THE STANDARDS OF THE STATE:

WEIGHTS, MEASURES, AND NATION MAKING IN THE EARLY AMERICAN REPUBLIC

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In January 1830, a committee appointed by the Delaware House of Representatives filed a report to the larger General Assembly. The committee, created in response to a petition praying that the Delaware state government do something to establish "uniform weights and measures," deemed it "inexpedient to make any legislative enactment upon this subject." Their argument for inaction, laid out in great detail, reveals something about the fault lines of federalism at this time. "Congress alone can remedy the evils under which we labor, for want of a uniform standard," they observed: Article I, Section 8 of the United States Constitution explicitly gave Congress the power to "fix the standard of weights and measures." But Congress, while possessor of this prerogative, had declined to act, despite entreaties to do so. The committee ruefully reported that while "a great variety of useful and curious learning has been developed" as Congress grappled with the problem, "no law has yet been enacted by that body, to fix that standard."

The individual states, the committee reported, had acted, despite the questionable constitutionality of doing so. Each established their own weights and measures, driven by whatever their "particular circumstances seemed to require." As a consequence, observed the committee, "scarcely any two States agree in their standards of weights and measures." A small state like Delaware, overshadowed by the large commercial cities of Baltimore and Philadelphia, followed at least two – and likely many more – sets of standards, all of them at variance with each other. Worse, conflicts had arisen in commerce over weights and measures: a standard measure "considered a good standard in one place, is pronounced to be defective and insufficient in the other." Delaware's "peculiar situation," while underscoring the need for action, could "only be removed by Congress, exercising the power secured it by the Constitution of the United States." [1]

Yet the diminutive state of Delaware was hardly alone in its frustration; states large and small struggled with these problems in the early republic, and state legislatures and private citizens submitted petitions to the federal government praying for action.[2] But the uncertainty plaguing weights and measures went much deeper, extending all the way down to smaller units of government: counties, townships, and municipalities. On the local level, weights and measures rarely exhibited any kind of uniformity. A bushel in one store did not equal a bushel two blocks away, despite local laws prescribing that weights and measures used by retailers be sealed and standardized. In Providence, Rhode Island, for example, a committee appointed by the municipal authority in 1820 discovered that "little uniformity prevails" and "that many of the weights and measures of shopkeepers are below the standard, while some considerably exceed it." Other state and local authorities found that deviations from the standard proved remarkably resistant to reform. In Philadelphia, for example, a grand jury in 1822 inveighed against the "irregularity of

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[1] *Journal of the Senate of the State of Delaware* (Dover, Delaware: Augustus M. Schee, 1830), 84-85; "Delaware Legislature. House of Representatives," *Delaware Gazette and State Watchman*, 26 January 1830.

[2] See, e.g., *Journal of the Proceedings of the Legislative Council of the State of New-Jersey* (Elizabeth-Town, New Jersey: Shepard Kollock, 1807), 688; "Memorial of Edward Gilpen and Others, Respecting Weights & Measures," 7 January 1817, in File SEN 14A-G13.5, part of the U.S. Senate Legislative Files and Petitions, RG 46, Records of the U.S. Senate, NARA, Washington, D.C.; *Journal of the House of Representatives of the State of Ohio* (Columbus: P. H. Olmsted, 1827),. 55-56.

weights and measures…as the source of very extensive frauds" – and this was after repeated attempts to impose some uniformity on the city's standards.[3]

In recent years it has become fashionable to assail the "myth of statelessness": the notion, promulgated by an earlier generation of historians that the American state was especially "weak" in this formative era. The work of William Novak and others has demonstrated conclusively that, if state and local statute books and the common law are any indication, the United States was a "well regulated" society in which ordinary citizens operated amidst a thicket of local regulations governing everything from fire hazards to public markets to gambling. Likewise, Brian Balogh's revisionist account of the scope of federal power in the nineteenth century has portrayed a far more active, if invisible, national government during this period. There is much to recommend these accounts, particularly if "weak" refers to some kind of prelapsarian land of *laissez faire*.[4]

But there are dangers in pushing this line of argument too far. The endless debates over weights and measures in the nation's states, counties, cities, and towns, points toward a more complicated story that reveals the limits as much as the latitude of state power at this time. While this may seem an extravagant claim, it is worth remembering that outside of the United States, the creation of unified systems of weights and measures – so-called "metrological systems" – was what one historian has described as a "constitutive element of state formation." Though such campaigns for unification have a centuries-old pedigree, from the late eighteenth century onward, they became inseparable from the larger project of building a powerful state. In the United States, as much as in Europe, the unification of weights and measures was an integral part of a number of other state projects dedicated to creating national markets, rationalizing the collection of taxes, and cultivating a sense of shared citizenship.[5]

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[3] "Weights and Measures," *Providence Gazette*, 8 September 1820; "Weights and Measures," *Niles Weekly Register*, 13 April 1822.

[4] William J. Novak, *The People's Welfare: Law & Regulation in Nineteenth-Century America* (Chapel Hill: University of North Carolina Press, 1996); Brian Balogh, *A Government Out of Sight: The Mystery of National Authority in Nineteenth-Century America* (Cambridge: Cambridge University Press, 2009); William J. Novak, "The Myth of the 'Weak' American State," *AHR* 115 (2010), 752-772. For a sympathetic critique, see Harry N. Scheiber, "Private Rights and Public Power: American Law, Capitalism, and the Republican Polity in Nineteenth-Century America," *Yale Law Journal* 107 (1997), 823-861. More broadly, see Richard R. John, "Government Institutions as Agents of Change: Rethinking American Political Development in the Early Republic, 1787-1835," *Studies in American Political Development* 11 (1997), 347-380.

[5] Bruce Curtis, "From the Moral Thermometer to Money: Metrological Reform in Pre-Confederation Canada," *Social Studies of Science* 28 (1998), 547-570. On the relationship between metrology and state formation, see Witold Kula, *Measures and Men*, trans. Richard Szreter (Princeton: Princeton University Press, 1986); Kenneth Alder, "The Metric Revolution: A Social History of the Metric System in France," *Proceedings of the Annual Meeting of the Western Society for French History* 21 (1994), 95-105; Kenneth Alder, "A Revolution to Measure: The Political Economy of the Metric System in France," in M. Norton Wise, ed., *The Values of Precision* (Princeton: Princeton University Press, 1995), 39-71; William J. Ashworth, *Customs and Excise: Trade, Production, and Consumption in England, 1640-1845* (New York: Oxford University Press, 2003), 269-298; Michael D. Gordin, "Measure of All the Russians: Metrology and Governance in the Russian Empire, *Kritika: Explorations in Russian and Eurasian History* (2003), 783-815; William J. Ashworth, "Metrology and the State: Science, Revenue, and Commerce," *Science* 19 (2004), 1314-1317.

In the United States, such reforms had many powerful proponents. Thomas Jefferson lent his expertise and political authority to metrological reform in the hopes that standard weights and measures could help unify the new nation. So, too, did many others who believed that new standard weights and measures would mark a decisive, revolutionary break with the past. But no such thing happened. In the United States, the philosophical pretensions of Jefferson and others collapsed in the face of active resistance and pervasive apathy. While the federal government continued to make desultory attempts to impose standard weights and measures, it would ultimately fall far short of success. A similar fate befell state and local governments. Though motivated by less lofty motives than Enlightenment thinkers like Jefferson, they found their efforts to standardize weights and measures foundered on many of the same shoals. Throughout the nineteenth century, the state – whether federal, state, or local – proved comically inept at setting, never mind regulating, weights and measures. Indeed, it was well into the twentieth century before the United States achieved some semblance of standardization in its weights and measures.[6]

This troubled narrative calls into question the notion that the state was particularly powerful, effective, or pervasive in the early republic, never mind the longer nineteenth century. But the argument advanced here does not revive the simplistic claim that the American state at this time was *exceptionally* weak relative to other countries at this time. In fact, the governments of England, France, and many other nations found imposing standard weights and measures an equally frustrating, decades-long process.[7] Instead, this chapter investigates the often vast divide between the rhetoric of a well-regulated society and the actual, on-the-ground reality that attended the implementation and enforcement of these regulations. Much could get lost in translating the legal imperatives of the state into a practical reality, and the history of weights and measures in the United States offers an object lesson in how difficult it can be to make the one mirror the other.

This was true in the case of the federal government as well as the state and local governments. Many of the difficulties encountered on each of these levels derived from the

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[6] The history of weights and measures in the early republic is not particularly well documented, save for the opening pages of a handful of government-sponsored histories. See, e.g.., Louis Albert Fischer, "History of the Standard Weights and Measures of the United States," *Bulletin of the Bureau of Standards* 1 (1905), 365-381; Ralph W. Smith, *The Federal Basis for Weights and Measures: A Historical Review of Federal Legislative Effort, Statutes, and Administrative Action in the Field of Weights and Measures in the United States*. National Bureau of Standards Circular No. 593. Washington: National Bureau of Standards, 1958; Lewis V. Judson and Louis E. Barbrow, *Weights and Measures Standards of the United States: A Brief History* (Washington: National Bureau of Standards, 1976); Arthur H. Frazier, "United States Standards of Weights and Measures: Their Creation and Creators," *Smithsonian Studies in History and Technology* No. 40 (Washington: Smithsonian Institution Press, 1978).

[7] Julian Hoppit, "Reforming Britain's Weights and Measures, 1660-1824," *English Historical Review* 108 (1993), 82-104; Ken Alder, "The Metric Revolution: A Social History of the Metric System in France," *Proceedings of the Western Society for French History* 21 (1994), 95-105; Richard Sheldon, Adrian Randall, Andrew Charlesworth, and David Walsh, "Popular Protest and the Persistence of Customary Corn Measures: Resistance to the Winchester Bushel in the English West," in Adrian Randall and Andrew Charlesworth, eds., *Markets, Market Culture, and Popular Protest in Eighteenth-Century Britain and Ireland* (Liverpool: Liverpool University Press, 1996), 25-45; Aashish Velkar, "Caveat Emptor: Abolishing Public Measurements, Standardizing Quantities, and Enhancing Market Transparency in the London Coal Trade c1830," *Enterprise & Society* 9 (2008), 281-313.

paradoxical nature of a federal system of government, where the line defining the sovereignty of different layers of government – national, state, and local – is elusive and ever changing. But many problems also arose from the more timeless contest between state authority on the one hand and local customs, traditions, and practices on the other. The American state could legislate, dictate, cajole, and threaten. But compared to more familiar forms of state power, from keeping the peace to collecting taxes, imposing standard weights and measures proved an extraordinarily vexing, perplexing challenge at this time. "Custom," mused one legislator as he contemplated resistance to new weights and measures, , "has a more controlling influence than law."[8]

A PHILOSOPHICAL STANDARD

When the United States declared its independence from Great Britain, the more pressing demands of fighting a war trumped concerns about weights and measures. Throughout the conflict, each of the former colonies continued using their own versions of the British standards of weight and measure, effectively continuing colonial practices. Likewise, states generally observed colonial-era regulations governing the sealing and stamping of weights and measures. Though they varied greatly from colony to colony, most of these laws endorsed the official British weights and measures as the preferred standard; prescribed the appointment of "sealers" or "regulators" of weights and measures on the local level; and required that merchants, grocers, and others have their own weights and measures verified by comparison to an official standard. Many laws drew distinctions between liquid and dry measures of capacity; stipulated the weight of certain commodities in bushels or other units; and required that high-quality copies of the official standards be available at county courthouses or other official buildings for purposes of comparison and verification, which in some cases was meant to take place at annual intervals.[9]

It was only with the ratification of the Articles of Confederation that the national government extended its sovereignty over weights and measures. Under the Articles, the national government acquired the "sole and exclusive right and power of…fixing the standards of weights and measures throughout the United States." This provision was added to the final draft, but does not appear to have been controversial in any way. While earlier plans for inter-colonial cooperation such as the Albany Plan of 1754 had not mentioned weights and measures,

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[8] *Journal of the Senate of the Commonwealth of Pennsylvania*, v. 1 (Harrisburg: Henry Welsh, 1833-1834), 86-89. This argument owes a debt to the work of James Scott, particularly *Weapons of the Weak: Everyday Forms of Peasant Resistance* (New Haven: Yale University Press, 1987) and *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998), 25-33; as well as Aashish Velkar's work, most notably *Markets and Measurement in Nineteenth-Century Britain* (Cambridge: Cambridge University Press, 2012).

[9] See, for example, the colonial and state laws compiled by John Quincy Adams in his famed report on weights and measures. H. Doc. No. 109, 16th Cong., 2nd Sess. (1821), *Report of the Secretary of State Upon Weights and Measures* (Washington: Gales & Seaton, 1821), 96-117. A rare meditation on the need to unify weights and measures at this time can be found in a letter from Cotton Tufts to John Adams in July of 1776. *The Adams Papers Digital Edition*, ed. C. James Taylor, Charlottesville, Virginia: University of Virginia Press, Rotunda, 2008), Adams Family Correspondence, Volume 2, June 1776-March 1778), 61-62.

the evidence from the early drafts of the Articles of Confederation would seem to suggest that most considered it axiomatic that the new, national government have responsibility for setting standards of weight and measures. This is hardly surprising, even for a state that was deliberately deprived of other powers necessary for creating a unified national economy. Indeed, none of the state constitutions drafted prior to the ratification of the Articles made any mention of weights and measures, effectively ceding that power to the new, national government without controversy. [10]

The Articles may have given Congress the power to fix weights and measures beginning in 1781, but the ongoing war effort precluded any movement on the issue. It was only after the Treaty of Paris in 1783 that a committee consisting of Alexander Hamilton, James Madison, and one other member was charged with implementing "the regulation of weights and measures and other articles of the Confederation not attended to during the war." In a harbinger of things to come, the committee failed to issue a report. In April 1785, James Madison wrote James Monroe, complaining about both the lack of a uniform currency as well as a national standard of weights and measures. "I hear frequent complaints of the disorders of our Coin," he reported. "Do not Congress think of a remedy for these evils? The regulation of weights & measure seem also to call for their attention…Next to the inconveniency of speaking different languages, is that of using different & arbitrary weights and measures." Perhaps prodded by Madison, a few months afterward the Continental Congress ordered the Board of Treasury to draft an "Ordinance fixing the Standards of weights and measures throughout the United States of America." But this, too, yielded nothing concrete.[11]

Congress, however, did contemplate a related question: the monetary standard for the new nation. In 1782, Robert Morris had put forward a rather complicated plan for reconciling the different currencies then in circulation. As Morris explained, "the ideas annexed to a pound, a shilling, and a penny, are almost as various as the states themselves." His solution, which relied on an imaginary "unit of account" based on 1/1440th of a Spanish silver dollar, found few defenders in Congress. In retrospect, it is easy to understand why: according to his esoteric calculations, twenty four of these units would add up to a penny in Georgia; fifteen would constitute a penny in North Carolina and New York; twenty a penny in Virginia, Massachusetts, Rhode Island, New Hampshire, and Connecticut; and sixteen would add up to penny in almost all the other states. In South Carolina, however, no simple equivalence existed. Here, Morris

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[10] Merrill Jensen, *The Articles of Confederation: An Interpretation of the Socio-Constitutional History of the American Revolution, 1774-1781* (Madison: University of Wisconsin Press, 1940), 108-139; Willi Paul Adams, *The First American Constitutions: Republican Ideology and the Making of the State Constitutions in the Revolutionary Era* (Chapel Hill: University of North Carolina Press, 1980).

[11] *Journals of the Continental Congress, 1774-1789* [hereafter abbreviated as *JCC*], v. 21 (Washington: Government Printing Office, 1906), 893-895; *JCC*, v. 25 , 953-954; *The Papers of James Madison Digital Edition*, J. C. A. Stagg, ed. (Charlottesville, Virginia: University of Virginia Press, Rotunda, 2010), Congressional Series, Volume 8 (10 March 1784-28 March 1786), 272; JCC, v. 29, 647.

observed that it would take forty eight units to equal thirteen pennies – hardly an equivalence that lent itself to conversion and calculation.[12]

Two years later, Thomas Jefferson proposed an alternative plan that would ultimately inform his proposal for standard weights and measures. In *Notes on the Establishment of a Money Unit, and of Coinage for the United States*, Jefferson argued that whatever "unit of money" the United States chose to adopt, it should be of a "convenient size," and that any fractions of the unit be simple and straightforward, lending themselves to easy calculation. Finally, he argued that this hypothetical unit be close in value to coins already in circulation in order to insure its swift adoption by the people. These requirements pointed Jefferson to an obvious candidate: the Spanish dollar. He argued that practicalities alone dictated this choice. The piece of eight, he argued, "offers itself as a Unit already introduced. Our public debt, our requisitions, and their appointments, have given it actual and long possession of the place of Unit." Moreover, he observe, foreign trade would bring more of these silver dollars to the United States than any other coin. Jefferson dismissed the idea of adopting the pounds, shillings, and pence in use in one of thirteen states, given that this would force the other twelve to radically restructure their monetary system. He likewise scoffed at idea of having the former colonies return to the British monetary system. "Shall we hang the pound sterling, as a common badge, about all their necks?"[13]

But Jefferson did not want the country to divide that coin according to custom. After all, the Spanish dollar was called a "piece of eight" for a reason: it was equivalent to eight reales, a smaller denomination of Spanish coin. Jefferson found this unnecessarily complex. A man of the Enlightenment, he observed that "in all cases, where we are free to choose between easy and difficult modes of operation, it is most rational to choose the easy." For Jefferson, that meant dividing the coin into decimal units. The dollar would therefore be minted in tenths (what became the dime) and hundredths (what became the cent). It could also be combined in multiples of ten: a ten-dollar piece, for example.[14]

Congress applauded Jefferson's proposal, and a committee report released in 1785 repeated many of the same objections to the Morris plan, arguing that it introduced "a coin unlike in value to any thing now in use. It departs from the national mode of keeping accounts, and tends to preserve inconvenient prejudices." The committee complained that the Morris plan would stand in the way of a "national uniformity" in monetary accounts. "The money of the United States," the reported argued, should be equally fitted to all," and the adoption of

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[12] Robert Morris to John Hanson, 15 January 1782, in *The Papers of Robert Morris*, vol. 4, Elmer James Ferguson, ed., (Pittsburgh, Pennsylvania: University of Pittsburgh Press, 1978), 25-40; Don Taxay, *The U.S. Mint and Coinage: An Illustrated History from 1776 to the Present* (New York: Arco, 1966), 11-25.

[13] *The Papers of Thomas Jefferson Digital Edition*, ed. Barbara B. Oberg and J. Jefferson Looney (Charlottesville, Virginia: University of Virginia Press, Rotunda, 2008), Main Series, Volume 16 (30 November 1789-4 July 1790), 150-160, 602-618.

[14] On Jefferson's interest in decimal divisions, see C. Doris Hellman, "Jefferson's Efforts towards the Decimalization of United States Weights and Measures," *Isis* 16 (1931), 266-314. On the larger history of decimalization and currency, see Adrian E. Tschoegl, "The International Diffusion of an Innovation: The Spread of Decimal Currency," *Journal of Socio-Economics* 39 (1010), 100-109.

Jefferson's dollar – the old Spanish dollar divided decimally -- would "produce the happy effect of Uniformity in counting money throughout the Union." In the wake of this endorsement, Congress unanimously resolved that the monetary unit of the United States be the dollar; a year later, it defined the dollar as having 375.64 grains of fine silver. Jefferson's proposal now became the basis of a new, monetary standard. George Washington, who had supported the plan, declared that Jefferson's ideas upon this subject are plain and simple; well adapted…to the nature of the case." Absent a national monetary standard, noted Washington, "a man must travel with a pair of money scales in his pocket."[15]

Congress had now defined a monetary standard in terms of a specific weight of silver. But it had not resolved the related problem of standard weights and measures. For many of the founders, these two matters had a natural affinity with one another: if the value of any a currency was pegged to a certain weight of gold or silver, it was inevitable that the two standards be governed by the same logic. It is hardly surprising, then, that when the delegates to the Constitutional Convention met in Philadelphia, they joined these prerogatives in the same clause. The Committee of Detail may have been the first to put this in writing, stipulating that Congress have the power "To coin money; To regulate the value of foreign coin; [and] to fix the standards of weights and measures." Though the prospect of national control over the money supply generated some debate, the clause relating to weights and measures does not seem to have aroused the slightest bit of anxiety or controversy. In the ratification debates that followed, almost no one mentioned the issue. One Anti-Federalist writer even conceded that, whatever his other objections to the Constitution, this particular prerogative and a handful of others should be vested in the national government.[16]

As ratification of the Constitution moved forward and Congress prepared to meet for the first time, several writers took up the question of how best to craft a system of weights and measures. Most took inspiration from Jefferson's reform of the monetary standard. In a series of newspaper articles, later published as a pamphlet in 1789, the Maryland planter John Beale Bordley endorsed Jefferson's decimal division of the dollar, declaring that "the divisions of monies of account and coin into tenths is wonderfully convenient." Bordley proposed to do the same for the new nation's weights. While he believed it best to retain some version of the pound used in Europe, he complained that "divisions of pounds and ounces into fourths, &c. are inconvenient fractions that accident seems to have produced…but which America is in a fine situation to avoid." Though Bordley wished to extend the decimal system to units of length and

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[15] U.S. Continental Congress, *Propositions Respecting the Coinage* (New York, 1785), 1; George Washington to William Grayson, 22 August 1785, in John C. Fitzpatrick, ed., *The Writings of George Washington*, vol. 28 (Washington: Government Printing Office, 1944), 233.

[16] George Ticknor Curtis, *Constitutional History of the United States, from Their Declaration of Independence to the Close of Their Civil War*, v. 1 (New York: Harper and Brothers, 1889), 524; William Winslow Crosskey, *Politics and the Constitution in the History of the United States*, v. 1 (Chicago: University of Chicago Press, 1980), 210, 221; John R. Vile, *The Constitutional Convention of 1787: A Comprehensive Encyclopedia of America's Founding*, v. 1 (New York: ABC-CLIO, 2005), 491-492; Herbert J. Storing, ed., *The Complete Anti-Federalist* (Chicago: University of Chicago Press, 2008), 239.

volume, too, he worried that this might engender too much resistance. "I wished to have divided measures to ascend and descend in tens as the federal monies do," he wrote. "But there are hindrances:--the change would be great; and the human heart is to consulted; now would there be great advantage in this applied to measures as to monies and weights."[17]

Other visionaries proposed more radical revision of the existing system of weights and measures. The Philadelphia mathematician William Waring, after praising the "extremely simple, convenient" division of the dollar, proposed a comparable plan "for Weights and Measures, deduced from a permanent standard, which could be easily and accurately obtain'd in any Age or Nation, independently of all prior Measures." In framing the problem this way, Waring joined a host of thinkers in search of a metrological holy grail: a timeless, indestructible standard derived from the natural world. Such a system would dispense with the ur-standards that countries and kingdoms kept locked away in reliquaries: ancient bushels, yards, and pints made of the finest copper or brass. His solution rested on twin certainties grounded in the earth itself. The first certainty was that the earth turned on its axis at a regular rate, permitting the calculation of units of time: hours, and ultimately seconds. The second certainty concerned the behavior of pendulums on the earth's surface. Since Galileo's time, it was well known the time it took for a pendulum to swing from one side to another was a function of its length. This made it possible to combine time and space into a single standard of measurement: the length of a pendulum that took precisely one second to oscillate from side to side offered a fundamental unit of measurement. This unit, which Waring dubbed a "Pend," was precisely 39 inches long when measured at the equator (slight variations on gravity on the earth's surface would yield different results). Waring hoped that this natural standard "would be of suitable Length for common Use." From this single standard a host of other standards could be derived for the measurement of plane surfaces as well as volumes.[18]

Waring's idea was not original: several thinkers in the seventieth and eighteenth centuries had outlined similar schemes for creating fundamental standards. The British architect Christopher Wren had done so as early as 1665, followed by Jean Picard in Paris in 1671. The Dutch mathematician Christiaan Huygens had likewise proposed using the seconds pendulum as the basis of a universal metrological system in 1673. In the succeeding decades, these proposals competed with a host of like-minded schemes that differed in one important way: rather than relying on the seconds pendulum, they proposed to use a fraction of the earth's circumference as the basis of a new, fundamental standard. This idea, which would become the basis of the modern metric system, had the most support in France, though many thinkers in that country also

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[17] John Beale Bordley, *On Monies, Coins, Weights, and Measures, Proposed for the United States of America* (Philadelphia: Daniel Humphreys, 1789); John Beale Bordley, *A Supplement to the Essay on Monies* (Philadelphia: Daniel Humphreys, 1790). Jefferson owned Bordley's writings. *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 31 (1 February 1799-31 May 1800), 387.

[18] "William Waring's Plan for Weights and Measures," in *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 621-623.

espoused the seconds pendulum. But it was in Britain and the United States that the pendulum had the greatest support, with Waring no exception.[19]

Waring's proposal may not have been especially original, but it arrived at a critical time. A few months after its publication, George Washington addressed Congress, informing them that "uniformity in the Currency, Weights and Measures of the United States is an object of great importance, and will, I am persuaded, be duly attended to." Washington was in all likelihood thinking of Thomas Jefferson, whom he had appointed to Secretary of State a few months earlier. In fact, when Jefferson arrived in New York to join the government, he discovered that the House of Representatives had put upon his shoulders the responsibility for drafting "a proper plan or plans for establishing uniformity in the Currency, Weights, and Measures of the United States."[20]

Jefferson, who was already familiar with the idea of using a pendulum as the source of a fundamental standard of length, spent the spring of 1790 crafting a plan in consultation with James Madison, David Rittenhouse, and others.[21] From the beginning he conceived of the project in comprehensive terms, viewing it as an extension of the monetary reforms he first proposed in 1784. In a note written to himself in March 1790, Jefferson sought to find a way to connect weights, measures, and money into a common system of interdependent standards defined in decimal terms. Observing that a cubic foot of water weighted 1000 ounces, Jefferson speculated that if the foot could be divided into ten inches instead of twelve, a cubic inch would be one ounce, which in turn could be defined as the weight of a dollar coin. "Cannot the Dollar, the ounce, and the inch be thus made the center of money, weights and measures," he inquired of himself in a passing scribbled note.[22]

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[19] Marcello Maestro, "Going Metric: How It All Started," *Journal of the History of Ideas* 41 (1980), 479-486. On the pendulum as a metrological standard, see also Allen David Cumming Simpson, "The Pendulum as the British Length Standard: A Nineteenth-Century Legal Aberration," in Robert Geoffrey William Anderson, James A. Bennett, and W. F. Ryan, eds., M*aking Instruments Count: Essays on Historical Scientific Instruments Presented to Gerard L'Estrange Turner* (Aldershot, England: Variorum, 1993), 174-190; Ken Alder, *The Measure of All Things: The Seven-Year Odyssey That Transformed the World* (Boston: Little Brown, 2002), 73-112. On the larger quest for a system of measurement derived from nature, see Robert P. Crease, *World in the Balance: The Historic Quest for an Absolute System of Measurement* (New York: W. W. Norton, 2011), 69-98.

[20] *Papers of George Washington Digital Edition*, ed. Theodore J. Crackel (Charlottesville, Virginia: University of Virginia Press, Rotunda, 2008), 544-548; Papers of Thomas Jefferson Digital Edition, Main Series, Volume 16 (30 November 1789-4 July 1790),. 602-605.

[21] On Madison's role, see *Papers of James Madison Digital Edition*, Congressional Series, Volume 13 (20 January 1790-31 March 1791), 226-227 and Main Series, Volume 27 (1 September-31 December 1793), 813-814. On Hamilton's role, see *The Papers of Alexander Hamilton Digital Edition*, ed. Harold C. Syrett (Charlottesville, Virginia: University of Virginia Press, Rotunda, 2011), v. 6 (December 1789-August 1790), 463, 465. On the involvement of Rittenhouse, see *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16, 509-510, 542-547, 587-588, 602-618; and Volume 22 (6 August 1791-31 December 1791), 55-56; and Volume 24 (1 June-31 December 1792), 44-45, 655. On Jefferson's longstanding interest in a new system of weights and measures, see *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 7 (2 March 1784-25 February 1785), 173-175, 221.

[22] *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 627.

In a series of drafts, Jefferson sketched out a plan for the wholesale reform of the nation's weights and measures.[23] Unlike Waring, Jefferson rejected the idea of using a conventional pendulum. Instead, he proposed substituting a metal rod, an idea he borrowed from Philadelphia watchmaker Robert Leslie, whom Jefferson would later hail as "the most ingenious workman in America." Leslie had proposed the substitution because a conventional pendulum consisting of a wire and a bob could readily introduce errors into the measurement. A rigid iron rod, by contrast, was less susceptible to these problems. But the physics of the device meant that the rod had to be longer in order to oscillate from one side to another in a single second. After numerous calculations corroborated by Rittenhouse, Jefferson arrived at the standard of length for such a rod: 58.69277 inches when oscillating at sea level at the 38th latitude, a location that Jefferson chose on account of its status as the "middle latitude of the U.S." It was a coincidence, perhaps, that this particular latitude passed directly through the center of Jefferson's native state of Virginia.[24]

But Jefferson found himself forced to modify his plan mid-way, as he received news that scientists and statesmen in France had issued competing proposals. In June 1790, Jefferson obtained the report written by Bishop of Autun in France – better known as Charles-Maurice de Talleyrand – who had put before the French National Assembly a plan for radical reform that relied on the seconds pendulum. Unlike Jefferson's plan, however, Talleyrand's report recommended the 45th parallel as the place to derive the all-important measurement of the fundamental unit of length. This latitude happened to bisect France and bypass Britain entirely. The Francophile Jefferson, while still wedded to the 38th parallel, could see advantages in conforming to the French proposal. In the final version of the report, Jefferson noted that the 45th parallel "is distinguished with us also, as forming our principal Northern boundary. Let the completion of the 45th degree then give the Standard for our Union, with the hope that it may become a line of union with the rest of the world." In the final reckoning, Jefferson's proposed rod would measure 58.72 English inches when oscillating at sea level at the 45th latitude. As a precautionary measure. Jefferson recommended that the device be operated in a cellar or some other chamber below ground to protect against the expansion and contraction of the metal in summer or winter.[25]

Here was a fundamental standard that could be used to derive an ordinary inch, foot, and by extension, measures of two-dimensional and three-dimensional space. No longer would the keepers of weights and measures need to jealously guard a brass yardstick or some other ancient,

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[23] Jefferson produced three, including the final draft, as well as a postscript. See *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (November 1789-4 July 1790), 624-647, 650-675.

[24] *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 628-648. On Leslie, see *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 618-619.

[25] *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 650-674; Alder, *Measure of All Things*, 90-95; Crease, *World in the Balance*, 107-114. On Jefferson's awareness of these events, see *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 417-419, 602-618, 623-624; Volume 17 (6 July-3 November 1790), 523-530; Volume 19 (24 January-31 March 1791), 633-638; Volume 20 (1 April-4 August 1791), 345-354, 363-371.

original measure. The fundamental unit would exist as long as the earth turned on its axis. This alone marked a radical departure from tradition, but Jefferson pushed for an equally substantial revision in the nation's weights and measures. Congress, he noted, had already created a monetary standard in the United States so that its "parts and multiples should be in a decimal ratio." This, he noted with a bit of self-congratulations, had been greeted with "general approbation." Why, Jefferson asked, should Congress to stop there? Why not "extend a like improvement to our measures and weights, and to arrange them also in a decimal ratio?"[26]

In advancing this argument, Jefferson joined his peers in Britain and France, all of whom turned to the writings of European scientists and philosophers for inspiration. In fact, very little written at this time on metrological reform was particularly new, and not just with regard to the idea of using a pendulum. In 1585, the Dutch mathematician Simon Stevinus had proposed that "all measures – linear, liquid, dry, and monetary – may be divided decimally." He was followed by the British scientist John Wilkins, who in 1668 published a plea for a common language of standards that could govern everything from weights to measures to money. Long before Jefferson elaborated the idea for an English-speaking audience, Wilkins proposed that this system be governed by a decimal logic, with a fundamental unit defined by a seconds pendulum. Wilkins, however, was not a cosmopolitan interested in introducing a genuinely universal system that did away with the older units in the way that advocates of the metric system would eventually propose. Rather, he wished to preserve the existing, British system of weights and measures while simultaneously rationalizing them and rooting them in a timeless, fundamental standard. It is not known whether Jefferson read his writings, but much of Jefferson's proposal followed the reasoning and nomenclature first outlined by Wilkins well over a century earlier.[27]

Jefferson's characteristic embrace of the pragmatic and the philosophical led to him advance two possible courses of action, one relatively conservative and the other more radical. The first, like his proposal for reformation of the money supply, preserved the existing Anglo-American units of measurement. He proposed that the iron rod be divided into 587.2 equal parts. This fundamental sub-unit would be called a "line," with ten lines making an inch. In this way, Jefferson redefined the most basic unit of length in decimal terms, even as prescribed the continuation of all the other existing measures. Thus, twelve inches still made a foot, three feet a yard, six feet a fathom, and so on. He likewise retained measurement of land such as the acre. "Let them remain the same," he wrote, in a concession to reality.[28]

But faced with a welter of both liquid and dry measures – pints, quarts, pottles, gallons, picks, firkins, bushels, kilderkins, barrels, hogsheads, puncheons, and other less-than familiar standards – Jefferson proposed to simplify matters. After an exhaustive review of the varying volumes connected to these terms, Jefferson spelled out an abridged list of measures. The

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[26] On the larger history of Jefferson's interest in decimal divisions, see C. Doris Hellman, "Jefferson's Efforts towards the Decimalization of United States Weights and Measures," Isis 16 (1931), 266-314.

[27] *La Thiende de Simon Stevin* (Paris: La Haye, 1924), quoted in Edward Franklin Cox, "A History of the Metric System of Weights and Measures, Ph.D. Diss., Indiana University, 1956, 64. On Wilkins, see R. Lewis, "The Publication of John Wilkins's Essay (1688): Some Contextual Considerations, *Notes and Records of the Royal Society of London* 56 (2002), 133-146.

[28] *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 24 (1 June-31 December 1792), 781-784.

gallon, which could contain 268.75, 270, 271, or 272 cubic inches depending on the standard used or the commodity measured, was replaced by a single gallon of 270 cubic inches. Jefferson recognized, however, that this was only half the battle: the shape of a container could make it difficult to evaluate its accuracy. "Cylindrical measures have the advantage of superior strength," he conceded, But square ones have the greater advantage of enabling every one, who has a rule in his pocket to verify their contents, by measuring them. Moreover till the circle can be squared, the cylinder cannot be cubed, nor it's [sic] contents exactly expressed in figures." That led Jefferson to settle on square or rectangular containers. A gallon, for instance, could be 6 inches square and 7.5 inches deep, or 5 inches wide, 6 inches long, and 9 inches deep. Both containers held precisely 270 cubic inches.

Existing standards of weight posed an even greater challenges. At the heart of Jefferson's solution was a new unit of mass: an ounce, which was defined as the weight of rainwater contained in a cubic inch. Unfortunately, from medieval times onward, Britain had used two separate systems for measuring mass. The first, known as the avoirdupois system, applied to a range of bulk commodities. The troy system of grains, pennyweights, ounces, and pounds was used for weighing precious metals and other goods where minute division of weight were essential. In his final proposal, Jefferson sought to combine the two systems into a single system by abandoning certain equivalences and modifying others. Jefferson's labors on this particular metrological project amounted to a unified field theory of metrology. He believed that the avoirdupois and troy standards shared a common origin in antiquity, based on a series of correspondences between them. This, Jefferson speculated, "must have been the result of design, and scientific calculation, and not a mere coincidence of hazard," and he sought to reunite them as a single system.

All these proposals alone marked Jefferson's report as visionary. But he also recommended that Americans contemplate a much more sweeping, "thorough reformation of their whole system of measures, weights and coins, reducing every branch to the same decimal ratio already established in their coins, and thus bringing the calculation of the principal affairs of life within the arithmetic of every man who can multiply and divide plain numbers." For Jefferson, this meant a more decisive break with the existing weights and measures. He therefore proposed that the oscillating rod of 58.72 British inches be subdivided into "five equal parts, each of which shall be called a Foot." This American foot, which was slightly shorter than a conventional English foot, became the basis of a units of measurement both big and small. Ten feet made what Jefferson called a "decad," and ten decads made a rood, ten roods a furlong, and ten furlongs a mile. Likewise, each foot was subdivided into ten inches, and each inch could be subdivided into ten units called "lines."

The philosopher king of Monticello defined capacity measures and weights with the same decimal logic.[29] A cubic foot (the new American foot, not the British one)constituted a bushel.

[29] Benjamin Vaughan wrote Jefferson from London in October 1790, noting that "I believe you are the first nation that ever produced statesmen who were natural philosophers." *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 17 (6 July-3 November 1790), 619-620.

Ten of these made up a "quarter," and ten quarters made a "last." The cubic foot or bushel was divided into ten "pottles," which could be subdivided into tenths still further: demi-pints, and finally, so-called "metres." The latter bore no relation to the French metre, but was instead defined as a single, cubic inch (the new inch, not the British inch). In turn, the weight of rainwater contained in one of these metres or cubic inches was the basis of the new ounce, ten of which made up a pound. Ten of those made a stone, ten stones made a kental, and ten kentals a hosghead. As with every other basic unit in Jefferson's system, the ounce could also be divided into tenths ("double scruples"), hundredths ("carats"), thousandths ("minims"), and ten-thousandths ("mites"). Finally, the new ounce was itself linked to the monetary system: a single silver dollar coin would weigh precisely one ounce, making it equivalent to "a cubic inch of rain water exactly."[30]

Jefferson's plan had much to recommend it, particularly his first, conservative proposal. But the more radical plan suffered from a number of obvious liabilities. First, it would have sowed confusion because it retained some, but not all, the existing nomenclatures of weights and measures. The new inch, ounce, foot, furlong, bushel, and many other standard varied slightly, but not insubstantially, from their older, English predecessors. Add to that the fact that Jefferson proposed to add a number of new, foreign units to the mix complicated matters still further. But its greatest liability, though, had nothing to do with the proposal itself, but with the fact that Jefferson happened to formulate it at precisely the same time both the British and French advanced competing proposals. It was, in other words, just one of a number of schemes for metrological reform circulating in the transatlantic "republic of letters" in the late eighteenth century.[31]

Jefferson completed his report in the summer of 1790, at which point the House of Representatives placed it on the table for consideration. At languished there until December of that year, when President Washington repeated his plea that Congress turn their attention to institutions capable of knitting together the disparate states into a single nation. Washington betrayed but the slightest impatience, noting that "the establishment of the militia, of a mint, of standards of weights and measures, of the post office and post roads, are subjects which (I presume) you will resume of course, and which are abundantly urged by their own importance." This seems to have prompted the Senate to create a committee to consider the proposal. Its members included Robert Morris, who had already clashed with Jefferson over reformation of the coinage, and who had previously claimed – notwithstanding a good deal of evidence to the contrary – that "the weights and measures throughout America are the same."[32]

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[30] The foregoing quotations are taken from Jefferson's final report in *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 650-674. See also "Plan for Establishing Uniformity in the Coinage, Weights, and Measures of the United States," H. Misc. Doc. No. 15, 1st Cong., 2nd Sess. (1790), *ASP*, Miscellaneous, Volume 1, 13-19.

[31] More derivative, but entertaining, is John Bemelmans Marciano, Whatever Happened to the Metric System? How America Kept Its Feet (New York: Bloomsbury, 2014), 9-75.

[32] *Annals of Congress*, 1st Cong., 3rd sess., 1738, 1740; *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 7 (2 March 1784-25 February 1785), 160-169; *Papers of George Washington Digital Edition*, Presidential Series, v. 7 (1 December 1790—21 March 1791), 45-48.

There was some truth to this: compared to Britain and France, the United States did not suffer from quite the same diversity of weights and measures. In continental Europe, the twin legacies of feudalism and political fragmentation in the late medieval era had bequeathed a multifarious system of weights and measures. For example, in the early nineteenth century the German state of Baden alone had some 112 standards for length; 92 for measuring area; 65 capacity measures for dry, but another 163 for cereals, 123 for liquids, and 63 for liquors; and no less than 80 different "pound" weights. But this paled next to France, where thousands of local weights and measures remained in use, each with their own peculiar names and functions. Even the royal system of weights and measures, which at least could claim to have a national reach, matched each other in name only. A single measure of length, the "pied de Roi" varied greatly from place to place: the king's footprint, it would seem, was far more pronounced in some parts of France than others .[33] Britain, while blessed with a more unified system of weights and measures, was hardly immune to these problems, either. By contrast, a quirk of history had conferred far greater uniformity of weights and measures on the United States. Most of the original colonial charters had privileged the official British weights and measures, though other standards had been adopted in deference to various trading partners.

Nonetheless, after nearly two centuries, each of the former colonies had drifted away from a common standard, if such a thing had existed in the first place. This was particularly the case in measures of capacity that merchants like Robert Morris used to buy and sell goods. Morris may have refused to contemplate the change out of personal pique, but like many merchants, he did not necessarily find diverse weights and measures an inconvenience. If anything, the confusion created endless opportunities for arbitrage, and ultimately, profit, typically at the expense of what one advocate of reform called the "poorer Sort of peopel [sic]."[34] Whatever the reason for his opposition, Morris was likely behind the committee's report issued in March, 1791. In it, the committee used the reforms contemplated in Britain and France to justify doing nothing, arguing that until the question was settled overseas, it was unwise "to introduce any alteration in the measures and weights which are now used in the United States."[35]

This was hardly the end of the matter. In October 1791, Washington again begged Congress to do something on the matter, citing his previous communications on the subject. "A uniformity in the weights and measures of the country is among the important objects submitted to you by the Constitution and, if it can be derived from a standard at once invariable and universal, must be no less honorable to the public council, than conducive to the public

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[33] Cox, "A History of the Metric System of Weights and Measures," 47-62; Ronald Edward Zupko, *British Weights & Measures: A History from Antiquity to the Seventeenth Century* (Madison: University of Wisconsin Press, 1977); Kula, *Measures and Men*, 18-113; Ronald Edward Zupko, *Revolution in Measurement: Western European Weights and Measures Since the Age of Science* (Philadelphia: American Philosophical Society, 1990), 3-24. See also Arthur E. Kennelly, *Vestiges of Pre-Metric Weights and Measures Persisting in Metric-System Europe, 1926-1927* (New York: Macmillan, 1928).

[34] On the poor as victims of irregular weights and measures, see James White to George Washington, 2 December 1793, in *Papers of George Washington Digital Edition*, Presidential Series, v. 14 (1 September-31 December 1793)., 458-459.

[35] "Weights and Measures," S. Misc. Doc. No. 21, 1st Cong., 3rd Sess. (1791), *ASP*, Miscellaneous, Vol. 1, 38.

convenience." This urgent request seems to have prompted the Senate to appoint another committee sans Morris, and the following year it endorsed the more revolutionary plan advanced by Jefferson in his report.[36]

By this time, however, Jefferson's proposal came under more sustained attack. Some critics questioned the wisdom of a complete overhaul of the existing system of weights and measures. Others, including Robert Livingston and Oliver Wolcott, proposed competing plans that, while they never secured support in Congress, clouded the issue. At the same time, the French, caught up in rising revolutionary fervor, had themselves moved more decisively toward the modern-day metric system. This progression, which took place between 1791 and 1795, yielded a system of universal measurement at odds with Jefferson's own vision. Instead of a fundamental unit derived from a seconds pendulum, the French instead opted for to define the new "metre" as one ten-millionth of meridian running through Paris from the pole to the equator. But this new unit of measure bore no relation to the existing Anglo-American system in use throughout the United States. When the French sent a report on the subject to Congress in January 1795, their competing ideas cast doubt on Jefferson's own proposal.[37]

As Jefferson's proposal went missing, Congress dithered on the question of weights and measures. It did appropriate funds to test the idea of using a pendulum, but enthusiasm for more radical reforms was receding. In 1796, when the committee in the House reported on both Jefferson's proposal and the new French system, they advised that "the unit of measures in length…and the units of weights to be adopted as standards ought not to vary in any sensible degree from the present foot now in use and the present pound avoirdupois."[38] This conservatism was likely a reaction to the violence of the French Revolution. The metric system had become symbolic of the revolutionaries desire to remake society, as had their obsession with subordinating all of society to a decimal logic. Under the new revolutionary calendar, weeks had ten, not seven days; and every day consisted of ten hours, each of which was subdivided into 100 minutes, with every minute further subdivided into 100 seconds. A mania for decimalization

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[36] *The Papers of George Washington Digital Edition*, Presidential Series, v. 9 (23 September 1791—29 February 1792), 110-117; "Weights and Measures," S. Misc. Doc. No. 28, 2nd Cong., 1st Sess. (1792), *ASP*, Miscellaneous, Volume 1, 48; *Annals of Congress*, 2nd Cong., 1st sess., 24-25; Annals of Congress, 2nd Cong., 2nd sess., 621-622. On Washington's interest in reforming weights and measures, see his correspondence with George Skene Keith, who had advanced proposals in Great Britain on the same subject. *Papers of George Washington Digital Edition, Presidential Series*, v. 8 (22 March 1791-22 September 1791), 312-314, v. 10 (1 March 1792-15 August 1792), 492-493, and v. 11 (16 August 1792-15 January 1793), 411-416.

[37] "Weights and Measures," H. Misc. Doc. No. 60, 3rd Cong., 2nd Sess. (1795), *ASP*, Miscellaneous, Volume 1, 115-116. On Livingston and Wolcott, see Papers of Thomas Jefferson Digital Edition, Main Series, Volume 19, 240-241, 295-296. Jefferson never warmed to the metric system, noting at one point that "I confess, indeed, I do not like the new system of French measures. Alexander Hamilton also undermined the portion of Jefferson's proposal linking the monetary unit to the new system of weights and measures. See *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 16 (30 November 1789-4 July 1790), 511-512 and *Papers of Alexander Hamilton Digital Edition*, Volume 11, February 1792-June 1792, 434. On Jefferson's view of metric system in its final form, see *Papers of Thomas Jefferson Digital Edition*, Main Series, Volume 27 (1 September—31 December 1793), 818-822 and Retirement Series, Volume 4 (18 June 1811-30 April 1812), 147-149.

[38] "Weights and Measures," H. Misc. Doc. No. 84, 4th Cong., 1st Sess. (1796), *ASP*, Miscellaneous, Volume 1, 148. Part of the resistance, too, may have arisen from a geunine uncertainty over the science behind many of ideas in Jefferson's reports. See, for example, *Annals of Congress*, 4th Cong., 1st sess., 1376-1383.

pervaded other aspects of life. The temperature scale was now divided into 100 units; the revolutionary government also contemplated dividing circles into 400 digress instead of 360 so as to guarantee that a right angle would be an even 100 degrees. All these developments, when paired with tales of the Terror, did little to arouse enthusiasm for the metric system, much less Jefferson's own arguments for decimalization.[39]

Jefferson would soon find himself mocked mercilessly in the press for his proposed reform of weights and measures. This had begun much earlier in 1790, when arch Federalist Noah Webster wrote a satire poking fun at Jefferson's insistence that the fundamental unit use an oscillating rod, not a pendulum.[40] But by 1795 and 1796, the sharpening political divide between the Federalists and the Jeffersonians erupted more fully in the press, with Jefferson's writings on weights and measures playing a starring role. Federalist editors accused him stealing most of his ideas from others, and mocked his "pretensions, as a philosopher and politician" while predicting that his election to the presidency would result in either the "debasement of the American name" or "the prostration of the United States at the feet of France."[41]

More biting still was doggerel published two years later in Federalist papers. "Those, who recollect [Jefferson's] antimathematical report on weights and measures [and] his choice of rain water for a standard," the article read, "will acknowledge the sarcasm and beautify of the following lines," which satirized Jefferson's efforts to secure accurate measurement of a seconds pendulum:

In latitude, just forty five,
Down a dark cellar did I creep;
And with my onion rope could strive
To measures pecks and bushels neat

Of kennel water I did weigh
A pound—and thus a standard pound;
For, spite of dirt, dead cats, or hay,
This pound will always weigh a pound

Here was a man, warned the paper darkly, "whose attachment, objects, religion, philosophy and morals, are wholly French" – a man famed for "his intimacy with Benjamin Banneker, the black;

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[39] Richard A. Carrigan, Jr., "Decimal Time," American Scientist 66 (1978), 305-313; Paul Smith, "La division decimale du jour: Lheure qu'il n'est pas," in Bernard Gamier et al., eds., Genese et diffusion du systeme metrique, (Caen,: Editions-diffusion du Lys, 1990), 123-134; Alder, *Measure of All Things*, 147-151; Hector Vera, "Decimal Time: Misadventures of a Revolutionary Idea, 1793-2008," *KronoScope* 9 (2009), 29-48;

[40] *Papers of Thomas Jefferson Digital Edition*, Volume 18 (4 November 1790-24 January 1791), 481; *Papers of James Madison Digital Edition*, Congressional Series, Volume 13 (20 January 1790-31 March 1791), 351.

[41] Columbian Herald, 22 August 1796; Gazette of the United States, and Philadelphia Daily Advertiser, 23 and 24 November 1796; Philadelphia Gazette, 30 August 1800; United States Chronicle, 31 March 1803. Though Congress took up weights and measures in passing in 1796, Jefferson's proposal was effectively dead at this time.

his skill in anatomizing spiders; and his learned accuracy in selecting muddy water as a scientific standard of weight."[42]

Jefferson would have the last laugh, gaining the presidency two years later. But he went to his grave disappointed that he failed to revolutionize the nation's standards.

THE DEAD WEIGHT OF TRADITION

For the next two decades, Congress rarely contemplated the problem of weights and measures, effectively abdicating its constitutional prerogatives on the question. At times this resulted in bizarre dead-letter laws. The Surveyor Act of 1799, for example, stipulated that the federal surveyor in charge of each port inspect and test the weights and measures used to assess federal customs duties. But absent a real standard, this was an empty gesture, and the complete lack of uniformity on the state level was striking. The inventor Benjamin Dearborn, writing James Madison in 1804, reported taking a tour from Boston to Savannah in which he "made many comparative experiments with the standard weights of different placers. " Dearborn found that "it was a rare instance to find the standard of any one place, corresponding with the standard of any other; and equally so, to find in any set of standard weights, the necessary correspondence between the Unit and its Component Parts." Most of the standard beams, Dearborn reported, "were incorrect as the weights, having one arm longer than the other, with defective construction generally." Given what Dearborn discovered, it is not entirely surprising that individual states periodically submitted memorials to Congress, begging for attention to the matter. Rhode Island had been the first back in 1798, followed by Pennsylvania in 1804, Delaware in 1806, New Jersey in 1808, and Maryland in 1810. In some cases, these memorials grew out of state-level assessments of laws and standards governing weights and measures.[43]

At first glance, the state laws in force during this would seem to corroborate the idea that the United States was a well-regulated society. While the precise language and wording of the laws varied considerably from place to place, most stipulated that counties and towns appoint sealers of weights and measures, though in some cases this was left to the discretion of town officials. While the language varied from state to state, sealers were generally appointed by local

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[42] Albany Centinel, 14 December 1798.

[43] *Papers of James Madison Digital Edition*, Secretary of State Series, Volume 6 (1 November 1803-31 March 1804), 551-552; *Papers of James Madison Digital Edition*, Presidential Series, Volume 1 (1 March-30 September 1809), 263. An excellent summary of the activities of Congress vis-à-vis weights and measures can be found in Sarah Ann Jones, "Weights and Measures in Congress: A Historical Summary of Events Culminating in the Weights and Measures Act of 1836." M.A. Thesis, George Washington University, 1935. For specific petitions, see, e.g., "Weights and Measures," S. Misc. Doc. No. 175, 8th Cong., 1st Sess. (1804), *ASP*, Miscellaneous, Volume 1, 388; Annals of Congress, 9th Cong., 2nd sess., 20; Annals of Congress, 10th Cong., 1st sess., 1331; Annals of Congress, 11th Cong., 2nd sess., 593; Annals of Congress, 14th Cong., 2nd sess., 436.

governing boards, inferior courts, justices of the peace, or other local authorities. A handful of states, including New York, appear to have elected sealers of weights and measures on the local level rather than appoint them. If counties got to choose, however, they also had to fund these offices: almost every state required that counties, cities, and towns pay for procuring sets of standard weights and measures. Most of these same laws, however, did not provide the state with much recourse if localities failed to comply, and there is scattered evidence that outside of major cities, many local governments often failed to appoint sealers, much less procure official weights and measures from a reputable source.[44]

What is most significant, perhaps, about the statutes governing weights and measures at this time is the question of compensation. Local governments did not pay sealers a salary. Rather, most sealers, like others in the employ of government, made their money from fees. In practice this meant that a sealer made his money from approving and "sealing" weights and measures in his jurisdiction. In most states, sealers would be get nothing in return if they deemed a weight or measure defective – except, possibly, the ill will of their fellow citizens. While it is difficult to know how these incentives played out on the ground, it is not unreasonable to assume that sealers found their regulatory authority circumscribed by the need to make money, never mind the desire to avoid alienating friends and neighbors in the community.

The state of Pennsylvania offers a particularly revealing case study of the challenges that both reformers and regulators faced. In 1807, the Pennsylvania legislatures undertook a review of the state's weights and measures. As in many states at this time, Pennsylvania relied on a colonial-era statute to regulate weights and measures. This law, which dated from the year 1700, had stipulated that every county and city in the colony obtain, at their expense, "standards of brass, for weights and measures, according to the king's standards for the exchequer." Officers in each jurisdiction would then "keep the standards" and use them in order to validate all weights and measures in use throughout the said county or city; they would also collect modest fees for this service. Anyone who failed to comply would be fined, and the inspector or sealer of weights and measures was empowered to seize defective weights and measures.[45]

When the committee appointed by the Pennsylvania Senate looked into the matter, it turned to the most populous, well-established city in the state: Philadelphia. This was the second-largest city in the United States, highly dependent on commerce, and possessing an unusually solid reputation for good government and regulatory oversight. And yet when the committee knocked on the doors of the two sealers of weights and measures in that city, they found that "the standards fore regulation mentioned in the said law, are now no longer to be found, except for a few small measures of capacity." In Philadelphia these included an "ancient" half bushel measure that was "coarsely made, the diameters and bottom unequal and irregular,"

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[44] See, e.g., "Communication from the Secretary of State, Relative to Furnishing the Counties with Standard Weights and Measures," *Legislative Documents of the Senate and Assembly of the State of New York*, v. 2 (Albany: E. Croswell, 1830), No. 188;

[45] *Journal of the Senate of the Commonwealth of Pennsylvania*, v. 17 (Lancaster: John Burnside, 1806), 442-448; *Digest of the Laws of Pennsylvania* (Philadelphia: M'Carty and Davis, 1824), 795-796; *Report of a Committee of the Senate on the Subject of Weights and Measures* (Harrisburg: W. C. Smythe, 1808), 1-35.

as well as "bruised and patched." It was marked "B.N.E." and "thought to have been brought from England by William Penn." But this half bushel did not agree with the de facto standard of measure, the so-called "Winchester bushel." Nor did some colonial-era quart and pint standards marked "W. R." that the examiners found. Reported the committee: "the whole of the standards, as well ancient as modern now used by the officers of regulation for the city and county of Philadelphia, are in an incomplete and irregular condition."

The examiners also located a number of scattered weights, including an antiquated set that ranged from 56 pounds to a half ounce. But these, whether from age, wear and tear, or tampering, did not measure up. "They do not bear the due and relative proportion each to the other, especially in the smaller weights," the report noted. In fact, when the examiners compared the pound weight to the sixteen ounce weights, they found a discrepancy of nearly an ounce. No standards for Troy weights could be located, nor was there any evidence that any existed. Moreover, the examiners failed to find "any evidence, that any of the said weights and measures, have been regulated as is by the said law required." In the examiners' eyes this meant that the "persons authorized as regulators cannot know how to act for want of proper data."

The problems with weights and measures extended well beyond the absence of genuine standards. In the day-to-day operations of weighing and measuring, the actual method of measurement could be notoriously difficult to define. In Philadelphia, as throughout the United States, the distinction between what was known as "heaped" and "stricken" measures could moot the very idea that a standard of measurement existed in the first place. "Heaping," the committee explained, "is generally as understood to be as much as can piled or put on" above and beyond the actual rim of the container. A stricken measure, by contrast, was level at the rim, with nothing additional added. This distinction, the committee reported, could be used to squeeze additional profits out of retail sales, as coal or other commodities might be purchased by the heaped measure and sold by the stricken measure. Additional discrepancies plagued the weighing and measuring of dry goods. A measure that was shaken could hold more than one that was not; likewise, two containers with the same volume but made in different shapes could differ in their actual capacity, particularly if the commodity being measured was bulky or irregularly shaped. One solution was to measure goods by weight. But here, too, certainty was elusive: water might be added to coal, for example. And in any case, no real standard of weight existed at this time.[46]

The Pennsylvania committee proposed a sweeping reform of the state's weights and measures. Their plan recommended that Philadelphia commission official, accurate weights and measures that would function as the ultimate, "Original Standards." These would be "kept in the most secure way from damage and fire" by the mayor and alderman in a special envelope and case that would have "three good locks" with different keys, each of which would be held by different people so as to prevent tampering; and the case itself would be held in the Bank of Pennsylvania, where it would be opened once a year and tested and re-tested at the exact temperature of 60 degrees Fahrenheit. These fundamental standards would then be used to

[46] See also the discussion in "Measures," Pennsylvania Mercury, and Universal Advertiser, 13 August 1789.

derive additional copies for the rest of the state, each of which would be embossed with the words "Pennsylvania Standard" before and then deposited for safe-keeping in each city and county. Local regulators – so-called "sealers" of weights and measures – could then use these to guarantee that all standards in their jurisdiction complied with these authoritative weights and measures. The proposed legislation also attempted to banish potential sources of confusion by specifying the actual shape and dimensions of capacity measures, as well as eliminating the practice of "heaped" measures.

Nothing came of the proposal, no doubt because it ventured into the territory that had consigned Jefferson's own report to oblivion. While the committee recommended retaining the English foot as the fundamental unit of length, it proposed a new, decimal system of division, complete with new names for all the units. A foot would now consist of 10 "decads," 100 "minas," 1000 "mites," or 10,000 "atoms." This was simply too radical an idea. The German physician Erick Bollman, then in residence in Philadelphia, wrote in 1814 that the legislation might have passed had it not been for the "peculiar ideas" it proposed. Bollman thought it "impossible" that such proposals would ever work in the United States. "This is strongly instanced by France," he observed: "though a despotic government, and a severe police, have there a much more effectual control over the people than the executive authority can have over ours under our free constitution, and though the use of the old weights and measures and of the old terms, is there prohibited under severe penalties," the metric system had not taken hold. "The new measures…are on the counter…but the transactions are regulated by the old."[47]

Pennsylvania nonetheless passed far more modest legislation in 1813 that aimed to supplement and elaborate the colonial-era statute already on the books. Similar reforms took place in other states at this time, though the focus of these reforms betrayed signs that whatever the problems with the actual standards, enforcement had run into serious difficulties. For example, in Pennsylvania the 1813 legislation now listed penalties for several impostures: counterfeit brands or marks that falsely indicated that the measure in question had been inspected; the alteration of weights and measures after they had been genuinely sealed; and the sale of weights and measures lacking the imprimatur of local authorities. But the legislation also imposed penalties on the sealer if he gave his stamp of approval to a weight or measure that he knew did not conform with the official standard; or if the sealer "shall refuse or neglect to do any thing enjoined on him" by the act of 1700, or worse, "charge more feels than is directed by said act." Such provisions, while they can certainly be read as evidence of a well-regulated society, can more logically be taken as evidence that the enforcement of regulations had gone awry.

When the Pennsylvania Senate revisited weights and measures once again in 1822, condemned the two pieces of legislation passed in 1700 and 1813. "Both these acts are deficient in their provisions," a committee report concluded, "and under their operation alone, it is impossible to enforce a conformity to the existing standards." This report in turn prompted far more extensive legislation on the subject in April 1822. The new legislation went much farther than the previous acts, dividing responsibilities for oversight between a "sealer of dry measures"

[47] *Journal of the Senate of the Commonwealth of Pennsylvania* (Harrisburg: Christian Gleim, 1814), 13-16.

and a "regulator of weights and measures." This codified what had already been an informal practice, and spelled out procedures for inspecting and verifying the weights and measures in use in Philadelphia. The legislation also called upon both officers to issue advertisements in Philadelphia newspapers summoning the owners of weights, measures, balances, and scales to have these verified and sealed. Notably, this legislation and the 1813 enactments only applied to Philadelphia, leaving the rest of the state under the more cursory, colonial-era law.[48]

In practice, the cumulative effect of this legislation was less than impressive. In 1824, the Pennsylvania Senate once again launched an inquiry. This time they requested John Johnson, Philadelphia's sealer of dry measures, to respond to six interrogatories. The answers are revealing. Johnson reported that in the previous year he had adjusted and sealed a little over 4000 separate dry measures, a rather impressive number for one person working alone, save for some part-time help. But this figure referred to new dry measures inspected prior to sale, not to the existing measures in actual use. Of the latter, Johnson reported that he had inspected approximately 1200 additional measures in use by approximately 810 grocers, shopkeepers, and shopkeepers in the county and city of Philadelphia. When pressed as to how many measures had been found wanting, Johnson admitted that he had not kept an "exact register of the dry measures required to be altered," but believed that "at least one half of the whole of the measures brought to me," suggesting that accurate measures remained in very supply.

What, then, of the coercive powers of the state? How many fines had Johnson collected from these errant shopkeepers? Here the sealer admitted that, in the entire city and county of Philadelphia, he had sued a rather modest 128 individuals. But this figure was undercut still further by the fact that he had only fined 10 of the 128. "The reasons why, from so many sued, so few have been convicted and fined," he explained, had to do with the fact that "a great majority of the delinquents, from whom this penalty might have been exacted…did not wish to offend [and] that their delinquencies arose from inattention or negligence, without any intention to evade the requisitions of law or do the people injustice." It is difficult to determine the truth of Johnson's answers, but they highlight that the actual implementation of the law inevitably led representatives of the state into ambiguous, challenging situations where the subjective judgment of the sealer trumped the objective letter of the law. As Johnson noted in closing, "probably a rigid compliance with the requisitions of the law, would require the number of dry measures destroyed to be greatly increased" – something that he found himself unwilling to do.

The committee submitted a similar array of questions to one Michael Baker, Jr., who served as Philadelphia's "Regulator of Weights and Measures." Baker, who inspected scales, beams, weights, and liquid measures, offered an equally telling tale. He conceded that while he kept "a record of all transactions of my office," this was a rough account at best. As a consequence, he was unable to state with certainty how many items he had inspected, but estimated that he had examined 99 beams and 92 pairs of scales. Of these, only five had been found to be correct. Of the 935 individual weights he had tested, only one matched his own

[48] *Journal of the Senate of the Commonwealth of Pennsylvania*, v. 32 (Harrisburg: Charles Mowry, 1821-1822), 474-476;

standard. Though Baker had indeed inspected a great number of weights and measures, he reported that some 622 individuals had failed to secure his imprimatur, as required by law. Of these, only 120 had actually been sued for non-compliance. More startling still, Baker noted that "I regard the authority vested in me to bring suits as given, not to exact fines, but to compel obedience to the act of assembly; therefore except in cases marked by peculiar circumstances, I pursue the provisions of the law, with as much forbearance as is consistent with their enforcement." The consequence of this policy, admitted Baker, was "that few persons have been fined."

But the piece-de-resistance of this inquiry was not the accounts of the activities of these men, but what they reported about the fundamental standards he used to verify weights and measures and, on rare occasions, impose fines. "There are in my possession three standard measures," Johnson reported. The first, marked with the letters "B.N.E." was in fact the exact same half bushel that the Pennsylvania legislatures had earlier condemned as faulty and inaccurate. He also reported having two additional measures marked "W.R." that were likely the same deficient, incomplete measures the Senate committee found in 1807. Johnson was apparently unaware of that earlier report, for he reported with no equivocation that "it is by these [three] measures that all others are regulated at this office." Likewise, Baker reported that the weights he employed for his job were the same set of brass weights that an earlier inquiry had condemned as faulty. In short, the entire regulatory edifice governing the city's weights and measures still rested on a flawed, irregular set of standards. The absurdity of this did not go unnoticed in Pennsylvania, much less other states, where similar problems had been detected.[49]

In Massachusetts, for example, the newspapers of the era captured the problem, noting that "our carpenters' rules and squares are very imperfect, scarcely any two being alike; which together yard-sticks, gallon, quarter, pint, and other measures & weights of all kinds cannot be corrected." Why? In an imaginary dialog, the Boston Patriot asked: "where is the standard for a foot or its parts in inches?—no known; where are the standards for Weights and Measures?—a Bostonian will say, in the Sealer's Office; indeed! Well, where does this Sealer prove or correct his Weights Measures?—Oh! That I don't know." All of this confusion reminded the writer of the "untutored Indian" who, when pressed to explain the universe, declared that the world rested on "the back of a great elephant," to which the obvious question was: What does the elephant stand on?" To this the Indian had a ready answer: "a large mud turtle." And what did the turtle stand on? "I don't know that," said the Indian. Such was the progress made in modernizing the nation's standards of weights and measures by the 1820s.

ROADS NOT TAKEN

[49] *Journal of the Senate of the Commonwealth of Pennsylvania*, v. 35 (Harrisburg: Mowry & Cameron, 1824), 152-156, 181-183.

For all the despair on the state level in 1820s, the federal government had not entirely ignored the problem in the preceding decade. On December 3, 1816, President James Madison delivered a message to Congress on the subject. "Congress will call to mind that no adequate provision has yet been made for the uniformity of weights and measures…contemplated by the Constitution." Madison, who had collaborated with Jefferson on the 1790 report, now assumed the burden or reviving the ideas contained din it. "The great utility of a standard fixed in its nature, and founded on the easy rule of decimal proportions, is sufficiently obvious," he declared. He exhorted Congress to contemplate a "completion of the work" already started. The plea led the House of Representatives to appoint yet another committee, but it also asked the Secretary of State, John Quincy Adams, for advice on how best to proceed.[50]

The report that Adams produced remains a towering work of erudition. As he prepared to write it in 1817, he took the time to write Thomas Jefferson on the challenges he faced. While he clearly respected the 1790 report, he warned Jefferson that "the great deviation which I have it in contemplation to propose is an implicit adoption of the new French metrological system as already established in France." This, he confided in Jefferson, struck him as the "best and most perfect system that ever has been attempted to be carried into execution," and better yet, one in which "the work is already done," thanks to the ministrations of the French. Adams, a consummate cosmopolitan who could speak or read a number of languages both alive and dead, argued that the adoption of the metric system would "extend the principles of uniformity to the intercourse between nations, and ultimately might lead to the adoption of it by all the commercial nations." Adams expressed disgust with the "weights and measures of England with all their varieties and confusions." For all his enthusiasm, Adams worried about making too strong an argument on behalf of the metric system. "Yet when I look at the other side of the question," he mused, "and observe the obstacles and resistances of every kind which stand in the way and make the practicability of so great a change questionable, I shall have some hesitation even in disclosing the opinion that I entertain."[51]

This question loomed large as Adams labored over his report. A report issued by the House committee in 1819 articulated the central problem with the metric system, and for that matter, any system that required abandoning older units of measurement in favor of new ones. "If a difference between the measures of two neighboring towns afford opportunities for fraud," they observed, "how much greater must these be, when entirely new measures are first introduced through a whole country." Invoking the example of France, the committee believed that any sweeping reform would be met with resistance and considerable confusion, and that "whatever benefits uniformity and system may give to posterity, that the present age must pay no scanty price for them." In recognition of this reality, the committee merely suggested that the national government codify some standards based on English precedent and then leave "the

[50] Annals of Congress, 14th Cong., 2nd sess., 234.

[51] John Quincy Adams to Thomas Jefferson, 11 October 1817, in *Writings of John Quincy Adams*, Worthington Chauncey Ford, ed., v. 6 (New York: Macmillan, 1916), 217-221. On the early history of the metric system in the United States, see Alan J. Clamp, "Attempts to Adopt the Metric System in the United States to 1907," M.A. Thesis, University of South Carolina, 2012;

power of enforcing the use of measures and weights" to the individual state governments. This was hardly a clarion call for reform, and in an honest aside, they offered an acknowledgement that much of their report consisted of "objections to the plans of others," and that they were proposing "that little should be done."[52]

Faced with such entrenched resistance to reform, Adams opted to issue a report that steered clear of controversy. In the end, he did not unequivocally counsel the adoption of the metric system. But nor did he really endorse a continuation of the status quo. This made his *Report on Weights and Measures* an exceedingly even-handed and judicious undertaking, but as a blueprint for public policy it left much to be desired. Moreover, at 245 pages, it resisted easy summary. It consisted of a number of parts, the first of which was a philosophical disquisition on the origins of weights and measures. This section bore a superficial resemblance to the ruminations of Locke or Hobbes, as Adams sought to link each element of metrology to a successive phase of human development. Linear measures, he speculated, originated with "individual existence," followed then by measures of capacity and the decimal system, which he linked to "domestic society," or the union of man and wife. Civil society, by contrast, gave rise to weights and other common standards, while money, coins, and "all the elements of uniform metrology," emerged in tandem with "civil government and law."[53]

Adams wedded this ethereal discussion to a more grounded account of the history of weights and measures from biblical times to the present. This was illuminating, gathering together a vast amount of information on obscure mediaeval statutes from England and continental Europe that brought the story up through the early nineteenth century. The point of this digression was not pointless pedantry; Adams hoped that by examining the thicket of edicts, regulations, and repeals that had led to the present, the legislators might come to an appreciation of the genuine challenges they faced in reforming weights and measures in the United States, particularly the choice between maintaining a kinship with British weights and measures versus adopting the French metric system. "Is your object uniformity?" asked Adams. "Then, before you change any part of your system, such as it is, compare that uniformity that you must lose, with the uniformity that you gain, by the alternation." If Congress retained the existing system, they would maintain a connection with Britain, the nation's most important trading partner. Abandon that connection, warned Adams, and Congress would effectively "destroy all this existing uniformity."[54]

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[52] "Weights and Measures," H. Misc. Doc. No. 463, 15th Cong., 2nd Sess. (1819), *ASP*, Miscellaneous, Volume 2, 538-541; *Annals of Congress*, 15th Cong., 2nd sess., 755-764.

[53] "Report of the Secretary of State Upon Weights and Measures," H. Doc. No. 109, 16th Cong., 2nd Sess. (1821), 6-11.

[54] Ibid, 46-47. It was at precisely the time when Adams wrote his report that Britain embarked on a significant revision of its own weights and measures, simplifying them and otherwise codifying the existing system. This likely weighed on Adams's mind as he prepared his recommendations. See Rebecca J. Adell, "The English Metrological Standardisation Debate, 1758-1824," M.A. Thesis, Carleton University, 2000; Rebecca Adell, "The British Metrological Standardization Debate, 1756-1824: The Importance of Parliamentary Sources in Its Reassessment," *Parliamentary History* 22, part 2 (2003), 165-182.

At the same time, declared Adams, if Congress should "deem their powers competent, and their duties imperative, to establish uniformity as respects weights and measures in its most university and comprehensive sense," Adams recommended the metric system for their consideration. Here Adams betrayed a distinct bias, describing the French system in millennial language as part and parcel of the "universal peace, which was the subject of a Saviour's mission." Adams, like so many cosmopolitan reformers before and after him, sincerely believed that standard weights and measures had the potential to effectively obliterate national boundaries, creating a global citizenry in which the invidious distinctions of language and nation might wither away. The metric system, declared Adams, could "furnish the links of sympathy between the inhabitants of the most distant regions; the metre will surround the globe in use as well as in multiplied extension; and one language of weights and measures will be spoken from the equator to the poles."[55]

These flights of fancy notwithstanding, Adams was a scholar, not a revolutionary, and the rest of his treatise offered numerous examples of the resistance such a project would likely encounter. Long before the concept of "path dependence" became part of the lexicon of economics and sociology, Adams understood that the standards of the past could persist long after the motivations for their adoption had grown obsolete, frustrating the adoption of new, more modern standards. As a telling example, he pointed legislators to the curious history of the monetary standard in the United States. While Congress had adopted a new monetary standard nearly three decades earlier, Adams observed that the decimal division of the dollar remained little understood. ""Even now, at the end of thirty years, ask a tradesman, or shopkeeper, in any of our cities what is a dime or a mille, and the chances are four in five that he will not understand your questions." Stranger still, noted Adams, if you tendered a Spanish piece of eight in New York, "the shop or market-man will take it for a shilling. Carry it to Boston or Richmond, and you shall be told it is not a shilling, but nine pence." Adams continued in this vein, detailing the absurd variations in the unit of account, as every single state continued to reckon prices in a motley mix of monetary standards "And thus we have English denominations most absurdly and diversely applied to Spanish coins," reported Adams, "while our own lawfully established dime and mille remain, to the great mass of the people, among the hidden mysteries of political economy—state secrets."[56]

Adams's candor was refreshing, but taken as a whole, the report was deeply frustrating. It very much resembled a scale where the weight of the evidence on either side balanced each other perfectly, offering no clear way forward. If Adams still favored the metric system, he managed to hide his opinion in a thicket of scholarship. This was not entirely his fault: at the time he completed the report, France had neither fully adopted the metric system nor entirely renounced it, thanks to a decree issued by Napoleon in 1813 that offered an awkward compromise between the *mesures usuelles* and the metric system. Perhaps as a consequence, Adams ultimately shied away from recommending its adoption, though he made it clear that

[55] "Report of the Secretary of State Upon Weights and Measures," 48.
[56] Ibid, 56.

doing so might well be both possible and desirable in the future. He counseled patience, prudence, and caution, noting that if there was "one conclusion more clear than another, deducible from the history of mankind, it is the danger of hasty and inconsiderate legislation upon weights and measures."[57]

In the end, Adams was emphatic that Congress should fix the nation's weights and measures, but on the question of which system to choose, he proved a bit more equivocal. Toward the very end of the report he reluctantly endorsed the idea of sanctioning the existing system of weights and measures, recommending that Congress secure copies of standards from the ultimate source: the British government, which was simultaneously trying to bring order to its own weights and measures. Despite Jefferson's entreaties, he rejected the idea of using the pendulum or some other natural standard, preferring instead the certainty of an ur-standard based on an actual material object: the standard yard held by Britain, which dated to 1601. After procuring a brass copy of this yard, the United States could derive all the necessary measures of length and capacity. He recommended that these standards should be furnished to the governors of the states and territories, and that Congress should mandate their use in the nation's post offices, customs-houses, and land surveys.

Despite his recommendations for enhanced powers on the national level, Adams bowed to the realities of federalism. "It is scarcely possible that any law of the United States to establish uniformity of weights and measures throughout the Union, should be made effectual without he cordial aid and co-operation of the state legislative and executive authorities." For Adams, this was "one of the most powerful reasons which have led to the conclusion, that, in fixing the standard, all present innovation should be avoided." By acknowledging that the federal government could in no way move in a unilateral pre presumptive fashion, Adams identified one of the key obstacles to metrological reform that did not plague the governments of France or Britain in quite the same way, even if in other respects campaigns for metrological reform encountered many of the same roadblocks, obstacles, and outright resistance from the populace.[58]

Congress appointed yet another committee to act on the Secretary of State's report. It enthusiastically recommendation that Congress obtain platinum copies of the British yard as well as the avoirdupois pound. These copies, to made of "platina" (platinum), would then serve as the fundamental standards for the nation. The committee argued that "by distributing accurate copies of these standards among the states, the present inequality of weights and measures, will be so far removed, as to leave little practical inconvenience in that regard." The committee's faith in the power of the federal government was quaint, if utterly native: at no point in the history of weights and measures has the distribution of standards led to actual standardization. But a more immediate obstacle to realizing their recommendations presented itself: Congress.

[57] Ibid, 134.
[58] Ibid, 128.

After the committee introduced its recommendations, the House of Representatives promptly, and completely, ignored the matter.[59]

Nonetheless, buried deep in Adams's Report were some statistics that would, in time, attract the attention of a more decisive civil servants. When Adams first began gathering data for his report, he obtained figures on the actual capacity of the capacity measures in use at 47 different custom houses. Though the resulting data made it into the report, it proved difficult to read because Adams did not reduce these to a common unit of measure. But a later report, which rectified this oversight, revealed considerable variation, even if the mean of the many bushels was in fact reasonably close to the official definition of the Winchester bushel: 2150.42 cubic inches. The figures ranged from a low of 1925.69 cubic inches in Bath, Maine, to a high of 2358.58 in Ocracoke, North Carolina. These deviations, while they passed without notice in 1821, would soon become the object of growing controversy.[60]

In 1826, Representative Czar Bradley of Vermont took the floor on behalf of the newly created House Committee on Weights and Measures. An ally of John Quincy Adams, who was now president, Bradley reported that his committee had conducted a far more comprehensive survey of the problem by opening an "extensive correspondence" with almost eighty custom houses in the United States. The substance of this report, since lost, was summarized by Bradley. "Such was the difference in the ascertainments and estimates of duties between some of the ports," he warned, "that merchants, alive to their own interests, had found it for their advantage to enter particular kinds of merchandise at one port, and secure the duties, and afterwards transport them to the port at which their sale was originally contemplated." Such clever acts of arbitrage enabled the merchants to "make a profit," for such maneuvers always came at the expense of the nation's revenue. Bradley went so far as claim that whatever the cost of fixing the problem, "the amount now lost to the revenue in one week would more than compensate the expense" associated with reform.[61]

Once more, reform would wait, as Congress shelved the report and went on with its business. The merchants of Philadelphia, no closer to solving the problem than they had been a decade earlier, submitted a petition in 1835 that echoed a common frustration. They bewailed the "irregularity in Weights & Measures," which they claimed caused "much inconvenience to the whole trading community…What is measure in one place and on one Side of a River may not be such and often is not, in another on the opposite side." The entire system was astonishingly inefficient: "goods transported from one state to another have constantly to be reweighed,

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[59] "Report of the Select Committee to Which Was Referred, on the 26th of December Last, the Report of the Secretary of State Upon the Subject of Weights and Measures," H. Rep. No. 65, 17th Cong., 1st Sess. (1822); Annals of Congress, 17th Cong., 1st sess., 1251-1253.

[60] Intimations of this problem can be found as early as 1792, when the Collector of the Customs in Newport, Rhode Island, warned Alexander Hamilton of discrepancies. See *Papers of Alexander Hamilton Digital Edition*, Volume 12 (July 1792-October 1792), 420-421.

[61] *Register of Debates in Congress*, v. 2 (Washington: Gales and Seaton, 1826), 2633-2644, 2648-2658. On Bradley, see *Biographical Dictionary of the American Congress*, 1774-1996 (Alexandria, Virginia: CQ Staff Directories, Inc., 1997), 697. Bradley would soon break with Adams, joining the Jacksonians. *National Cyclopedia of American Biography*, v. 2 (New York: James T. White, 1926), 433.

regauged, or measured anew," and fraud and malfeasance reigned. The petitioners saw until the "National Legislatures shall adopt and enforce the necessary laws to equalize and define a standard," the memorialists saw "no end to the existing evils."[62]

The merchants of Pennsylvania would see their prayers answered that same decade, but not remotely in the way they envisioned or desired. Congress would not set the standard; rather, the Treasury Department, operating outside of legislative sanction, would initiate the first tangible campaign to impose national metrological standards, largely in a bid to rationalize tax collection. Stranger still, the architect of these state standards, which remain in use today, was not a Jefferson or an Adams, but an eccentric Swiss scientist. An outsider, a foreigner, a man whose manners, one contemporary sharply noted, "are repulsive and by no means affable": this curious individual would, for all intents and purposes, serve as the conscience of the state when the time came to create the first standard weights and measures in the United States.[63]

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The history of standards in the United States during first half century of its existence was notable less for what was accomplished than for what was left undone. Despite a clear mandate under both the Articles of Confederation and the Constitution, the federal government and its representatives relinquished its authority over weights and measures. This was not for a lack of discussion or debate: the question of how best to secure standard weights and measures became an abiding obsession of some of the finest scientific and political minds of the founding generation. But their deliberations and experiments yielded nothing. In the process, the national government ceded the problem to the individual states. But if the states did pass laws in the hopes of accomplishing what the federal government could not, they took little initiative, preferring to delegate the matter to even smaller, more local institutions of government. It was here, in the everyday negotiations between the rather ordinary representatives of the state and equally ordinary citizens that the question of how best to secure standard weights and measures would be asked but rarely answered.

Absent a genuine standard, much less an effective state, is it any wonder that the citizens of the early republic turned to scripture for consolation, and to Deuteronomy in particular, lecturing one another, and their representatives in government: "Though shalt not have in thine house divers measures, a great and a small. But thou shalt have a perfect, a just weight; a perfect

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[62] "Memorial of Importers, Auctioneers, Commission Merchants and Merchants Engaged in Dry Goods Business in Philadelphia to Establish a Standard of Weights & Measures," 2 February 1835, in File HR 23A-G21.1, part of Legislative Files and Petitions, RG 233, Records of the U.S. House of Representatives, NARA, Washington, D.C. So disengaged was the federal government by this point that when newly created states sought to secure standards, they often turned to other states, not the national government, for guidance. See, e.g. *Journal of the Senate of the State of Ohio* (Columbus: James B. Gardiner, 1835), 126-127, 354-359.

[63] Huntress, 1 June 1839. On the personality of Ferdinand Hassler, see Florian Cajori, The Chequered Career of Ferdinand Rudolph Hassler, First Superintendent of the United States Coast Survey (Boston: Christopher Publishing House, 1929).

and just measure shalt thou have." Americans would eventually lay their hands on some approximation of that perfect and just measure. But they would have to wait a century to do so.