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## Constitutional Fracticality: Structure and Coherence in the Nation's Supreme Law

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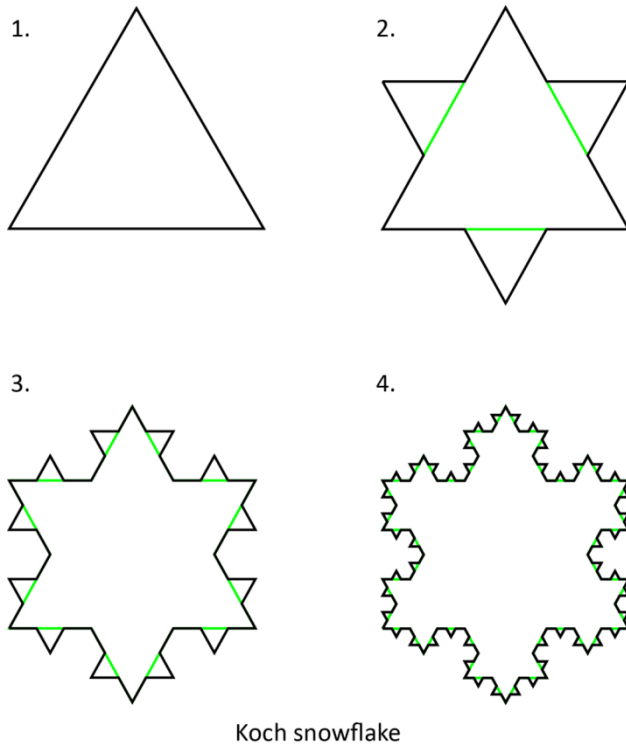
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## CONSTITUTIONAL FRACTALITY: STRUCTURE AND COHERENCE IN THE NATION'S SUPREME LAW

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TABLE OF CONTENTS

ABSTRACT .....	390
I. INTRODUCTION.....	391
II. FRACTALS.....	392
III. “POPULAR FRACTICALITY,” CONSTITUTIONAL STRUCTURAL COHERENCE AND INTERPRETATION .....	394
a. Coherence .....	397
b. Constitutional interpretation. ....	399
IV. ARTICLE I, SECTION 10: ATTAINDER, EX POST FACTO, AND NOBILITY.....	402
V. REPUBLICAN GOVERNMENT CLAUSE.....	404
VI. FRACTOGRAPHY: CONSTITUTIONAL FAULT-LINES AND STRUCTURAL WEAKNESSES .....	406
VII. CONCLUSION .....	409

ABSTRACT

*Yale mathematician, Benoît B. Mandelbrot, revolutionized the way in which we view and understand the natural world. Where earlier visionaries were only able to see mathematical “monsters,” Mandelbrot was able to discern nature’s geometric masterpiece. This dramatic breakthrough allowed him to identify and comprehend patterns and shapes that no one had previously understood and led him to develop the field of fractal geometry. Similar patterns, this article contends, are deeply embedded in the U.S. Constitution, and the metaphor of fractals, therefore, enables us to significantly bolster our understanding of the nation’s supreme law. This article, thus, develops the fractal theory of American constitutionalism, which posits that profound patterns of self-similarity ought to inform our fundamental understanding of the Constitution’s inherent structure and elemental coherence. In doing so, this novel theory not only illuminates the very nature of the U.S. Constitution and its contents, but it elucidates how the Constitution operates and provides a foundation for a key method of constitutional interpretation. Finally, the fractal theory of American constitutionalism provides a new methodology for gauging the document’s tensile strength and exposing historical fault lines and present structural weaknesses. In doing so, this theory also provides general guidance on how to mend possible constitutional deficiencies.*

## I. INTRODUCTION

Salvador Dali's painting, *The Visage of War*, depicts a morbid disembodied face against the backdrop of a desolate landscape. The face's frozen, furrowed brow, locked-open jaw, and emaciated appearance virtually exude the stench of decomposition and instills in the observer the sense of pain associated with conflict. Both of the face's cavernous eye sockets and its open mouth all contain reduced-sized versions of the whole image. And within the eyes and mouths of those reduced-sized versions are further reduced-sized versions of the whole. The clear intent is to suggest that these repetitions continue *ad infinitum*. The surreal, dark work conveys Dali's conception of the infinite horrors of war.<sup>1</sup> It is also the case that this artwork exhibits a fractal-like structure.

Fractals are geometric shapes. When a fractal is split into parts, its respective components possess a property called self-similarity. This means that a fractal's components are each reduced-sized copies of the whole shape. Or, conversely, the whole shape is, in a sense, a copy of its pieces. This repetition, or perhaps, redundancy, arguably reinforces the fractal shape, at least insofar as repetition signifies patterns and relations, and generates clarity. Indeed, fractality provides insights into the nature of geometric shapes, with respect to their complexity, dimensions, and scale. Fractal patterns abound in nature, and although we have observed them for millennia, the late, revered Yale mathematician, Benoît B. Mandelbrot, was the one to coin the term "fractal" and develop the field of fractal geometry. Mandelbrot, who was a modern-day Renaissance man, not only recognized fractals in nature, but discovered fractal patterns in a multitude of fields, including finance, physics, architecture, and fractography (the study of the mechanics of fractures in materials).<sup>2</sup> These patterns not only represented fractal geometry's remarkably wide set of applications, but illuminated key issues in each of these diverse areas. So, too, will this article argue that fractals bolster our understanding of the nation's supreme law—the U.S. Constitution.

Chief Justice Marshall famously wrote in *McCulloch v. Maryland*, "we must never forget that it is a *constitution* we are expounding."<sup>3</sup> Indeed, the U.S. Constitution is more than a mere checklist of clauses memorialized by an ink-stained parchment. It is also more than a formula or mathematical concept. And, the Constitution is *not*, literally speaking, a mathematical fractal. Yet, the Constitution does have a certain, special order to it, something that makes it

1. Michael Frame & Benoît B. Mandelbrot, *A Panorama of Fractals and Their Uses: Dali's Fractal*, YALE UNIV., <http://classes.yale.edu/fractals/panorama/welcome.html> (last visited Apr. 19, 2013).

2. BENOÎT B. MANDELBROT & RICHARD L. HUDSON, *THE (MIS)BEHAVIOR OF MARKETS* xvi (2006).

3. *McCulloch v. Maryland*, 17 U.S. 316, 407 (1819).

more than a mere statute. It is not simply the supreme law because it has been labeled as such; the Constitution embodies a deep democratic logic. Yet, this logic needs to be animated by a diligent, vigilant, and thoughtful populace in order for it to have effect. For this to happen, there must be a robust understanding of how the Constitution operates. Philip Bobbitt has helped improve the clarity of constitutional thought and discourse by delineating various methods of constitutional argument, particularly historical, textual, doctrinal, structural, prudential, and ethical.<sup>4</sup> This article suggests that the metaphor of fractals can aid constitutional thought by deepening our understanding of the Constitution's inherent structure. Such an understanding, it will be argued, will enable us to better comprehend the Constitution's coherence as well as the profound nature of the document itself and the grand themes and principles that it embodies. This understanding, in turn, not only illuminates the very concept of the Constitution and its contents, but it also highlights the Constitution's historical fault lines and present structural weaknesses. In doing so, the fractal theory of American constitutionalism is also prescriptive, because it provides some general guidance on how to improve the Constitution, which although a work of genius, still is a work in progress.

To be sure, this is a work on constitutional thought, rather than fractal geometry, and, as such, the fractal metaphor should be used with a degree of prudence and caution. The metaphor, however, does seem to have heuristic value. Hopefully, just as the fractal pattern in Dali's painting illustrates the infinite horrors of war, so too, perhaps, can the recognition of a fractal-like structure girding the U.S. Constitution illuminate the document's eternally profound themes and spirit.

## II. FRACTALS

Although a complex mathematical understanding of fractals is not required for the purposes of this article, a brief discussion of the basic concepts in fractal geometry is in order, and a look at some examples of fractals should prove useful to understanding how the fractal theory of American constitutionalism operates.

The classical mathematics of the nineteenth century was rooted in the regular geometric structures of Euclid and in Newtonian dynamics.<sup>5</sup> These approaches were useful and furthered understanding up to a point. The problem, however, was that certain subsequently discovered mathematical structures failed to conform to the patterns of Euclid and Newton.<sup>6</sup>

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4. Philip Bobbitt, *Methods of Constitutional Argument*, 23 U. BRIT. COLUMBIA L. REV. 449, 449 (1989).

5. BENOÎT B. MANDELBROT, *THE FRACTAL GEOMETRY OF NATURE* 3 (1983).

6. *Id.*

Mathematicians regarded these structures as “monsters.”<sup>7</sup> Enter Mandelbrot. The latter, an Eastern European refugee who spent years in obscurity after coming to America, had an unusual gift for recognizing patterns. In his original position as a researcher for I.B.M., he would notice patterns in data that everyone else had overlooked.<sup>8</sup> This talent eventually led him to pioneer fractal geometry, which mirrored the real complexity of nature rather than just the ideal forms of thought.<sup>9</sup>

Fractals produce a kind of paradox. Normally, if one divides a shape into separate parts, or zooms in on a portion of that shape, one would expect to see simpler shapes—the building blocks of the structure. The shape of a house, for example, conforms to this intuition. Viewed from one hundred yards away, a standard house will look like a roof atop a set of walls. From ten feet away, one can see that this structure is comprised of simpler objects, small rectangular tiles and bricks (or some other building materials). Fractals are different.

Take Mandelbrot’s classic example of a cauliflower.<sup>10</sup> It is a simple enough vegetable, shaped like a tree, complete with what resembles a trunk, branches, and canopy. Now, slice off one of its florets. What does one find? A small piece of the vegetable, shaped like a whole cauliflower. Now, slice off a sub-floret. What does one find? An even smaller piece of the vegetable, but again shaped like a whole cauliflower. And, should one continue this process, one would find increasingly small pieces of the vegetable, all shaped like a whole cauliflower. Therefore, unlike the structure of a standard brick house, which when viewed more closely is made up of bricks and mortar, a cauliflower’s macroscopic structure is made up of smaller cauliflowers, in theory, *ad infinitum*. It is in this sense that a cauliflower—or more broadly, a fractal—is paradoxical. The whole shape, like that of a cauliflower, can be quite simple. However, since that whole shape repeats itself as one zooms in on it, that shape defies intuition by remaining equally complicated at every level of magnification. It is in this sense that fractals are infinitely intricate and produce an enigmatic mix of complexity and simplicity.<sup>11</sup>

Yet in the midst of this mystery, there is also clarity. As Mandelbrot quipped, “there is hardly a paradox without utility.”<sup>12</sup> Here, the repetitive

7. *Id.*

8. Jascha Hoffman, *Benoît Mandelbrot, Novel Mathematician, Dies at 85*, N.Y. TIMES (Oct. 16, 2010), [http://www.nytimes.com/2010/10/17/us/17mandelbrot.html?\\_r=0](http://www.nytimes.com/2010/10/17/us/17mandelbrot.html?_r=0).

9. James Gleick, *Fractal Vision*, N.Y. TIMES (Dec. 21, 2010), [http://www.nytimes.com/interactive/2010/12/26/magazine/2010lives.html?\\_r=0#view=benoit\\_mandelbrot](http://www.nytimes.com/interactive/2010/12/26/magazine/2010lives.html?_r=0#view=benoit_mandelbrot).

10. Elaine Woo, *Benoit Mandelbrot dies at 85; mathematician known as the father of fractals*, L.A. TIMES (Oct. 21, 2010), <http://articles.latimes.com/print/2010/oct/21/local/la-me-benoit-mandelbrot-20101021>.

11. MANDELBROT & HUDSON, *supra* note 2, at 145.

12. MANDELBROT, *supra* note 5, at 405.

pattern in these so called “monsters” revealed a kind of structural order, and have now been organized by fractals into a coherent field, enabling us to better understand the world in which we live. Indeed, as it turns out, humans have been producing fractal patterns for millennia, dating back 5,000 years to kolams in southern India.<sup>13</sup> And prior to that, humans had in a sense, been breathing, thinking, and even *being* fractals, as these self-repeating patterns have been observed in the bronchioles of our lungs,<sup>14</sup> in brain waves,<sup>15</sup> and even in our DNA,<sup>16</sup> respectively. It has been posited that these fractal patterns may even help distinguish the beat of a healthy heart from a diseased one,<sup>17</sup> and so perhaps here, too, such an analysis can help assess even the “health” of a constitutional democracy. With these basic concepts in mind then, let us now turn to how fractals can help us specifically understand the U.S. Constitution and its content.

### III. “POPULAR FRACTICALITY,” CONSTITUTIONAL STRUCTURAL COHERENCE, AND INTERPRETATION

Fractals have at times been discovered in surprising places. Lucy Pollard-Gott, for example, has identified striking instances of self-similarity in poetry by finding subsets of a poem that bear structural resemblances to the whole.<sup>18</sup> At an even deeper level, certain poems such as Alan Ginsberg’s *Howl*, repeat not just word patterns, but *ideas* across several scales.<sup>19</sup> And likewise, structural fractals have been observed in literature, as in Paul Auster’s novel, *Mr. Vertigo*, in which the first sentence “contains the essence of the whole book.”<sup>20</sup> Perhaps similarly, then, underlying the words and clauses of the Constitution is a kind of a meta-structure—a deep, self-repeating pattern that shapes the entire document, evidence of which appears in its Preamble, with its timeless opening phrase, “We the People.”

The Preamble’s mere fifty-two words capture the entire Constitution’s very essence: popular sovereignty. A phrase that is of both profound simplicity and complexity, the Preamble embodies in plain English, the spirit of the

13. Frame & Mandelbrot, *supra* note 1, at *Kolams*, <http://classes.yale.edu/fractals/panorama/welcome.html> (last visited Apr. 19, 2013).

14. Stacey R. Boser et al., *Fractal Geometry of Airway Remodeling in Human Asthma*, 172 AM. J. RESPIRATORY & CRITICAL CARE MED. 817, 821 (2005).

15. Yoshiya Shinagawa et al., *Fractal Dimensionality of Brain Wave*, 6 FORMA 205, 205 (1991).

16. Yu Zu-Guo et al., *Fractals in DNA sequence analysis*, 11 CHINESE PHYSICS 1313, 1313 (2002).

17. Barry A. Cipra, *A Healthy Heart is a Fractal Heart*, 36 SIAM NEWS 1, 2 (2003).

18. Frame & Mandelbrot, *supra* note 1, at *PollardGott: Other Directions*.

19. *Id.* at *Cantoring Poetry*.

20. *Id.* at *Structural Fractals in Literature*.

Constitution in both word and deed. Madison/Publius declared in *The Federalist* No. 39,

the real character of the government . . . may be considered in relation to the foundation on which it is to be established; to the sources from which its ordinary powers are to be drawn . . . and to the authority by which future changes in the government are to be introduced.<sup>21</sup>

That character here seemed to be starkly defined by the people, as the Preamble not only promised popular self-government, but both embodied and enacted it.<sup>22</sup> Not only would “the people” go on to be the most recurrent phrase in the Bill of Rights,<sup>23</sup> but it is a self-similar motif incorporated into and throughout the 1789 document itself. The document was designed for the people, and it was ratified by the people.<sup>24</sup> Indeed, as Akhil Amar writes, the Constitution was *founded* on popular sovereignty.<sup>25</sup>

The Preamble’s foundational principle of popular sovereignty reverberates throughout (virtually) the entire Constitution. It pulsates through the Constitution’s various articles and clauses, informs even the order in which the former appears,<sup>26</sup> and emerges powerfully in Article VII, structuring the Constitution from tip to tail. As Amar explains, “[t]extually, Article VII even echoes the exact wording of the Preamble, explaining how ‘this Constitution’ is to be establish[ed].”<sup>27</sup>

The above, though, does lead to a couple of critical questions. First, why is this apparent pattern noteworthy? And second, prior to the Bill of Rights, how exactly did popular sovereignty manifest itself throughout (most parts of) the Constitution? Indeed, we see the existence of other themes, such as separation of powers, checks and balances, rule of law, transparency, and various Enlightenment values, but what connection might they have to each other and to popular sovereignty? This is where a fractal analysis can perhaps be informative, offering a unifying theory in constitutional thought.

The fractal theory essentially answers these questions simultaneously. To see how, let us deconstruct and begin by addressing the second question. And to do so, a discrete fractal analogy here will help. Let us take a Koch snowflake, a fractal resembling an actual snowflake. The structure begins with

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21. THE FEDERALIST NO. 39, at 239 (James Madison) (Clinton Rossiter ed., 1999) (emphasis added).

22. AKHIL REED AMAR, *AMERICA’S CONSTITUTION: A BIOGRAPHY* 5 (2005).

23. See Akhil Reed Amar, *Intratextualism*, 112 HARV. L. REV. 747, 793 (1999).

24. Akhil Reed Amar, *Architexture*, 77 IND. L.J. 671, 675 (2002).

25. *Id.* at 681.

26. See AMAR, *supra* note 22, at 208 (noting that the Constitution has a pyramidal structure that conveys a democratic logic, with “the People” as the pyramid’s foundation, then the legislature, then the executive, and then the judiciary).

27. Amar, *supra* note 24, at 684.



an “initiator”—here, an equilateral triangle.<sup>28</sup> Erase the middle third of each side of the triangle, and then fill each gap with a “tent” shape (here, another equilateral triangle, but minus one full side). At first, this algorithm will produce a Star of David, but when applied recursively, will generate a snowflake shape. In a sense, the Constitution is structured like a Koch snowflake fractal. If we think of the individual person as the “initiator”, and “We the People”, or, popular sovereignty as the “tents”, we can go through similar iterations of the latter to arrive at the Constitution. Now, the various grand Constitutional themes, at first glance, might not look too similar to our original “tents.” Indeed, these themes appear to be different from (albeit deeply complimentary to) popular sovereignty. But, it is argued here, that just as the various branches of the Koch snowflake are repetitions of that original tent shape, the Constitution’s grand themes are in actuality permutations of popular sovereignty.

Popular sovereignty is, in one deep sense, a particular conception of power. It suggests that, just as an individual ought to have control over her own fate and enjoy a deep respect of her personhood and autonomy, so too should “the People” have rule over themselves (and indeed, each seems impracticable without the other). To realize such popular self-governing and self-government, there must exist a particular distribution of political power. A deep respect for the *equal endowment* of the unalienable rights of all human beings (ideally) is what logically generates these power relations. I say “logically” because “equal” *necessarily* means that one person or group *cannot* enjoy unalienable rights over and above those of their peers, for any such disparity would by definition undermine such a distribution of political power. Logically, then, popular sovereignty in the U.S. leaves no room for monarchies, oligarchies, aristocracies, or any other such type of rule whereby political power is similarly concentrated in the hands of the few. Indeed, Madison, who recognized that “power is of an encroaching nature,”<sup>29</sup> spoke to this in *The Federalist* No. 39, stating that a republic is “a government which derives *all* its powers directly or indirectly from the great body of the people.”<sup>30</sup>

The Constitution’s grand themes, it seems, are essentially analogues of popular sovereignty. Just as popular sovereignty calls for an equal distribution of political power amongst the populace (insofar as each individual is endowed with equal inherent rights which, ideally, instills in them power over their own personhood and entitles them to equal respect thereof), the separation of powers for instance, evinces that distribution. As Madison/Publius explained in *The Federalist* No. 47, “[t]he accumulation of all powers, legislative,

28. MANDELBROT, *supra* note 5, at 42.

29. THE FEDERALIST NO. 48, at 305 (James Madison) (Clinton Rossiter ed., 1999).

30. THE FEDERALIST NO. 39, *supra* note 21, at 237 (emphasis added).

executive, and judiciary, in the same hands, whether of one, a few, or many, and whether hereditary, self-appointed, or elective, may justly be pronounced the very definition of tyranny.”<sup>31</sup> Hence, such a separation of powers is designed precisely to keep power out of the hands of the few, retain power in “the People”, and embody the principle of popular sovereignty.

Indeed, the same can be said for checks and balances. Madison/Publius argued in *The Federalist* No. 51 that the logic of a system of checks and balances fundamentally mirrored that of popular sovereignty:

This policy of supplying . . . better motives, might be traced through the whole system of human affairs, private as well as public. We see it particularly displayed in all the subordinate distributions of power, where the constant aim is to divide and arrange the several offices in such a manner as that each may be a check on the other — that the private interest of every individual may be a sentinel over the public rights. These inventions of prudence cannot be less requisite in the distribution of the supreme powers of the State.<sup>32</sup>

Checks and balances, then, is also a fractal-like iteration of popular sovereignty since, in a critical sense, it is a deep expression of popular self-government.

And ultimately, the Constitution’s general commitment to (various) Enlightenment values also represents yet another iteration of popular sovereignty. For instance, the rejection of the idea and practice of conferring titles of nobility represents a certain restatement of popular sovereignty, as it forbids an upset of the latter’s basic and fundamental diffuse distribution of political power. In *The Federalist* No. 39, Madison/Publius clearly indicated that any titles of nobility would be contrary to the very “complexion” of the republican system, which enables “that honorable determination which animates every votary of freedom to rest all our political experiments on the capacity of mankind for self-government.”<sup>33</sup> Indeed, the very concept of nobility would elevate one class of individuals above another, and thereby undermine any notion of popular sovereignty by invariably altering the sort of equal power relations for which it calls.

Certainly, the list of examples of grand Constitutional themes continues, and the above logic would generally apply to those as well. The next relevant question then, is why this pattern of popular sovereignty and its iterations matter. Essentially, there are two main reasons here: constitutional coherence and constitutional interpretation.

a. Coherence

The American composer, Charles Wuorinen, observed fractals in music, noting that “the same harmonic progression may determine the course of a

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31. THE FEDERALIST NO. 47, at 298 (James Madison) (Clinton Rossiter ed., 1999).

32. THE FEDERALIST NO. 51, at 319 (James Madison) (Clinton Rossiter ed., 1999).

33. THE FEDERALIST NO. 39, *supra* note 21, at 236.

whole movement.”<sup>34</sup> Although a fractal pattern does not itself constitute “composing”, it is still deeply important because it represents the preparation for it. Wuorinen explained that, “[h]aving made such preparation, then, I have found it possible to compose with a kind of intuitive freedom which still assures *macrostructural coherence*. Those who try for this coherence without *structural underpinnings* usually fail.”<sup>35</sup> Similarly, popular sovereignty and its fractal-like iterations in the U.S. Constitution are critical because, it is argued here, they form the structural underpinnings of the Constitution and provide for the document’s macrostructural coherence. Such coherence is key because it makes the Constitution intelligible as a unified body of profound values, rather than a mere checklist of discrete clauses. This coherence provides for a certain legal richness and texture capable of embodying the nation’s deep democratic logic, that a mere set of rules could not.

In a sense, then, such coherence speaks to the very *constitution* of the Constitution. The latter is not simply a set of concepts that are “merely juxtaposed and contingently aggregated under a single rubric.”<sup>36</sup> Rather, the fractal-like structural underpinning of the Constitution represents a kind of implicit ordering principle—a sort of underlying reason, somewhat comparable to Kant’s notion of reason. Kant believed that reason serves the important function of ordering concepts for, if such concepts are “isolated from one another, separated, as it were, by an empty intervening space,”<sup>37</sup> then that rubric would merely be a compilation of its various components. The U.S. Constitution, however, is very much more than the sum of its parts. As Laurence Tribe has argued, the Constitution is not merely a set of written commands and instructions.<sup>38</sup> Rather, in *The Invisible Constitution*, he posits that there is an entire “dark matter” that animates and undergirds much of the visible text.<sup>39</sup> As such, the Constitution seems to have a kind of conceptual fabric, an underlying logic and pattern that holds it together and informs its various parts.

And, under the fractal theory of American constitutionalism, such coherence further indicates that, just as the whole shape promotes the various parts, the various parts inform the whole structure. We see this cross-pollination, for instance, in the Article III treason clause which, as Akhil Amar pointed out, both contains the Constitution’s grand themes, and also informs

34. Frame & Mandelbrot, *supra* note 1, at *Music: Wuorinen*.

35. *Id.* (emphasis added).

36. This phrase is borrowed from Ernest Weinrib, who used it in the context of his treatise on private law, but it is apropos here. See ERNEST JOSEPH WEINRIB, *THE IDEA OF PRIVATE LAW* 88 (1995).

37. IMMANUEL KANT, *IMMANUEL KANT’S CRITIQUE OF PURE REASON* 543 (Norman Kemp Smith trans., 1st ed. 1929).

38. LAURENCE H. TRIBE, *THE INVISIBLE CONSTITUTION* 9 (2008).

39. *Id.* at 38.

the document as a whole as it seems to have constituted an entire proto-Bill of Rights.<sup>40</sup> Indeed, a deeper look at additional examples will follow. The immediate point, however, is about how the Constitution coheres, and about what such coherence tells us about the Constitution and how it operates. Here, the Kant-like notion of reason, implicit in the Constitution's fractal-like structure, it seems, functions to arrange the document's concepts in a way that provides for each part of the Constitution to simultaneously condition, and be conditioned by, each of the other parts as well as the whole. Like a fractal, then, the Constitution is both remarkably complex and yet simple.

Such coherence, moreover, suggests a certain depth and profoundness to the Constitution and the democratic logic and values that it embodies. Since the Constitution's grand themes manifest themselves on broad levels, across articles, and in various individual clauses, which generally cohere, those grand themes not only tend to be ubiquitous, but also multidimensional. In a fractal-like fashion, these themes remain equally robust at every level and scale. Indeed, that foundational principle of popular sovereignty—whether it be a permutation of individual rights or a “generator” of the vast fractal-like structure of the Constitution—signifies, thanks to such coherence, a powerful coalescence of American statehood and individual personhood, which is most fitting for a document that was ratified by and for the People.

b. Constitutional interpretation.

Yale historian John Gaddis has used fractals to describe how seemingly inconsequential occurrences could spawn historical events.<sup>41</sup> By looking at how particular incidents could shape larger phenomena, he was able to deduce a certain process from the structure of events.<sup>42</sup> Indeed, a somewhat similar logic is not entirely foreign to the law. Charles Black, for example, posited that, in interpreting the Constitution, certain inferences can reasonably be, and ought to be, drawn from the structures and relationships created by the Constitution,<sup>43</sup> suggesting that there exists “a close and perpetual interworking between the textual and the relational and structural modes of reasoning.”<sup>44</sup> Such an interaction between the Constitution's structure and text is of particular interest here, because the fractal-like structure of the U.S. Constitution indeed provides a certain logic for a type of textual interpretation of the document.

40. AMAR, *supra* note 22, at 244.

41. JOHN LEWIS GADDIS, *THE LANDSCAPE OF HISTORY: HOW HISTORIANS MAP THE PAST* 25, 83 (2002).

42. *See id.* at 35.

43. CHARLES L. BLACK, JR., *STRUCTURE AND RELATIONSHIP IN CONSTITUTIONAL LAW* 8 (1969).

44. *Id.* at 31.

The Constitution's macrostructural coherence, in a way, calls for interpretive coherence. Therefore, just as there is a legal principle that like cases ought to generally be treated alike, various words and phrases that reappear multiple times in the Constitution generally ought to be interpreted in a similar fashion. The fractal theory posits that the Constitution is a unified body of profound values, and as such, ought to be read in a holistic way. The grand, animating principle of popular sovereignty and its various iterations run deeply throughout (most) of the Constitution,<sup>45</sup> and therefore, reading any ambiguous words, phrases, or clauses in a disjunctive fashion would be to ignore the document's deeper thematic relations. Indeed, such a disjointed interpretation could threaten to reduce the written Constitution to a mere set of rules, rendering its written commands inconsistent with (to borrow a phrase) the "invisible Constitution."<sup>46</sup> The latter's fractal-like pattern signals a certain profoundness and consistency, and the words and phrases on the parchment are, insofar as it is linguistically possible, supposed to make visible (or at least evident) the document's deep underlying principles. Reading the text as a set of disconnected clauses would not merely incline one to understand the Constitution's terms inconsistently, but it would generally function to sever word from Constitutional principle.

Therefore, given the self-similar properties inherent in the Constitution's structure, the document's wording ought to be, logically, read congruently with the latter, in what Amar calls an "intratextual" fashion.<sup>47</sup> This mode of interpretation, as Amar explains, is methodologically distinct from standard doctrinal, historical, prudential, structural, and even textual techniques.<sup>48</sup> Unlike a standard textual interpretation, which Bobbitt explains "rest[s] on a sort of ongoing social contract, whose terms are given their contemporary meanings continually reaffirmed by the refusal of the People to amend the instrument,"<sup>49</sup> intratextualism necessarily examines at least two clauses in the Constitution in order to underscore the connection between them and understand how they might cohere. To be sure, the fractal theory does not exclude other modes of constitutional interpretation (provided that those methods understand the Constitution in a coherent manner). But it does specifically make sense that, where a word or phrase is repeated, and the

45. See, e.g., AMAR, *supra* note 22, at 35 (noting that Articles V and VI of the Constitution "extinguished the right and power of unilateral secession for each state populace that joined the . . . union, thereby merging itself into the continental sovereignty of the American people.").

46. TRIBE, *supra* note 38, at 77.

47. Amar, *supra* note 23, at 788–91.

48. See *id.* (explaining that unlike the traditional textualist approach, which looks to words in isolation, intratextualism "always focuses on at least two clauses and highlights the link between them."); see also PHILIP BOBBITT, *CONSTITUTIONAL FATE: THEORY OF THE CONSTITUTION* 7–8 (1984) (providing a brief summary of the various modes of constitutional interpretation).

49. BOBBITT, *supra* note 48, at 26.

principles underlying them are part of a structure that makes the latter self-similar, then the words or phrases in question should analogously be treated as self-similar, fractal-like images of each other, too.

This apparent pattern in the Constitution, then, seems noteworthy with major implications for Constitutional interpretation. Nonetheless, before proceeding to the next section, it should be worthwhile here to address a possible criticism of the fractal theory and its implications for constitutional interpretation. All this self-similarity, particularly with respect to the specific mode of constitutional interpretation that the fractal theory logically calls for, conceivably might be criticized as promoting a redundant understanding of the Constitution. Certainly, insofar as constitutional rules of construction are concerned, it is commonly asserted that the document should be read in a way so as to avoid redundancy.<sup>50</sup> While redundancy is sometimes desirable in life (for example, in airplane safety mechanisms), the argument here suggests that, with respect to the Constitution, we are to presume that the Framers were sound and skillful drafters, and that we are therefore to ask what is the value added by each clause.<sup>51</sup> The intratextualist method that the fractal theory logically suggests as an approach, then, might appear to contravene this rule of construction since the self-similarity not only of concepts, but of clauses, signals a certain repetitiousness that arguably adds no value.

Such a criticism of redundancy is misguided. It is useful here to adopt a metaphor used by Laurence Tribe. In his piece, “The Curvature of Constitutional Space,” Tribe draws on Einstein’s general relativity theory, explaining that Einstein posited that space itself is bent, and that the “curved space” metaphor was pertinent to the law.<sup>52</sup> The metaphor is certainly most useful, but its application here is slightly different. In the present context, it is material to focus on the *material* of space. That is, Einstein realized that space—that vast void which had previously been thought to be nothingness—was actually *something*. That so called emptiness has curvature and may indeed be a kind of fabric of our universe. Similarly, the alleged absence of value added by redundancy misconstrues repetition as devoid of meaning. In actuality, as Amar explains, such redundancy is illuminative and bolsters clarity, making that which had been implicit more explicit.<sup>53</sup> In so doing,

50. Akhil Reed Amar, *Constitutional Redundancies and Clarifying Clauses*, 33 VAL. U. L. REV. 1, 2 (1998).

51. *Id.* at 12.

52. Laurence H. Tribe, *The Curvature of Constitutional Space: What Lawyers Can Learn from Modern Physics*, 103 HARV. L. REV. 1, 6–8 (1989) (“A parallel conception in the legal universe would hold that, just as space cannot extricate itself from the unfolding story of physical reality, so also the law cannot extract itself from social structures.”).

53. See Amar, *supra* note 50, at 2, 20.

intratextualism (if performed non-mechanically and sensibly<sup>54</sup>) thus operates to explicate the text and highlight the conceptual fabric of the Constitution.

Now that we have seen what such fractal analysis reveals about the nature of the Constitution and why this is significant, let us return to some additional, noteworthy examples of constitutional fractality.

#### IV. ARTICLE I, SECTION 10: ATTAINDER, EX POST FACTO, AND NOBILITY

Article I, section 10 of the Constitution provides fertile ground for an examination of constitutional fractality. This section's prohibition on bills of attainder, ex post facto laws, and conferrals of titles of nobility represents a powerful iteration of the Constitution's grand themes, and further functions as a generator for recurrences of these very same themes elsewhere.<sup>55</sup> Indeed, popular sovereignty seems to animate these prohibitions. "We the People" signals a government by and for the people, and as such, no one may be above the law. A bill of attainder, ex post facto law, or a title of nobility, would each contravene this principle. A bill of attainder would essentially create a class of one—namely, the individual targeted by the legislation. While that one person would be subject to the law in question, all others, by corollary, would be above it. As such, it would create a society in which there would be a *de facto* class of "power-crats"—a class of privileged legislators who would enjoy the authority to wield governmental law-making powers against specific individuals. As such, this would contravene popular sovereignty because this would in effect be a censorial power in the Government over the people, for no one would be safe from such punitive legislation.

Ex post facto laws would offend popular sovereignty in a similar way, for as Amar explains, such retroactive statutes could equally be used to target a specific victim by "reverse engineer[ing] an attainder," substituting the exact description of the victim's past, innocent conduct for his name.<sup>56</sup> Titles of nobility, likewise, would transgress popular self-government, for any hereditary Congressional posts would *not* signify representation of, accountability to, and sovereignty in the people, but rather authority on the basis of bloodline. It is for this reason that Hamilton/Publius remarked in *The Federalist* No. 84,

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54. See Amar, *supra* note 23, at 799–800 (noting that intratextualism, when carried to extremes, can lead to misinterpretations if overly "mystical," too "mechanical," or exclusive of all other tools of interpretation).

55. See AMAR, *supra* note 22, at 124 ("With this short list of don'ts protecting individual liberty and republican equality against Congress and the states, the Constitution offered, in miniature, a stylistic and conceptual template for the later Bill of Rights and Reconstruction Amendments.").

56. *Id.* at 125.

[n]othing need be said to illustrate the importance of the prohibition of titles of nobility. This may truly be denominated the cornerstone of republican government; for so long as they are excluded there can never be serious danger that the government will be any other than *that of the people*.<sup>57</sup>

Certainly then, the Framers designed a document that was in sharp contrast with English practices, where bills of attainder were permitted, titles of nobility were conferred, and sovereignty resided in the Parliament rather than the people.<sup>58</sup>

Article I, section 10 exhibits fractality, moreover, not only because this particular section is shaped by the overarching theme of popular sovereignty, but because in its mere fifty-seven words, it essentially captures all of the complex contours of this principle that animates the entire Constitution. The Attainder Clause, as Amar suggests, promotes separation of powers by dichotomizing penal adjudication from penal lawmaking since it makes it the exclusive domain of the judiciary to apply laws against named individuals,<sup>59</sup> and also affirms checks and balances by “preventing any single branch of government from unilaterally depriving persons of life, liberty, or property.”<sup>60</sup> The section’s prohibition against ex post facto laws encourages open and transparent government, both by preventing the sort of legislative duplicity described above, and by enabling individuals to know what is the law prior to, rather than subsequent to, acting.<sup>61</sup> And, the forbiddance on conferrals of titles of nobility reflects the Enlightenment value that individuals ought to be recognized for their deeds rather than their descent.<sup>62</sup>

Indeed, this pattern of self-similarity is not only evident within Article I, section 10, but this section also in turn informs other areas of the Constitution, generating even deeper self-similarity. In a variety of ways, this section, to borrow a phrase, functioned as a “proto-Bill of Rights.”<sup>63</sup> The ban on bills of attainder and ex post facto laws prevented the threat of punitive legislation that could inhibit free speech; the attainder clause, as Amar explains, “implicates rights of individualized adjudicatory process—due process rights of notice and the opportunity to be heard”;<sup>64</sup> and the prohibitions of attainder and ex post facto laws arguably adumbrates protections against cruel and unusual punishments—all thereby foreshadowing the First, Fifth and Eighth

57. THE FEDERALIST No. 84, at 511 (Alexander Hamilton) (Clinton Rossiter ed., 1999) (emphasis added).

58. AMAR, *supra* note 22, at 103, 124–25.

59. Akhil Reed Amar, *Attainder and Amendment 2: Romer’s Rightness*, 95 MICH. L. REV. 203, 210 (1996).

60. *Id.* at 211 n.23.

61. *Id.* at 210.

62. AMAR, *supra* note 22, at 243.

63. *Id.* at 244.

64. Amar, *supra* note 59, at 211 n.23.



amendments, respectively.<sup>65</sup> Additionally, Article I, section 10 operated as proto-Reconstruction Amendments: the bar against attainders portended the principle underlying the prohibition against slavery by illuminating the evils of persecuting individuals for who they were rather than what they did.<sup>66</sup> Attainders are, as Amar suggested, “all about equality”<sup>67</sup> and, thus, forecasted the idea of equal protection; and, the ban on granting titles of nobility (and thus hereditary Congressional posts) would help ensure that the right to vote goes unabridged. Consequently, there seems to be evidence of deep self-similarity on a variety of levels and scales.

#### V. REPUBLICAN GOVERNMENT CLAUSE

Fractality abounds in the U.S. Constitution, and it is evident in the Article IV, section 4 Republican Form of Government Clause.<sup>68</sup> The Reconstruction Era senator, Charles Sumner called it a “sleeping giant in the Constitution,”<sup>69</sup> and certainly, it embodies yet another repetition of the Constitution’s monumental theme, popular sovereignty. Laurence Tribe alluded to this repetition when he noted that “it would be very hard to say that this clause embodies some unique vision of popular sovereignty,”<sup>70</sup> and Akhil Amar has stated that “the big idea [of the Republican Government Clause] was to shore up popular sovereignty.”<sup>71</sup> Madison, who explained in *The Federalist* No. 43 the significance of such a provision, likewise recognized a pattern, for he indicated that the provision would be at the very least a “harmless superfluity”<sup>72</sup>—or in this context, a necessary redundancy, a crucial element of self-similarity, promoting Constitutional coherence.

Equally, the Clause encapsulates the complexities of this central underlying principle of the Constitution, thereby not only cementing the philosophical integrity of the document, but bolstering the cohesion of the nation. Indeed, the Republican Government Clause captures the wholeness of popular sovereignty, advancing critical tenets of indivisibility of the nation, checks and balances, and the ban on conferring titles of nobility. As Amar elucidated, a tyranny in any state would constitute “a geostrategic threat to each and every neighboring state.”<sup>73</sup> The materialization of such tyrannies, and even the threat of such dangers, could thwart the People’s pledge to “form a

65. *Id.*

66. *Id.* at 219.

67. *Id.*

68. U.S. CONST. art. IV, § 4 (“The United States shall guarantee to every State in this Union a Republican Form of Government”).

69. CONG. GLOBE, 40TH CONG., 1ST SESS. 614 (1867) (statement of Sen. Sumner).

70. TRIBE, *supra* note 38, at 90.

71. AMAR, *supra* note 22, at 279.

72. THE FEDERALIST NO. 43, at 271 (James Madison) (Clinton Rossiter ed., 1999).

73. AMAR, *supra* note 22, at 280.

more perfect Union, establish justice, insure domestic Tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and Our Posterity”.<sup>74</sup> For, as Madison/Publius wrote in *The Federalist* No. 43, “[t]he more intimate the nature of such a union may be, the greater interest have the members in the political institutions of each other.”<sup>75</sup> As such, Article IV, section 4 advanced the key notion of indivisibility of the nation.

The Republican Government Clause, moreover, expounded the concept of checks and balances. By guaranteeing to every state a republican form of government, Article IV, section 4 created an environment in which each state would effectively check and balance each other.<sup>76</sup> The Clause preempted the conceivable objection that a state might be construed as somehow “nosy” or meddlesome if it were to keep watch over its neighbor’s affairs. As Madison explained, states in a more perfect union acquire “the greater right to insist that the forms of government under which the compact was entered into should be *substantially* maintained,” and what better location for that right than in the Constitution.<sup>77</sup> Moreover, the concept of checks and balances embedded here, operates on additional levels. According to Tribe, for example, it takes little imagination to interpret this Clause as a prohibition against “the open-ended delegation of direct governmental authority over others’ lives to private individuals neither elected by the people nor appointed by anyone so elected.”<sup>78</sup> As such, Article IV, section 4 helps to ensure a certain political accountability, in which the people have power over politicians, and, thus, act as a check on the latter.

And, by forbidding such a delegation of unfettered governmental power, the Republican Government Clause effectively functions as a ban on nobility. Indeed, such a disallowance in the U.S. of aristocracy, monarchy, or any such type of unaccountable governmental post, is the logical corollary of maintaining sovereignty in the people. Put differently, if Article IV, section 4 is all about popular sovereignty—and indeed it is—then it necessarily leaves no room for titles of nobility, and as such, operates as a prohibition against it.

Furthermore, the Republican Government Clause not only has properties of constitutional self-similarity, but it simultaneously produces further iterations. In certain respects, the Clause resembles a proto-Fourteenth Amendment. Article IV, section 4’s protocol that each state be guaranteed a republican form of government tenably provided a logical blueprint for the

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74. U.S. CONST. pmb.

75. THE FEDERALIST NO. 43, *supra* note 72, at 271.

76. U.S. CONST. art. IV, § 4.

77. THE FEDERALIST NO. 43, *supra* note 72, at 271.

78. TRIBE, *supra* note 38, at 89–90.

“incorporation” doctrine.<sup>79</sup> The underlying importance of consistency and coherence that helps drive the Republican Government Clause, similarly informs the well-established judicial principle that the Fourteenth Amendment applies, or “incorporates,” nearly all of the provisions of the Bill of Rights against states.

Lastly, on another level, we see what in fractal geometry is called, a cascade effect. A “cascade” in this context is a generating mechanism.<sup>80</sup> According to Mandelbrot, “[w]hen each piece of a shape is geometrically similar to the whole, both the shape and the cascade that generate it are called self-similar.”<sup>81</sup> Here then, states’ republican governments, and the U.S. Constitution’s “generating mechanism” contained in Article IV, section 4, appear to have that property of self-similarity. As such, we see another fractal-like iteration, here not just within the U.S. Constitution itself, but between the latter and state constitutions, thereby introducing profound elements of self-similarity on an even smaller scale, promoting a synergetic structure that buttresses American democracy at every scale.

#### VI. FRACTOGRAPHY: CONSTITUTIONAL FAULT-LINES AND STRUCTURAL WEAKNESSES

There remains a critical, looming question. This was foreshadowed, and indeed, the reader might have noticed important qualifiers throughout, such as the statement that popular sovereignty runs through “*virtually*” the entire Constitution. The question, put in stark terms, is: “what about slavery”? Slavery plagued lives and U.S. history. Does the fractal theory simply handle such a major, tragic aspect of the American story with a few qualifiers, in order to substantially align history with the theory’s tenets? *No*. The theory makes no attempt to describe slavery in fractal terms. To be clear, slavery is fundamentally anti-fractal. Yet, this is not a weakness of the fractal metaphor. On the contrary, this is where the fractal theory of American constitutionalism does some of its most important work. Let us recall that fractals have an application in fractography, a field that studies the mechanics of fractures in materials, models crack growth behavior, and practices failure analysis. Similarly, the fractal theory of American constitutionalism, far from writing off anti-fractal elements as anomalous, in fact highlights these deep flaws, signals that they may represent fault lines or structural weaknesses in the Constitution’s makeup, and provides at least some general prescriptions on how to mend these fractures, cracks, and chasms.

79. AMAR, *supra* note 22, at 386.

80. MANDELBROT, *supra* note 5, at 34.

81. *Id.*

A simple fractal-like and fractographic-style failure analysis reveals not only the obvious, deep moral problems with slavery, but also illuminates how slavery introduced to the Constitution a significant element of egregious incoherence. The Three-Fifths Clause and the Fugitive Slave Clause each fundamentally contravened popular sovereignty and its iterations.<sup>82</sup> The first and clearest level on which this occurred was that slavery ineluctably violated the personhood of blacks. Whereas American statehood was inspired by a certain idea of individual personhood, where a people should have power over themselves just as an individual ought to be able to decide her own fate, the very notion of slavery contradicted this principle. But alas, this argument would have lacked sway in early America, as slaves were not considered part of the constitutional compact.<sup>83</sup> Yet, the fractal theory demonstrates how, nevertheless, the Three-Fifths Clause and Fugitive Slave Clause both failed on their own terms.

The fractal theory of American constitutionalism, as noted, holds that self-similarity is a key component for constitutional coherence. Popular sovereignty, it is argued here, is the Constitution's fundamental principle, and as such, it and its iterations must permeate the Constitution. The Three-Fifths Clause and Fugitive Slave Clause contravene popular sovereignty, even if slaves were not considered part of the constitutional compact. First, let us return to popular sovereignty as a particular conception of power. If power is to fundamentally reside in the great body of the people, rather than be *concentrated* in the hands of the few in an unjust manner, then slavery—and the Three-Fifths Clause in particular—undermined such a distribution because it concentrated political power in the slave holders insofar as they enjoyed proportionately more voting power than their counterparts in free states. That is, slave states could increase their number of seats in Congress by acquiring more slaves, thereby inflating the political power of each of their citizens relative to those in free states. This kind of disparity of voting power between citizens in slave states and free states was, thus, itself a violation of popular sovereignty. Indeed, the 650,000 slaves in 1793 gave the South an extra thirteen seats in the House.<sup>84</sup> This grave inconsistency even created further “cracks” in the structure, for in a similar fashion, slavery inflated slave owners’ power in presidential elections via the electoral college. The slave state of Virginia circa 1800, for instance, enjoyed twenty-five percent more electoral

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82. Amar, *supra* note 59, at 216 (arguing that clauses like the Fugitive Slave Clause, although inconsistent with the spirit of the Constitution, were tolerated until “the Constitution worked itself pure with amendments that abolished slavery and reconfirmed the truest meaning of the freedom principles embodied in the Attainder, Due Process, Republican Government and other Clauses.”).

83. *Id.*

84. AMAR, *supra* note 22, at 94.

votes than the free state of Pennsylvania, even though the latter had ten percent more free persons than the former.<sup>85</sup>

Likewise, this accumulation of disproportionate political power in the hands of slave owners created a condition similar, in principle, to aristocracy. Slave owners unjustly bolstered their political power, undermining the credo of one person, one vote. Fittingly, Akhil Amar has used the term, “slavocrats,”<sup>86</sup> and it is thus clear how, in this way, slavery offended the Constitution’s ban on nobility. It is perhaps less than surprising that such inconsistencies, such *incoherence*, caused deep tensions and tectonic friction. Certainly, in this way too, slavery undercut the Constitution’s theme of indivisibility of the nation. Slavery’s profound *lack* of self-similarity to popular sovereignty and its iterations created a constitutional fault line, ultimately turning the nation on itself in the Civil War.

To borrow a phrase, “[a]lthough America has not always been smart, at least she has been lucky — so far.”<sup>87</sup> Here, fortunately, freedom prevailed and the Reconstruction Amendments, reflecting *inter alia* Republican Government, rule of law, and of course, popular sovereignty *reconstructed* the very structure of the Constitution in key respects, bolstering coherence where the deep inconsistencies created by the Three-Fifths Clause and Fugitive Slave Clause had severely compromised macrostructural integrity. Hence, an important lesson emerges here. The fractal theory not only demonstrates that the Constitution has deep elements of self-similarity, but that it *ought to have* the property of self-similarity since the latter is an essential ingredient in Constitutional coherence. Therefore, an absence of self-similarity could signal structural fault lines as in the examples just discussed, or even structural weaknesses that should be addressed.

The electoral college, to this day, represents such a structural weakness. Apart from what policy arguments exist either for or against the electoral college, the fractal theory shows that it is incoherent in the constitutional paradigm. As alluded to above, the original concept of the electoral college is epistemologically connected to the Three-Fifths Clause, in that it enabled the Southern states to count (three fifths of) their slaves toward their allotment of electoral college votes.<sup>88</sup> Even though slavery has been abolished, and even though no less than ten post-1791 constitutional amendments have either directly or indirectly reformed the electoral college,<sup>89</sup> the latter continues to undercut the precept of one person, one vote. While the electoral college might not, today, signify a fault line, it does, it is argued here, represent a structural

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85. Amar, *supra* note 24, at 688.

86. See AMAR, *supra* note 22, at 262.

87. *Id.* at 173.

88. Amar, *supra* note 24, at 688.

89. *Id.* at 691.

weakness for the notion of unequal voting power runs contrary to the principle of popular sovereignty. The reason is that, if some individuals have more weighty votes than others then in principle it means that, all other things being equal, those persons have proportionately more political power than the individuals with less weighty votes, thus, in essence, giving the former at least a modicum of political rule *over* the latter.

While the electoral college might not be creating a fault line in the way that slavery did, the former nevertheless produces structural weaknesses, which can contribute to instability, as evidenced by the numerous occasions on which a presidential candidate was denied residency in the White House despite securing a plurality of the popular vote.<sup>90</sup> While the fractal theory might not offer specific details on how to solve this problem (indeed, it is not a panacea), it does function to expose the dilemma. And by illuminating the nature of the Constitution and constitutional coherence, fractal theory provides general guidance on how to fix these flaws by pointing us not towards makeshift solutions, but toward coherent amendments that naturally coalesce with the deeply integrated structure of the Constitution.

## VII. CONCLUSION

Although the present length of the U.S. Constitution is less than that of this article, the former's profound tenets have animated a way of life for hundreds of millions of people over several generations. "We the People" are but three simple words that, in a fractal-like fashion, have generated a philosophical harmony that set the tone for the entire Constitution and the nation that it binds. Indeed, the fractal theory helps us to hear all of the Constitution's tonal elements, understand its composition, appreciate how its clauses work in concert, and identify which of its notes, despite its overall majesty, are off key.

Indeed, the fractal theory of American constitutionalism has illuminated telling patterns of self-similarity, cohesiveness, and profoundness in the Preamble and Article VII, the Treason Clause, the Attainder Clause, the prohibition against ex post facto laws, the ban on granting titles of nobility, the Republican Government Clause, the Bill of Rights, and in state constitutions. To be sure, this is far from a comprehensive list of examples, for one need not strain to find fractality elsewhere, as in the Article I, section 6 free speech clause, the Vesting Clauses, or the compensation of Senators and Representatives, for instance. Recognizing such patterns opens up seminal opportunities for vital insights into the nature of the Constitution, its structure, contents, and operation, as well as provides guidance on logical methods of interpreting the document. And conversely, the fractal theory provides

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90. See Paul Finkelman, *The Proslavery Origins of the Electoral College*, 23 CARDOZO L. REV. 1145, 1145 (2002).

assistance in diagnosing dilemmas in the Constitution, as well as general guidance on how to address them. It is in this way that the fractal approach aids the voice of the American people, for it bolsters an understanding of the democratic symphony, thereby better enabling all to participate in, contribute to, and sustain the harmony in a meaningful way.