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Mathematics and the Legal Imagination: A Response to Paul Edelman

Michael I. Meyerson
University of Baltimore School of Law, mmeyerson@ubalt.edu

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MATHEMATICS AND THE LEGAL IMAGINATION: A RESPONSE TO PAUL. EDELMAN

Michael I. Meyerson[1]

I was very flattered to read Paul A. Edelman's review of my book, *Political Numeracy*.[2] He is a first-rate mathematician and legal thinker, so his kind words are very much appreciated and his criticisms are taken seriously.[3]

My goal in writing the book was to explore different aspects of the multifaceted relationship between mathematics and the Constitution. The Constitution itself contains many numbers, and the very heart of democracy, the concept of "majority rule", is an arithmetic concept. I wanted to examine the reasoning behind the framers' numerical choices—why 2/3 of the Senate is needed to ratify treaties; why slaves were counted as 3/5 of a "person"; and why we have two houses of Congress and 538 presidential electors.[4] I also wanted to explore the nature of logic, both the logic used in the presentation of legal arguments and the dangers that result from not questioning the fundamental postulates of one's own reasoning. On the whole, Professor Edelman has positive things to say about my approaches to these first two goals.[5]

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1. Professor of Law and Piper and Marbury Faculty Fellow, Baltimore University.

2. Michael I. Meyerson, *Political Numeracy: Mathematical Perspectives on Our Chaotic Constitution* (W.W. Norton, 2002).

3. I was especially pleased that Professor Edelman approved of my attempt to explain mathematical concepts to those who have avoided the subject for years: "Meyerson's mathematical introductions are surprisingly good, especially given the limited space they are allotted. They are smoothly written and give a friendly introduction to lot of attractive mathematics." Paul H. Edelman, *The Law and Large Numbers,* 19 Const. Comm. 459, 470 (2002).

4. The Constitution does not specify the actual number of Electors, only the formula for determining how many Electors each state is allotted. Art. I, §1, cl.2. See also Amend. XXIII.

5. As for my study of the numbers within the Constitution, which he terms "technical mathematics," Professor Edelman writes, "It is in chapters 2-4 that Meyerson is best able to support his claim that mathematics can illuminate legal thinking. In these chapters he examines voting rules—including ruminations on the benefits of the electoral college—considers the super-majority aspects of the Constitution, and discusses the difficulties in apportioning seats in Congress. With interesting mathematics to be discussed and interesting law to ponder, this is the best part of the book." Edelman, *The Law and Large Numbers* at 463 (cited in note 3).
Regarding my discussion of logic, Professor Edelman writes, "Meyerson's use of general

My final goal was to explore how an understanding of various areas of modern mathematics could inform and improve our thinking about the constitution. This is the part of the book which receives Professor Edelman's strongest criticisms. He asserts that the use of what he terms "mathematical metaphor" is essentially a waste of time. As he put it, the more one knows about mathematics and the law, "the less persuasive these metaphors tend to be."

I suspect that Professor Edelman's background as a mathematician is preventing him from seeing that mathematics can trigger a non-mathematical imagination and create mental images that permit new ways of thinking about non-mathematical topics.

Mathematics is not simply a tool for resolving problems. Despite its reputation for being tedious, inaccessible, and boring, mathematics is actually a glorious way of thinking, with a deeply aesthetic quality. The poetry of mathematics can illuminate all manner of thought.

Consider, for example, this passage from Oliver Wendell Holmes, Sr.'s pre-Civil War essay, *The Autocrat of the Breakfast Table*: "All economical and practical wisdom is an extension of the following arithmetical formula: 2 + 2 = 4. Every philosophical proposition has the character of the expression a + b = c. We are mere operatives, empirics, and egotists until we learn to think in letters instead of figures."[6]

All thinkers, especially those engaged in legal analysis, can benefit from this admonition to reason abstractly, in the universal rather than the particular. Math does not serve as a mere "metaphor," but creates an effective means for reexamining one's thoughts.

Likewise, James Madison used a simple mathematical picture in *Federalist No. 10*, to describe how a national government minimizes the evils of majority factions:

> *Extend the sphere,* and you take in a greater variety of parties and interests; you make it less probable that a majority of the whole will have a common motive to invade the rights of

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logic is impeccable, but I will question if its use is distinctly mathematical. . . . . He reminds us that it is important to make clear what one is assuming and what one is concluding in any argument, but particularly in legal ones, where it is easy to leave the hypotheses unstated. The more transparent the logic, the better it can be assessed." Id. at 461-63.

6. Oliver Wendell Holmes, Sr., *The Autocrat of the Breakfast-Table* 1 (Phillips, Sampson, and Co., 1858).

> other citizens; or if such a common motive exists, it will be more difficult for all who feel it to discover their own strength, and to act in unison with each other.[7]

Obviously, when Madison referred to a "sphere" he was not contemplating a literal geometric shape. Rather, he was creating a mental picture of a container increasing in size, to encompass a larger geographic area. Moreover, his basic point was inherently mathematical: The larger the voting population, the more difficult it is to maintain a permanent working majority.

I believe that what Laurence Tribe wrote about the legal import of modern physics holds for modern mathematics as well: "my conjecture is that the metaphors and intuitions that guide physicists can enrich our comprehension of social and legal issues."[8]

Professor Edelman notes, without significant analysis, my discussion of topology. To understand this discussion, one needs to know that topology is a novel way of considering geometrical figures. It views shapes as flexible, as if drawn on a piece of Silly Putty. Topology asks what properties remain unchanged after a figure is continuously bent and stretched, without being cut or torn. For example, a donut can have a large or small hole, and still be a donut, but you must preserve some hole for the new shape to be "topologically equivalent" to the original.

The concept of flexibility within limits is essential for a sophisticated understanding of constitutional law, and I believe that topology offers one way of illustrating that concept. The evolution of the Supreme Court's federalism jurisprudence can be captured with a topological picture.

Imagine federal power as the ring of the donut and the states' residual power as the hole. In my book, I write: "Over time, the size of the hole has grown and shrunk relative to the size of the sphere, but the hole must remain if the Constitution's topological structure is to remain intact".[9] In other words, the scope of federal power grew enormously during the twentieth century, but that expansion ended with *United States v. Lopez*,[10] when the Court ruled that there were constitutional limits on

7. Federalist 10 (Madison) in Clinton Rossiter, ed., *The Federalist Papers* 51 (Mentor, 1961) (emphasis added).

8. Laurence H. Tribe, *The Curvature of Constitutional Space: What Lawyers Can Learn from Modern Physics*, 103 Harv. L. Rev. 1,2 (1989).

9. Meyerson, *Political Numeracy* at 138 (cited in note 2).

10. 514 U.S. 549 (1995).

federal commerce clause power, and, in particular, that Congress had no power to make mere gun possession near school property a federal offense. Particularly noteworthy was the plaintive ending to Chief Justice Rehnquist's decision, that the Court was "unwilling" to concede, "that there never will be a distinction between what is truly national and what is truly local."[11]

The idea that the extent of federal power need not be rigid for all time, but that there must always be some issues reserved to the states, can be framed in many different ways. Picturing *Lopez* as "preserving the hole" can be one effective illustration.

Professor Edelman also criticizes my discussion of "Constitutional Chaos." In mathematical terms, chaos occurs under certain very specific conditions. One major characteristic of chaotic systems is the concept of feedback or "iteration."[12] In a series of calculations, the result of your next calculation is determined in part by the solution to your previous one.

Another characteristic of chaotic systems is that even the tiniest error completely changes the results. Thus, for chaotic systems, long-range prediction is impossible. In the absence of perfect, super-human knowledge, mistakes are inevitable, and the variations caused by the smallest error increase dramatically over time.

In my book, I propose that the essence of constitutional interpretation has much in common with a dynamic, chaotic system. Under the doctrine of *stare decisis*, the mathematical concept of iteration is paralleled by the Supreme Court's use of its own precedent to decide future cases. Since our knowledge of the intent of the framers is incomplete, anyone attempting to interpret the Constitution according to the framers' understanding is bound to make errors. Over time, as implied by the theory of chaos, this lack of precision will result in a very different constitutional path from what the framers would have expected. The inevitability of error limits the capacity of modern constitutional rules to reflect original intent.

Professor Edelman objects to this analysis:

> Meyerson assumes a very mechanistic form of legal rulemaking in which the outcome of each case is completely decided by previous decisions. He has to take this view if he wants to

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11. Id. at 567-68.

12. Robert L. Devaney, *Introduction to Chaotic Dynamical Systems* 2 (Perseus, 2nd ed. 1989).

> view constitutional interpretation through a chaotic lens, because his chaotic model is dependent on the system being deterministic.[13]

At no point do I say that the system is deterministic, such that the Court blindly follows precedent from one case to the next. Moreover, I go out of my way to say that, "the unquantifiable nature of Constitutional doctrine and structure make formal modeling impossible"[14] Unlike Professor Edelman, however, I strongly believe that the lessons from chaos theory are still valuable for the constitutional scholar.

Where I differ most from Professor Edelman is in my conviction that mathematical imagery and concepts can open the mind, even absent a perfect analogue. Much of modern mathematics is based on the surprising inability to obtain precision and certainty. I remain convinced that an understanding of this aspect of mathematics can facilitate an appreciation of the difficulty, if not the impossibility, of guaranteeing the certainty of our own legal conclusions. This newfound humility, I submit, would benefit all of us greatly.

13. Edelman, *The Law and Large Numbers,* 19 Const. Comm. at 474 (cited in note 3).

14. Meyerson, *Political Numeracy* at 196-97 (cited in note 2).