gallons of rum; one young female for 80 gallons of rum. (Civil Rights Museum Exhibits, Memphis, Tennessee, 2017).

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abundant calories resulting in new population growth here.[57] The great centers of the "Mississippian Period," Native American cities such as Cahokia, opposite St. Louis, sprouted up and flourished. It is not surprising that corn also supported the Great Mayan civilization of Central America, where their culture described a great "Maize Tree" from which humans formed. They placed a representation of this tree in their heavens. You can see it now, growing out of a crack in a turtle shell that you were foolishly taught was "Orion's Belt." The Mayans were perhaps the first true "People of the Corn."

Are plants such as corn facilitating human evolution and expansion? Or is the opposite true? Are we simply the tools for the expansion and evolution of the corn genome? It is a subject fun to consider.

We now have the investigative tools to trace back corn's genetic origins. Our corn, maize, was developed from a tall weedy grass in the highlands of Mexico. Teosinte is what it is called there now, and I have grown it in Kentucky. It requires a long growing season. But one cold October day I saw its short "silk" tassels form and, by first frost, a single row of triangular kernels had matured in a slender paper-like casing. Wow, the first "corncob!"

As the Three Sisters provided the extra calories for population growth, Native American societies abandoned the early gardening crops they had been selectively growing. The plants that had formed the earlier Eastern Agricultural Complex disappeared from both cuisine and the environment, although a Bolivian relative of goosefoot, Quinoa is now a nutritious and trendy health food.

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[57] **Corn, what can I say about it? Everything! That's the problem.** There is so much to say. Corn is everywhere. All throughout the U.S., all throughout the globe. People of the corn we truly are. And corn is color of the sun. Really, the sun. A child of that fierce fusion of hydrogen into helium. A sponge of solar chaos caught in a smooth yellow kernel of life. How wonderful. And it pops! But far too much of a journey to even begin here. You take the first steps of research and cultural exploration. I will catch up with you later.

There are many issues, facts and events that bear on our experience with food in history. Not all of them, obviously, can be included in this small discussion regardless of the author's intent. But I include, in various footnotes, a cornucopia of delicious entries.

VIII. GRASSES, GRAINS, BEEF, AND CAFOS![58]

We used to classify them as "monocots," more modern forms of the great flowering (literally) of angiosperms. The first flowering plants were a revolution in reproductive success and they soon overwhelmed their predecessors as the dominant plants on land. Those earlier plants, the gymnosperms (including conifers such as pines, spruces, and hemlocks) still exist but generally inhabit more stressed environments. In cold and severe soils, like in the Canadian forests, angiosperm advantages are discounted and the gymnosperm adaptations become competitive. But it is in angiosperm monocot grasses, specifically the order *Poales*, from which the great proportion of the world is fed.

Energy from carbohydrates, carbohydrates from grasses. Small seeds embraced by the big imaginations, feeding even bigger brains in evolving humans. Human minds, which independently across the globe selected tiny seeds to become the basis of their civilizations.

[58] **Agricultural data is telling about the human condition and its manifestations.** 75% of all agricultural lands support animal husbandry and 35% of our agricultural crops go to feed animals. The World Food Programme (United Nations) estimates that 795 million people globally are undernourished, primarily in Asia. In Sub Saharan, Africa, 25% of the population is underfed. This is so even though the global production of food increased approximately 30% from 1985 to 2005. Meat production is caloric intensive. In the United States, to grow one calorie of meat tissue, farmers utilize 29 calories of feed. And, generally, cattle require 20 times more water per calorie than grains for human consumption.

The biggest components of that human feeding come in six grasses: corn (*Zea_mays*), wheat (*Triticum sp.*), rice (*Oryza sativa*), barley (*Hordeum vulgare*), millet (a generic term for numerous species of small-seeded grasses such as pearl millet (*Pennisetum glaucum*), and rye (*Secale cereale*). So perhaps a Queen knew what her people really wanted when she allegedly said, "Let them eat cake." And Cleopatra was valuable to Caesar not only as a consort, but as a supplier of grain. History is all about Carbs!

And that doesn't even include the massive production of sugar from another grass, the sugarcane (*Saccharum officinarum*), or the domestication of rice. And still to be told, the amazing saga of the potato. But those must be revealed in other stories. Too much for this meal.

The dog was the first animal domesticated by humans. The earliest evidence that we have for this domestication is from Iraq, about 12,000 years ago. Whether for hunting, protection, or just human companionship, all modern dog breeds track back to the wolf genome.

Sheep and goats were domesticated in Northern Iraq around 9,000 B.C. They were the first to be herded for food, including meat and milk. And, of course, sheep provided their hair as wool.

By 7,000 B.C., ox and cattle had become domesticated in Asia. They provided abundant meat, milk products, and, importantly, work. Power for transportation and the plow. The big developments of agriculture and animal husbandry fostered more permanent villages. Larger ones, too. Enter Hammurabi.

Cattle (including cows) and ox (in India, the bullock) are different species but are both considered "bovines," a subfamily of the mammal family, *Bovidae*. The Hindu religion generally restricts the slaughter and consumption of cows. The diversity of bovids explains how India, with a religious composition greater than 90% Hindu, can be a large exporter of what we call "beef" in the West.

So how did India become such a large exporter of beef? Water buffalo (*Bubalus bubalis*), another bovid. Water buffalo are in a

different genus than our domesticated cattle (*Bos taurus*). Thus, the slaughter and export of water buffalo as "beef" is not prohibited on religious grounds in India. There are many genera of bovids, including the American bison (*Bison bison*), a species with a tragic history in America and one that, for Native Americans, was an important food source.[59]

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[59] **Bovines (family *Bovidae*) are a large group of ungulates (hooved mammals, formerly the order *Ungulata*).** Ungulates are now classified in two orders, *Artiodactyla* (even-toed, cloven hoof) and *Persissodactyla* (odd-toed). Artiodactyls include cattle, deer, pigs, camels, sheep, dolphins, whales and hippos. Persissodactyls include horses, tapirs and rhinos. The Bovidae family is comprised of Artiodactyls with 60 genera and 143 species, including cattle, sheep, bison, water buffalo, impalas, and goats. Deer are a member of another ruminant (see below) family of artiodactyls, *Cervidae*. Bovids have horns that are not annually shed, like deer. Bovid horns continue to grow year after year.

Another important characteristic of some bovids involves digestion. They are called ruminants. Ruminants "chew cud," hence their name, which is derived from the Latin word for chewing. They chew cud because they can. They have four stomachs and can regurgitate vegetation mass to re-chew and further breakdown the plant cellulose that bacteria is fermenting in their first two stomachs, the rumen and reticulum. The third stomach is the omasum, and the fourth, like a normal singular stomach, is the abomasum. This is "foregut" digestion. We don't have the stomachs or the bacteria to do it. It is a highly specialized system.

There are other animals that house bacteria and can eat and digest plant tissue. They are "hindgut" digesters where the bacteria necessary to ferment and breakdown cellulose lives in the ceacum, an enlarged area between the small and large intestines. These animals include elephants (order *Proboscidea*), and the bovid horses, and rhinos. Hindgut digestion is much less efficient than foregut digestion. But the ability to digest plant tissue increases the size of the candy store. And I won't even tell you how rabbits and termites go about it. You might lose your appetite!

The foregut, hindgut dichotomy has also influenced the evolution of plant-animal relationships and the dispersal of seeds. Some plants have evolved larger, bitter tasting seeds designed to deter crushing and pass through the digestive tract of hindgut fermenters. The seeds are then deposited in dung gardens throughout the land. The bitter toxins may offer pest protection but will also deter large animals from chewing the large seeds. Those seeds become passengers to faraway places on a lumbering bus. Not so for their ruminants cousins that are compelled to chew and rechew their cuds, crushing any large seeds. And the passages between stomachs are smaller in ruminants. Ruminants must also protect the alkaline environment in their foregut's digestion chambers. Too much fruit, sugar, or carbohydrates and the foregut acidifies. Not good for ruminants. And the bacteria will eat up all of the available sugar themselves!

In America, beef cattle are a major economic force, tying tightly into the production of corn and the dietary habits of the nation. Meat production in America is highly regulated through the laws and regulations of the United States Department of Agriculture. The outbreak of Creutzfeldt-Jakob Disease and "Mad Cow Disease" in England in the 1990s, gave us all concern. It led us to understand that a naked protein, the prion, was actually a form of life capable of reproducing in cattle populations. Prions are also present in deer populations where it is believed to be the cause of "chronic wasting disease." The United States Department of Agriculture (USDA) also investigates and orders recalls of American animal products contaminated with infectious disease vectors such as E. coli and Salmonella.

Concentrated animal feeding operations (CAFO) can include smaller animal feeding operations (AFO). They can involve cattle, swine, poultry, and seafood. Much of our animal foods can be concentrated in "Factory Farms." Industrialized agriculture. These operations speak much of our nature, needs, and habits. It speaks to costs, efficiencies, and environmental impact. And it speaks to our humanity. The Wondrous Journey of Food is not necessarily pretty.[60]

By the way, microbes in those fore-stomachs produce a complete range of amino acids, as well as all the B-vitamins.

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[60] **CAFOs are defined by the EPA as large, medium, and small.** 1,000 or more cattle are large CAFOs; 300 or fewer, small. For swine greater than 55 pounds in weight, 2,500 constitutes a large CAFO and less than 750, a small one. Less than 55 pounds? Well, it takes more than 10,000 swine to become a large CAFO in that case. Turkeys? 55,000 will get you in the large category, as will 125,000 non-laying chickens. See 40 CFR 122.23 for EPA's permit regulations regarding "Concentrated Animal Feeding Operations." 40 CFR 122.24 deals with "Concentrated Aquatic Animal Production Facilities." What constitutes an aquatic animal is described in Appendix C to Part 122.

Now for some data. This information gives perspective to the CAFO dialog.

In the United States in 1950, chicken consumption per person per year was 21 pounds. In 2000, it had risen to 77 pounds. In 1950, about 616,000 chickens were killed for meat. In 2000, it was approximately 8 billion. Yet egg consumption has declined per person; 380 eggs in 1950 and 247 per person in 2000.

In 1950, 65 pounds of pork was consumed per person. In 2007, it was 51 pounds. And the number of hog operations declined (and concentrated) from over three million to approximately 65,500 during that same time period.

Beef consumption annually per person increased from 44 pounds to 67 pounds from 1950 to 2000. (Imhoff, 2010).

According to the Humane Society, in the United States 1.8 billion animals were slaughtered in the United States in 1960. In 2014, they calculated that 9.1 billion animals were killed. (The Humane Society, "Farm Animal Statistics: Slaughter Totals;" www.humanesociety.org).

In 1958, the Humane Slaughter Act was passed. It has had three significant amendments. (7 U.S.C. § 1901 et seq.). The Humane Slaughter Act applies to cattle and pigs but not poultry. That exclusion was the subject of a lawsuit by the Humane Society and others against the Secretary of the United States Department of Agriculture. (*Levine v. Vilsack*, 587 F. 3d 986, 9th Cir. 2009). The plaintiffs sought to include poultry as "other livestock" under the Humane Slaughter Act. The 9th Circuit upheld the lower court's dismissal of the action, stating, "Because Levine's alleged injuries are not redressable by way of this lawsuit, there is a lack of standing to proceed with this action." (*Levine*, Supra, at P. 997). The "Findings and Declaration of Policy" in the Humane Slaughter Act are set out below:

> The Congress finds that the use of humane methods in the slaughter of livestock prevents needless suffering; results in safer and better working conditions for persons engaged in the slaughtering industry; brings about improvement of products and economies in slaughtering operations; and produces other benefits for producers, processors, and consumers which tend to expedite an orderly flow of livestock and livestock products in interstate and foreign commerce. It is therefore declared to be the policy of the United States that the slaughtering of livestock and the handling of livestock in connection with slaughter shall be carried out by humane methods. (7 U.S. Code § 1901)

Milk has a wonderful history, and its various products are mainstays of many diets. We have already discussed the fact that as adults, many humans lose the enzyme that was necessary to process lactose (milk sugar) in their mother's milk. That gene in many people of the world turns off the lactase enzyme production as the child matures. Only in dairy-dominated cultures has this gene been selected over time to continue the production of the enzyme in adulthood. Of course "soured" milk, where bacteria have turned milk sugar into lactic acid resulting in cheese and yogurts, is another subject.

Milk dairies have been big business in America. There may have been 650,000 American dairies in 1970, perhaps 65,000 (including concentrated operations) in 2000. Yet there has been an increase in milk cows to 9.2 million head

IX. RELIGION AND AGRICULTURE

References to food are replete in the great writings of history. And these texts present culinary "laws" of what can and cannot be eaten, and what form is acceptable for consumption.[61]

producing 189,320 million pounds of milk in 2009. Milking operations have become larger with more milk produced per cow.

In 2015, total cheese production in the United States was 11.8 billion pounds, Wisconsin producing more than 26% of that total. Mozzarella, Cheddar, and American were the most produced, in that order. Butter production was 1.86 billion pounds. Yogurt, 4.7 billion pounds, along with 865 million gallons of regular ice cream.

[61] **Food figures prominently in the Bible.** For example, take Luke 9:13-17:

> 13. But He said unto them, Give ye them to eat. And they said, We have no more but five loaves and two fishes; except we should go and buy meat for all this people.
> 14. For they were about five thousand men. And He said to His disciples, Make them sit down by fifties in a company.
> 15. And they did so, and made them all sit down.
> 16. Then He took the five loaves and the two fishes, and looking up to heaven, He blessed them, and brake, and gave to the disciples to set before the multitude.
> 17. And they did eat, and were all filled; and there was taken up of fragments that remained to them twelve baskets.

See also Matthew 14:21; Mark 6:31-44; and John 6:5-15 (King James Version).

A second miraculous feeding of the masses is reported in Matthew 15:32-38 (King James Version). See also Mark 8: 1-9 (King James Version).
Water turning into wine is described in John 2:1-11 (King James Version). The catching of fish in Luke 5:4-10 and again in John 21:1-11 (King James Version).

There are also many descriptions of food described in the Quran. For example, see honey (Quran, 16:69), fish (Quran, 18:61-63), the olive (Quran, 24:35), pork (Quran, 2:173), the date (Quran, 19:23-26), milk (Quran, 16:66), and the fig (Quran, 95:1). And the Old Testament contains many additional dietary instructions.

There is a significant debate in the United States concerning the meaning of the First Amendment of the United States Constitution. It is often referred to as the "Establishment Clause," and states: "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; ..."

The language is, of course, relevant to many of the social debates of the day. For example, see a bill introduced in the Kentucky legislature in January 2017 by Representatives D.J. Johnson of Owensboro, and Wesley Morgan of Richmond,

Many religions developed from ancient cultures in the Middle East. Recent archaeological excavations in the area have uncovered evidence that an early prohibition on eating pork had developed in the highlands of Israel during the Iron Age. Pig bones are absent from fire

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regarding "An act relating to bible literacy courses in the public schools." (Kentucky House Bill 128, 2017). The amended Bill passed the Kentucky House of Representatives on February 13, 2017 by a vote of 80-14. On March 6, 2017, the Kentucky Senate passed SB 17 regarding "an act relating to the expression of religious or political viewpoints in public schools and post-secondary institutions."

There are many Supreme Court decisions involving the Establishment Clause of the constitution and the separation of church and state. *Town of Greece v. Galloway*, (2014) 134 S. Ct. 1811, 188 L. Ed 2d 835, is instructive of the issues and dynamics before the court. The case upheld prayer in school and Justice Alito, concurring with the majority opinion of the court, stated in part as follows:

> This brings me to my final point. I am troubled by the message that some readers may take from the principal dissent's rhetoric and its highly imaginative hypotheticals. For example, the principal dissent conjures up the image of a litigant awaiting trial who is asked by the presiding judge to rise for a Christian prayer, of an official at a polling place who conveys the expectation that citizens wishing to vote make the sign of the cross before casting their ballots, and of an immigrant seeking naturalization who is asked to bow her head and recite a Christian prayer. Although I do not suggest that the implication is intentional, I am concerned that at least some readers will take these hypotheticals as a warning that this is where today's decision leads–to a country in which religious minorities are denied the equal benefits of citizenship. Nothing could be further from the truth. All that the Court does today is to allow a town to follow a practice that we have previously held is permissible for Congress and state legislatures. In seeming to suggest otherwise, the principal dissent goes far astray. (572 U.S. _____, (2014); Slip Opinion, pg. 13).

In dissent, Justice Kagan wrote, in part, as follows:

> For me, that remarkable guarantee means at least this much: When the citizens of this country approach their government, they do so only as Americans, not as members of one faith or another. And that means that even in a partly legislative body, they should not confront government-sponsored worship that divides them along religious lines. I believe, for all the reasons I have given, that the Town of Greece betrayed that promise. I therefore respectfully dissent from the Court's decision. (572. U.S. _____, (2014); Slip Opinion, pg. 25).

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pits and trash middens there from that time period.[62] And both the Bible and the Quran provide abundant prohibitions and culinary instructions. Much of their adherents' lives are measured by these strictures.

Cattle are a mainstay of western nutrition. The market for beef drove much of the human migration across the plains of America. But cattle are an ancient product of domestication, providing early advantages to agricultural communities of the Middle East and Central Asia. Beasts of Burden. A cow could provide work, milk, cream, butter, cheese, yogurt, meat, fuel (cow pies), and more cattle. The bull was revered in many ancient societies. For example, Gilgamesh kills the "Bull of Heaven." Moses returned from the Mount of Sinai to a "Golden

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[62] **See Finkelstein and Silberman, 2001, pg. 119.**

A restriction on swine is found in both the Old Testament and the Quran.

> And the swine, though he divide the hoof, and be
> cloven-footed, yet he cheweth not the cud; he is
> unclean to you. (Leviticus 11:7, King James Version).

> He has only forbidden to you dead animals, blood,
> the flesh of swine, and that which has been dedicated
> to other than Allah. (Quran, Surah 2:173).

I would be negligent in my reporting duties if I did not point out a section from the Old Testament Book of Genesis that is often referred to as the "Dominion Clause." It is often interpreted as giving humans sway over all plant and animal life with the power to use them, as well as the Earth itself, to their needs and interests. Here is the King James Version:

> Then God said, let us make man in our image, after
> our likeness, and let them have dominion over the
> fish in the sea, and the fowl of the air, and over the
> cattle, and over all the Earth, and over every creeping
> thing that creepeth upon the Earth.
> (Genesis 1:26, King James Version).

The Quran has similar language:

> Do ye not see that Allah has subjected to your (use)
> all things in the heavens and on Earth, and has made
> his bounties flow to you in exceeding measure, both
> seen and unseen? (Quran, Surah 31:20).

Thus much has been done to this planet and its life forms using religion as support for the authority of human actions.

Calf." The Roman cult of Mithras was based on the ritual slaughter of bulls. And there is always the "Bull Market" of the American Stock Exchange!

In the Hindu religion, cows are an important representation of Hindu beliefs concerning the presence of the Divine in all living creatures. The cow, with its afore-mentioned benefits to society, is the embodiment of such principle. As a result, many Indian states have restrictions on the killing of cows. The Supreme Court of India upheld the validity of such laws in the Indian state of Gujarat.[63] As a result, cows in much of India are protected with sanctuaries provided for their care. These religious prohibitions, however, are not shared by all cultures in India. Their consumption of "beef" has sometimes resulted in political strife.

X. WATER, SALT, AND FERTILIZER

Human beings are as much as 66% water by weight. We are creatures of water, evolved from development in liquid medium. We are born in an amniotic sac of water-based fluids. Water is required for our cellular and bodily functions. Without it, we quickly die. Yet,

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[63] **In 2005, India's Supreme Court overruled the Gujarat High Court's** determination that such a ban was unconstitutional. The law in question was the Bombay Animal Preservation Act of 1994. *State of Gujarat v. Mirzapur Moti Kureshi Kassab Jamat & Ops.*, 2005, Supreme Court of India, Appeal (civil) 4937-4940 of 1998.

The Court's decision was based on Article 48 in the Constitution of India 1949 which states:

> Organisation of agriculture and animal husbandry:
> The State shall endeavour to organise
> agriculture and animal husbandry on modern
> and scientific lines and shall, in particular, take
> steps for preserving and improving the breeds,
> and prohibiting the slaughter, of cows and calves
> and other milch and draught cattle [sic].

In 2016, an owner of a roadside food stall was arrested for selling meat in a rice and vegetable dish in the Indian state of Haryana. He faces a maximum penalty of ten years for the slaughter and five years for selling the meat. (Sorge, 2016).

submerged in water, we die even more quickly. Water, the basis of our lives, is a dangerous alien environment to us.

Water is a simple, yet beautifully acting molecule. In mass, it flows like a silken liquid lace. Because of its structure, molecules or minerals with an ionic charge dissolve within it and are evenly transported throughout its medium. Thus, the ability of water to move nutrients and wastes throughout the body. When these compounds splash up against the cellular wall, the mysterious Second Law of Thermodynamics takes over and transports water's cargo across the cell's semipermeable membrane. Diffusion and Osmosis. Magical processes.

Water floods throughout the human cell. It permeates the tiny and mighty mitochondria, the powerhouse of the cell, providing for respiratory release of energy in the consumption of sugar. From that combustion, Adenosine Triphosphate (ATP), the locomotive of life, quickly travels about the body, dispersing energy for growth and metabolism.

Yet, for all of the water in the world, most has too much salt and is, by the action of that same Second Law of Thermodynamics, dehydrating and toxic.

Migrate to strange lands and you will look for salt. Walk across the Cumberland Gap in Kentucky and you will look for salt. Find salt and you have found a home, for not only do you need salt for the proper function of your cells, you will need it to preserve food over winter. In an age of refrigeration, we forget that. But in lands with limited or no electricity, salt is still golden.

Yet the agricultural revolution was not enough. It built the launch pad and rocket ship for population growth, but still lacked enough fuel. Fuel to carry larger payloads of people. Unconstrained growth in feed stocks is necessary to support such an explosion in population growth. And the selective breeding of grains was not enough. There were other limiting factors.

Fresh water, yes. An immediate concern. But with language, coordination and ever-larger groups of workers, water could be brought to the crops through irrigation. And arid lands were often best suited to grow crops.

No, the real limiting factors are nitrogen and phosphorous. Nitrogen for the amine group in amino acids, and phosphorous for the backbone of genetic material. And pesticides were just as necessary as fertilizers for the modern "Green Revolution." We are not here in such great numbers by chance. We have "terraformed" this planet to support us.

XI. AGRICULTURAL PRODUCTION IN THE UNITED STATES

The United States is comprised of diverse landforms with fertile and productive soils. The story of America's farm production is an exciting, romantic, and sometimes disturbing tale of the settling of this land. Think of the great western cattle drives, and the hunting to near extinction of the mighty bison. Think of the forced migration of Native Americans, the "amber waves of grain," and the "dust bowl." And think of sassafras, tobacco, corn, and cotton.

Sassafras was one of the reasons for the location of English colonies in America. A member of the *Lauracea* family of flowering plants, sassafras oils are aromatic. European plants lack these oils and, consistent with the doctrine of signatures, they were thought to be a cure for illness.[64] Yet the New World actually contained few new spices for the world's consumption.

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[64] **Native Americans called the tree, Pauame, the French, Sassafras.** Nicolas Monardes of Seville in 1574 reported that it was a tree "... of greate vertues, and great excellencies, that thei heale there with greevous and variable diseases [sic] "(Peattie, 1948). Early exploration of America included the search and export of sassafras.

It is the root bark that contains aromatic essential oils. Such aromatic trees were uncommon in Europe. Sassafras was native to North America and Asia. Its use as a "cure-all" has faded, but it is still popular in foods, soaps, and perfumes. It is also used as a demulcent (soothing application for irritation) and an emollient (skin moisturizing).

Tobacco contains a powerful stimulant, which was quickly exported to the rest of the world. The regulation of tobacco production in the United States and the separate regulation of its labeling and consumption represent a uniquely American experience in culture and law.

Cotton, though not primarily a foodstuff, was the natural beneficiary of global trade systems. The importation, and eventual breeding, of human slaves in America to grow and harvest cotton led to a plantation-based system in America where slaves supported other agricultural production as well as animal husbandry. Much of America's agricultural history is reflected by and described in the Declaration of Independence and the United States Constitution. Yet arguments continued over the admittance of new territories as "free" or "slave" states and led to Civil War. Even today there seems to be a modern "politic" separating rural and urban populations. Is the location and production of foodstuffs still the defining character of our nation?

XII. KENTUCKY'S EXPERIENCE

Kentucky is an exceptionally fertile and productive land. It is ancient land, barely touched by the glaciers. Its surface has been eroding and its soil forming since the great seas retreated more than 300 million years ago during the Pennsylvanian Period. Due to a great arching of rock caused by uplift of the Appalachian Mountains, Central Kentucky had eroded down to ancient Ordovician stone laid down more than 450 million years ago.

Kentucky has many unique resources. Some are relatively unknown. The native Paw Paw, *Asimina triloba*, is a delicious fruit of understory trees found in Kentucky's mesic valleys. There are currently programs to develop this fruit into a delicious agricultural commodity.

Uniods, or freshwater mussels, are abundant in Kentucky. In fact, the Green River of Kentucky was one of the centers of mussel

evolution. More than 5,000 years ago, during the Archaic Period, Native Americans feasted on mussels in the Green River of Kentucky. The western portion of that river is replete with ancient trash piles of shells known as "shell middens."

Have you ever tried to eat a freshwater mussel in Kentucky? Good luck! It is hard to get the tough slimy meat from the shell, much less cut the muscle into strips. You should not even try since many of Kentucky's species are threatened or endangered.

And legal protection is in place to regulate mussel shell harvest. One hundred years ago, buttons were made from the shells of these unionoids. And now tiny spherical cuttings of these shells are used as "starters" for the cultivated pearl industry. Although regulated, "midnight" mussel harvesting continues.[65]

Here is current data for crop production in Kentucky.[66]

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[65] **Freshwater mussels also have a place in the industrial history of our culture.** One hundred years ago, there were sixty factories along the Mississippi River with machines that punched out plug-sized sections from thick walled freshwater mussels such as the pistol grip (*Tritogonia verrucosa*). They were then milled for use as buttons. By 1930, over-harvesting caused the industry to decline and substitutes to be found for buttons.

By 1950, the industry was back, but not for buttons. Kokichi Mikimoto of Japan discovered that bits of freshwater mussels used as starter material caused cultured marine oysters to produce beautiful pearls. Chances are that the pearl on your dresser is winking at you. It may have been your neighbor and started out as a freshwater mussel right here in Kentucky.

"Brailling" is fully regulated in Kentucky. That is how the mussels are harvested. Blunt hooks are attached to chains and allowed to drag across mussel beds. The shells close on the hooks and are pulled up with the chains. You can see this operation in the 1955 movie, "The Kentuckian." Burt Lancaster is in search of a freshwater pearl to make his fortune.

In Kentucky, a license is needed to take mussels. KRS 150-520 and KRS 150-525. See also 301 KAR 1:085.

[66] **Kentucky is a state of small farmers.** About 76,500 of them, averaging 170 acres per farm. 51% of Kentucky land is farmed. 57% of these farms averaged less than $10,000 in annual sales. Total receipts from Kentucky farms in 2013 were approximately $5.7 billion. In 2013, Kentucky ranked 16th in farm income, but

XIII. ENVIRONMENTAL LAW AND REGULATION

Alexander Hamilton! To him, in a great part, we owe our Federalist system of government. And to him also, we must attribute some of the angst over state rights when the federal government passes legislation of national application.[67] The individual states claim to know

second in tobacco production. The top four agricultural exports in Kentucky for 2013 were: 1) soybean; 2) other livestock products; 3) wheat; and 4) poultry products. Shelby County is the 4th in number of farms, and Barren County is first.

Poultry production is the top Kentucky agricultural product. 1,274 Kentucky farms raised broilers and meat chickens in 2012. The top five counties are in Western Kentucky. There were more than one million head of cattle in Kentucky in 2015, more than any state east of the Mississippi River. Kentucky has about 714 dairy farms, averaging 88 milk cows per dairy. That's 115 million gallons of milk in 2014. In swine, Kentucky ranks 21st, with 325,000 head in 2014.

Kentucky is first among states in horse sales and has 35,000 horse-based operations. There are approximately 242,000 horses in Kentucky. In 2015, there were 65,700 goats and 48,000 sheep in Kentucky. Shelby County is fourth in the state for the number of sheep.

Kentucky is 14th in state rankings for corn. Corn is second only to soybeans in production in the state. In 2014, Kentuckians harvested 1,300,000 acres, producing almost 225 million bushels of corn (about 158 bushels per acre). The counties with the biggest production are in Western Kentucky.

Soybeans are the number one agricultural product in the state. 1,750,000 acres harvested in 2014, averaging 48 bushels per acre. Again, Western Kentucky led in production. (Kentucky Farm Bureau, 2015)

[67] **The Federal Environmental Protection Agency has recently been the focus of political criticism.** Kentucky Governor Matt Bevin is reported to have said that:

> Nothing would make me happier than to see his [President Trump] administration say, 'you know what? We're going to gut the EPA.' The EPA is not needed at the Federal level ... There's not one state in America that wants dirty water and dirty air for its people ... Not one. We've got the ability to implement, we're already the ones that enforce all the action at the state level. ("Bevin Wants Trump to 'Gut' the EPA," James Bruggers, "Watchdog Earth," *Louisville Courier-Journal*, November 10, 2016)

The Governor of Kentucky has also indicated that he objects to some environmental laws based on constitutional arguments, which include the Tenth Amendment and "Interstate Commerce Clause." Those constitutional provisions state as follows:

> The powers not delegated to the United States by the Constitution,

better. Let us do it. But when it comes to our food supply, the federal government has acted with many comprehensive national programs. Some deal with foods themselves, or additives thereto, and some with food safety. Some deal with farming and agricultural operations. Others deal with the impact of agriculture on the environment. And two of them deal with our most important food of all. Water!

There is a wonderful history to environmental law. Here in the United States, you can trace its development, examine its science, and judge the regulatory response to challenges facing our population. And when it comes to water, its progress is enlightening.

So much discovery and change occurred in America after World War II. It culminated in the exploration of new cultural freedoms and expressions in the 1960s. Americans believed that they could face any challenge and, with science, technology, and the law, conquer it. That newly embraced awareness led to the great efflorescence of federal laws addressing the environment that were passed in the 1970s. And leading

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> nor prohibited by it to the states, are reserved to the states respectively, or to the people. (The United States Constitution, Amendment X).
>
> The Congress shall have Power ... to regulate Commerce with foreign Nations, and among the several states, and with the Indian tribes, (The United States Constitution, Article 1, Section 8, Clause 3).

But see also the "Necessary and Proper Clause" of the United States Constitution:

> To make all laws which shall be necessary and proper for carrying into Execution the foregoing Powers, and all other Powers vested by this Constitution in the Government of the United States, or in any Department or Office thereof. (The United States Constitution, Article 1, Section 8, Clause 18).

Chief Justice Marshall of the United States Supreme Court wrote the seminal case on the "Necessary and Proper Clause" in 1819. It is entitled *McCulloch v. Maryland*, 17 U.S. 316 (1819). Go ahead and Google the citation. The Supreme Court posts its Decisions to the web. Fun reading, especially in times of change!

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the charge was President Richard Nixon and the "Rivers and Harbors Act of 1899" (Refuse Act).[68]

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[68] **33 U.S.C. § 407. Also known as "The Refuse Act," this provision is the oldest statute dealing with environmental law in the United States.** It states, in part:

> It shall not be lawful to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged, or deposited either from or out of any ship, barge, or other floating craft of any kind, or from the shore, wharf, manufacturing establishment, or mill of any kind, any refuse matter of any kind or description whatever other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the United States, or into any tributary of any navigable water from which the same shall float or be washed into such navigable water; and it shall not be lawful to deposit, or cause, suffer, or procure to be deposited material of any kind in any place on the bank of any navigable water, or on the bank of any tributary of any navigable water, where the same shall be liable to be washed into such navigable water, either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed. ...
> (33 U.S.C. § 407).

Notice the use of the term, "navigable water." Much litigation has sought to clarify the meaning of that term! (See *Rapanos v. United States*, 547 U.S. 715 (2006)).

A sharp focus of President Donald Trump's Administration is the repeal or modification of the definition of "Waters of the United States" under the Clean Water Act. The Final Rule at issue was published in the *Federal Register* on June 29, 2015. (80 F.R. 37054):

> Congress enacted the CWA 'to restore and maintain the chemical, physical, and biological integrity of the Nation's waters,' section 101(a), and to complement statutes that protect the navigability of waters, such as the Rivers and Harbors Act. 33 U.S.C. 401, 403, 404, 407. The CWA is the nation's single most important statute for protecting America's clean water against pollution, degradation, and destruction. To provide that protection, the Supreme Court has consistently agreed that the geographic scope of the CWA reaches beyond waters that are navigable in fact. Peer-

In 1970, in the face of an unpopular war and concern over contaminated waterways, President Nixon invoked the provisions of the "Refuse Act" by Executive Order requiring all wastewater discharges to navigable waters be permitted by the United States Corps of Engineers. Consistent with national interest in controlling water pollution, Congress passed the Federal Water Pollution Control Act Amendments (FWPCA, the Clean Water Act, 33 U.S.C. §§ 1251 et seq. and § 1344), codifying much of President Nixon's action.[69] President Nixon vetoed the law as being too expensive. Congress overrode his veto, making this seminal statute law.

Water makes up about 66% of the human body and 75% of the human brain. In comparison, a tomato is 95% water and a chicken, 75%. The average person requires 2 1/2 quarts of water per day.

Of the Earth's surface, three-quarters is covered by water. Yet 97% of Earth's water is salty. Of the remaining fresh water, two-thirds

> reviewed science and practical experience demonstrate that upstream waters, including headwaters and wetlands, significantly affect the chemical, physical, and biological integrity of downstream waters by playing a crucial role in controlling sediment, filtering pollutants, reducing flooding, providing habitat for fish and other aquatic wildlife, and many other vital chemical, physical, and biological processes. ... (80 F.R. 37055)

The United States Congress has also utilized the Congressional Review Act of 1996 (5 U.S.C. § 8) to overrule the Office of Surface Mining Reclamation and Enforcement's "Stream Protection Rule." That action is subject to President Trump's signature.

[69] **FWPCA is now codified as part of the Clean Water Act and is codified at 33 U.S.C. §§ 1251 et seq.** The FWPCA was based on a "command and control" template for protecting human health and the environment, first promulgated under the Clean Air Act of 1970. (42 U.S.C. §§ 7401-7671Q). It would become the model for ten more years of federal environmental legislation.

is frozen in glaciers and ice caps. In the United States, 95% of the fresh water is under the ground.[70]

In 1974, Congress enacted the "Safe Drinking Water Act" (SDWA) (42 U.S.C. § 300F et seq.). The SDWA established maximum contaminant levels (MCLs) if "... the contaminant may have an adverse effect of the health of persons ..." (42 U.S.C. § 300G-1(b)1(A)). The SDWA standards apply to "public water systems." As the drinking water crisis in Flint, Michigan has demonstrated, the effects of drinking water on the populace can be acute and the cost to protect them, significant.

There are a number of federal environmental-oriented statutes that deal with food and agricultural issues. They include many environmental laws, such as the Clean Water Act (FWPCA, above) and the Resource Conservation and Recovery Act (hazardous waste, 42 U.S.C. § 6901 et seq.). Many environmental laws exempt much of the agricultural activity. (40 CFR 261.4(b)(2)).

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, 7 U.S.C. §§ 136-136y) was originally passed in 1947 in response to the increase of pesticide use in agriculture spurred on by World War II. In 1962, Rachel Carson drew the attention of the world to the dangers of pesticides when she published her influential work, "Silent Spring." (Carson, 1962). Carson caught the attention of the nation. A quote from her book is noteworthy:

> The history of life on earth has been a history of interaction between living things and their surroundings. To a large extent, the physical form and the habits of the earth's vegetation and its animal life have been molded by the environment. Considering the whole span of earthly time, the opposite effect, in which life actually modifies its

[70] **The largest underground aquifer in the United States is in the Ogallala Aquifer, stretching from Nebraska to Texas.** Yet many of the world's aquifers are subsiding due to groundwater withdrawal. (Peabody, 2016).

> surroundings, has been relatively slight. Only within the moment of time represented by the present century has one species–man–acquired significant power to alter the nature of his world. (Carson 1962, Chapter 2; but consider the impact of the Great Oxygenation Event).

FIFRA was significantly amended in 1972. The amendments required the registration of new pesticides in the United States. There are now more than 1,600 categories of pesticides in use. Globally, more than five billion pounds of pesticides are used annually. Twenty-two percent of that total is used in the United States. EPA administers the program and takes into account risks as well as social and economic benefits. (Angelo, 2013).

The Federal Endangered Species Act was passed in 1973. This exceptional, forward-thinking legislation has withstood many attacks concerning its impact to private property rights. (ESA, 16 U.S.C. §§ 1531-1544; see also, *Tennessee Valley Authority v. Hill*, 437 U.S. 154 (1978)). A listing by the United States Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) protects against the killing or taking of the protected organism and, in some cases, prevents the disturbance of its habitat. As agricultural production expands and the use of fertilizers and pesticides increase, the ESA becomes even more relevant. Will the spread of genetically modified organisms in agriculture further impact the natural plant and animal communities? Will the Endangered Species Act play an even more prominent role?

The Federal Food, Drug and Cosmetic Act was originally passed in 1938. It was significantly amended in the Food Quality Protection Act of 1996 and is administered by the Food and Drug Administration (FDA). (21 U.S.C. § 301 et seq.). The Food Safety Modernization Act of 2010 is also administered by the FDA and seeks to prevent and respond to contamination in our food supply.

In 1990, Congress passed the Organic Foods Production Act (OFPA), setting standards for "organic" products. (7 U.S.C. §§ 6501 et seq.) It is administered by the United States Department of Agriculture (USDA), as is the National Organic Program (NOP), a regulatory

program overseen by the USDA's Agricultural Marketing Service. The NOP sets standards but does not regulate food safety or nutrition. (7 CFR Part 205).

Perhaps the most significant federal action involving American agriculture is what we call the "Farm Bill." This extensive economic and political legislation is promulgated approximately every five years. It is eagerly anticipated and is the subject of hearty controversy. The first Farm Bill was passed in 1938 as part of the New Deal. The most recent promulgation was entitled, "The Agricultural Act of 2014." (H.R. 2642; Public Law 113-79). The Farm Bill provides farm subsidies and agricultural price supports. Among other programs, this Farm Bill also supports the significant Supplemental Nutrition Assistance Program (SNAP). One source calculates the cost of the current Farm Bill at approximately 956 billion dollars.[71]

XIV. POPULATION

Food is about people. And people, at least in our species, are gregarious and aggregate at the family level. Put agriculture in the picture, and an even more settled lifestyle develops. Villages form. Soon, ambitions of infrastructure sprout. Irrigation, food storage, audacious temples, and warfare follow. For all of these developments–progress let us say–more people are needed. So many that one population can dominate its neighbors. So many that they get in each other's way. And then so many that they can't be fed. Or so Robert Malthus and Paul Ehrlich thought. [72]

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[71] **"Food stamps and nutrition, $756 billion;** crop insurance $89.8 billion; conservation $56 billion; commodity programs $44.4 billion; everything else $8.2 billion." (Plumer, 2014).

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[72] **The human population of the Earth at the beginning of the Christian Era (CE) was approximately 300 million.** By 1500 CE, it was about 500 million people. Around 1800, it was approximately 1.0 billion. In 1950, it had climbed to more than 2.5 billion. In 2014, the world's population was greater than 7.1 billion people. Reasonable projections of the Earth's human population in 2050 are at 9.6 billion people.

> The number of Native Americans inhabiting Kentucky prior to 1500 is unknown. Archaeological evidence, however, indicates that the Commonwealth was thoroughly

> settled at different times prior to European contact. Regardless, after obtaining firearms from the Dutch during the "Beaver Wars" of the 1600s, the Iroquois drove out the Shawnee from Ohio and Kentucky. As a result, land explorer Christopher Gist, in 1751, found only one Native American settlement in Kentucky, that of forty dwellings in lower Shawneetown in South Shore, Kentucky opposite modern Portsmouth, Ohio and the mouth of the Scioto River. That and Eskippakithiki (Indian old fields) near Winchester, Kentucky, may have been the only permanent Native American village at the time of European colonization of the Commonwealth. (Van Stockum, Jr., Fall/Winter 2015).

This was not to be typical of population growth in the world as a whole. It did not take long to understand the potential of human reproduction.

> I think I may fairly make two postulata. First, that food is necessary to the existence of man. Secondly, that passion between the sexes is necessary and will remain nearly in its present state ... but toward the extinction of the passion between the sexes, no progress whatever has hitherto been made ... Population, when unchecked, increases in a geometric ratio. Sustenance increases only in an arithmetical ratio ... I see no way by which man can escape from the weight of this law which pervades all of animated nature. (Malthus, 1798). (Van Stockum, Jr., footnote 10, Fall/Winter 2015).

> Americans are beginning to realize that the underdeveloped countries of the world face an inevitable population-food crisis. Each year food production falls a bit further behind burgeoning population growth, and people go to bed a little bit hungrier. While there are temporary or local reversals of this trend, it now seems inevitable that it will continue to its logical conclusion: mass starvation. The rich may continue to get richer, but the more numerous poor are going to get poorer. Of these poor, a minimum of ten million people, most of them children, will starve to death during each year of the 1970s. But this is a mere handful compared to the numbers that will be starving before the end of the century. And it is now too late to take action to save

The development of advanced genetic analysis has exploded the field of anthropological genetics and the study of our peoples. And the complete sequencing of the human genome has allowed comparison between different groups of human populations. The use of statistical analyses has allowed for the tracking of specific genetic traits within populations. Thus, scientists have recently identified the timing and direction of the migration of peoples across the planet.

The revolution of plant and animal domestication allowed for the first great expansion of the human population. The Columbian Exchange brought new, intensely caloric foods into global use. Just after World War II, the Green Revolution brought advanced plant breeds, chemically manufactured fertilizers and pesticides to enhance productivity. Malthus and Ehrlich were proven wrong, at least for

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many of those people. (Ehrlich, 1968).

(Van Stockum, Jr., Fall/Winter 2015).

That did not happen, of course, but there are a mighty lot of people on this planet, and some countries have taken action.

China instituted a "one child per family" policy in 1979. Using a combination of benefits and penalties, the country has tried to control population growth. This policy has been difficult to administer and has had many exceptions that applied differently in urban versus rural areas. The policy has also possibly exacerbated a cultural preference for male offspring. There is now an excess of 33 million more men than women in China. In 2013, these policies were relaxed allowing, along with other changes, two children when one parent is an only child.

Japan, on the other hand, is actively seeking to increase its birthrate. As the Japanese population has aged, the country has been unable to sustain its numbers. The government seeks, through economic incentives, to maintain its population at 100 million people. Its current population is approximately 127 million and is expected to fall as low as 87 million by 2060 if there is no intervention. Japan is a homogeneous culture with immigration generally disfavored as a method of increasing population.

India is expected to be the world's most populous nation in 2030, with 1.5 billion people. The current population is approximately 1.25 billion. Female sterilization has been a voluntary method of birth control in India (and China also). Sterilization is often accompanied with payment by the state. India also has a surplus of male children due to selective abortion or the practice of infanticide. In India, cultural bias has resulted in few male vasectomies.

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now.[73] What next revolution will support the continuing rise of our population? And what will be the effect of Climate Change? Read on!

XV. CLIMATE CHANGE

Much has been said of this testy subject. What fun! End of worlders, climate deniers, politicians ("I'm not a scientist"), hippies (yup, still out there), socialists, capitalists, scientists, and worst of all, statisticians. But climate change is real, always has been. Big Ice Ages, little Ice Ages, dust bowls, volcanoes, continental drift, and even meteor impacts.

Wow, what a great place! So what's all the fuss about? What to do about it, I suppose. But for us, here in this discussion, we limit ourselves to its impact on food. And its impact will be as much about

[73] **According to the results of the *2015 Revision*,** the world population reached 7.3 billion as of mid-2015 (table 1), implying that the world has added approximately one billion people in the span of the last twelve years. Sixty per cent of the global population lives in Asia (4.4 billion), 16 per cent in Africa (1.2 billion), 10 per cent in Europe (738 million), 9 per cent in Latin America and the Caribbean (634 million), and the remaining 5 per cent in Northern America (358 million) and Oceania (39 million). China (1.4 billion) and India (1.3 billion) remain the two largest countries of the world, both with more than 1 billion people, representing 19 and 18 per cent of the world's population, respectively. ... Currently, the world population continues to grow though more slowly than in the recent past. Ten years ago, world population was growing by 1.24 per cent per year. Today, it is growing by 1.18 per cent per year, or approximately an additional 83 million people annually. The world population is projected to increase by more than one billion people within the next 15 years, reaching 8.5 billion in 2030, and to increase further to 9.7 billion in 2050 and 11.2 billion by 2100 ... (United Nations, 2015).

"where" food will be, as "what" food will be. Where is our food production going to migrate? What new areas will increase in agricultural fecundity and diversity?

Then there is that nagging problem of desertification.

And do you really think the seas are rising?[74]

There is science behind the analysis of climate change. Exciting science. Take, for instance, Milutin Milankovitch of Serbia. In 1920, he published his studies of multi-year ice age cycles and related them to

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[74] **In January 2017, the National Oceanic and Atmospheric Administration of the United States Department of Commerce issued a report** entitled "Global and Regional Sea Level Rise Scenarios for the United States."

> We recommend a revised extreme upper-bound scenario for GMSL [Global Mean Sea Level] rise of 2.5 m [8.2 feet] by the year 2100 ... These scenario-based RSL values fill a major gap in climate information needed to support a wide range of assessment, planning, and decision-making processes. GMSL was adjusted to account for key factors important at regional scales, including: 1) shifts in oceanographic factors such as circulation patterns; 2) changes in the Earth's gravitational field and rotation, and the flexure of the crust and upper mantle, due to melting of land-based ice; and 3) vertical land movement (VLM; subsidence or uplift) due to glacial isostatic adjustment (GIA, which also changes Earth's gravitational field and rotation, as well as the overall shape of the ocean basin), sediment compaction, groundwater and fossil fuel withdrawals, and other nonclimatic factors. ... (NOAA, 2017).

The International Panel on Climate Change had this to report:

> Sea level rise projections over the next century vary considerably, with the high-end scenarios yielding a rise of up to 6 or 7 feet by 2100. About 7 to 8 million people in the U.S. live within 6 feet of the local high tide line, and storm surge can extend flooding far beyond the high tide line, as witnessed in Superstorm Sandy. (IPCC, 2013).

changes in the Earth's eccentricity, axial tilt, and precession.[75] Good science, excellent observations. But there are other factors afoot impacting climate change. Does the flip of Earth's magnetic field have such impact? Although not regular, the shift occurs about every half million years. The North Pole migrates to the South Pole and vice versa during this phenomenon.

Sunspots are tremendously large and energetic events. The smallest visible sunspot is 50 times the size of Africa.[76] But we are 93 million miles away from the sun. What other factors might impact climate change on Earth? Well, here is a string cite of available factors–remember, some could cause warming of Earth, others cooling: methane (don't forget methane hydrates); soot (black carbon); hydrofluorocarbons (HFCs); volcanic action; sulfur dioxide; mountain building; solar flares; tropospheric ozone; nitrous oxide (N_2O); ocean conveyer systems; El Nino; La Nina; polar amplification; algal growth; cattle populations; aerosols; and, of course, the one receiving the most attention, carbon dioxide (CO_2).

In 1958, Charles Keeling began reporting CO_2 concentration in the atmosphere over Hawaii's Mauna Loa crater. In 1958, the global concentration was approximately 315 ppm. It is now over 400 ppm. CO_2 levels in the atmosphere track global temperatures fairly well, so the question arises; where is it coming from? Can such a small change in a

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[75] **Obliquity refers to the planet's tilt.** It is currently at an angle of 23.5 degrees but changes over a 44,000-year cycle. Eccentricity involves the circuit of the Earth's orbit around the sun. That circuit bulges slightly on a 96,000-year cycle. Precession relates to the spinning of Earth. Like the top that is spun with a wound string, Earth wobbles in its spin. Its axis migrates over a 23,000-year cycle, describing a circle in the north sky. That's why 2,000 years ago sailors were not navigating by the North Star. The celestial North Pole then lay in darkness.

[76] **The amount of energy released can equal all of electricity that would be used on Earth for a million years.** Giant prominences flare out from the sun at the distances equal to that from Earth to the moon. And the sun's temperature is astoundingly hot. If a pin was heated on Earth to the temperature in the center of the sun, it would instantly incinerate anything within 60 miles of it. That's 154 million degrees kelvin.

minor constituent of the atmosphere–nitrogen and oxygen together make up about 99%–really trigger climate change? Do you really care enough to change lifestyles and economies to address it? And was the "global warming hiatus" real?

The Intergovernmental Panel on Climate Change (IPCC) made some startling statements in its "Climate Change 2013: The Physical Basis" report.[77] And the prominent American Association for the Advancement of Science (AAAS) issued a review entitled "What We

[77] **Warming of the climate system is unequivocal,** and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. ... Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983-2012 was *likely* the warmest 30-year period of the last 1400 years ... The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification. ... It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
(IPCC, 2013)

Know: The Reality, Risks and Response to Climate Change."[78] And isn't it getting warmer around here?[79]

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[78] **Climate scientists agree: climate change is happening here and now.** Based on well-established evidence, about 97% of climate scientists have concluded that human-caused climate change is happening ... The evidence is overwhelming: levels of greenhouse gases in the atmosphere are rising. Temperatures are going up. Springs are arriving earlier. Ice sheets are melting. Sea level is rising. The patterns of rainfall and drought are changing. Heat waves are getting worse as is extreme precipitation. The oceans are acidifying. ... The oceans are absorbing much of the CO_2 that smokestacks and tailpipes emit into the atmosphere. As a result, the oceans are rapidly acidifying, with early impacts on shelled organisms such as oysters already documented. The current acidification rate is likely the fastest in 300 million years. (AAAS, 2014)

[79] **On February 24, 2017, the National Weather Service at the Louisville International Airport recorded temperatures of 79° F.** That is the highest temperature recorded there during the month of February over the 134 years data has been collected. In 1883, 1889, and 1932, temperatures reached 78° F. The months of January and early February 2017 have been 6.7° F and 5.9° F warmer than the average temperature for these time periods. The warmest winter in Kentucky was in 1931-1932 when it averaged 44.2° F across the state.

One report suggests that the reduction of air pollution, especially aerosols, has allowed for the penetration of more sunlight over the industrialized nations. The authors calculate that this "Solar Brightening" is a significant factor in the increase in American corn yields of 27% over the past thirty years. It is probable that the increase in atmospheric carbon dioxide accounts for as much as 6% of that total (Tollenaar, 2017).

Jim Ellis is an engineer and a long-time farmer in Shelby County, Kentucky. He now farms with his son, Seth, the third generation of his family farming legacy. Here is what Jim says:

> We have experienced significant weather events in our corn and soybean crops. The summer of 2012 was so hot that the corn pollen died and corn yields were greatly reduced. In the following crop years the yields have been record highs. Never before has the climate been so warm and wet as it was in these recent growing seasons. (Ellis, personal communication, 2017).

The National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) have determined that 2016 was the warmest year on record.[80]

XVI. GENETICALY MODIFIED ORGANISMS

We live in a world with seemingly divergent interests. We wish to feed our massive populations, many of whom are undernourished, while also providing naturally healthy, wholesome, and "organic" food choices. We have already moved through one Green Revolution brought on by chemically generated fertilizer and pesticide production along with accelerated plant selection. And we have staved off the starvation earlier predicted.

But as our population on the planet continues to grow, will we need another revolution, a genetic one, to again increase agriculture

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80 **Because weather station locations and measurement practices change over time,** there are uncertainties in the interpretation of specific year-to-year global mean temperature differences. However, even taking this into account, NASA estimates 2016 was the warmest year with greater than 95 percent certainty. '2016 is remarkably the third record year in a row in this series,' said GISS Director Gavin Schmidt. 'We don't expect record years every year, but the ongoing long-term warming trend is clear.' The planet's average surface temperature has risen about 2.0 degrees Fahrenheit (1.1 degrees Celsius) since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 35 years, with 16 of the 17 warmest years on record occurring since 2001. Not only was 2016 the warmest year on record, but eight of the 12 months that make up the year–from January through September, with the exception of June–were the warmest on record. ... ("NASA, NOAA Data Show 2016 Warmest Year On Record Globally," Release 17-006, January 18, 2017).

production and efficiency? And can this be done in a sustainable, balanced way so as to protect the land and environment in which we live? Probably not, if our general record of past progress is any indicator. And now, with the release of genetically engineered "genies," and the creation of lamassu-like "chimeric" creatures, will we irreparably change nature? In ways we don't understand and can't control? But isn't that what we've always done?

It is these questions and more that make not for a "Brave New World," but for an "Unknown World." We tamper with the essence of life. Might we mistakenly produce Shelley's monster? So much yet to learn. Here follows some of the mechanisms by which we will accomplish these changes, along with a brief discussion of the nascent and confusing regulatory scheme that we have created to address them.

Genetic Engineering (GE) leads to "Genetically Modified Organisms (GMO)." You might think that such organisms would have an agreed upon regulatory definition. It is a reflection of the speed and intensity upon which this issue bears upon us, that such agreement is lacking.[81]

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[81] **A search of definitions within the United States Environmental Protection Agency (EPA) retrieves the following:**

[1] Genetic Engineering

Definition: A process of inserting new genetic information into existing cells in order to modify a specific organism for the purpose of changing one of its characteristics.

[2] Genetic Engineering

Definition 1: Directed modification of the gene complement of a living organism by such techniques as altering the DNA, substituting genetic material by means of a virus, transplanting whole nuclei, transplanting cell hybrids, etc. [NIH Genetics Home Reference Glossary]

Definition 2: Procedure used to join together DNA segments in a cell-free system (an environment outside a cell or organism). Under appropriate conditions, a recombinant DNA molecule can enter a cell and replicate there, either autonomously or after it has become integrated into a cellular chromosome. [NIH Genetics Home Reference Glossary]

[3] *Definition 3:* Genetic engineering is the process of using recombinant DNA (rDNA) technology to alter the genetic makeup of an organism. Traditionally, humans have manipulated genomes indirectly by controlling breeding and selecting offspring with desired traits. Genetic engineering involves the direct manipulation of

The genetic process whereby GMOs are produced is surprisingly diverse. And yet the structure of DNA, the "double helix" of James Watson, Francis Crick, and Rosalind Franklin, is amazingly simple. Chromosomes are composed of matching strands of deoxyribonucleic acid (DNA), each strand a simple stacking of 4 types of nucleotides, each nucleotide composed of a nitrogenous base, a 5-carbon sugar (deoxyribose) and a phosphate group. In DNA (ignoring for the moment RNA), there are only four nitrogenous bases: adenine (A), thymine (T), guanine (G), and cytosine (C). These bases have specific affinities: adenine to thymine; guanine to cytosine. So each nucleotide contains a simple variable code, with only four possible types of information (A, T, G, or C). Among other things, chromosomes code for proteins, primarily enzymes. Enzymes do most of the work in building and operating organisms. So, in order to provide the instructions necessary to build a life form, you must code for the building blocks of protein; amino acids. There are twenty of those amino acids needed for construction in humans. So we need a code arrangement with at least twenty different settings. Let's see, one nucleotide gives us just four; a group of two nucleotides gives us sixteen. Too small. A group of three nucleotides gives us sixty-four possible codes. More than we need, but it will do. That group of three is called a "codon," and a codon is the basic building code of genetics.

Change a nitrogenous base within a codon and you've likely changed the amino acid sequence in a protein. Add or delete a nitrogenous base and a similar change occurs. These are mutations, but can also be tools of genetic engineering. In fact, by using nucleases we can knock out whole series of codons, disabling deleterious proteins or changing their effect.

We can also rearrange codons on the chromosome. That is because chromosomes generally come in similar groupings. In our case, they come as "homologous pairs." Somewhere back in our evolution, the

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one or more genes. Most often, a gene from another species is added to an organism's genome to give it a desired phenotype. [NIH Genetics Home Reference Glossary]. (aspub.epa.gov, "EPA terms and Acronyms")

number of our chromosomes doubled, the nucleus retaining an extra copy of its genetic data. This development is common in life forms, and is an example of a mutation providing more material on which natural selection can work. So we humans have forty-six chromosomes in twenty-three pairs. We call that condition "diploid." Some species have three or four copies of their chromosome and are referred to as "triploid" or "tetraploid."

Now don't confuse the homologous-paired chromosomes with the double-stranded helix of DNA within a single chromosome itself. Nature uses only one of those strands for coding purposes. The second is a covering protection that "unzips" during "transcription" of the coded message into Messenger Ribonucleic Acid (mRNA).

Sometimes a break will occur in the limbs of adjacent chromosomes and the nucleus reattaches the loose pieces in the wrong order. Another mutation and another opportunity for variation. We also use this technique in genetic engineering.

In meiosis, the homologous chromosomes line up and are separated into the separate egg or sperm cells containing twenty-three chromosomes each (now haploid, referred to as gametes).

There is a history in science, as well as in law, and in both, excitement. The fact that so many discoveries in the field of genetic engineering were found in living organisms makes them even more intriguing.

By 1970, discoveries in molecular biology gained insight into the action of nucleic acids such as DNA (Deoxyribonucleic Acid) and RNA (Ribonucleic Acid).[82] Studies of the bacterium *Escherichia coli* and the movement of nucleic acids spurred our understanding of gene manipulation. The recognition that some cells contained independent loops of replicating sections of nucleic acids (called plasmids) that could transfer foreign genes into a host cell, was just one of such mechanisms discovered. Viruses, including bacteriophages, were also discovered to

[82] **Research by Paul Berg, Herbert Boyer, Stanley Cohen, and others.**

accomplish the same goal. *Agrobacterium tumefaciens* is a soil bacterium that causes plant tumors–called crown gall disease–in vegetable, fruit, and tree species. DNA in plasmids within the bacterium can be manipulated and transferred into the nucleus of another cell, e.g. a plant cell, to be joined with the cell's DNA where it will be added to the genome.

Cells naturally contain enzymes that maintain, copy, and repair DNA. Some of these have been identified, isolated, and copied so as to be usable in the laboratory. DNA Polymerase works to build and copy DNA from nucleotide building blocks. Restriction Enzymes (endonucleases) allow for the cutting of DNA at specific locations.[83] The Polymerase Chain Reaction (PCR) allows for a small quantity of a specific region of genetic material to be copied and multiplied.[84]

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[83] **In 1918, the Nobel Prize in physiology or medicine went to Werner Arber, Hamilton Smith, and Daniel Nathans for the discovery of restriction enzymes.** The Nobel Committee stated in its press release as follows (in part):

> Restriction enzymes provide the 'chemical knives' to cut genes (=DNA) into defined fragments. These may then be used (1) to determine the order of genes on chromosomes, (2) to analyze the chemical structure of genes and of regions of DNA which regulate the function of genes, and (3) to create new combinations of genes. These techniques open up new avenues to study the organization and expression of genes of higher animals and to solve basic problems in developmental biology. In medicine, increased knowledge in this area should help in the prevention and treatment of malformations, hereditary diseases and cancer...
> ... Restriction enzymes are used as tools to dissect DNA into smaller defined fragments. These can be used to determine the order of genes on chromosomes, to analyze the chemical structure of genes and to recombine genes by chemical means. Most important restriction enzymes are used to analyze the function of regions of DNA which regulate gene expression...

[84] **In 1993, Kary Mullis gained the 1993 Nobel Prize in chemistry for the development of PCR.** The Nobel Committee stated in its press release as follows (in part):

> The applications of Mullis' PCR method are already many. It is for example possible using simple equipment

There is also now much interest in bypassing DNA altogether and inserting genetically engineered messenger RNA (mRNA) directly into

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> to multiply a given DNA segment from a complicated genetic material millions of times in a few hours, which is of very great significance for biochemical and genetic research. The method offers new possibilities particularly in medical diagnostics, and is used, for example, for discovering HIV virus or faulty genes in hereditary diseases. Researchers can also produce DNA from animals that became extinct millions of years ago by using the PCR method on fossil material.
> The genetic code programmed into the DNA molecule determines the number and sequence of amino acids in a protein, and thus also the functional properties of the protein. ... Chemically, the genetic material of living organisms consists of DNA (deoxyribonucleic acid). DNA molecules consist of two very long strands twisted around each other to form a double helix. Each strand is formed of smaller molecules, nucleotides, that represent the letters of the genetic material. There are only four different letters, designated A, T, C and G. The two DNA strands are complementary, being held together by A - T and G - C bonds. It is only when the genetic code is to be read off e.g. for protein building in the cell that the two strands are separated. The genetic information in DNA exists as a long sentence of code words, each of which consist of 3 letters which can be combined in many different ways (e.g. CAG, ACT, GCC). Each three-letter code word can be translated by special components within the cell into one of the twenty amino acids that build up proteins. It is the proteins that are responsible for the functions of living cells, including their ability to function, among other things, as enzymes maintaining all the chemical reactions required for supporting life. The proteins' three-dimensional structure and hence their function is determined by the order in which the various amino acids are linked together during protein synthesis. ...

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a cell. Once there, the mRNA template can slide into the cell's ribosomes, which will assemble the protein products called for in the mRNA code. Think antibiotics, hormones. Lots of possibilities here. The trick is to keep the cell's immunity system from attacking.

The vehicles used for inserting foreign DNA into host cells are surprisingly varied. Plasmid DNA in bacteria is double-stranded, usually in circular form, and separate from the cell's chromosomal DNA. And plasmid DNA carries its own replication mechanism. These plasmids induce a number of reactions in their hosts, including beneficial traits such as nitrogen fixation as well as antibiotic resistance. Some are pathogenic, however, such as those inducing tumors in plants.

Bacteriophages are viruses that attack bacteria (prokaryotes). They are excellent vehicles for the transfer of genetic material. Yeasts are eukaryotes ("true cells"). The similarity of their cell structure and metabolism to higher forms of life, including human, make them useful for many genetic engineering procedures. As *Escherichia coli* has been thoroughly studied as a representative of prokaryotic cell metabolism, *Saccharomyces cerevisiae* (yeast, a unicellular fungus) has been studied for eukaryote analysis. This is the yeast common to both bread baking and wine fermentation.[85]

It is also possible to combine vectors such as plasmids and bacteriophages into hybrids called cosmids, phagemids, and fosmids. And finally, for our purposes, recombinant DNA can be directly transferred into host cells using such methods as "microprojectile bombardment," "electroporation," "UV laser irradiation," and "ultrasonication" through silicon carbide "whiskers," and by use of chemicals and heat shock.

[85] **It reproduces through an asexual budding process and is approved for use by the United States Food and Drug Administration (FDA) as a "Generally Recognized as Safe" (GRAS) organism.** (21. U.S.C. § 321(s); 21 CFR Part 182).

An early application of genetic engineering to agriculture was the insertion of a gene with a valuable trait from one species into a receptor species that could benefit from that trait. So for example, look at the bacteria, *Bacillus thuringiensis* (BT), that lives in the soil. These bacteria have intracellular plasmids containing DNA molecules that operate independently of the regular chromosomal DNA. Within this isolated DNA are genes that code for proteins that are toxic to a broad spectrum of insects (lepidopterans, coleopterans, dipterans, hymenopterans) and some nematodes. Such toxins are natural pesticides within the bacterium that could provide protection from pests if reproduced within agricultural crops.

To engineer the transfer of such traits, the first step is to identify, isolate, and "clip out" the target bacterial gene through the use of restriction enzymes. These genetic strips can then be replicated in bacterial DNA or through the Polymerase Chain Reaction (PCR) to produce multiple copies. Then the gene can be physically forced through the membrane of a target species or carried inside as part of a bacterial plasmid or a virus. Once within the target species, the gene is incorporated into the host's genome. It will express the beneficial protein and provide protection to the entire plant. For research in animals, stem cells are often targeted to receive such gene transfer.

Genetic engineering activities are now widespread in industry and science. Corn is an example of a food plant that has been engineered to contain the BT gene, which provides pest protection during its growth. Another category of GMO plants includes soybeans, which have been genetically engineered to tolerate herbicides (HT) such as glyphosate, which interrupts amino acid metabolism in non-protected plants.[86] In

[86] **Glyphosate is the active ingredient in the Monsanto Company's registered herbicide "Roundup."** Many of the GMOs listed for this footnote are considered "Roundup Ready." Glyphosate is a type of organic phosphorus compound. The chemical formula is $C_3H_8NO_5P$. It is effective by disrupting amino acid synthesis (tyrosine, tryptophan, and phenylalanine). It works on many grasses, woody plants, and other herbaceous growth that competes with agricultural production. It has enabled the use of "no till" farming, thereby reducing erosion. Although regulatory approval has been widespread, concerns exist as to the chemical's environmental fate, toxicity, and the evolution of glyphosate resistant weeds and pests.

addition, scientists are experimenting with manipulating plant and animal genomes to enhance desired traits.

A recent development in the field of genetic engineering involves "CRISPR." This acronym relates to primitive DNA sequences called "Clustered Regularly Interspersed Short Palindromic Repeats." When associated with RNA-guided Nucleases (CRISPR Associated Proteins, e.g. CAS9), pinpoint surgery can be performed on genomes, inserting, deleting, or rearranging gene sequences.[87]

Many food plants have been genetically engineered. Alfalfa (*Medicago sativa*), Argentine canola (*Brassica napus*), cotton (*Gossypium hirstum*), maize (corn, *Zea mays*), potato (*Solanum tuberosum*), soybean (*Glycine max*), sugar beet (*Beta vulgaris*), and wheat (*Triticum aestiuum*) have been engineered to resist the glyphosate herbicide. The "cry genes" of *Bacillus thuringiensis* (Bt toxin,

[87] **CRISPR is the most recent "darling" of the genetic engineering world.** This powerful but yet relatively simple system is based on primitive microbial cell systems for identifying and disabling viruses. It was examined in a microbe, *Haloferax mediterrane*, living in extremely salty marshes in Spain. The system was investigated by Francisco Mojica at the University of Alicante, who published data in 1993 (Mojica et al. 1993). The molecular system has now been found in numerous microbes, including bacteria such as *Mycobacterium tuberculosis*, *Clostridium difficile*, and *Yersinia pestis*.

Three types of CRISPR systems have been described, with perhaps the Type II system in *Streptococcus thermophilus* being the simplest. Generally put, the CRISPR Associated Proteins (such as the RNA-guided nuclease CAS 9) seeks out and cleaves any DNA that matches the sequence of an invading virus. These sequences, over time, have been catalogued in the bacterium's genome as an immunity guide to destroy viral attackers with similar sequences. CAS 9, in association with CR-RNA (CRISPR RNA) and TRACR-RNA (trans-activating CRISPR RNA) and G-RNA (Guide RNA) provide the acquired immunity now found in many bacteria and archean microbes.

Researchers modified the CRISPR system so as to provide guide RNA alignment with specific DNA sequences. Many have contributed to research in this area and significant litigation concerning patent rights has developed. Current litigation centers between the University of Berkeley and the Broad Institute of Harvard and MIT.

Cry protein) target specific ranges of insect pests. These have been transferred into transgenic plants such as corn, cotton, and potatoes.[88] Crop plants can also be genetically engineered to express multiple types of resistance (stacked), providing protection against more than one herbicide and several different insect pests.[89]

Many other organisms have been genetically engineered. They include rice, jatropha (palm oil-like plant), yeast, cassava, papaya, banana, and tomato. A curious panoply of traits has been bred into plants, e.g. retarding fruit decay, antibiotic resistance, lignin production, drought tolerance, increased photosynthetic yield, male sterility, amylase changes, amino acid changes, flower color, reduced nicotine, and viral defense.

As a result, the cultivation of GMO crop plants is widespread. The leading producers of GMO crops are the United States, Brazil, and Argentina, followed by India and China. GMO crops are disfavored in countries of the European Market.

In 2015, the United States, Brazil, and Argentina grew 75% of the world's acreage in GMO crops. As much as 90% of the corn, soybeans, cotton, and canola crops in these countries has been genetically modified. In all, approximately 18 million farmers, in 28 different

[88] **In addition to the BT toxins (Cry proteins),** agricultural crops have also been engineered to resist pests by proteins that inhibit insect metabolism involving protease, 2-amylase, lectins, cholesterol and tryptophan. For example, alfalfa, tobacco, and apple have received protease inhibitors.

[89] **The Monsanto Company, in association with the DOW Chemical Company, has produced genetically modified corn seed called "Smart Stax."** The corn is resistant to four herbicides (two from DOW - Hercules Xtra and Liberty Link; and two from Monsanto - Yieldgard VT and Roundup Ready 2). DOW lists eight insects that Smart Stax controls, including: 1) Western corn rootworm larvae; 2) Fall armyworm; 3) Corn ear worm; 4) Southwestern corn borer; 5) Black cutworm; 6) European corn borer; 7) Western bean cutworm; and 8) Northern corn rootworm larvae. These are caterpillars and larvae of moth and butterfly in the family *Lepipoptera*, class *Insecta*.

countries, grew 440 million acres of GMO crops in 2015.[90] In 2015, the United States grew maize, soybean, cotton, canola, sugar beet, alfalfa, papaya, squash, and potato crops that had been genetically engineered. Worldwide, soybean has 51% of the Biotech market, followed by corn (30%) and cotton (13%). Of genetically engineered plants, 53% are herbicide tolerant and 33% express "stacked" traits. Herbicide tolerance is the dominant engineered trait in soybean, corn, and cotton.[91]

The regulation of genetically modified organisms, GMOs, is relatively new, seemingly scattered, and perhaps insufficient to address the magnitude of change that faces us. Different schemes are applied in different countries.[92] The United States' experience in the regulation of GMOs is split between different agencies and different issues. To briefly describe that process, it is helpful to reflect on the Supreme Court case of *Diamond v. Chakrabarty*, 447 U.S. 303 (1980). There the court decided (5-4) that a bacterium containing genetically engineered plasmids transferred within was patentable under 35 U.S.C. § 101.[93] Value added I suppose!

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[90] **New York Times, April 13, 2016,** Andrew Pollack, "Acreage for Genetically Modified Crops Declined in 2015."

[91] **International Service for the Acquisition of Agri-Biotech Applications** (ISAAA, 2015).

[92] **India was an early entrant into GMO regulation** (see the "Rules of 1989, December 5, 1989, The Environmental Protection Act of 1986). The rules of 1989 set-up committees on recombinant DNA, institutional biosafety, and genetic engineering approval. Guidelines were published in 1990, 1994, and 1998. "The Seed Policy," 2002, was established dealing with trans genetic plants. In 2003, plant quarantine procedures were established and field trials regulated in 2008. (Rastogi, 2009).

[93] **35 U.S.C. § 101 states (in part):**

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions of this title. (35 U.S.C. § 101).

Chief Justice Warren Burger wrote the majority opinion for the court. In it, he made the following illustrative statements:

> The grant or denial of patents on micro-organisms

In the United States, jurisdiction over GMO organisms is split between the United States Department of Agriculture (USDA), the Food and Drug Administration (FDA), and the Environmental Protection Agency (EPA). There are a number of policies and agreements seeking to regulate the activities of the agencies in this arena. The "Coordinated Framework for the Regulation of Biotechnology" was first promulgated in the Reagan Administration. In January 2017, the Obama Administration published two documents: 1) Update to the Coordinated Framework for the Regulation of Biotechnology;[94] and 2) National Strategy for Modernizing the Regulatory System for Biotechnology Products.[95] The White House also released a January 2017 statement

> is not likely to put an end to genetic research or to its attendant risks. The large amount of research that has already occurred when no researcher had sure knowledge that patent protection would be available suggests that legislative or judicial fiat as to patentability will not deter the scientific mind from probing into the unknown any more than Canute could command the tides. Whether respondent's claims are patentable may determine whether research efforts are accelerated by the hope of reward or slowed by want of incentives, but that is all. (*Diamond*, 447 U.S. 318).

94 **Today's release of the 2017 Update to the Coordinated Framework for the Regulation of Biotechnology** represents the first time in 30 years that the Federal government has produced a comprehensive summary of the roles and responsibilities of the three principal regulatory agencies with respect to regulating biotechnology products. This update and the accompanying *National Strategy for Modernizing the Regulatory System for Biotechnology Products (Strategy)* offer the public a complete picture of a robust and flexible regulatory structure that provides appropriate oversight for all products of modern biotechnology.
("Increasing the Transparency, Coordination, and Predictability of the Biotechnological Regulatory System," White House Blog, January 4, 2017).

95 **The policy of the United States Government** is

relating to the National Strategy for Modernizing the Regulatory System.[96]

In January 2017, the Center for Veterinary Medicine of the FDA (part of the U.S. Department of Health and Human Services) issued draft guidance for the regulation of intentionally altered genomic DNA in animals (Guidance for Industry, #187).[97]

> to seek regulatory approaches that protect health and the environment while reducing regulatory burdens and avoiding unjustifiably inhibiting innovation, stigmatizing new technologies, or creating trade barriers. ... In some cases, uncertainty about agency jurisdiction, lack of predictability of timeframes for review, and other processes have imposed unnecessary costs and burdens on small and mid-sized companies and academics.

(Executive Summary," *National Strategy for Modernizing the Regulatory System for Biotechnology Products*, September 2016).

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96 **While the current Federal regulatory system for biotechnology**

> products effectively protects health and the environment, advances in science and technology have altered the product landscape rapidly. ... directing the primary agencies that regulate the products of biotechnology–the U.S. Environmental Protection Agency (EPA), the U.S. Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA)–to update the Coordinated Framework for the Regulation of Biotechnology (Coordinated Framework) ...

("Executive Summary," *Modernizing the Regulatory System for Biotechnology Products: Final Version of the 2017 Update to the Coordinated Framework for the Regulation of Biotechnology*).

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97 **FDA is issuing this draft revised Guidance for Industry to clarify its approach to the regulation of intentionally altered genomic DNA in animals.** This guidance addresses animals whose genomes have been intentionally altered using modern molecular technologies, which may include random or targeted DNA sequence changes including nucleotide insertions, substitutions, or deletions, or other technologies that introduce specific changes to the genome of the animal.

The Plant Protection Act (7 U.S.C. § 7701 et seq.) was enacted by Congress in 2000 to consolidate activities previously dealt with under the Federal Noxious Weed Act of 1974, the Plant Quarantine Act, and the Federal Plant Pest Act of 1957. Regulations can be found at 7 CFR 340 and are enforced by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS). The Biotechnology Regulatory Services (BRS) deals with genetically engineered organisms under the Federal Coordinated Framework for the Regulation of Biotechnology referenced above.

XVII. CONCLUSION

I am still hungry. That is the general condition of all living things. Hungry. And there are lots of living things surrounding me in these woods along the streambed.[98] The stream itself is alive. For even

> This guidance applies to the intentionally altered genomic DNA in both the founder animal in which the initial alteration event occurred and the entire subsequent lineage of animals that contain the genomic alteration. ...
> ... More recently, new technologies have emerged that are intended to alter the genomes of various organisms, including animals. Some of these include the use of 'nucleases' or 'genome editing technologies' including engineered nuclease/ nucleotide complexes such as zinc finger nucleases (ZFN), transcription activator-like effector nucleases (TALENs), and the clustered regulatory interspersed short palindromic repeats CRISPR) associated systems. These nucleases are intended to introduce alterations at specific sites in the genome, rather than the more random changes associated with rDNA technology. ...

("Introduction and Background," *FDA Draft Guidance for Industry #187*)

[98] **Rats, bats, and saber-tooth cats**. There are thirty-three families, 481 genera, 2,277 species of rodents. The most numerous mammal group on Earth, 40% of the total. And that does not even include extinct species of which there may be five times as many. Rodents include rats, mice, squirrels, capybaras, porcupines, muskrats, beavers, chipmunks, hamsters, guinea pigs, chinchillas, gophers, and voles.

Bats are the only mammals that fly, excluding those few that "sail" on fleshy skin extensions. 20% of mammal species are bats. 18 families, 186 genera, and 1,240 species are currently extant. Only rodents have more species.

The protagonist at the beginning of this work is fortunate in his timing. Perhaps as recently as 10,000 years ago, the large saber-toothed cat, *Smilodon*

in dry periods, the watercourse saves itself up in deep pools within dark bank undercuts or moist undersurfaces of limestone slabs.

Here, fish still dart around and crayfish scoot over algae-covered rocks. Underneath those rocks, a science fiction-like world exists, full of monstrous-looking creatures with shovel-like scoops to extend out and gather in prey. Some hide within tiny gravel-encrusted tunnels. Fish food. Dragonfly, damselfly, caddisfly, and mayfly larva. Truly an alien world to us, but vibrant and alive. No fresh fish food for us without it.

The warrior was an Algonquin speaker. His people hunted game, mostly smaller in those times, and gathered nuts and berries in their season. His people moved around in small groups, returning to certain rich bottomlands where they were experimenting with gardening, nascent agriculture. He, his wife, and child were back now. And they were hiding.

They were watching the strange man that had suddenly appeared in their fields and alongside the creek. Invaded, they were certain. But they couldn't figure him out. He did not seem to have a weapon, no flint-knapping kit. He made sparks easily, however, and that was troubling. What other tricks did he have hidden under that smooth animal skin he was wearing? They did not recognize such a pelt from any animal they had killed. This stranger, seemingly alone–and they had watched in hiding for most of two days–was full of unrecognized actions. The Native American's life was already full of the unknown. Change is scary. They held on tight to what their lives and culture had already proved.

The warrior rose quietly up and cocked his spear thrower directly to the back of his shoulder. Like me, he too was hungry.

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fatalis, roamed this land. *Smilodon* is a true cat, but saber-tooth cats convergent evolved in other types of mammals. Have you ever watched a cat chew through a tough piece of meat or crush a hard piece of meal on the side of its jaw? The carnivorans and creodonts have large, specialized cutter teeth. They are called carnassial teeth. So the *Smilodon* had stabbing canine fangs, scissor-like cheek teeth, and crushing carnassials. Be glad that they are not still around!

SLAP! POP!

The dart entered the water in a small pool extending out from under the bank. The shaft quivered as the point hit and stuck in its mark. The warrior jumped into the edge of the pool, quickly sliding his hand down the shaft to the dart itself. He didn't want the dart to separate from the shaft and thus lose his prey.

There, got it! And the warrior pulled the writhing catfish from the water. With a wide grin, he turned to display it to me. It was an offering of food, a universal gesture, and it would prove to be a very tasty meal cooked over my fire.

I had jumped at the sound of the dart's impact, as had the other two, wife and boy. I hadn't heard the swing of the atlatl–the effect of the bannerstone I think–even though I had become sensitive to any sound around me.

Survival sounds. We ignore them now, but here many of those sounds were threats. The whoosh slap of the spear point scared me badly.

It took many primitive attempts at hand signals before we came together.

I will not ever forget that meeting that day and this place. Food became our communication, and through communication, my life. It became my place in the wondrous journey of food.

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