

Notes from the Ground

Science & Agricultural Improvement in the Early American Republic

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Abstract

This dissertation is an analysis of systematic studies of the land in the early American Republic, from the 1790s to the 1840s; more specifically, it explores the role scientific and technical practices played within that era's improvement ethic. I argue that science, as seen through the lens of agricultural chemistry and, to a lesser extent, geology, became an important, acceptable, and credible way to interact with early Republic land because it fit within the multivalent improvement ethic of that period. Through a study of the agricultural press, farmers' diaries, and county and statewide scientific surveys, I examine how scientific and technical practices aided agricultural improvement, how they were promoted or resisted by local farmers, and in what ways they gained social credibility for interpreting and interacting with agrarian nature. Part I, "The Place of Science," explores how science was interpreted by people. I there ask about the social, moral, instrumental, and literary places of agricultural science in rural culture. Part II, "The Science of Place," asks instead how science interpreted the land, there studying county and state scientific surveys in Virginia. Underlying the entire work is an exposition of the georgic ethic (as distinct from the pastoral ethic), which emphasizes the labor-based means through which most rural peoples understood their land and ties the moral plea for cultural improvement to the material pursuit of agricultural progress.

The story herein introduces the production of an important set of conditions that allowed later scientific developments across the land to have meaning and significance: forms of communication, precedents of organization, field-tested modes of analysis, a tradition of improvement and experimentation, the long-standing search for solutions to soil exhaustion, increasingly mechanistic philosophies of soil composition, a market force to drive all of these, and a unique American political and agricultural environment into which the above could take shape. The lesson is not that the entirety of our modern scientific worldview can be traced to the activities of a disgruntled antebellum American farming class, but that this example of rural science and agricultural improvement provides a fruitful example of what it takes to make a scientific worldview. Thus, arguments about philosophical and conceptual bases for scientizing the land—topics of great importance in the fields of environmental history and various branches of science and technology studies—gain strength and plausibility by reference to the workings of antebellum agents who first argued over the value of using science to define their land.

By putting the circulation of agricultural science in the context of early Republic improvement-minded agents, we can better locate agrarian American culture into a post-Enlightenment setting, we are better equipped to recognize how everyday citizens came to treat scientific practices as legitimate means of interacting with their lands, and we have a more developed picture of how morality, materiality, and theory were wedded in the much-revered principles of practice and practicality. The sum of those points highlights how traditional means

of managing the land, as with religious doctrine, almanac strictures, the lessons inherited through family lineage by generations of daily practice, or uncodified folk knowledge in general, were being complemented with or displaced by organized, methodical, and systematic—eventually, scientific—practices on the land.

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Introduction

“I admit that twice two makes four is an excellent thing, but if we are to give everything its due, twice two makes five is sometimes a very charming thing too.... Consciousness, for instance, is infinitely superior to twice two makes four. Once you have mathematical certainty there is nothing left to do or to understand.” Fyodor Dostoevsky, *Notes from Underground*, 1864

"...in the course of the period marked by the birth of modern scientific discourse the map has slowly disengaged itself from the itineraries that were the condition of its possibility." Michel De Certeau, *The Practice of Everyday Life*, [1974] 1984¹

In *Notes from Underground*, Fyodor Dostoevsky's unnamed narrator decries Enlightenment rationalism and the progressive ideology ushered in by a materialist scientific worldview. It was an 1860s commentary on the disenchantment of a world created by Enlightenment values, a view that was already echoing from the Romantic movement and would later take sharper form from the Frankfurt School and post-World War II critics of technical rationality. Quantification, technical analysis, disembodied logic, and the values of efficiency and rationality were considered hallmarks of modernity, guarantors of progress, and the underpinnings for political and economic success. The Industrial Revolution and the rise of the professional scientific class helped forward those values and confirm the association of progress with science. At least, this was the outlook the psychically fragmented Dostoevsky offered as he provided a gloss on the standard macro-view of the rise of modernity. His point was to question whether the thoroughly cultivated improvement ethic of the previous century had in fact made the world better.

In another work downplayed as mere “notes,” but written a century before Dostoevsky, Thomas Jefferson envisioned a natural world of unified description made common by the language and practice of science. *Notes on the State of Virginia* (1787), surprisingly the only

¹ Fyodor Dostoevsky, *Notes from Underground*, as excerpted in Walter Kauffman, *Existentialism from Dostoevsky to Sartre* (New York: Penguin Books, 1975), 52-82, quote on 64; Michel de Certeau, *The Practice of Everyday Life* (Berkeley, CA: University of California Press, [1974] 1984), 120.

book Jefferson ever published, was a pioneering survey of his native state, a veritable compendium of the natural features of the Old Dominion intended to present in systematic form its extant identity and future possibilities. An embodiment of the American Enlightenment, Jefferson dreamt of the very world that Dostoevsky's *Underground Man* rejected. At one point, while arguing at length against the French natural historian Buffon, he appealed to the truth of universal scientific descriptions to make his case that America was as fertile, lush, and ripe for improvement as anywhere in the world. "[A]s if a soil of the same chemical composition was less capable of elaboration into animal nutriment," he wrote, in the process premising his argument for the possibilities of a great nation on assumptions of composition and soil identity made evident by science.² Jefferson, rather than speaking at a high level of abstraction, evoked the possibilities of science at the level of a practical and concrete subject: the physical land of Virginia.

Jefferson's prediction of a scientifically identifiable landscape was ultimately borne out, albeit through avenues less direct and more culturally situated than he could have ever imagined. Today, the credibility of science for observing and defining elements *of* nature and then prescribing a plan of action *in* nature is taken without question. For the purposes of achieving some specific goal, be it economic or political, we take science as the obviously best way to know our world. In the context of an agrarian America, that view was set into its basic form by the mid-nineteenth-century. We hear from farmers like the Virginian Richard Eppes, who believed in 1859 that "A farm is another name for a chemical laboratory." Politicians of the period expressed similar sentiments. James Campbell, a congressman from Pennsylvania, asked his audience in the 1850s to "Let science, applied to the culture of the earth, go hand in hand

² Thomas Jefferson, *Notes on the State of Virginia*, ed. Frank Shuffleton (New York: Penguin Books, [1787] 1999), 48.

with practical labor.” In the 1860s, the professional chemist James Nichols wrote in his *Chemistry of the Farm and the Sea*, “Let us...feel assured that chemistry, which holds the key which has unlocked so many rich chambers in the storehouse of nature, will open others fully capable of supplying all the wants of the husbandman.”³ Indeed, as the historian Carolyn Merchant has observed, “As mechanists gained victory over vitalists, they were simultaneously transforming grains and fertilizers into scientific objects, farms and fields into laboratories, and farmers into chemists.” “By the 1860s,” she adds, “through scientific management of agricultural production, human control over nature was increased.” A long list of environmental and scientific historians offers similar conclusions.⁴ My own questions in this project are geared toward an environmental analysis that falls along these lines: how did we first come to interact with, define, and understand the land with scientific means and for technically quantified ends? That is, what role did the sciences play in producing views of actual physical nature that were materialist, quantifiable, and, because of that, controllable?

This dissertation is an analysis of systematic studies of the land in the early American Republic; more specifically, it explores the role science played within that era’s improvement

³ Richard Eppes, in his diary, as quoted in Jack Temple Kirby, *Poquosin: A Study of Rural Landscape* (Chapel Hill: University of North Carolina Press, 1995), 37; James Campbell, before Congress, as quoted in Sarah Philips, “Antebellum Agricultural Reform, Republican Ideology, and Sectional Tension,” *Agricultural History* 74 (2000): 799-822, on 817-818; James Nichols, *Chemistry of the Farm and the Sea, with Other Familiar Chemical Essays* (Boston: A. Williams and Co., 1867), 45.

⁴ Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press, 1989), on 206 and 220; For more on the nineteenth century context of American science see Charles Rosenberg, *No Other Gods: On Science and American Social Thought* (Baltimore: Johns Hopkins University Press, 1976); Alexander Oleson and Sanborn Brown, eds., *The Pursuit of Knowledge in the Early American Republic: American Scientific and learned Societies from Colonial Times to the Civil War* (Baltimore, MD: Johns Hopkins University Press, 1976); Alan Marcus, *Agricultural Science and its Quest for Legitimacy: Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa University Press, 1985); Margaret Rossiter, *The Emergence of Agricultural Science: Justus Liebig and the Americans, 1840-1880* (New Haven, CT: Yale University Press, 1975); Sally Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1846-1860* (Urbana: University of Illinois Press, 1976); John Greene, *American Science in the Age of Jefferson* (Ames: Iowa State University Press, 1984); and Robert Bruce, *The Launching of Modern American Science, 1846-1876* (New York: Knopf, 1987). See John Stilgoe, *Common Landscape of America, 1580 to 1845* (New Haven, CT: Yale University Press, 1982) for more discussion of the increasingly dominant ideals of productivity and efficiency in the practices of agriculture.

ethic. My argument is that agricultural science became an accepted practice in rural America because it fit into the pre-existing dominant value structure of a practical and practice-oriented culture. I look between Jefferson and the mid-nineteenth century—more precisely, from about the 1790s to the 1840s—and within the practical instantiation of Enlightenment protocol, “improvement,” to elucidate one prominent way that the sciences came to define the land. Since this is an American story, with attention to unique features of American identity and calls for improvement, I begin my examination after the Revolution. And since my point is to show how the terms of acceptance for agricultural science were already developed by the 1850s—when the likes of Richard Eppes, James Campbell, James Nichols, and, soon, Fyodor Dostoevsky, made the same observation—I end my study in that era.

In brief, then, I examine how science aided agricultural improvement, how it was promoted or resisted by local farmers, and in what ways it became a credible practice for interpreting and interacting with agrarian nature. To locate my answer, I study the agricultural press, farmers’ diaries, and county and statewide scientific surveys as I focus on the tenuous acceptance and interpretation of agricultural chemistry and geology. I can hardly claim that the success of agricultural science in the antebellum era accounts for the rise of the modern techno-scientific nation-state. However, I do see that site of analysis as providing the first politically significant and ecologically relevant association of science and the environment. I complement environmental history by studying one area of that field, the history of human interaction with cultivated farmland. At the same time, I speak to the literature of science studies by examining how the sciences of agriculture became that form of interaction in a socially credible way.

The agrarian landscape and agricultural identity are key features of the American ideal; therefore, any discussion of what farmers thought about science and their land is also a

commentary on what most people thought about them.⁵ Ostensibly, then, my work is meant to show that by the mid-nineteenth-century a large proportion of American culture interacted with their land in new, scientific ways. My more ambitious goal, however, is to understand the conceptual foundations of environmental science, because with the example of agrarian America we find the combination of science and nature coming together for the first time with intentional political coordination for the explicit goal of changing the landscape. Before George Perkins Marsh noted the human ability to alter nature profoundly, another observation from the 1860s, Americans had already been acting on that assumption for decades, making it the very premise by which they sought moral, political, and economic improvement.⁶



That is the basis of my project. I explain here some of its conceptual background. The keywords of improvement, science, place, and nature form the foundation below. Of those four, “improvement” is by far the most central term. The clearest idea of improvement, with its constant partner progress, was born in the Enlightenment, thereafter rising in stature as a primary value of society. Improvement narratives are central to historical discussions of science, to explanations of the motivation for social policies, and to the very concept of modernity. In America, famously considered an Enlightenment experiment, improvement narratives were wedded to the political landscape from the start in ways both cultural and material. Given the

⁵ An older standard contrast in historical analysis existed between agricultural and industrial economies. Scholars, though, have come to observe that industry was not created in opposition to agriculture, but produced from it. See David Meyer, *The Roots of American Industrialization* (Baltimore: Johns Hopkins University Press, 2003); Allan Kulikoff, *The Agrarian Origins of American Capitalism* (Charlottesville: University Press of Virginia, 1992); and Sue Headlee, *The Political Economy of the Family Farm: Agrarian Roots of American Capitalism* (New York: Praeger, 1991). Lawrence Peskin, *Manufacturing Revolution: The Intellectual Origins of Early American Industry* (Baltimore: Johns Hopkins University Press, 2003) discusses the “harmony” between the two.

⁶ George Perkins Marsh, *Man and Nature*, ed. David Lowenthal (Seattle: University of Washington Press, [1864] 2003)

preeminence of America's natural bounty, the abstract principle of improvement was explored with concrete political action into the nineteenth-century by demanding increased attention to natural resources and to the possible benefit of such attention. It seemed, in a word, natural to do so. Many progressive narratives would contend that, with science, improvement found a mechanism for achieving its principle aims.

This basic idea of improvement is crucial to understanding my story, and it is the consistent thread weaving through every discussion in the following chapters. With its various incantations, improvement brought out the tensions, disputes, and ultimate justifications for and about decisions of political economy. Not just the principle giving foundation to ideals of material gain in today's world, improvement was as much about the opportunities of moral betterment from the Old World as it was about the pursuit of financial gain. This dissertation is embedded within America's multivalent improvement ethic.

My chronological span from Jefferson to the years before the Civil War is meant partly as an introductory rhetorical overview, usefully bounding that early American pursuit of improvement's value. Two other figures form the basic span of my work, neither of whom was American: the agricultural chemists Sir Humphry Davy of England and Justus von Liebig of Prussia. Davy first published his seminal *Elements of Agricultural Chemistry* in 1813 after a decade of research at the British Board of Agriculture. Liebig first published his *Organic Chemistry and its Relations to Agriculture and Physiology* in 1840 after several years of comparable research. Any allusion to the sciences of agriculture by the second and third decades of the nineteenth-century made reference to Davy's work; by the 1840s, all similar references noted the trumping of Davy's work by the new theories of Liebig. When Merchant observes the

mechanists gaining victory over vitalists, she is referring to Liebig's following gaining victory over Davy's.

What interests me, though, is not that Davy and Liebig's work was preeminent in scientific rigor, but that people outside the chemical community accepted them as so. In my mind, it is not simply remarkable that the sciences of agriculture had made their mark by mid-century, but that so many farmers and non-scientists listened. Thus, my questions and the structure of this dissertation are as much about values, beliefs, and credibility in the non-scientific, agrarian class as they are about those of the nascent scientific class. Science was still in the early days of its culturally authoritative role in matters of social and political importance. Therefore, demonstrating the validity of science for agricultural and political improvement, in the early nineteenth-century, took some work—that is, we cannot stand on the conclusion that science became aligned with the improvement ethic because science provided obviously valuable and credible knowledge of the land; it did not yet do so. Of course, scientific inquiry was not new then, nor was the idea of studying the land, sea, forests, animals, and sky novel at the time. But by the mid-nineteenth-century, the combination of a new professional scientific class, an expansionist national policy, and the political wherewithal to unite the two ended up leaving an indelible mark on the landscape.

Given my dual topics of agricultural science and the American landscape, my questions and interests bridge two relatively young academic fields, environmental history and science and technology studies. Fortunately, the work of not just Carolyn Merchant, but Gregg Mitman, Robert Kohler, and a host of younger scholars has already provided important precedents for spanning the two forums. Scholarship over the past few years by Conevery Bolton Valencius, Stuart McCook, Michael Bryson, and Joseph Taylor provide only the most recent examples of

this growing symbiosis between studies of science and studies of the environment.⁷ For my own part, from an environmental history perspective I look to the agricultural arena, to land already cultivated by humans or already being worked to redress problems of over-cultivation. Within science studies, I look to the undersubscribed forum of chemistry, examining the unauthorized, or amateur, promoters of agricultural science instead of the popular doyens of agricultural chemistry, Davy and Liebig. I came to this combination of topics through a unique, though traceable, path.

Among the scholarship that forms the stepping stones for that path are three central works: Margaret Rossiter's *The Emergence of Agricultural Science* (1975), Carolyn Merchant's *Ecological Revolutions* (1989), and Steven Stoll's *Larding the Lean Earth* (2002). Each work, with varying degrees of emphasis, has something important to say about the combination of agriculture, environment, science, and America. Rossiter's work tells the story of the diffusion of Liebig's theories into the American rural landscape, explaining that the translation of his work to specific local contexts was not direct, uncontroversial, nor preordained. She writes to show the early genesis of agricultural experiment stations, in the process providing a still-unmatched exploration of Liebig's influence in America but without any attention to the ecological

⁷ See Robert Kohler, *Labscales and Landscapes: Exploring the Lab-Field Border in Biology* (Chicago: University of Chicago Press, 2002); Gregg Mitman, *The State of Nature: Ecology, Community, and American Social Thought, 1900-1950* (Chicago: University of Chicago Press, 1992); Conevery Bolton Valenčius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002); Stuart McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940* (Austin: University of Texas Press, 2002); Michael Bryson, *Visions of the Land: Science, Literature, and the American Environment from the Era of Exploration to the Age of Ecology* (Charlottesville: University of Virginia Press, 2002); Joseph Taylor, *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: University of Washington Press, 1999); Deborah Fitzgerald has also crossed the two fields, with particular emphasis on agricultural technology, as with *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven, CT: Yale University Press, 2003). Also bridging environmental history and the history of technology are Ed Russell, *War and Nature: Fighting Insects with Chemicals, from World War I to Silent Spring* (New York: Cambridge University Press, 2001) and David Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: MIT Press, 2003). And bridging agricultural history and the history of technology, through STS, is Ronald Kline (2002) *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore, MD: Johns Hopkins University Press).

ramifications of such influence. Merchant balances those two sides in her work—the influence of science and the consequences for nature—offering a number of insights about philosophies of nature and their relation to philosophies of economy. *Ecological Revolutions* is far more ambitious and wide-reaching than my own work. In that range Merchant leaves open a number of questions that I hope to address below, such as the details of particular contexts and the dynamics of everyday practitioners encountering the new sciences she discusses. I came to the third work, Stoll's *Larding the Lean Earth*, after I began my project, but its contributions have nonetheless offered an important contextual background for my own research. Stoll's chronological, geographical, and topical scope matches my own almost precisely. His framing is similar to Merchant's, in that he aims to reveal the ecological consequences of political activity. However, where Rossiter neglects the ecological for the scientific, Stoll forgoes the scientific for the ecological. He puts the introduction of fertilizing strategies in the early Republic into the “improvement” context, while arguing that the impetus for conserving land was first defined by political and cultural directives to maintain power in the eastern states. That is, by improving the soil, those in the eastern states could maintain farming populations and, thus, their strength in the Union. But, because Stoll's purpose is otherwise directed, he leaves open a number of questions about the social credibility of the newer scientific techniques and gives the impression that their introduction was part of an inevitable trend.

I also address the combination of agriculture, environment, and science in American history, but for different reasons than these three books. If the reader learns about the place of science in antebellum rural culture, then that is probably enough. That, in fact, is the true core of this work. But my focus on that context is meant only as a means to another end. The more suggestive realm of this work is about a way to conceptualize how people interact with nature,

how they participate in the construction of ideas about it, how the material and conceptual, the practical and the theoretical, are always intertwined, and how we can reintroduce those timeless notions of active (even if uncredited) participation today to reassess our own environmental sensibilities. I use the keyword “place” with a good degree of flexibility below—place as a site of work, the actual location where science is practiced; place as a simple synonym for land; and place as a cultural marker, of an indication of what standing science holds in the minds of farmers.⁸ This multifaceted treatment of place is helpful, because it makes many of my comments about the specific historical context of antebellum America congruous with current notions and expressions of place-based narratives and senses of living in the world.

Place-based narratives about agriculture conjure up statements of environmental ethics based on living off the land, ethics that demand attention to the work we do to make that living. I make almost no explicit reference to Wendell Berry’s agrarian ethic in this work, but his kind of land sensibility does pervade my own story. As I will outline below, I make extensive use of ideas about engagement and action with philosophical precepts of work, practice, and know-how that one can find in the writings of not just Wendell Berry, but also Michel de Certeau, James Scott, Joseph Rouse, Gilles Deleuze, and Felix Guattari. I also find recent work in the field of literature and environment, especially that on the georgic ethic by Timothy Sweet, especially

⁸ See Yi-Fu Tuan, *Space and Place: The Perspective of Experience* (Minneapolis: University of Minnesota Press, 1977); Certeau, *The Practice of Everyday Life*; David Jacobson, *Place and Belonging in America* (Baltimore, MD: Johns Hopkins University Press, 2002); A. Ophir and Steven Shapin, “The Place of Knowledge: A Methodological Survey,” *Science in Context* 4 (1991): 3-21; and, though more particular to blurring the nature-culture divide than merely an explication of “place,” Kent Ryden, *Landscape with Figures: Nature & Culture in New England* (Iowa City: University of Iowa Press, 2001). David Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003) offers an entry point to the vast literature on geography. See, in particular, his bibliographic essays on science, nature, and place (187-223).

consistent with these philosophical precepts and, as will become clear, the georgic ethic of environmental engagement will thread through this entire project.⁹

These ideas of work and practice provide a strong methodological bridge across the already fertile and interconnected fields of environmental history and science studies. *Work*, in any form, has and is a *value*. “Work itself,” as the historian Richard White has written, “is a means of knowing nature....”¹⁰ It provides a valuable bond between humans and nature, forcing us to admit that we are always connected in some way, we can never be dissociated and set outside it. And value, in any context, is an amorphous term. There is economic value, personal value, and moral values. These are built by practices that take place in everyday settings, such as the farm, and not simply or directly imposed from beyond. My project addresses how the value of science—science as an activity and not just a disembodied set of theories—was regarded by the agrarian classes. My contrast is not between the upper and lower class, since I draw on a long list of wealthy planters, but between the scientific and non-scientific class. Steve Shapin and Simon Schaffer, in their influential *Leviathan and the Air Pump*, describe the early modern era Royal Society as a place where certain social values were embedded in physical objects, where both (moral) values and (material) objects represented and reinforced broader social and political values. My work is very similar to theirs, except for its nearly reverse direction of action. That is, instead of demonstrating how the values of science were developed as a way to

⁹ See Wendell Berry, *The Unsettling of America: Culture and Agriculture* (San Francisco, CA: Sierra Club Books, 1977); Certeau, *The Practice of Everyday Life*; and Gilles Deleuze and Felix Guattari, *A Thousand Plateaus* (Minneapolis: University of Minnesota Press, 1987). James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), especially 11-52 and 309-357, addresses “practical knowledge” through the term “*mētis*,” meant in contrast to “more formal, deductive, epistemic knowledge” (6). Likewise, Timothy Sweet, *American Georgics: Economy and Environment in Early American Literature* (Philadelphia, PA: University of Pennsylvania Press, 2002) and Laura Sayre, “Farming by the Book: British Georgic in Prose and Practice, 1697-1820” (Ph.D. diss., Princeton University, 2002) posit the meaning of labor and exploitation of nature as seen in a georgic prose tradition that promotes knowledge through direct interaction. With respect to the philosophy of science, see Joseph Rouse, *Engaging Science: How to Understand its Practices Philosophically* (Ithaca, NY: Cornell University Press, 1996).

¹⁰ Richard White, “Are You an Environmentalist or Do You Work for a Living?” in William Cronon, ed., *Uncommon Ground: Toward Reinventing Nature* (New York: W.W. Norton & Co., 1995), 171-185, on 171.

create a new social order, I look to the ways in which the values of an agrarian social order were appealed to in order to justify and legitimize the values of science; I look from the society at large *to* the contributions of science, rather than *from* the scientific community *into* the society at large.¹¹ The values used to interpret and judge the merits of improvement practices were based in the existing society of non-scientific specialists, not from the social sphere of a chemical community. And those values were tightly integrated with improvement rhetoric that hinged on the work practices of laboring agrarians. I find important aspects of decision-making about the association of science with improvement coming from the non-specialists, those laboring in the fields, over the specialists.



Underlying my basic premise that a study of agrarian America is a study of the dominant form of interaction with nature are several more uncontroversial premises in this project. I will review these and then provide an outline of the dissertation that follows. The first premise is that people know their environment by their mode of interaction with it: how we know our world depends on how we live in it. Richard White may have made this point most explicit in a concise article now

¹¹ A large body of work in science studies deals with the social values of science, discussing, for example, how virtue and gentlemanly conduct have of scientific (or, better, natural philosophical) practice shaped larger portions of society. Shapin and Schaffer offer the classic expression of this in *Leviathan and the Air Pump* (Princeton, NJ: Princeton University Press, 1985). Shapin, in *The Social History of Truth* (Chicago: University of Chicago Press, 1995) adds to the arguments. I don't want to overstress the difference in directions between my work and theirs, since Shapin and Schaffer do not divide their approach into a stark inside-out framework and, furthermore, such a division would imply firm boundaries between different social realms that did not yet exist. But generally speaking, the purpose of their work is to study the scientific community, whereas my purpose is to study the world that eventually accepts that community. Since I argue that modes of acceptance—of gaining credibility within a community—have everything to do with prevailing perceptions of virtue and vice, the literature in science studies on credibility, trust, and legitimacy is also relevant here. For a sampling, see discussions of the cycle of credibility in Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton, NJ: Princeton University Press, 1979/1986). Also see Steve Shapin, "Cordelia's Love: Credibility and the Social Studies of Science," *Perspectives on Science* 3 (1995): 255-275. And for a look at contemporary lay (non-specialized) knowledge, see Steven Epstein, *Impure Science: AIDS, Activism, and the Politics of Knowledge* (Berkeley: University of California Press, 1995).

a decade old, observing that even when we are boxed off from the outside world we are experiencing nature in some way.¹² In fact, in our modern world it is likely that we consider our lives boxed off from and not dependent on the patterns of non-human nature because of our physical distance from it. In the agrarian past this notion of removal and disengagement was far more difficult to maintain. A second premise—and another one that is hardly contentious—is that agriculture is an important form of interaction with the land and, as such, is an important facet of environmental history.¹³ These interests in mediation and interaction lead to my most clear connection between studies of the environment and studies of science, which is my third premise, that science too is a practice, an activity that people do in specific settings; it too is a mode of interaction. Therefore, when the sciences of agriculture were developed and practiced for reasons beyond simply the development of a professional sphere of scientists, they provided a new form of interaction with the land.

Along with these premises, I use several theoretical reference points throughout the course of my work. These include (1) the notion of a georgic ethic, (2) the exegesis of science

¹² White, “Are You an Environmentalist or Do You Work for a Living?” and White, *The Organic Machine* (New York: Hill and Wang, 1995). Donald Worster, *A River Running West: The Life of John Wesley Powell* (New York: Oxford University Press, 2001), 351-354, offers an interesting example of the same issue by discussing the contribution of Mormon knowledge of irrigation strategies to Powell, strategies developed through practical experience of making a life from the land. With respect to the subject of hands-on (activa) as distinct from theoretical (contemplativa) knowledge, Thoreau’s “Walking” and work on forest succession offer historical precedents for a perspective of knowing nature by direct interaction instead of disembodied contemplation.

¹³ There has been a good deal of debate in the environmental history scholarship about what role agriculture can or should play in the broad reach of the field. Donald Worster, “Transformations of the Earth: Toward an Agroecological Perspective in History,” *Journal of American History* 76 (1990): 1087-1106, called for a more explicitly agro-ecological approach to the field, basing his call on the premise that feeding ourselves—growing food—is a mode of production defined by restructuring the natural world. Even the title of Alfred Crosby, “An Enthusiastic Second,” *Journal of American History* 76 (1990): 1107-1110, indicates his approval of this call. William Cronon, “Modes of Prophecy and Production: Placing Nature in History,” *Journal of American History*, 76 (1990): 1122-1131, for one, offered a critique of Worster’s view as too narrowly defined. However, my work takes a different tack than that proposed by Worster: I use agricultural environments because they are sites of knowledge *about* the land, not just places that exemplify how humans *have changed* the land. Worster’s call for more agro-ecological studies was based on agriculture as a mode of *production* in nature; my work uses agriculture as a mode of *interaction* between humans and the land, emphasizing how humans produced the concepts with which they could change the land. Ted Steinberg, “Down to Earth: Nature, Agency, and Power in History,” *American Historical Review* 107 (2002): 798-820, provides a brief commentary on the agricultural basis of environmental history.

not just as an activity, but as a lens through which people see their world, and (3) the philosophical and cultural topic of the conditions of possibility. These theoretical reference points overlap in several chapters, while remaining implicit or avoiding overt reference in several others. Each carries with it some sense of active engagement, of direct connection, to the world. In Chapter 1, I introduce and elaborate the georgic ethic, drawing out its connotations, relevance, and particular usefulness in an early American context. Briefly, the georgic ethic is defined at its core by labor, by the work we do in the world. This stands in contrast to the more widely discussed pastoral ethic, the pastoral being defined by its association with leisure and sublime appreciation. The georgic environmental ethic has been my way to understand agrarian interaction as moral and material. It is firmly rooted in the improvement ethic championed by the post-Enlightenment climate and is directly reliant upon ideas of place. The practical, hard-working ethic of early American society, I should note, is but a generalized description of what I see as this more revelatory georgic narrative. The second theoretical reference point, conceptualizing science as a lens, is developed in the process of the entire dissertation and not at one singular place. This treatment of science mandates that it is a tool, something we use as we work on the land. Viewing science this way has helped me place it within the improvement-embedded georgic ethic.

Both the georgic ethic and the view of science as a lens, in turn, provide important conditions of possibility for the later expansion of scientific means for environmental ends. This third point is one that underpins everything I do, even though I do not elaborate it at any one place. By discussing “conditions of possibility” I do not argue for a simple causal relationship between antebellum arguments in favor of agricultural science and the later dominance of an entire scientific worldview—that the one led solely and directly to the other. I refer to them,

instead, as a way to understand how the context around a given issue offers the process by which that issue can have meaning and significance.¹⁴

I will argue that the introduction of science into the landscape did not occur passively or without resistance. Instead, it arrived as part of an ethic of work and practice. Our understanding, then, of how it happened cannot rely on notions of inevitability, fate, or a sense of science's tacit superiority over other ways of knowing the world. It occurred because people made it so. And while mine is a dissertation set in a specific historical context, I emphasize action, process, and engagement because those elements are timeless; they are just as relevant to our views of nature and science today as two hundred years ago. In current issues of environmentalism, I see the necessity of highlighting forms of human interaction with the land, of recognizing the tenuous though useful role the sciences play in deciphering nature, and of drawing out the existing cultural conditions which can allow us to act as proper stewards of the land in the future.

The central problem in this dissertation is to understand how science became an acceptable practice in the rural culture of the early American republic. My approach to addressing this problem comes in two parts, both of which rely on the flexibility of the term

¹⁴ I borrow the explicit term "conditions of possibility" first from Arnold Davidson, who himself borrows it from Foucault's work. See Davidson, *The Emergence of Sexuality: Historical Epistemology and the Formation of Concepts* (Cambridge, MA: Harvard University Press, 2001). Davidson uses the term to forward a philosophical point about whether or not a given question is even possible to answer. I use the term to forward the social and conceptual point that the necessary conditions giving foundation to an historical accomplishment need to be elaborated for us to understand how that accomplished succeeded. The historian Hans Blumenberg presents a similar approach in *The Genesis of the Copernican World* (Cambridge, MA: MIT Press, 1987). In looking for the roots or causes of scientific developments, Blumenberg is examining what made it possible for a discovery or idea to arise and gain acceptance. He is concerned with the outflowing effects of an idea rather than the causes of it, asking, in his example, about the wider social and intellectual world that made Copernicanism a sensible, meaningful, and interesting idea to those other than Copernicus. Michel de Certeau, *The Practice of Everyday Life*, as in the epigram to this introduction, also uses the term, as does Antonio Gramsci before him. Almost all of these scholars owe a debt to Marxist philosophy in general, even though my use of the term is not meant to force the forthcoming analyses into a Marxist mold.

“place.” In Part I, “The Place of Science,” I ask questions about the social, moral, instrumental, and literary places of agricultural science in the early American Republic. As I noted above, the first chapter deals with the explication of the georgic ethic and what I call georgic science. I there draw on literary, political, and agricultural sources from the eighteenth- and early-nineteenth-century, laying out the chronology up to the era of the nascent rural press in the 1820s. Evidence from the papers of Scottish and English improvers, American political and agricultural leaders, and fertilizing farmers comprise the core of the chapter. I maintain that the georgic ethic best expresses the relationship Americans of the early national period had to their environments when agriculture was central to political economy, cultural identity, and, with the land that gave it foundation, national exceptionalism. What is more, the georgic ethic tightly holds together the material, moral, and cultural dimensions of the American improvement narrative.

In Chapter 2, I use georgic science to explain the dynamics of the “book farming” debate. That controversy was about the value of science for agriculture, as understood through this struggle to assess written works on farming. I interpret the importance of book farming by noting how well its promotion or rejection illustrated the tensions between moral and material dictates of georgic improvement. The idea of place becomes even more diffracted here, because the triumph of book farming by the 1840s was not a matter of accepting *science* wholesale, but an issue of prescribing what *kind* of science could be accepted wholesale. I argue that the science of agriculture became culturally acceptable when it was perceived as fitting within a georgic ethic that emphasized place—for making a georgic science, as I term it. The chapter extends my chronology into the mid-1800s, using the rural press, account books and diaries from farmers, and a range of agricultural treatises as my sources.

Chapter 3, “Dabbling with Davy, Knowing Nature,” looks directly at three agricultural treatises of the 1820s and 1830s to see how agricultural chemistry, specifically that advanced by Humphry Davy, was used as a lens through which to view the land. Set inside the prevailing tensions of vitalist and materialist philosophies of nature, the chemistry espoused by the georgic authors Edmund Ruffin of Virginia, John Lorain of Pennsylvania, and Daniel Adams of New Hampshire gives us a deeper picture of the complexity of organic and mechanistic views of the environment. Where the second chapter elaborated the place of science in the moral fabric of rural America, the third chapter elaborates the place of chemistry in rural, working philosophies of nature.

All of Part I is predicated on exploring how science was interpreted by people. Part II, “The Science of Place,” asks instead how science interpreted the land. I ask in what ways new scientific practices redefined the landscape, working to make tacit and local concepts of land and soil into codified and scientific concepts. The goal of changing the land was implicit in all notions of agricultural improvement, but we still lack an analysis of what the combination of science and improvement meant for how people understood their environment—the land, cultivated or cultivatable.

In this half of the dissertation I restrict my geographical and cultural focus to consider the case of Virginia, a state with a rich historiography but which has nevertheless suffered from relatively little attention to its environmental history.¹⁵ I am interested in how people were using

¹⁵ On this lack of attention to Virginia specifically, see Jack Temple Kirby, “Virginia’s Environmental History: A Prospectus,” *Virginia Magazine of History and Biography* 99 (1990): 449-488. For a review essay on notions of the landscape of the built-environment throughout Virginia’s history, see Dell Upton, “New Views of the Virginia Landscape,” *The Virginia Magazine of History and Biography* 96 (1988): 403-470. For a view of eighteenth century Virginia, see Rhys Isaac, *The Transformation of Virginia 1740-1790* (Chapel Hill, NC: University of North Carolina Press, 1982). For a view of seventeenth century Virginia, see Stephen Adams, *The Best and Worst Country in the World: Perspectives on the Early Virginia Landscape* (Charlottesville, VA: University Press of Virginia, 2001). For other work that either aims directly at or touches on the environmental history of Virginia; Joan Cashin, “Landscape and memory in Antebellum Virginia,” *VMHB* 102 (1994): 477-500. Donald Davis, *Where There Are Mountains: An*

scientific practices to redefine the landscape, or, how they made a science of place. This focus on science thus also elaborates histories of scientific practice and organization in the South, another field, like Virginian environmental history, that has not been fully developed in the existing literature.¹⁶

In Chapter 4, I explore how Virginian improvers were using field-based experimentation to re-envision their lands through the activities of county improvement societies. My questions are straightforward. In promoting fertilizer experimentation, how did those county-based agricultural societies organize their activities to produce a generalized, instead of merely localized, interpretation of their lands? What did individual planters do to introduce quantified

Environmental History of the Southern Appalachians (Athens: University of Georgia Press, 2000), though only touching on Virginia proper, is relevant and revealing, as are Ronald Lewis, *Transforming the Appalachian Countryside: Railroads, Deforestation, and Social Change in West Virginia, 1880-1920* (Chapel Hill: University of North Carolina Press, 1998) and Warren Hofstra, *The Planting of New Virginia: Settlement and Landscape in the Shenandoah Valley* (Baltimore: Johns Hopkins University Press, 2004). On the dearth of southern environmental history in general, see Otis L. Graham, "Again the Backward Region? Environmental History in and of the American South," *Southern Cultures* 6 (2000): 50-72 and Mart Stewart, "Southern Environmental History," in John Boles, ed., *A Companion to the American South* (Malden, MA: Blackwell, 2002), 411-423. Notable exceptions to the claim that the South lacks fully developed environmental histories are Albert Cowdrey, *This Land, This South: An Environmental History* (Lexington: University Press of Kentucky, [1983] 1996); Timothy Silver, *A New Face on the Countryside: Indians, Colonists, and Slaves in South Atlantic Forests, 1500-1800* (New York: Cambridge University Press, 1990); Jack Temple Kirby, *Poquosin: A Study of Rural Landscape and Society* (Chapel Hill: University of North Carolina Press, 1995); Mart A. Stewart, *"What Nature Suffers to Groe": Lift, Labor, and Landscape on the Georgia Coast, 1680-1920* (Athens: University of Georgia Press, 1996); Davis, *Where There Are Mountains*; and Philip Curtin, ed., *Discovering the Chesapeake: The History of an Ecosystem* (Baltimore, MD: Johns Hopkins University Press, 2001). For more on Virginia history and historiography in general, see William Shade, *Democratizing the Old Dominion: Virginia and the Second Party System* (Charlottesville: University Press of Virginia, 1993), David Hackett Fisher and James C. Kelly, *Bound Away: Virginia and the Westward Movement* (Charlottesville: University Press of Virginia, 2000), and, for a more pictorial version, Wayne Rasmussen and Robert Tilton, *Old Virginia: The Pursuit of a Pastoral Ideal* (Charlottesville, VA: Howell Press, 2003).

¹⁶ Unfortunately, secondary sources on southern science are few and usually directed at explaining the South's lack of science. For commentary on this, see Ronald Numbers and Todd Savitt, eds., *Science and Medicine in the South* (Baton Rouge: Louisiana State University, 1989); John Greene, *American Science in the Age of Jefferson* (Ames: Iowa State University Press, 1984); Robert Bruce, *The Launching of Modern American Science, 1846-1876* (New York: Knopf, 1987); and Lester Stephens, *Science, Race, and Religion in The American South: John Bachman and the Charleston Circle of Naturalists, 1815-1895* (Chapel Hill : University of North Carolina Press, 2000). Generally speaking, studies of southern science have suffered from a methodological focus on urban and professional loci, thereby limiting topics like the agricultural society from providing provocative examples. They also tend to use metrics of publication, laboratory usage, and university activity to assess prominence and success. Explaining the absence of science, in fact, has sometimes been a function of simply demonstrating that there was no dominant population center in which such studies could be developed. Yet science for the sake of improvement in Virginia came not from within institutions of learning and science; it came instead from the wealthy planter patrons of improvement.

and systematic studies of their lands? And what labor was actually involved in performing those field-based scientific fertilization experiments? In the antebellum South, any conversation about culture will involve slavery and, indeed, the answer to that last question involves slave labor. I use archival sources from planters and their plantation activities, county society records, and the rural press to find out how people were using science to explore their land.

The last chapter focuses on Virginia's first state geological survey. As with Chapter 3, which made frequent reference to Humphry Davy, here we actually get to hear about a professional scientist, the Professor of Chemistry, Geology, and Mineralogy William Barton Rogers. Rogers was the principle actor in the Virginia Geological Survey that the state assembly funded from 1835 to 1842. I look at the extensive records of that survey and the papers of Rogers himself. I examine how Rogers, his staff, state-wide contributors, and the politicians who funded the survey worked together to produce a new description of the state based on geological and chemical investigation. I ask about the labor involved (as I do in Chapter 4), but also explore more technological issues of correspondence, instrumentation, and reporting.

I structure the two chapters of this second half similarly. I begin at the broad organizational level—county agricultural societies in Chapter 4; the state geological survey in Chapter 5. Then I narrow down to the people involved in those organizations—first the society members, then Rogers himself. Finally, I look to the level where the actual work took place, the level (in chapter 4) of the slaves who dug out marl pits, hauled it to the fields, and spread it in specific quantities on specific plots of land and the labor (in chapter 5) of the field assistants and local sample contributors who trudged across Virginia taking data for Rogers while analyzing soil, fertilizer, water, and rock specimens.

The trend of Part II is to telescope out from local contexts, to indicate a direction from small-scale studies of nature to ever-larger and grander ones. Chapter 4 deals with the geography of the county; Chapter 5 deals with the state. Both cases are set within a georgic improvement ethic put in place years before any of those studies of the land ever began. The efforts of George Washington and Thomas Jefferson did not, of course, cause the surveys to take place. But they did play an important part in producing the conditions that made those later surveys possible. The trend of the entire dissertation is set up in similar fashion. Were I to add another chapter, or another Part, I would look at agricultural experiment stations of the later nineteenth-century and at federal geological and scientific surveys of the same time period. In similar fashion, I would note that the farmers of Virginia did not, of course, directly cause the success of Liebig's theories, but they did produce the conditions of possibility that made the later acceptance of scientific agriculture possible.

My approach here is to offer a complementary narrative, a story that does not take the place of the Davy-to-Liebig transition but accompanies it. Too many historical narratives assume too much about science. In environmental history, where ecology remains the primary scientific reference point, this deference may be even more prominent. My work responds to this deficiency first by making less-studied earth sciences central—chemistry and, to a point, geology—and second by placing the role of the users (the non-scientists) in the starring role. I emphasize the importance of non-scientist contributions to the acceptance of science as a viable mediator and provider of agricultural knowledge.

Dostoevsky's view relies on the conditions of possibility developed in the half century prior to his penning of his words. Steven Stoll summarized it well when he wrote that “[R]eformers of the early Republic... should be considered progenitors of a general regard for

nature that would, in the next century, become a policy of government. They provide good evidence that what ultimately became codified by professional scientists and conservationists had roots in amateur practice.” Rossiter, on the contrary, and writing about the rise of agricultural chemistry, explained the success of agricultural science as a singular publishing event, stating that after a decades-long period of confusion, “Then Liebig’s book appeared in 1840.”¹⁷ But this perspective of Liebigian triumph simply cannot hold up when we develop the context that allowed Liebig’s work to have meaning. His mechanistic mineral theory of fertilization relies in part on the conditions of possibility put in place by practicing agrarians in the fields of rural America, in great measure due to the efforts of amateurs working on their farms and among kinship networks to improve their lands. The research in this dissertation is rooted in sources from the early American Republic, with the sciences of agriculture taking center stage. But, as I conclude at the end, those examples from that time provide a useful and relevant situated case of how science was built into the land, of how people accepted and promoted a localized, but then generalizable, version of scientized nature.

¹⁷ Stoll, *Larding the Lean Earth*, 168; Rossiter, *The Emergence of Agriculture Science*, 19

Part I / The Place of Science

In 1840, the Prussian chemist Justus von Liebig promised that “A time will come when fields will be manured with a solution of glass (silicate of potash), with the ashes of burnt straw, and with the salts of phosphoric acid prepared in chemical manufactories, exactly as at present medicines are given for fever and goiter.”¹ Backing up that promise was a mineral theory of fertilization, as presented in his *Organic Chemistry and its Relations to Agriculture and Physiology* (1840). The view Liebig presented was mechanistic, materialist, and reductionist, the chemist suggesting that nature was just so many pieces of improvable stock. One historical assessment of Liebig shows that his book “came as a thunderbolt out of a clear sky.”² Margaret Rossiter has written that “It was probably one of the most important scientific books ever published and marks the beginning of a ‘scientific revolution’It created order out of the previous thirty years of agricultural chemistry. . . .”³ A more recent analysis by a team of historians of soil science considers the mineral theory the very mark of modernity and Liebig agricultural science’s “most significant scholar.”⁴ Liebig was contributing to notions of soil fertility and, by extension, fertilizing strategies. His theories were aimed at improving the way farmers treated their land. He placed science at the exact center of agrarian nature, estimating that its precision and progressive characteristics would turn agricultural lands into thoroughly scientific places. But he was hardly the first to use chemical ideas to redefine place.

¹ Justus von Liebig, as quoted in William Brock, *Justus Liebig: The Chemical Gatekeeper* (New York: Cambridge University Press, 1997), 145

² A.G. McCall, “The Development of Soil Science,” *Agricultural History* 5 (1931): [n.p.]

³ Margaret Rossiter, *The Emergence of Agricultural Science: Justus Liebig and the Americas, 1840-1880* (New Haven, CT: Yale University Press, 1975), 25

⁴ R.R. van der Ploeg, W. Bohm, and M.B. Kirkham, “History of Soil Science: On the origin of the Theory of Mineral Nutrition of Plants and the Law of the Minimum,” *Soil Science Society of America Journal* 63 (1999): 1055-1062

In America, codified agricultural chemistry had first arrived through the works of Humphry Davy. His *Elements of Agricultural Chemistry* was published in England in 1813, followed by its first American reprint in 1815. It stood as concrete evidence of an increased focus on theories of soil fertility. Davy's was a humus theory, an organic explanation of the complicated action occurring within the soil. His work, set into a vitalist philosophy of organic nature, showed that animal and vegetable matter provided the necessary food for plant growth. Those ideas would lead farmers to increase animal manure usage and vegetable composting, while pursuing a general farming strategy of mixing the two. Farmers were already doing that, for the most part, so Davy's theories were easily received into the rural community. Put simply, as one historian of chemistry said, "Davy's advice was uncontroversial."⁵

The reception of agricultural chemistry in America has thus been explained by connecting the dots between Davy and Liebig. The two chemists—Davy in Britain, and under the auspices of the British Board of Agriculture; Liebig in Giessen, and to the rebuttal of Davy—promoted theories of the complex phenomenon of plant growth. Food sources, planting techniques, issues of solubility, and climatic conditions were each important. But the two men offered a clear contrast: where Davy's humus model suggested that the process of fertility was living and organic, Liebig proposed that fertility was a simple matter of replenishing lost material. Where Davy worked within a Romantic milieu that had him viewing nature as alive and interdependent, Liebig worked from a strong reaction to *naturphilosophie's* Romantic excesses, promoting material reductionism as the way to understand nature's action.⁶ That

⁵ William Brock, *Justus Liebig*, 146. For similar assessments of Davy's work, see David Knight, "Agriculture and Chemistry in Britain around 1800," *Annals of Science* 33 (1976): 187-196; Christabel Orwin and Edith Whetham, *History of British Agriculture, 1846-1914* ((London: Newton Abbot, David and Charles, 1971); and Vance Hall, *A History of the Yorkshire Agricultural Society 1837-1987: In Celebration of the 150th Anniversary of the Society* (London: Chrysalis Books, 1987), 60.

⁶ For Liebig's philosophy of nature and place within nineteenth-century science, see: Brock, *Justus von Liebig*; Martin Kirschke, "Liebig, his University Professor Karl Wilhelm Gottlob Kastner (1783-1857), and his Problematic

contrast is instructive, offering us the clarity of hindsight to see how and where visions of the land prepared the way for scientific agriculture.

Part I of this dissertation complicates this received view of the path from Davy to Liebig. I make the ease of transition from Davy to Liebig more problematic, more tenuous, and less revolutionary than has previously been described. Since my goals are directed at the meaning of science for environmental sensibilities, and not at the view from the scientific side alone, I bring to the fore aspects of the above transition period that have heretofore been concealed. Some of those concealed aspects include the role of local, non-authorized people in the acceptance and use of chemical theory, the multiple meanings of science and chemistry, and the ways rural people interpreted, used, and forwarded chemical insights. My story does not necessarily refute the details of the received view, but focuses on the people whose lives were affected by it in daily practice.

What place did science hold in the rural America of the early national period? Where did it stand culturally, how was it interpreted in daily practice, and in what ways was it being used to mediate farmers' views of their land? My plan in these first three chapters is to look outside the mainstream of professional chemists. I instead develop the context of the early national period within which the science of agriculture developed. Agricultural science had to work with a philosophy of nature in flux in the early American Republic. Nature held a multifaceted role as provider of national sanctity, a site of God-given sustenance, and a source of personal virtue and morality. The contributions of Davy, Liebig, and other natural philosophers had to fit within the prevailing culture of an agrarian American society. In the following chapters, I develop the

Relation with Romantic Natural Philosophy," *Ambix* 50 (2003): 3-24; Uschi Schling-Brodersen, "Liebig's Role in the Establishment of Agricultural Chemistry," *Ambix* 39 (1992): 21-31; Pat Munday, "Liebig's Metamorphosis: From Organic Chemistry to the Chemistry of Agriculture," *Ambix* 38 (1991): 135-154; and Mark Findlay, "The Rehabilitation of an Agricultural Chemist: Justus von Liebig and the Seventh Edition," *Ambix* 38 (1991): 155-167.

context of virtue, vice, and labor (chapters 1 and 2), associate the acceptance of science to this value-based context (chapter 2), and show that while the place of agricultural science was diffuse and polymorphous, it was indeed circulating in conversation and land-based practice (chapters 1, 2, and 3). I use Davy and Liebig mostly as a backdrop against which to set my narrative and not its main touch points. Briefly put, I look at how Liebig's agricultural chemistry was enabled by the dynamic conditions of possibility that were already extant in American farming culture.

Chapter 1

Distinguishing the Georgic

“In a political view, [agriculture] is perhaps the only firm and stable foundation of national greatness. As a profession, it strengthens the mind without enervating the body. In morals, it has been well observed, it leads to increase of virtue, without introducing vice. In religion, it naturally inspires devotion and dependence on Providence.” Henry Home, Lord Kames, 1776

“[Agriculture is a science] morally and politically conducing to the true happiness of man, . . . whence flow health, social order and obedience to lawful authority.” Archibald Cochrane, Earl of Dundonald, 1795

“With reference either to individual or national welfare, Agriculture is of primary importance. . . . [B]y diffusing information, [we could] encourage and assist a spirit of discovery and improvement.” G. Washington, 1796¹

In this chapter, I define and use the georgic ethic, as differentiated from the pastoral, to situate the science of agriculture in the early American Republic. The georgic ethic is based on the practice of agriculture. It is an environmental sensibility that comes from lived experience, connecting humans to land by the virtues of work. The georgic ethic best expresses the relationship people had to their environments in the early American Republic, where agriculture was central to political economy, cultural identity, and, with the land that gave it foundation, national exceptionalism. It takes its direction from the classical expressions of farming virtue given in Virgil’s poem, the *Georgics*. Like his *Eclogues*, where the traditional pastoral or Arcadian ethic was most clearly delineated, Virgil’s *Georgics* was concerned precisely with the occupational, social, and moral role of agriculture in society.² Deriving from this literary fount,

¹ Lord Kames (Henry Home), *The Gentleman Farmer: Being an Attempt to Improve Agriculture by Subjecting it to the Test of Rational Principles* (Edinburgh: W. Creech, 1776), iii; Archibald Cochrane (Earl of Dundonald), *A Treatise Shewing the Intimate Connection that Subsists between Agriculture and Chemistry* (London: for the author, 1795), 3-4; George Washington, “Address to U.S. Congress, 7 Dec 1796,” in *The Diaries of George Washington*, edited by Donald Jackson and Dorothy Twohig (Charlottesville: University Press of Virginia, 1976), March 1797, p. 15, n. 3.

² See Virgil, *Georgics*, edited with a commentary by Roger A.B. Mynors (New York: Oxford University, 1990), for the actual poem and modern commentary about it. Also see Charles Martindale, ed., *The Cambridge Companion to Virgil* (New York: Cambridge University Press, 1997), for the breadth of Virgilian interpretation, and William Batstone, “Virgilian Didaxis: Value and Meaning in the *Georgics*,” in Martindale, ed., *The Cambridge Companion*

the georgic was represented most often in some rhetorical form. In the early American Republic, that form grew from the colonial-era, subscription-based agricultural treatise to the dawn of the rural press in the 1820s.

My goal in the first half of this dissertation is to examine how the science of agriculture gained legitimacy in rural culture, an objective that requires an explication of the georgic ethic. I present that ethic as a dual moral and material discourse, since it concerned the virtue of agriculture as much as its practice. In brief, it offers a shorthand concept for associating the virtues of science with the cause of improvement in the early American Republic. It helps us see the place of science in rural culture. The georgic ethic can provide the basis for that discussion by introducing “place” as a multivalent concept. It refers to the physical, geographical place (location) and the social (value-based) place by binding the two together. Thus, while I devote the present chapter to elaborating how this connection between physical location and social virtue works, the georgic also grounds the discussion of the science of agriculture in Chapters 2 and 3.

Orienting the Pastoral and Georgic

Rather than the georgic, the pastoral ideal has wielded significant influence over studies of nineteenth-century environmental history. The analytical utility of the pastoral is perhaps due to its relevance for a wide range of scholarly approaches. The pastoral ethic helps define a middle-ground along a spectrum from wilderness to civilization, as Roderick Nash expresses it in his *Wilderness and the American Mind*; it stands as the organic, life-affirming antipode to

to *Virgil*, 125-144, for particular attention to the *Georgics* and a concise commentary on modern exegeses of the poem. Cato's *De Agricultura* was also influential in promoting virtues like those of the *Georgics*.

dehumanizing technology, as Leo Marx frames it in his landmark *The Machine in the Garden*; it suggests an ideal of literature that emphasizes, as the ecocritical scholar Lawrence Buell says, “an ethos of rurality or nature or wilderness over against an ethos of metropolitan.” Donald Worster, in *Nature’s Economy*, draws clear distinctions between the Arcadian (as synonymous with Pastoral) and imperial studies of nature. That Arcadian view represents a peaceful relationship to the world within which humans live (as with, for example, Gilbert White and Thoreau), while the imperial school of thought is understood by its goal of controlling and dominating nature (as with, for example, Linnaeus and Bacon).³

As a way to express a sense of contrast in studies of environmental thought, of nature writing, and of technological history, the pastoral offers a clear tool demarcating one view of nature from another—civilization from wilderness, culture from nature, city from country, mechanical from organic. It is born of Virgil’s *Eclogues* and of the aesthetic and emotional response to timeless, gentle, and leisured cultivation. It situates humans as part of the natural world, not outside it; even as they cultivate, herd, and develop their resources, they do so within the constraints of a world greater than themselves. In the 1830s, Thomas Cole, the founder of the Hudson River Valley School of landscape portraiture, portrayed the pastoral as the prelude to civilization in his magisterial sequence *The Course of Empire*. His landscape shows humans gently and almost passively placed within the contours of the mountains, valleys, streams, and fields of his view. People frolic.

³ Roderick Nash, *Wilderness and the American Mind* (New Haven, CT: Yale University Press, [1967] 1982); Leo Marx, *The Machine in the Garden: Technology and the Pastoral Idea in America* (Oxford: Oxford University Press, [1964] 2000); Lawrence Buell, *Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture* (Cambridge, MA: Harvard University Press, 1995), and Donald Worster, *Nature’s Economy: A History of Ecological Ideas* (Cambridge: Cambridge University Press, [1977] 1994)



Figure 1. Thomas Cole (1835) “The Pastoral or Arcadian State,” from his five-portrait series *The Course of Empire*. This portrait followed the first in the series, “The Savage State,” and preceded “The Consummation of Empire,” in the process exemplifying the middle ground of the pastoral between wilderness and civilization. The portrait also indicates the passive, leisurely placement of humans into the landscape—note the philosopher seated to the left, pondering the world around him, and the shepherd in the center, easily tending his flock in the sun.

But Virgil gave us more than the pastoral: he also presented the land as a site of labor. In this georgic world, people work. As one literary scholar put it, the essence of the georgic is “not a Golden Age where apples drop freely from the boughs but a fallen world of hardship and toil where one lives by the sweat of one’s brow.”⁴ The environmental literary critic Timothy Sweet lends further clarity to the definition. He contrasts the georgic to the pastoral, seeing them as two distinct modes of orientation to the land: for the georgic, labor is life; for the pastoral, leisure is

⁴ William Dowling, *Poetry and Ideology in Revolutionary Connecticut* (Athens: University of Georgia Press, 1990), 36.

life.⁵ Human intervention is a central tenet of the georgic ethic, not a problematic relationship to be explained away. The distinction between the two ethics, then, is not that the georgic elides nature/culture or wilderness/civilization differences while the pastoral keeps them separate; nor is it that the one places humans in the landscape while the other keeps us out. In fact, the georgic has often been subsumed within the pastoral, sometimes as a “hard” pastoral, and as such is often conflated with it. The distinction is more a matter of emphasis, with the georgic highlighting the ways humans *interact* with their world and the pastoral highlighting the two sides of that interaction instead of the mediation between them.

That element of interaction introduces moral demands, since it emphasizes relations between different people and between people and their land. Virgil understood this. Rather than defining his work reductively, he combined moral instruction with practical advice in the person of the farmer. In so doing, he enfolded moral and material elements: promoting the occupation of farming was part and parcel to modeling the practice of agriculture as civic virtue. In American historical lore, Thomas Jefferson’s 1787 view that “Those who labor in the earth are the chosen people of God” stands as the early national expression of agriculture’s virtuous identity. Today, perhaps Wendell Berry’s neogeorgic call to return human labor to the core of an environmental ethic stands as the legacy of this lost ethic.⁶

⁵ See Timothy Sweet, *American Georgics: Economy and Environment in Early American Literature* (Philadelphia: University of Pennsylvania Press, 2002)

⁶ For entry points to Berry’s work, see Wendell Berry, *Recollected Essays, 1965-1980* (San Francisco, CA: North Point Press, 1980); idem., *The Unsettling of America: Culture and Agriculture* (San Francisco, CA: Sierra Club Books, [1977] 1996), 3rd edition; and Kimberly Smith, *Wendell Berry and the Agrarian Tradition: A Common Grace* (Kansas : University Press of Kansas, 2003)



Figure 2. Scene of working farmers, from Diderot and D’Alembert’s *L’Encyclopédie*. Unlike strictly pastoral imagery, this plate represents farmers working the land, applying labor to the fields in ways similar to the pastoral ethic—the farmers here also live in a middle ground between uncultivated wilderness and controlled civilization, like the pastoral—but in ways importantly different too—here, they work the landscape, rather than sit in passive contemplation.

The georgic offers a valuable interpretive perspective of how Americans have understood their land, especially in the early decades of the nation’s history. Any discussion of the environmental sensibilities of the early American Republic must not just *make reference* to agriculture, but should be embedded *within* it. Through the georgic, we can study agriculture for its moral connotations as much as its economic materiality. Scholars from a range of disciplines

have found the approach useful, emphasizing the georgic role of work in environmental studies.⁷ This labor-based mode of orientation also meshes well with some recent and innovative environmental historiography. In particular, Richard White's environmental narratives have encouraged attention to the modes of interaction with our surroundings—like labor, or work—as a way to explore more realistically how human concepts and attitudes about nature develop and become entrenched. All people live in nature, but our environmental ethics do not always acknowledge the connections we have with it as active agents. White's work, with *The Organic Machine* as a prime example, draws our attention to twentieth century developments and the issue of industrialized nature.⁸ The georgic underscores a similar point about connection to nature, though in an agricultural era just coming to deal with further separations from working the land that industrialization would bring.

Because my focus is on the early decades of the United States, it is actually the revival of the georgic in the genre of the eighteenth-century agricultural tour that is more relevant here than a faithful reference to the original. The georgic tour, to which I will speak more below, was a literary genre that sought to promote Enlightenment ideals of improvement through observations of farming. The historian Laura Sayre, in her study of Arthur Young, William Marshall, and other prominent eighteenth-century rural British tourists, has observed that the georgic “suggested new ways of reading and writing the rural landscape, establishing an essential

⁷ See Sweet, *American Georgics*; Laura Sayre, “Farming by the Book: British Georgic in Prose and Practice, 1697-1820” (Ph.D. Diss., Princeton University, 2002); Buell, *Environmental Imagination*; John Grammer, *Pastoral and Politics in the Old South* (Baton Rouge, LA: Louisiana State University Press, 1996); Dowling, *Poetry and Ideology in Revolutionary Connecticut*; and Leo Marx, “Pastoralism in America,” in *Ideology and Classic American Literature*, ed. Sacvan Bercovitch and Myra Jehlen (New York: Cambridge University Press, 1986), 36-69.

⁸ Richard White, *The Organic Machine* (New York: Hill and Wang, 1995); see also, White, “Are You an Environmentalist or Do You Work for a Living?,” in William Cronon, ed., *Uncommon Ground: Toward Reinventing Nature* ((New York: W.W. Norton & Co., 1995), 171-185. Additionally, as I alluded to in the Introduction, William Cronon has argued that mixtures of “nature, political economy, and belief” have mostly fallen into three distinct categories and not been approached as integrated, symbiotic interpretive elements. The georgic, with its attention to morality and materiality, lends itself to such a mixture of nature, political economy, and belief. See Cronon, “Modes of Prophecy and Production: Placing Nature in History,” *Journal of American History*, 76 (1990): 1122-1131, on 1123.

connection between the intellectual work of the gentleman and the physical work of the laborer.”⁹ These tourists traveled the countryside taking notes and reporting observations. In the person of the improvement-minded tourist, the georgic was a way to knot together the civic virtue of labor with the demands of agricultural improvement. To paraphrase Scotland’s popular Earl of Dundonald, Archibald Cochrane, in *A Treatise Shewing the Intimate Connection that Subsists between Agriculture and Chemistry*, the georgic tours simultaneously promoted health, wealth, and social order. On the other side of the ocean, agricultural and political leaders of the new American nation, including Washington, Jefferson, and Madison, participated in trans-Atlantic correspondences with the georgic tourists and crafted views of improvement in America that transcended mere material comforts. Although they did not travel as Young and Marshall did, the Americans picked up the ideals of the georgic tour as part of their formulation of culture and economy.

Bringing the Georgic to America

The georgic ethic tied the political economy of agrarianism to the Enlightenment goal of improvement. With it, agrarian promoters were able to forge a bond between agriculture (as a form of cultural and economic life), improvement, and nature. In America specifically, improvement was being pursued as a general value and for a variety of reasons. Americans wanted to maintain and improve the farm, their social system, and economic viability. They wanted to ensure stability, guarantee a supply of food, and assure the success of the democratic experiment.¹⁰

⁹ Sayre, “Farming by the Book,” 8 (of chapter 1).

¹⁰ The goal of improvement was almost always synonymous with progress. However, with a concomitant aim to *maintain* certain systems of social economy and cultural viability not all improvement meant gain or increase. See

From the start, the attempts at material advance through improved agricultural practice were also matters of moral order; the founders' agrarianism treated the virtue of the farmer and the moral basis for the new nation synonymously. This ideal rested on a much broader conception of "the farmer" than the strict occupational one we hold today. As the historian Alan Marcus has noted, in the early nineteenth century "Farming was a state of mind and its practitioners included virtually all Americans regardless of where they lived, how they made a living, or how much wealth they had accrued." Marcus also gives substance to the dual discourse of improvement: "Farmers... extolled the virtues of orderliness and Godliness [and of] working with one's hands." They were the "self-reliant souls upon whom the democratic republic was based."¹¹ The term was broad enough to include a wide range of citizens, though narrow enough to define a specific moral code. Improvement of the farming class, then, was commonly understood as a social, material, and political goal.

In pursuing this multivalent goal, early republic Americans had not yet made clear distinctions between agricultural, commercial, and industrial interests. The three elements were integrated, not autonomous. To be sure, Jeffersonian Republicans believed more firmly in the views of the Physiocrats, a group of French political economists who proposed that the wealth of a nation derived from its agricultural base, than did the competing Federalist policy makers.¹² But even in disagreement with the manufacturing-based views of arch-Federalist Alexander Hamilton, the agrarians were safe in asserting that factories were merely the end product of

Leo Marx, "Does Improved Technology Mean Progress?" *Technology Review* 90 (1987): 32-41. Also see Leo Marx and Bruce Mazlish, eds., *Progress: Fact or Illusion?* (Ann Arbor: University of Michigan Press, 1996).

¹¹ Alan Marcus, "The Wisdom of the Body Politic: The Changing Nature of Publicly Sponsored American Agricultural Research Since the 1830s," *Agricultural History* 62 (1988): 4-26, quotes from p. 7.

¹² The French thinkers Anne-Robert-Jacques Turgot and Francois Quesnay stand as representative Physiocrats. Jefferson's thoughts on Physiocracy come across most clearly in his correspondence with Pierre Samuel DuPont de Nemours, in *The Correspondence of Jefferson and Du Pont de Nemours* (Baltimore, MD: The Johns Hopkins Press, 1931). For more on the Physiocrats, see Elizabeth Fox-Genovese, *The Origins Of Physiocracy: Economic Revolution And Social Order In Eighteenth-Century France* (Ithaca: Cornell University Press, 1976) and Keith Baker, *Condorcet: From Natural Philosophy to Social Mathematics* (Chicago: University of Chicago Press, 1975).

agricultural origins, not an opposing principle. Differences in political economy were differences in prioritizing the three coordinated elements of agriculture, commerce, and industry. Hamilton himself considered industry a way “to improve the State of Agriculture,” arguing that “manufacturing establishments” would promote a “more certain and steady demand for the surplus produce of the soil.”¹³ Because of this common understanding, Americans most often forwarded political economies based on *how* to encourage cultivation rather than *whether or not* to encourage it. Commerce, the third political economic component, was simply the means by which those products could move from agricultural origins to their industrial or manufacturing ends.¹⁴ The farmer was the core of nearly all the policy arguments; agriculture, to be clear, was the basis for promoting growth.

It was in his *Notes on the State of Virginia*, a survey in the 1780s of the vast expanse of Virginia’s territory, that Jefferson called farmers the chosen people of God. His popular framing of the issue set agriculturalists as the “deposit for substantial and genuine virtue.” That Americans “should be employed in its improvement,” Jeffersonian agrarians believed, was thus the highest calling of the citizenry.¹⁵ Washington, even if not as forcefully, expressed a sentiment similarly touting agriculture when he suggested that a national Board of Agriculture would be beneficial for both individual and national welfare. It would “assist a spirit of

¹³ Alexander Hamilton, “Report on Manufacturers [1791],” as reprinted in *Major Problems in the History of American Technology*, Merritt Roe Smith and George Clancey, eds. (New York: Houghton Mifflin, 1998), 111.

¹⁴ To be sure, Federalists proposed a different emphasis on the political economic triumvirate of agriculture, commerce, and manufacturing when they suggested the view, usually understood as the expression of Alexander Hamilton, Tench Coxe, and John Adams, that the manufacturing sector was of greatest importance. But even then, manufacturing was the endpoint of a conversion process from agricultural and natural resources to fabricated ends and not a mode of production that denied the importance of the farm. As John Adams put it in 1816, “The Enthusiasm for Agriculture like Virtue will be its own reward. May it run and be glorified.” As quoted in Rodney Loehr, “Arthur Young and American Agriculture,” *Agricultural History* 43 [1969]: 43-67, on 46

¹⁵ Jefferson’s apparent retraction of this view in the early 1800s, writing in 1816 that “We must now place the manufacturer by the side of the agriculturalist,” was not truly a wholesale reversal. It was, given the new context of the post-War of 1812 era, a call to shift emphases within the agriculture-commerce-manufacturing triumvirate of political economy. As quoted in Smith and Clancey, eds, *Major Problems in the History of American Technology*, 119.

discovery and improvement,” as he argued in the epigraph at the top of this chapter. It is worth noting as well that by tying Jefferson to the georgic ethic, my analysis stands apart from traditional evaluations of Jefferson’s pastoral identity. Leo Marx specifically distinguishes between an agrarian and pastoral identity when he discusses Jefferson’s moral and political concerns. Jefferson, Marx writes, was concerned primarily with “rural virtue” (a sign of the pastoral) and not agrarianism (a mere economic descriptor). Marx’s outlook is valid in the context of his discussion, but it points out the need for a distinction between the georgic and the pastoral as I have drawn it. In the cases I address, a georgic conception can explain better the lack of distinction at the time between virtue and economy, between moral improvement and material progress.¹⁶

No matter the perspective, improvement, land, and economy were intertwined, running through the identity of the farming—the young American—class. The American improvement discourse may have inherited a georgic tradition from Britain, but in the new nation that ethic encompassed moral and material duality far more directly. The strong cultural narratives of unbounded land and the burgeoning ethic of the practical Yankee made the appeal to promoting a georgic attitude especially forceful and clear. It also dovetailed with a set of social values based on the practice of farming, where practice was understood as experience. Thus, the story of how agriculture and the American improvement ethic were brought together will require attention to modes of practice and experience.

¹⁶ See Marx, *The Machine in the Garden*, 125-128. Marx also ends *The Machine in the Garden* with a final chapter, “Two Kingdoms of Force,” in which he poses a contrast in American literature between the natural, organic, life-affirming pastoral and abstract, dehumanizing technology. The georgic is also a useful bridge between those two supposed poles, allowing for the acceptance of technological means (as work) and the life-affirming substance of agricultural virtue (as work). Jeffrey Meikle, “Leo Marx’s *The Machine in the Garden*,” *Technology and Culture* 44 (2003): 147-159 has provided recent commentary on Marx’s influential work that touches on a similar point.

Delimiting a Georgic Science

There is far more to say about the georgic spirit in America, most of which would take me further into literary analyses than I am prepared to go. Instead, I want to focus on the core of the georgic ethic—the dual discourse of moral and material improvement—that was being pursued with “the science of agriculture,” as so many farmers called it. In the early national period, the georgic orientation to the land became associated with both the practical use of science and the variously conceived goal of improvement (moral, material, social, etc.). This left Americans with what I am calling georgic science. Georgic science is that type of science which entails a set of virtues consistent with the celebrated moral order of the early national period, among them hard work, diligence, industriousness, and individual experience. It denotes a form of scientific investigation that begins with praxis-oriented studies of the land. Georgic science, as a tool for ends other than itself, is not abstract or laboratory-based, instead suggesting direct attention to daily activity (though to propose a laboratory/field dichotomy during this era would be inappropriate with respect to the history of science). Georgic science refers not to scientific principles in general, or as definitive of all “science,” but as they address the dual discourse of improvement within an agrarian political economy, bridging agriculture and science with the values of rural virtue. As I will elaborate in the next chapter, debates after the 1820s about “book farming” referring to the social value of science were also entangled in this material and moral discourse. As such, they make reference to earlier constructs of the late Enlightenment and must be understood as an extension of this notion of georgic science.

While American uses of the science of agriculture saw various invocations in the early Republic, rarely were they divorced from the larger georgic goal of moving toward a more virtuous society. A few agricultural texts of the era highlight this point. Samuel Deane’s *The*

New England Farmer, or Georgical Dictionary, a popular compendium of the “ways and methods” of husbandry, was first collected in 1790 and had gone through a third edition by 1822. The encyclopedic work made obvious reference to the georgic tradition not just in title, but through the moral dictates in the text. It also drew in part on the *Georgical Essays*, a set of essays from the 1770s commissioned by Alexander Hunter, a Scottish physician and Fellow of the Royal Society, to “reduce [York’s farmers] thoughts and observations into writing.” (Those *Georgical Essays* had already been well-received in Europe and America, with Baltimore’s *The American Farmer* recommending it to its readers.)¹⁷ Deane was a Congressionalist clergyman from Maine as well as a member of the American Academy of Arts and Sciences. His contributions to improvement thus bridged the clerical and agricultural.¹⁸ He spent years farming and dutifully recording his own experiences and experiments, seeking in the same spirit as Washington to “promote the improvement of agriculture” for the sake of individual and country alike. The *Georgical Dictionary* spanned topics from seed preparation, manuring techniques, and livestock feeding suggestions to questions about artificial fertilizers, crop rotations, and different soil conditions for different crops (clayey, loamy, sandy, etc.). In it, Deane suggested that attempting a systematic approach to all of these elements at once would be unreasonable; the natural economy of the farm was too complex to be reduced to one system. But approaching them piecemeal was not altogether out of place, and Deane encouraged a systematic study of each.

¹⁷ Samuel Deane, *The New England Farmer; or Georgical Dictionary*, 3rd edition (Boston: Wells and Lilly, 1822; reprinted by New York: Arno Press, 1972), 265; Alexander Hunter, *Georgical Essays*, 8 volumes (London, 1770-1774). Hunter (1729-1809), a native of Edinburgh, settled at York where he founded the Agricultural Society of York in 1770, published numerous pieces on medicine and agriculture, and was elected a Fellow of the Royal Society. See the *Dictionary of National Biography*, vol. 10, 283-284. See also Samuel Austin Allibone, *Critical Dictionary of English Literature, and British and American Authors, Living and Deceased, from the Earliest Accounts to the Middle of the Nineteenth Century*. (Philadelphia: J. B. Lippincott & Co., 1859-1871), 922. See also the Reverend Dr. John Walker’s “Georgical Lectures” of 1790 in Withers, “A Neglected Scottish Agriculturist,” and Withers, “Improvement and Enlightenment.” Finally, also confer *American Farmer* (July 2, 1819), 1: 105.

¹⁸ See “Samuel Deane” in the *Dictionary of American Biography*, vol. 4 (New York: Scribner, 1946-58), 172-173.

Significantly, Deane promoted the value of writing and reporting individual experience as a way to work through this tension between ungainly complexity and manageable system, just as Young and Marshall had made attempts to codify the “ways and methods” in the context of their agricultural tours in the decades before. Daniel Adams’s *Agricultural Reader*, a popular school book of the antebellum period, deferred to Dr. Deane’s georgic testimony throughout its pages. Adams, himself a physician and as well as a “farmer” in the classical antebellum sense, forwarded Deane’s work not just for its bald agricultural facts, but for the insistence that through its advice “civilization, with all the social virtues, would, perhaps, be proportionably promoted and increased.”¹⁹ He too encouraged the participation of farmers in a world of improvable land, supporting Deane’s georgic orientation and motivating his readers with the overriding moral cause inherent in agricultural improvement.

More specific to the call for a science of agriculture was the frequent attention to chemistry. Connecting chemistry to agriculture was a fashionable and popular topic of the early nineteenth-century, just as agriculture itself was perceived as socially virtuous.²⁰ John Spurrier, a British transplant who farmed the Brandywine region of Delaware after moving from England, compiled *The Practical Farmer* in 1793 on an agro-chemical basis. He defined chemistry as an art with which the “several properties of soils and manures are discovered.” Natural philosophy was

¹⁹ Daniel Adams, *The Agricultural Reader, Designed for the Use of Schools* (Boston: Richardson and Lord, 1824); quote from Deane, *Georgical Dictionary*, 213. In colonial America, a new husbandry was already being developed with increased attention to mechanical implements. See Jared Eliot, *Essays Upon Field Husbandry in New England, and Other Papers, 1748-1762*, ed. Harry Carman and Rexford Tugwell (New York: Columbia University Press, [1762] 1934); in England, prior to Eliot, see Jethro Tull, *The Horse-hoeing Husbandry; or, An Essay on the Principles of Tillage and Vegetation* (London, 1733).

²⁰ Agricultural improvement in general was popular among men of leisure, wealth, and education. The fashion of agriculture among the gentry – in England and colonial and early Republican America – and the political economy of agrarianism both made common reference to the virtues of agriculture. See John Adams’s view, n. 14, above. Also see Sweet, *American Georgics*, especially his passages on the “Ideologies of Farming,” 97-121 and John Fea, “The Way of Improvement Leads Home: Philip Vickers Fithian’s Rural Enlightenment,” *Journal of American History*, 90 (2003), 462-90, for an analysis within the Republic of Letters about, as the title suggests, improvement and enlightenment in eighteenth-century America. As one historian noted, it was “fashionable to show an interest in agricultural improvement”; it was “a convenient hobby.” Loehr, “Arthur Young and American Agriculture,” 45.

knowledge “founded on reason and experience” that, when used, would “enrich the earth, and...promote vegetation.”²¹ Deane’s work, as another example, carried entries on “Air,” “Experiments,” “Improvement,” “Manure,” and “Marle”—crushed shell deposits useful as calcareous manures—that each considered the arguments of chemistry and “natural philosophy.” Deane encouraged readers to “ascertain the composition of sterile soils” for the sake of improvement, and wrote of the chemists Carl Scheele, Joseph Priestley, and Antoine Lavoisier when detailing for New England’s rural classes “the essential qualities of atmospheric air.” By the 1822 edition of his *Georgical Dictionary*, Deane was deferring to Davy’s *Elements of Agricultural Chemistry* (1813) to explain “general principle[s] in chemistry.”²² In Europe too, of course, amateurs, gentlemen of science, and philosophers alike had been devoted to connecting agriculture and chemistry for the sake of social and individual welfare. Archibald Cochrane’s *A Treatise Shewing the Intimate Connection that Subsists between Agriculture and Chemistry* (1795) appears as just one contribution to the genre. Samuel Parkes, a British chemist, saw his *Chemical Essays* of 1815 often reprinted. In the United States, his fourth essay in particular, “On the Importance of Chemistry as Connected With Agriculture,” was excerpted in agricultural papers for its clear relevance.²³

²¹ John Spurrier, *The Practical Farmer, Being a New and Compendious System of Husbandry, Adapted to the Different Soils and Climates of America. Containing the Mechanical, Chemical, and Philosophical Elements of Agriculture* (Wilmington, DE: Brynberg and Andrews Printers, [1793] 1974), 28 and 56.

²² Deane, *Georgical Dictionary*, quotes from 211 and 260, but also see 1-4, 9, 210-213, 243-244, 250-262, 264-66, 400-403, and 483-485 for other entries confirming the front-page advertisements claim that the compendium suited both the “practical as well as the scientific agriculturalist.”

²³ See Archibald Cochrane, *A Treatise Shewing the Intimate Connection that Subsists between Agriculture and Chemistry* (London, 1795) and Samuel Parkes, “Extract from Parke’s *Chemical Essays*,” *The New England Farmer* 1 (May 29, 1824): 349. For more on Parkes see Frederick Kurzer, “Samuel Parkes—Chemist, Author, Reformer: A Biography,” *Annals of Science* 54 (1997): 431-462. See as well the chemically informed work of Francis Home, *The Principles of Agriculture and Vegetation* (Edinburgh, 1757); Lord Kames (Henry Home), *The Gentleman Farmer, being an Attempt to Improve Agriculture by Subjecting it to the Test of Rational Principles* (Edinburgh, 1776); and A. Fothergill, “On the application of chemistry to agriculture,” *Letters and Papers of the Bath Society* 3 (1791): 54-62. The historian of chemistry Jan Golinski characterized Lord Kames’s view as suggesting that “Improving farmers were natural patriots, because in seeking to raise their own productivity they were simultaneously serving national and civic needs.” Golinski, *Science as Public Culture*, 35. William Cullen, one of

In America, by seeking to align chemistry with farming, rural economists had a precise example of a practical science for practical benefits. Jefferson complained, in fact, that his peers were wasting time with abstractions while the rural foundation of the country languished for want of more practical studies. He suggested the chemistry of cooking and household economies as examples of practical measures, but also applied chemical studies of soil fertility as an arm of his improvement ethos. He also made his point by negation, in one instance chastising chemistry itself as “useless” as compared to “botany, natural history, comparative anatomy, etc” because “for chemistry you must shut yourself up in your laboratory.”²⁴ The very fact of its distance from the field cast it in a negative light. Jefferson’s sense of practical was meant in reference to chemistry’s role as a practice on the farm rather than merely as something beneficial. For him, the location of chemistry determined its value. He would be pleased to laud chemistry, were it based on field conditions.

Like many works of the day, Thomas Ewell’s *Plain Discourses on the Laws or Properties of Matter* (1806)—dedicated to Jefferson, no less—aimed to use chemical principles, no matter how uncodified, to achieve agricultural gains. As with his contemporaries, Ewell saw his work as a discourse on modern chemistry “connected with domestic affairs,” believing that “Agriculture is the most intimately connected with chemistry.”²⁵ In the coming decades, even someone like Eli Davis, a small, otherwise unknown farmer from South Carolina, could write to

the foremost chemists of the Scottish Enlightenment, prepared an unpublished manuscript called “Lectures on the chemical history of vegetables” as early as 1755. See Charles Withers, “William Cullen’s Agricultural Lectures and Writings and the Development of Agricultural Science in Eighteenth-Century Scotland,” *The Agricultural History Review* 37 (1989): 144-156 for further citations to Cullen’s work. Golinski, *Science as Public Culture*, 32-35, also discusses the correspondence between Kames and Cullen.

²⁴ Jefferson to Thomas Jefferson Randolph, 3 January 1809, BB. 307 as quoted in Charles Miller, *Jefferson and Nature: An Interpretation* (Baltimore, MD: Johns Hopkins University Press, 1988), on 45, n. 68.

²⁵ Thomas Ewell, *Plain Discourses on the Laws or Properties of Matter* (New York: Printed by Brisban and Brannan, 1806), 22

the agricultural press about “the importance of chemistry as connected with Agriculture.”²⁶ To be sure, chemistry was not the only science considered useful for the farm, but here it provides an interesting and clear case of the means for georgic improvement. It was, as a practice employed on the land, considered a tool useful for achieving a higher goal.

The above details indicate a certain circulation of chemistry in the farming community. They say little, however, about the specific correlations between science and improvement that hinged on the moral dimensions demanded from the georgic. On that point it is crucial, though almost simplistic, to recognize that for the culture of the late Enlightenment in America, agriculture came first and the goal of improving it second. That is, the baseline for cultural identity was agriculture, while the call for improvement relied on the existence of that pre-existing baseline. Yet this starting point suggests a great deal about how science could be credibly aligned with improvement. It shows that the values used to interpret and judge the merits of improvement practices—georgic science—were based *in the existing culture*, not from the social sphere of a chemical community. On the face of it, that should not be surprising. The dawn of professional chemistry was still decades in the future. Thus, there was no significant American chemistry community and no set of values within such a community that could be promoted outside it. But, to study how the science of agriculture gained legitimacy in rural culture—my primary interest in the first half of his dissertation—it is necessary to begin by noting that science had to fit within an existing social sphere, defined by certain values and virtues that could not be simply imposed from the outside. When I refer to chemistry, then, I have in mind specific moral, social, political, and economic goals which derive from the pre-existing and non-chemical rural culture. Telling the story of how chemistry became perceived as a useful mediator with the land for the bulk of the population—the farming classes—thus requires attention outside the pre-professional

²⁶ *AF* 1 (1819): 68; also see *AF* 1 (1819): 265

community of chemists alone. Finally, then, I mean for the term georgic science to stand as shorthand for discussing the moral and material goals of the American agrarian culture that debated the value of chemistry. As I discuss perceptions of science in the following sections and later chapters, I mean for that discussion to be based on the premises of a georgic science.

Situating “The Science of Agriculture” in the Early American Republic

The diaries of both George Washington and Thomas Jefferson provide interesting touch points for issues of fertilizing, writing, systematic attention to improved agricultural practices, and the confluence of material and moral improvement. Simply put, they offer a gloss on georgic science. Reading them, one gets the sense that the planters were almost more interested in strategies of cultivation than policies of government. (Of course, one also gets the impression that they were more concerned with their financial well-being than the success of their political experiment.) As founders of the new nation, both men had a clear interest in promoting virtuous behavior and moral righteousness with the economic, that is, agricultural, tenets of the new government.

To do this, Washington long sought to improve his Virginia property by experimenting with crop rotation systems, crop variety, and fertilizers. By materially improving his own lot, and doing so with experiments, he would also stand as an example of the virtuous American. Demonstrating the value and practicality of experiments was an important element of his broader success and it defined Washington georgically. Those “experiments” were in fact widespread, extending to the use of “animal dung, marl, green crops plowed under, and in at least one instance mud from the Potomac River bottom.”²⁷ He corresponded frequently with Arthur

²⁷ "Introduction" to *The Diaries of George Washington*, xxxi.

Young—“the climax of the late eighteenth-century improvers,” as one agricultural historian has noted—considering him the foremost British agricultural improver even before Young became the first Secretary of the new British Board of Agriculture in the 1790s.²⁸ With Young, Washington discussed the techniques and merits of manuring, exchanged plant seeds, and compared test plots of crops throughout the late 1780s. Jefferson was also in touch with the British improvers, trading seeds and ideas with John Sinclair, President of the British Board of Agriculture, on numerous occasions. He introduced crop varieties from afar to aid the cause of local improvement.²⁹

In the late eighteenth-century, the georgic tourists took part in British improvements integrated within the broader culture of the Enlightenment. It was hardly by chance that Arthur Young was Secretary of the Board of Agriculture after his years of tourism, since the one followed logically from the other. The ideals of progress captured in high Enlightenment rhetoric took specific form in Britain’s political economy with agricultural developments, even

²⁸ George Washington, *Letters from His Excellency George Washington, to Arthur Young...and Sir John Sinclair... Containing an Account of His Husbandry, with His Opinions on Various Questions in Agriculture; and Many Particulars of the Rural Economy of the United States* (Alexandria: Cottom and Stewart, 1803). The quote is from G.E. Fussell, “Science and Practice in Eighteenth-Century British Agriculture,” *Agricultural History* 43 (1969): 7-18, on 15. Also see Rodney Loehr, “Arthur Young and American Agriculture.” Young had come to prominence by writing about agricultural practices in his popular *Tours*. In the 1780s, Young founded the periodical *Annals of Agriculture*, which he edited through 1808. In the early 1790s, he was appointed the Secretary of the new British Board of Agriculture and, with John Sinclair (President of the Board), was one of the most known agricultural writers in England. Individuals as wide-ranging as King George III and Jeremy Bentham published in the *Annals of Agriculture*. See Arthur Young, *A Six Months Tour through the North of England, Containing, an Account of the Present State of Agriculture, Manufactures and Population, in Several Counties of this Kingdom* (London: Printed for W. Strahan, 1771), 4 volumes; and idem., *Travels During the Years 1787, 1788, & 1789* (London, W. Richardson, 1794). For a recent reconsideration of Young’s influence, see Liam Brunt, “Rehabilitating Arthur Young,” *Economic History Review* 56(2003): 265.

²⁹ See Washington’s diary entries of 21 April 1787, 25 October 1787, 15 March 1788, 18 March 1788, 4 December 1788, for his commentary on fertilizing and correspondence with Arthur Young.; also, letters from John Sinclair to George Washington, 29 March 1797, 15 July 1797, and 6 June 1798, and from Washington to Sinclair on 6 November 1797 and 28 November 1797. All correspondence in *The Diaries of George Washington*, edited by Donald Jackson (Charlottesville: University Press of Virginia, 1976-), six volumes. For Jefferson, see Edwin Morris Betts, ed., *Thomas Jefferson’s Garden Book, 1766-1824* (Philadelphia, The American Philosophical Society, 1944) and idem., *Thomas Jefferson’s Farm Book* (Charlottesville: University Press of Virginia, 1976). For more on the relation between agricultural improvement and fear of westward migration, see Steven Stoll, *Larding the Lean Earth: Soil and Society in Nineteenth-Century America* (New York: Hill and Wang, 2002).

though examples of industrialization more often command attention in that regard. The tourists contributed to the Enlightenment milieu—one thinks of the systematic knowledge-collecting endeavor of Diderot and D'Alembert's *L'Encyclopédie*—by reporting the best practices from across the countryside, intending along the way to provide a common stock of farming knowledge. They took local practices and distributed them in literary form to the far reaches of the nation, in the process introducing a semblance of order and system to agricultural practice. Certainly the readership for those Tours was limited, perpetuating the gentlemanly nature of the pursuit in its very format. But this early foray into systematic investigation was one specific means by which “improvement,” in its many connotations, could be achieved. It suggested an understanding of the science of agriculture that was synonymous with systematization.

The intersection of agriculture, improvement, and georgic values was most evident in Scotland. There, the academic culture at Edinburgh, in fostering the Scottish Enlightenment, promoted in particular the medical and chemical studies that made possible studies of agriculture and chemistry. Prominent philosophers, chemists, and patrons like James Hutton, William Cullen, Henry Home (Lord Kames), and the Reverend Dr. John Walker took part in sustained studies of agriculture, further forcing the integration of chemical pursuits with Enlightenment ideals.³⁰ In the end, the Scots and the British Georgics may not have all gotten their boots as muddy as farmers—in fact Marshall would criticize Young for his view from the carriage, rather than the understanding he could gain from putting his hands in the dirt, so to speak—but their

³⁰ Golinski, *Science as Public Culture*, 11-49 elaborates the context of those studies. For more on the association of georgic values with agricultural chemistry, see the series of articles by Charles Withers about the Scottish Enlightenment: Withers, “A Neglected Scottish Agriculturist: the ‘Georgical Lectures’ and Agricultural Writings of the Rev Dr John Walker (1731-1803),” *The Agricultural History Review*, 33 (1985): 132-143; idem., “Improvement and Enlightenment: Agriculture and Natural History in the Work of the Rev. Dr. John Walker (1731-1803),” in Peter Jones, ed., *Philosophy and Science in the Enlightenment* (Edinburgh, 1989), 102-116, and idem., “On Georgics and Geology: James Hutton’s ‘Elements of Agriculture’ and Agricultural Science in Eighteenth-Century Scotland,” *The Agricultural History Review* 42 (1994): 38-48. An earlier piece by Fussell, “Science and Practice in Eighteenth-Century British Agriculture,” draws out the British setting of science and improvement.

goals kept the ideational and material interconnected. In sum, agricultural tourists and commentators like Young and Marshall sought to bring together the labor of both farming and writing with their literary strategy by explicit reference to the *Georgics*.

In America, and as correspondents with their European contemporaries, both Washington and Jefferson fit the model of the improvement-minded planter for many more reasons than I can address here. Viewing Jefferson as the Enlightenment paragon, for example, goes some way in helping us see the connection between his practices and his philosophy. Although the two gentleman farmers differed in ideology, age, and agricultural success, they shared an interest in new fertilizing strategies and in participating in both foreign and domestic correspondence networks.

State side, both men were devoted followers of Judge Richard Peters and his experiments with Plaster of Paris (gypsum) near Philadelphia. Jefferson was a frequent correspondent with Peters who, as the second president of the influential Philadelphia Society for the Promotion of Agriculture (hereafter, PSPA), had written *Agricultural Enquiries on Plaister of Paris* in 1797. The PSPA had been founded in the 1780s by wealthy Philadelphians in a spirit quite similar to the georgic writers of Britain. The members sought to advance agricultural practice by collecting reports of experience and offering public addresses. Peters fit precisely in the middle of the organization with his experiments and reports. In 1816, Jefferson wrote to him that “plaister [sic]...is become a principal article of our improvement, no soil profiting more from it than that of the country around this place.”³¹ According to Washington, with whom Peters was

³¹ GW Diary, March 1797, 14; Thomas Jefferson, March 16, 1816, in *Thomas Jefferson's Garden Book*, 199. As a commentary on a lack of political sectional specificity in the late eighteenth-century, I should note that these experiments were not relegated only to the South and mid-Atlantic either – for example, Robert Livingston presented the results of his experiments in the 1790s with “calcareous and gypseous earths” and then “gypsum and lime” to the Society of the Promotion of Agriculture, Arts, and Manufactures of New York, of which he was President, and in their Proceedings. See *Transactions of the Society for the Promotion of Agriculture, Arts, and*

also close friends, the *Agricultural Enquiries* treated “more extensively on Gypsum as a manure than any I have seen before.”³²

Peters was not alone with his promotion of plaster, nor were his prescriptions for applying fertilizers based on scientific principles unique. Jefferson found similar advice in the work of a northern Virginia farmer, his neighbor John Binns, who wrote a *Treatise on Practical Farming* in 1803.³³ Binns reported on nineteen years of field experiments to suggest that the plaster acted as a manure and that his honed techniques of applying the manure promoted better wheat growth. John Spurrier, the author of *The Practical Farmer* referenced above, presented twenty-two pages of discussion on varieties of fertilizing manure. His treatise, in fact, was notable for its omission of plaster, though he emphasized the value of a range of other lime and shell-based manures. Washington bought ten copies of the treatise; Jefferson, five.³⁴ Spurrier’s aspirations, much like Peters and Binns’s, were to offer a compendium of the “mechanical, chemical, and philosophical elements of agriculture.” Like his contemporaries, he dedicated the treatise to Jefferson by promising to “promote and increase upon the most rational principles, the

Manufactures of New York (1801) on 34-56 and 330-334. Like Washington, Livingston also corresponded with Arthur Young. See the reprint of his letter in the *Transactions* (1801), 163-167.

³² GW to John Sinclair, 6 March 1797, and Richard Peters to GW, 12 May 1796, in *The Papers of George Washington, Retirement Series*, edited by Dorothy Twohig (Charlottesville: University Press of Virginia, 1998), Vol. 1, Retirement Series. Also, see Richard Wines *Fertilizer in America: From Waste Recycling to Resource Exploitation* (Philadelphia: Temple University Press, 1985), 15. The American-British nexus ran straight through Peters and the PSPA, as when Washington personally delivered a gift from Arthur Young of Young’s six-volume *Annals of Agriculture* to the Society. See Simon Baatz, “Venerate the Plough”: *A History of the Philadelphia Society for the Promotion of Agriculture, 1785-1985* (Philadelphia: PSPA, 1985), 119.

³³ Jefferson, in fact, was so enamored with Binns’s work that he sent John Sinclair copies in England. Sinclair wrote back to say the plaster did not work there: he conjectured from that failure that it works by “attracting moisture from the atmosphere,” which was already plentiful in England. Letter to TJ from JS, 1 January 1804, in *Thomas Jefferson’s Farm Book*, 197. Under his influence, and with Binns’s local experience recommending it, Jefferson literally bought tons of plaster over the years from dealers in Baltimore, continuing to encourage his friends in the practice for years.

³⁴ See Spurrier, *The Practical Farmer*, v and x.

real strength and wealth of the commonwealth.”³⁵ It was yet another summary statement of a georgic ethic, binding political improvement with principles of rationality on the farm.

These letters on farming were a rural and local subset of the broader Republic of Letters.³⁶ Participation in correspondence networks, seed trading, and economic planning across the Atlantic world was an effort to encourage attention to method and process in farming practice. The practical emphasis in this literature was indeed on *process*. Better methods would lead to better practices, better yields, and an improved agronomy. Washington and Jefferson provided a crucial rhetorical connection between eighteenth-century European improvers and nineteenth-century American farmers with their georgically oriented practices. They encouraged and read these works, promoting new fertilizing strategies and reports of experiments on their own land because of it.

As Laura Sayre notes, the georgic writers approached that labor-agriculture-writing junction “by stressing the time and effort of authorial production, by basing the authority to write about farming on a résumé of farming experience, and above all by insisting that the experience of farming could only be fully realized through habits of writing and reading.”³⁷ The strong deference to authority, experience, and writing was common among the georgic agriculturists, in fact almost definitive of them, establishing a union that would later pervade the antebellum agricultural press (as I discuss in Chapter 2). Despite a confusing assemblage of interpretive

³⁵ Spurrier, *The Practical Farmer*, iii-iv; Thomas Ewell’s *Plain Discourses on the Laws or Properties of Matter* was likewise dedicated to Jefferson. Like his contemporaries, Ewell saw his work as a discourse on modern chemistry “connected with domestic affairs,” believing that “Agriculture is the most intimately connected with chemistry” (22).

³⁶ For background, see Dena Goodman, *The Republic of Letters: A Cultural History of the French Enlightenment* (Ithaca, NY: Cornell University Press, 1994); Robert Ferguson, *The American Enlightenment, 1750-1820* (Cambridge, MA: Harvard University Press, 1997); Gilman M. Ostrander, *Republic of Letters: The American Intellectual Community, 1776-1865* (Madison, WI: Madison House, 1999), in particular chapter 1; and Lorraine Daston, “The Ideal and Reality of the Republic of Letters in the Enlightenment,” *Science in Context* 4 (1991): 367-386.

³⁷ Sayre, “Farming by the Book,” 8 (of Chapter 1).

elements—farming, writing, morality, improving—lived experience stood as the common factor binding them together and foregrounding the moral component of the rhetoric. When Jefferson and Washington contributed to the goal of improvement through experiments and fertilization—as written in tours, treatises, and letters—they were following through in practice with the connection of agriculture to the success of an agrarian and republican social system.

The georgic science of early Republic authors “presented opportunities for political, economic, social, moral, and aesthetic judgments” as based on an active philosophy of praxis—doing was knowing.³⁸ Thus, discussing literary expressions of farming practice fell within a broader framework of establishing and enforcing value systems, that is, of how people should live and work in their communities. Aesthetic and economic values, such as comprehending the bounty of nature for its beauty and as a resource, mattered for how early Americans and their British correspondents perceived the world around them. Most tellingly, and in summary, the ostensible goal of addressing farming practice—for example, to improve crop production and promote fertilization—was enmeshed in far deeper commentary about structuring social life, political economy, and perceptions of nature.



The early national literature on scientific agriculture was often the product of civic societies that had been established to promote local values and agricultural virtue. Those organizations, like the Philadelphia Society for the Promotion of Agriculture (PSPA) and, in Virginia, the Agricultural Society of Virginia (also referred to as Society of Virginia for Promoting Agriculture; hereafter the ASV), were gentlemanly groups formed to sponsor calls for progress. They were the agents of agricultural improvement in America and, by again tying

³⁸ Sayre, “Farming by the Book,” 10 (of chapter 6). See also L. Marx, *The Machine in the Garden*.

together moral and material improvement, they were georgically defined. The individual members of those societies and those member's practices—and not just the historically dominant figures of Washington and Jefferson, to whom I pointed as recognizable examples—were of course instrumental in forwarding local policies. Witness Judge Peters's platform at the PSPA. From there, he was able to use the *Memoirs of the PSPA* as an outlet for publishing reports of experiments and comments on prevailing theories of agricultural improvement.³⁹ As another example, Daniel Adams, the author of *The Agricultural Reader* mentioned above, was also once the President of the Hillsborough [New Hampshire] Agricultural Society. From that podium, he spoke at length about the civic virtues of “scientific agriculture” to his constituency, explaining that to become a “practical, scientific agriculturalist...it will be necessary [that the farmer] should have some acquaintance with the principles of natural philosophy, and especially of *agricultural chemistry*.”⁴⁰ In fact, the full role of those organizations as outlets for the advancement of scientifically based improvement is a key subject, but beyond my aims in this chapter.⁴¹ (I will return to them more fully in Chapter 4.) Of interest here is their position as a bridge from eighteenth-century studies in the “sciences” of agriculture to nineteenth-century outlets for promoting written work on science and farming through the rural press.

John Taylor is an excellent transition figure in this regard. He fits the profile of the georgic American. As a US Senator representing Virginia and a veteran of the Revolutionary

³⁹ The relation between agricultural literature and civic organizations was also tied through the later rural press. For example, Baltimore's *American Farmer* had the Agricultural Society of Virginia's members subscribe. The Albany *Cultivator*, founded in 1834, was the mouthpiece of the New York Agricultural Society. I discuss these linkages more closely in Chapters 2 and 4.

⁴⁰ Daniel Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” delivered as president of the Society, reprinted in *The New England Farmer* 4 (no. 19) (2 December 1825): 148-150

⁴¹ See Simon Baatz, “Venerate the Plough,” for a treatment specifically of the Philadelphia Society for the Promotion of Agriculture and its publishing ties; for general background, see Gray, *History of Agriculture in the Southern United States to 1860*, vol. 2, 779-810; Demaree, *The American Agricultural Press, 1819-1860*; and Gates, *The Farmer's Age*.

War's Battle of Yorktown, he was a prominent statesman. He was also a wealthy, slave-owning, interested, and active planter, contributing to local farming issues by authoring agricultural treatises and leading the ASV.⁴² Interested, as he said, in “fitting ideas to substances, and substances to ideas,” he exemplified the dual moral and material discourse on agriculture in his 1813 collection, *Arator*.⁴³

Taylor, who wrote *Arator* in response to the English tourist William Strickland's (1801) *Observations on the Agriculture of the United States*, accepted Strickland's main point that American farming exhausted soil. The problem of soil exhaustion so well canvassed in agricultural history fits into my georgic story because it provided the specific object—soil—to be improved.⁴⁴ It also forced attention to the material problem with farming, which was the *quality* of that soil, the means for assessing that quality, and the proposals for amending it. In *Arator*, Taylor set out to address these facets of the exhaustion problem. His solution, in brief, was to establish a program of improvement and rational agriculture that drew on philosophical principles and direct experience. Despite various interpretations of character, historians have agreed that Taylor's contributions were intended to improve soil fertility, and thus agriculture, with appeals to a moral constitution fostered by rationality and systematization. In essence, he was an early American Republic georgic writer.⁴⁵

⁴² Robert Shalhope, *John Taylor of Caroline: Pastoral Republican* (Columbia: University of South Carolina Press, 1980). Shalhope is representative of Taylor scholarship in the sense that he presents him as a Pastoral figure. As should be clear by my discussion, I treat Taylor's legacy as georgic, which, given the prevailing overlap between ideas of the georgic and pastoral discussed above (and in note 45, below), is still consistent with the larger body of Taylor exegesis.

⁴³ John Taylor, *Arator: Being a Series of Agricultural Essays, Practical and Political, in Sixty-Four Numbers* (Indianapolis, IN: Liberty Fund, [1813] 1977), 313.

⁴⁴ The classic work on the subject is Avery Craven, *Soil Exhaustion as a Factor in the Agricultural History of Virginia and Maryland, 1606-1860* (Urbana, IL: University of Illinois Press, 1926). Jack Temple Kirby, ed., *Nature's Management: Writings on Landscape and Reform, 1822-1859* (Athens: University of Georgia Press, 2000), xiii-xxv, provides concise commentary on the literature on soil exhaustion, and Donald Worster, ed., *The Ends of the Earth: Perspectives on Modern Environmental History* (Cambridge: Cambridge University Press, 1988).

⁴⁵ As Kirby has noted, after the agrarian crisis of the 1790s, Taylor “linked his agrarian politics with agricultural reform” (*Poquosin: A Study of Rural Landscape* [Chapel Hill: University of North Carolina Press, 1995], 67);

Arator was widely read and favorably received. Taylor's essays indeed bore testimony to moral and social order as much, if not more than, agricultural order. As the historian John Grammer has written, they provided "not just an image of virtue but also a description of the daily practical labor by which virtue, in the real world, must be maintained."⁴⁶ A Jeffersonian Republican, Taylor closely followed the ideal that God preferred farmers, claiming thirty years after Jefferson's similar line that those who opposed agriculture dangerously preferred "a system which sheds happiness, plenty and virtue...fosters vice, breeds want, and begets misery" (316).

Inasmuch as *Arator* was a collection of farming advice, it was so only in relation to the commentary it offered on the moral structure of labor. The eleven essays on the "Political State of Agriculture," as well as essays on "Labour," rights, economy, and militia, were thus not peculiar for their inclusion in a collection on agricultural improvement, but definitive of it. As a "reason for uniting agriculture and politics," Taylor characterized "agriculture as the guardian of liberty, as well as the mother of wealth."⁴⁷ As another *Arator* scholar has written, Taylor's writings involved "a prescriptive wisdom, based on experience, and embodie[d] a practice of good manners toward the gods," a feat accomplished by associating "virtue and the proper order of human life with the disciplines of the farmer and the stockman."⁴⁸ Hard work and diligence, Taylor repeated, were the foundation of agriculture and the guarantor of its virtuous calling.

Steven Stoll, *Larding the Lean Earth*, 71, writes that Taylor "wrote a hard pastoral, insisting on agriculture as moral instruction, not Arcadian escape"; see also Grammer, *Pastoral and Politics in the Old South*, 33-35 and M.E. Bradford, "A Virginia Cato: John Taylor of Caroline and the Agrarian Republic," Introduction to Taylor (1813) *Arator: Being a Series of Agricultural Essays, Practical and Political, in Sixty-Four Numbers* (Indianapolis, IN: Liberty Fund, 1977), 36-37. Initially published anonymously, Taylor signed the updated version of 1814. Four more editions were printed, concluding with Edmund Ruffin's 1840 reprint in *The Farmer's Register*, before again being published (as the seventh edition) as a historical text in 1977. For the agrarian crisis of the 1790s see Charles Sellers, *The Market Revolution: Jacksonian America, 1815-1846* (New York: Oxford University Press, 1991), 17-18 and the notes therein.

⁴⁶ Grammer, *Pastoral and Politics in the Old South*, 42

⁴⁷ Taylor, *Arator*, 53

⁴⁸ M.E. Bradford, "Introduction to *Arator*," 37. John Grammer, *Pastoral and Politics in the Old South*, gives much the same assessment of Taylor's work, summarizing *Arator* as providing "not just an image of virtue but also a description of the daily practical labor by which virtue, in the real world, must be maintained" (42).

When he promoted fertilizer experiments for agriculture—the “queen,” he said, of the circle of art and science—he associated the same virtues with those agricultural pursuits. Experiments too had to be diligent and borne of hard work. In this way the science of agriculture could be an arm of improvement and not simply a shortcut to easy answers.

The georgic ethic that understood labor as life was both implicit and explicit in Taylor’s *Arator*. Both science and farming were to be pursued with thorough and attentive rigor; both were meant to help each other define and promote improvement in society and improvement in the fields. With its 1813 publication, the book stood at a crossroads in American agriculture between earlier—and more individually guided—Washingtonian and Jeffersonian efforts at improvement and later regional and communal efforts.

1813 was a good year for agricultural texts, as the first edition of Humphry Davy’s *Elements of Agricultural History* was also published. Like *Arator*, Davy’s book was a collection of past experience, a compendium of thoughts, experiences, and experiments on agricultural production and soil fertility.⁴⁹ But Davy’s work was born of a different social atmosphere, not just because it was British but because Davy’s hands-on experiments were not actually those of a working farmer. This small point will take on more salience in the next chapter, but it is worth noting here that, from the perspective of most Americans, the differences between Davy and Taylor were less that the former was a chemist and the latter was not, but that the latter had farming experience while the former did not.

Taylor’s experiences through the 1810s kept him on his Virginia farm and brought him new notoriety as a successful improver.⁵⁰ As that recognized improver, he soon shifted from his

⁴⁹ This is not to say Taylor and Davy were writing the same thing, in the same style, and with the same skill; just that, understandably, both were the end result of years of reflection on agricultural attention.

⁵⁰ With *Arator* behind him, he then began to turn his attention to the future, participating in the nascent agricultural societies of his home state by addressing the ever-increasing demands for local improvement. Given his

position as an individual author of distinction to a more participatory regional leader. As part of this shift, he also carried forth more forcefully the dual discourse of moral and material improvement. In 1817, he became the first President of the ASV, a title, he claimed, that was preferable to the United States Presidency. When he spoke to other planters and farmers of the Virginia countryside as a respected social and political figure and as the ASV's President, he brought with him the views of writing, working, and agrarian virtue that had already been developed with *Arator* and the earlier tour literature.

Consistent with his focus on the morally purifying virtues of labor and work, Taylor continued to plead against the vices of idleness, habit, and prejudice. With respect to science, he argued that improvement would come about with the successful scientific methods, namely, circulated reports of experience. In this, he associated science not with standards of an admittedly unassembled scientific community, but as a tool geared towards the virtuous and economic profits of agriculture. Thus, he encouraged farmers to circulate reports of experience, since that *experience* of farming bound virtue and material improvement together and countered perceptions of “error, rudeness, and vice.”⁵¹ In an address in late 1818, he again championed improvement-minded farmers who, rather than falling “under the banner of vice,” exemplified the “execution of a strong, virtuous, and patriotic mind.” The Vice-President of the ASV, Wilson Cary Nicholas, seconded the plea for a social dynamic of “health, happiness and virtue”

disagreement with the land-grabbing justification for the War of 1812, he was further attentive to the needs for local improvement as a way to conserve social stability in the East, rather than promote emigration to the fertile west.

⁵¹ John Taylor, “President’s Address to Agricultural Society of Virginia,” *Proceedings of the Agricultural Society of Virginia* (June 8, 1818), 28-33, on 28. He further noted that “The chief obstacle to the success of [agriculture] in Virginia, in my view, is the morbid aversion to writing on that subject for publication.” To be sure, and as I think should be clear by my connection of the British tourists to American improvers, Taylor’s approach was hardly new. As Sweet, *American Georgics* notes, as early as 1758 a writer using the pseudonym “Agricola” recommended “a course of improvement that agrarian writers would soon develop in greater detail....He proposed that farmers form agricultural societies ‘to converse about every method of improving the lands’ and ‘to make new experiments,’ which might be reported in periodicals such as the *American Magazine*” (100). This plea was repeated nearly each time a new civic organization formed to improve the common lot of its members. The greater social prominence and local authority of Taylor and the early national context of his address, in particular, give his similarly styled ideas a stronger and as such different legacy.

based on the positive values of strength, patriotism, and labor. Be it physical or mental labor, each was defined in opposition to idleness.⁵²

What matters here, finally, is that moral and political economy were co-produced and that the use of a scientific approach to social goals was common to both aspects of that production.

While there was a distinct lack of clarity with references to “science”—sometimes meant as a method, sometimes as a category, sometimes as an ideal of study—the consistent association of labor-based virtues with the perceived value of experiment and observation was clear. We find, then, that a georgic science was one that enabled moral and material improvement through the practice and experience of farmers. Altogether, the term helps us recognize the importance of place (location) in the construction of the authority of science, because these georgic virtues relied upon a direct connection to the land.

Utilizing a georgic science would necessarily mean providing new forms of interaction, and thus understanding, between Americans and their natural environment. The term also provides us with the context in which the rural press developed in the 1820s and within which arguments for and against the value of science for agricultural improvement gained meaning. In the next chapter, I use the georgic foundation to explore the rural circulation of science in the early nineteenth century. The nexus of farming, improving, and writing that took shape into the third and fourth decades of that century was bound up in the concurrent rise of regional agricultural societies and the rural press. With respect to the science of agriculture, one issue, “book farming,” dominated both of those forums. “Book farming” referred to a longstanding tension

⁵² John Taylor, “The Necessities, Competency and Profit of Agriculture,” *Proceedings of the Agricultural Society of Virginia* (October 19, 1818), 79-87; and W.C. Nicholas, “Address to the Agricultural Society of Virginia,” *Proceedings of the Agricultural Society of Virginia* (March 10, 1818), 25-28. Nicholas’s address announced that the value of the agricultural society was as a source for local knowledge, while providing the credibility (through organization) that locality did not have. It was the same tension between universal and local that was forever confounding agricultural pursuits and confusing the pure relation of moral rectitude – always the same, unvarying across regions – with an agricultural political economy – always subservient to local conditions, yet searching for universal appeal in principle.

between those favoring codified, written works on agriculture and those encouraging the knowledge gained by everyday working experience. It was the agricultural instantiation of the philosophical dilemma between arm-chair speculation and real-world experience, embedded in the virtues of lived experience while tied to possibilities of improvement found in written treatises on systematic farming. The georgic ethic stood across that divide. Taylor's *Arator*, for example, taught that truth inheres in "books but also in experience."⁵³ For the science of agriculture and agricultural chemistry to achieve credibility in farming communities, they had to be understood as Taylor suggested, that is, georgically.

⁵³ Grammer, *Pastoral and Politics in the Old South*, 41

Chapter 2

“The Science of Agriculture and Book Farming”: Homespun Virtue, Dandy Vice, and the Credibility of “Chimical Men” in Rural America

“Our *first* wish is to communicate the *experience* of the sun-browned practical Farmer, in preference to the fine spun lubrications of the Philosopher.” John Skinner, *The American Farmer*, 1822

“Who are to be believed in this discussion, either the observing, practical farmers, who have ocular demonstrations of their own experiments, or chimical [sic] men, who know more about eating wheat than growing it?” Gideon Ramsdell, *Genesee Farmer*, 1832

“That many of these theories, concocted by the philosopher in his closet, are destined to fall before the superior knowledge of the *practical* farmer, we do not doubt. The philosopher must exchange his laboratory for the open field.” [Anon.] *The Southern Planter*, 1842

“Book farming! Away with your book farming. I want no books to teach me how to raise wheat, corn, and potatoes...” [Anon.] *Northwestern Farmer*, 1856

Chapter 1 developed the notion of georgic science. There, I first distinguished the georgic ethic from the pastoral to emphasize how the labor of agriculture was simultaneously a moral, material, and environmental cause. Then I conceptualized a georgic science to show how scientific practices in rural settings were being developed as part of a wider improvement context, a context that was irreducibly moral and material. In this chapter, georgic science will help us better understand debates about book farming, namely, how those debates illustrate the means by which science became a credible practice in the early nineteenth-century.

In the early American Republic, book farming—the practice of guiding field management by reference to written works on agriculture—was either a problem or a solution.¹ The dispute

¹ The secondary literature on book farming is vast, although almost unanimously none of those scholarly works address the social dimension of science, instead taking it as given that science was a force on the horizon, inevitably to be accepted and utilized. To begin with, see Albert Demaree, *The American Agricultural Press, 1819-1860* (New

between those two positions turned on the perceived role of science for improvement. For those who favored it, book farming represented the pinnacle of modern thought and the very underpinning of improvement. The best practices and most detailed studies could be published and distributed for all farmers, equally and at the same time, to see. As well, sharing knowledge with one's neighbors was an important sort of communication, simultaneously fostering community and bettering each individual's land. By codifying practice and theory in text, book farming advocates thought they could negate certain harmful features of the agricultural community, offering a break from dogma, tradition, and the resistance born of ignorance. One anonymous writer, representative of the advocate spirit, wrote that "The *mere* clodhopper, the contemner [despiser] of 'book-larnin' tells his ill-fated progeny to...put their trust in their mules and their oxen, and for the rest to watch the changes of the moon, and the shifting of the winds...as more important than all the philosophy that ever was promulgated..." Another considered the resistance of dirt farmers, who "will neither take an agricultural paper, read it when given them, nor believe its contents if by chance they hear it read," a position of mere stubbornness.²

For those who opposed book farming, however, it was just another quick, easy, and ill-considered solution to the problems of land management. A rural press contributor using the

York: Columbia University Press, Columbia University Studies in the History of American Agriculture No. 8, 1941/1974) and Demaree, "The Farm Journals, Their Editors, and Their Public, 1830-1860," *Agricultural History* 15(1941): 182-188. Also, see Lewis Gray, *History of Agriculture in the Southern United States to 1860* (New York: Peter Smith, 1933/1941), 780-810; Paul Gates, *The Farmer's Age: Agriculture, 1815-1860* (New York: Harper Torchbooks); Richard Abbott, "The Agricultural Press Views the Yeoman: 1819-1859," *Agricultural History* 42(1968): 35-44; Clarence Danhof, *Change in Agriculture; the Northern United States, 1820-1870* (Cambridge, MA: Harvard University Press, 1969); Julius Rubin, "The Limits of Agricultural Progress in the Nineteenth-Century South," *Agricultural History* 59(1979): 362-373; Donald Marti, "Agricultural Journalism and the Diffusion of Knowledge: The First Half Century in America," *Agricultural History* 54 (1980): 37; Brenda Bullion, "The Agricultural Press: To Improve the Soil and the Mind," in Peter Benes, ed. *The Farm* (Dublin Seminar for New England Folklife, Annual Proceedings 1986, Boston University, 1988); and Sally McMurry, "Who Read the Agricultural Journals? Evidence from Chenango County, New York, 1839-1865" *Agricultural History* 63 (1989): 1-18.

² *American Farmer* [hereafter *AF*] (1819) 1: 210 and *AF* (1831) 13: 359-360.

pseudonym “Anti-Philosopher” considered it simply “the rage of the day.” He condescendingly remarked that the “desire to explain every thing upon *philosophical* principles” was only a fad.³ On the contrary, he asserted, personal experience was the best guarantor of agricultural knowledge. A direct acquaintance with one’s own plot of land, anti-philosophers everywhere contended, could hardly be superceded by advice from beyond the farm. Book farming was bad farming promoted by “men with silk gloves on,” the product of inexperienced agents of improvement who, rather than help, were likely to damage the fields.⁴ That is, the improvement trope could in fact make things worse, with plenty of evidence from generations of farming to know that miracle solutions were often wasteful—just so many “fine spun lubrications,” to quote the editor of Baltimore’s *American Farmer*, John Skinner. And thus, the argument that science and improvement were synonymous did not come across naturally to the minds of the working agriculturalists.

I use book farming to explore how the place-based virtues and vices of the rural community set the terms for evaluating science’s utility or, put another way, how science gained a place of social and epistemic authority in agricultural settings. I do this for three reasons: first, to make the topic of agricultural chemistry in America one of values; second, to show that Americans first accepted science (and chemistry) as a means to interact with their land because it was considered virtuous and useful; and third, to expand notions of environmental history by considering how we conceive of and thus act upon our lands.

The concept of georgic science helps us situate the salient issues of book farming. With it, we can examine perceptions of agricultural science in rural social experiences. Thinking georgically, we can also treat the concern over book farming’s validity as a question of

³ Anti-Philosopher [pseudonymous], “Philosophy,” *Southern Planter* (1842) 2: 177

⁴ [Anon.] *Northwestern Farmer* 2 (October 1857): 374, as quoted by Mildred Throne, “‘Book Farming’ in Iowa, 1840-1870,” *Iowa Journal of History* 49 (1951): 117.

promoting the most morally legitimate way to define the nature under one's feet. In a sense, the loose debates were a direct instantiation of the age-old problem of armchair philosophy, of listening either to the hands-on workers or the physically disengaged pontificators, the "men with silk gloves on." The tension I want to underscore from the epigraphs above is a georgic one, highlighting just that difference between knowledge from lived experience and knowledge from beyond the field. Experience in farming, producing place-based knowledge, was the measure by which the value of philosophical or scientific advice could be gauged. That lived experience was a site of the interplay, to paraphrase the historian Richard White, between ideational and material elements, where the goal of improvement was moral as much as material.⁵

Ultimately, the fundamental issue was whether or not the science was virtuously pursued, not if it was scientific or not. The consequences of this shift were mainly ecological, since they indicate a certain acceptance of scientific analysis that brought a new form of interaction between humans and their land to agrarian America. (In Chapter 3, I will address more directly the different philosophies of nature associated with these forms of interaction, philosophies that follow [or are led by] the use of scientific analysis to interpret the land.) The same John Skinner who sided with "the *experience* of the sun-browned practical Farmer," for example, believed that "No man can be a good farmer, and make the most of his land and his means, without some acquaintance with chemistry." His concern, rather than being trapped in a dichotomy of pro- or anti-science, was more nuanced, asking questions about *whose* science was valued, the farmer's or the philosopher's. Again associating the moral and material, Skinner claimed that the farmer correctly using chemistry would become in "*society*, a more accomplished gentleman."⁶

⁵ Richard White, "Are You an Environmentalist or Do You Work for a Living?" in William Cronon, ed., *Uncommon Ground: Toward Reinventing Nature* (New York: W.W. Norton & Co., 1995), 171-185.

⁶ *AF* 1 (1819): 209-210

In this chapter, I look to the rural practitioners who took science into their lives for the benefit of improved farmland and to those who resisted that move. I argue that the science of agriculture became culturally acceptable when it was perceived as fitting within a georgic ethic that emphasized place. The values of the rural community, not the scientific one, interest me because they point to the means by which science could gain a footing on the farm and in the farmer's mind. Social and epistemic authorities were not separate: the value of the fact was related to the virtue of the fact-gatherer.⁷ Our awareness of these issues of authority comes primarily from the early nineteenth-century rural press, an outcrop, as I view it, of the earlier georgic genre of the agricultural tour. It is to the era of the nascent rural press that I turn first.

Cultivating the Land in the Rural Press

“Fear not to attempt an improvement or discovery...” Richard Peters, *Memoirs of the PSPA*, 1818⁸

Book farming was bound up with the rural, or agricultural, press. That press, which began in earnest toward the 1820s, resulted from a confluence of factors including the rising prominence of agricultural societies (which were interested in communicating their meeting minutes and public addresses), diligent local editors, new publishing and mailing opportunities that made serialized literature possible, and the plea for improvement that pervaded American culture at the time. Its purpose was to advocate rural economy by providing a forum for presenting and debating the issues of agriculture. It worked as a complement and counter-weight to urban newspapers, listing market prices for farm goods, advertising rural products, and

⁷ My approach here is not completely novel. Some classic studies in the diffusion of innovation and technology, though focused on more strictly technologically artifactual, rather than conceptually scientific, examples, offer similar analyses. In particular, Everett Rogers, *Diffusion of Innovations*, 4th ed. (New York: Free Press, 1995) and George Foster, *Traditional Societies and Technological Change* (New York: Harper and Row, 1973) both suggest that close associates and peers with similar value systems influence adoption decisions to a significant degree, well beyond mere technical arguments.

⁸ “Notices for a Young Farmer,” in *Memoirs of the PSPA* 4: xlii-xliii

commenting on agricultural development. The *American Farmer* of Baltimore, which began publication in 1819, is generally credited as being the first successful agricultural paper. By the fourth volume, it had 1500 subscribers. In one year alone, 1829, it added another 300. *The New England Farmer*, published in Boston from 1822, claimed 16,000 subscribers by the 1850s. By the Civil War, 400 different agricultural papers had appeared, at least one in every part of the country.⁹ Overall, readership was significant but not overwhelming, as judged by bare circulation statistics—though the use of that statistic to gauge influence is problematic, an issue I return to later in the chapter. Nonetheless, subscription figures did steadily increase over the years.

The *American Farmer*, Albany's *Plough Boy* (also founded in 1819), and Boston's *New England Farmer* (1822) stand as three prime examples of the early wave of the rural press. Each paper participated in debates about book farming and each of their editors acted as a pro-book farming advocate by invoking georgic values. In terms of rhetorical style, the papers were part of the same spirit of "improvement or discovery," as Richard Peters put it, being fostered in the transactions of agricultural societies and public addresses.¹⁰ The editors, John Skinner (1788-

⁹ By comparison, *The Richmond Enquirer*, an influential urban paper, had 5000 subscribers in 1829. See Charles Henry Amber, *Thomas Ritchie; A Study in Virginia Politics* (Richmond, VA: Bell Book & Stationery Co., 1913), 121. (Ritchie was the editor of the paper and an influential Virginian political advocate for several decades.) The quoted rural press circulation statistics are from Demaree, *The American Agricultural Press*, 36 and Danhof, *Change in Agriculture*, 56. Demaree also notes that *The Cultivator*, founded in 1834 and published in Albany, began with 15,000 subscribers. Lewis Gray notes that the "first purely agricultural paper in the United States [was] the *Agricultural Museum*," established in 1810 in Georgetown. However, it lasted but two years. See Gray, *History of Agriculture in the Southern United States to 1860*, 788. The classic work on the rural press (and a contributor to the literature on book farming, as noted in footnote 1, above) is Demaree, *The American Agricultural Press, 1819-1860*. Demaree, "The Farm Journals, Their Editors, and Their Public, 1830-1860," provides a succinct review of the salient themes in his book. McMurry, "Who Read the Agricultural Journals?" provides the most recent useful account of the meaning of the press, in the process providing references to the main secondary sources dealing with agricultural journalism before the Civil War.

¹⁰ John Skinner, editor of *The American Farmer*, was grateful to have members of the Albemarle Agricultural Society (AAS) as subscribers—good for business and good for the diffusion of farming knowledge—so he sent complimentary copies of his paper to the attention of James Madison, then President of the AAS. At an 1819 meeting, the AAS minutes noted that "In consequence of the polite offer of Mr. Skinner...it was further resolved, that the Society would make use of the *American Farmer*, as a medium of communicating its proceedings to the

1851) at the *American Farmer*, Solomon Southwick (1773-1839) at the *Plough Boy*, and Thomas Fessenden (1771-1837) at *The New England Farmer*, were farmers in the general sense of term. That is, their identity was embedded within the common culture of land cultivation even if they did not all or always engage in daily farming activity. Skinner, a lawyer and Baltimore's Postmaster, parlayed his War of 1812 experience and friendship with James Madison into a successful publishing career. The *American Farmer* was only the first of a series of rurally directed papers he edited from Baltimore in his four decades of editorship.¹¹ Southwick founded and edited the *Plough Boy* after editing the *Albany Register* and another paper, the *Christian Visitant*. He was a charismatic but divisive figure, embedding a strong and overt tone of moral advocacy—from the value of improvement to the necessity for temperance—in his papers.¹² Fessenden brought an already successful career in writing and publishing to the *New England Farmer* as well as firsthand knowledge of the farm from young adult experiences and his lifelong work on the annual harvest. He was well-known for his satires, many of which, like *The Modern Philosopher, or Terrible Tractoration!*, were attacks on the folly of what he considered

public." *Minute Book of the Agricultural Society of Albemarle County*, Sheet 4 in Mss4, Virginia Historical Society, Richmond, VA.

¹¹ After his editorship ended at *American Farmer* in 1829, he published and edited the *American Turf Register and Sporting Magazine* (from 1829 to 1839), edited a series published by Horace Greeley and Charles McElrath called the *Farmer's Library and Monthly Journal of Agriculture*, and then returned to the agricultural press to edit *Plough, the Loom, and the Anvil* from 1848 until his death in 1851. Skinner also had a prominent interest in Latin American affairs. Through his connections in South America, he was the first to introduce guano—bird dung, a highly effective fertilizer—to the United States in 1824. See Wines, *Fertilizer in America*. See James Grant Wilson and John Fiske, eds., *Appleton's Cyclopaedia of American Biography* (New York: D. Appleton and Company, 1888), volume 6, and Harold Bierck, "Spoils, Soils, and Skinner," *Maryland Historical Review* 49 (1954): 21-40 and 143-155.

¹² A New York Democrat before Democrats were well-organized, Southwick later heralded the anti-Masonic cause as he spent decades in publishing. See *Appleton's Cyclopaedia*, vol. 6, Allen Johnson, ed., *Dictionary of American Biography*, vol. 9 (1957), 413-414, and the John Garraty and Mark Carnes., eds., *American National Biography*, vol. 20, (1999) 396-397 for further biographical detail.

speculative knowledge. Jefferson, in fact, was the target of many of Fessenden's early Federalist-based critiques.¹³

Despite this diversity of editorial backgrounds, the early years of the press shared more common features than they were divided over, not the least of which was concern for the very issue of book farming. In this regard, the editors and their papers exhibited a distinct lack of overt political sectionalism, a strong though mostly informal affiliation with regional agricultural societies, and a propensity to couch book farming in terms of the specific problem of soil exhaustion and its converse, fertility. Each paper participated in bringing the science of agriculture into public debate even though none of the editors had any chemical or scientific training. They were all, however, determined to act as purveyors of method, system, and rationality.

In the 1820s, with political sectional strife still in its infancy, the first wave of papers had an air of commonality not just in general, but specifically with their various invocations for improvement. Differences that might have been expected from the geographical space that separated them were in fact minimal. *The American Farmer*, for instance, published reports and commentaries from Maryland, Pennsylvania, Virginia, Tennessee, South Carolina, New York,

¹³ See Christopher Caustick [Thomas Greene Fessenden], *The Modern Philosopher or Terrible Tractoration!* (Philadelphia: E. Bronson, 1806). An old New England Federalist, staunchly anti-Jeffersonian, Fessenden had turned from satire and literature to newspaper and then agricultural journal editing. In 1804, under the pseudonym Christopher Caustick, he polemicized against the pretensions of Jeffersonian-style science within the framework of American Philosophical Society. There, as a recent commentator noted, he exposed “the absurdity of the rhetoric of ‘useful knowledge,’ suggesting that truly ‘useful’ knowledge is...the product of benevolent and pious and thoughtful men, ‘men of real science’, who are interested primarily in social stability, morality, and truth” (Elizabeth Hayes (2003) “Science, Politics, and Satire: Reconsidering the American Philosophical Society in its Political Contexts, 1771-1806,” Paper delivered at the History of Science Society Annual Meeting, Cambridge, MA). Fessenden thought, as Hayes describes it, that APS facts rested “on dubious authority, but which, by the mere fact of their printing, are lent a kind of legitimacy that can only be undermined through careful criticisms by people who have the knowledge and the inclination to set the record straight” (10). For biographical details of Fessenden, see Marcus McCarrison, “Thomas Green Fessenden, 1771-1837: Not in *BAL*,” *Proceedings the Bibliographic Society of America* 89 (1995): 5-59 and Demaree, *The American Agricultural Press*, 321-326.

and Europe in its first volume.¹⁴ The material was sometimes original, but just as often reprinted from such geographically diverse sources as the *Albany Argus*, the *Memoirs of the Philadelphia Society for Promoting Agriculture*, *The Richmond Enquirer*, and *The Nashville Whig*. *The Plough Boy* and *The New England Farmer* used similar patterns of publishing and reprinting. Common editorial outlooks also added to the similarity in regional approaches. Both Skinner in Baltimore and Fessenden in Boston had the same concern for preventing emigration with their pleas for local improvement (like Jefferson, Washington, and Arthur Young in the half century before). Fessenden, in an editorial on “The Science of Agriculture and Book Farming” saw that the “practical farmer...must understand, and in some degree practice these improvements,” such as systematic rotation of crops and the use of Plaster of Paris, or else “he [the farmer] must go...either to a poor house or to the state of Ohio.”¹⁵ The papers, in common, presented a view of agriculture in need of attention and improvement, despite growing rifts between political economies in the South and North.

The press forged a tight relationship with regional agricultural societies, as both forums regularly considered the salient issues of improvement and economy. Organizations, of course,

¹⁴ For a sampling, see (with all references to *AF*, volume 1): “An Address to the Members of the Maryland Agricultural Society” (April 23, 1819), “Notices for a Young Farmer [in Philadelphia]” (May 21, 1819), a “Paper laid before the Agricultural Society of Virginia, (June 11, 1819), “Mr. Madison’s Address: Delivered before the Agriculture Society of Albemarle on Tuesday, May 12, 1819” (August 20, 1819 (and Madison’s address was reprinted even before that in *The Plough Boy*, on June 12, 1819)), a “Treatise on Agriculture” (October 1, 1819), an “Address to the Cumberland [Tennessee] Agricultural Society,” and the Constitution and first presidential Address of the “South Carolina Agricultural Society” (October 8, 1819). The minutes of the PSPA, to provide another example, indicate a similar pattern of wide geographical correspondence, with letters to South Carolina, Connecticut, New York, and Canada. See Lawrence Peskin, *Manufacturing Revolution* (Baltimore, MD: Johns Hopkins University Press, 2003), 125 and 258, for direct references to the PSPA’s minutes.

¹⁵ Thomas Fessenden (August 3, 1822) “The Science of Agriculture and Book Farming,” *New England Farmer* [hereafter *NEF*] 1: 14-15. This logic had already been laid out between Jefferson and Washington [see Chapter 1] when Jefferson wrote in 1793 that “Manure does not enter [into a good farm] because we can buy an acre of new land cheaper than we can manure an old acre.” Letter to George Washington, July 28, 1793, as excerpted in Jefferson’s *Farm Book*, ed. Edwin Morris Betts (Charlottesville: University of Virginia Press, 1976). For further discussion of the early dimensions of sectionalism see Grammer, *Pastoral and Politics in the Old South* and Stoll, *Larding the Lean Earth*, 37-48. In particular, Grammer looks to John Taylor as one of the earliest authors of a sectional doctrine.

play a key role in producing acceptable knowledge and encouraging practice and innovation and, as I suggested in the previous chapter, the agricultural societies were clear examples in this regard. The Philadelphia Society for Promoting Agriculture (PSPA), Agricultural Society of Virginia (ASV), and Albemarle Agricultural Society (AAS) each had their own *Memoirs* or *Proceedings*. But for greater influence and reach they could also count on the press to spread their organized advice.¹⁶ In brief, the press and societies worked together toward improvement in a few key ways: by publishing reports on society prizes awarded for the best studies of farming experiments, by detailing the activities on the society members' lands, by fostering a generally cooperative spirit between the members of those societies and the readers of the press, and by publishing the transactions of the societies. These factors stood as markers of closer attention to systematic, experimental, and then literary expressions of promoting rational agriculture.

The partnerships between agricultural societies and the press were important and mutually beneficial. At the *American Farmer*, Skinner sent complimentary copies of his paper to the attention of his friend James Madison, then President of the AAS. At an 1819 meeting, the AAS minutes noted that "In consequence of the polite offer of Mr. Skinner... it was further resolved, that the Society would make use of the *American Farmer*, as a medium of communicating its proceedings to the public."¹⁷ Skinner was grateful to have the AAS members as subscribers as it was both good for business and good for the diffusion of farming knowledge.

¹⁶ I discuss the agricultural societies of Virginia at greater length in Chapter 4. Here I mention their status as agents of improvement and their approach to promotion and organization.

¹⁷ *Minutes of the Albemarle Agricultural Society* (May 8th, 1820), sheet 49, Mss4, Virginia Historical Society, Richmond, VA. Also see note 10, above.

The georgic writings I referred to in Chapter 1, like those of John Taylor and Richard Peters, also became staples of the early press.¹⁸ That is, the concern for soil improvement through attention to fertilization giving common cause to turn of the century treatises was echoed and reinforced in the press. Taylor believed that “the first necessity of agriculture is fertility,” while his peers and followers took similar views.¹⁹ Issues of animal husbandry (like proper feeding patterns and breeding strategies) and mechanical equipment (like new threshers and plows) also came under debate, of course, but the brunt of book farming I address here was more specific to fertilization and soil nutrition. At the time, a fertilizer was thought of as a natural agent added to the dirt, a product of the farm or the land such as animal dung, vegetable manure, lime, marl, and Plaster of Paris (or gypsum).²⁰ To fertilize a field was to perform a simple, routine task that generations of farmers had enfolded into their daily practices. The dung heap was long a mainstay of farm life, so there was certainly nothing new about using various manures to help vegetation grow.

The *methods* for using fertilizers, however, were coming into development as was an increased understanding of variety.²¹ At the same time, the vagueness in earlier references to “science” for the sake of agriculture was becoming more specific by calling for systematic approaches and invocations of chemistry. Following the tone set by works like Deane’s

¹⁸ See Chapter 1. Also see John Taylor, *Arator: Being a Series of Agricultural Essays, Practical and Political, in Sixty-Four Numbers* (Indianapolis, IN: Liberty Fund, 1813/1977) and Richard Peters, *Agricultural Enquiries on Plaister of Paris* (Philadelphia: PSPA, 1797).

¹⁹ As quoted by Thomas Griffin, “Paper Laid Before the Agricultural Society of Virginia,” reprinted in *AF* (1819) 1: 18.

²⁰ References to the use of lime and plaster for improved fertility are too numerous to adequately cite, even in addition to the late eighteenth-century references I already provided. See, for a sampling, a notice from the Memoirs of the Philadelphia Agricultural Society advising that farmers always add “appropriate manures – Lime, Plaster, Marle, etc.” as needed (*AF* 1: 61); a reader’s response to Skinner’s query about the effects of plaster on fields, enthusiastically noted the benefits of both lime and gypsum (*AF* 1: 82); and a contribution from “A.B.M.” delineated the components of marl (carbonic acid and lime) and plaster (sulphuric acid and lime) and advising on their application (*AF* 1: 366).

²¹ See Richard Wines, *Fertilizer in America: From Waste Recycling to Resource Exploitation* (Philadelphia: Temple University Press, 1985).

Georgical Dictionary, the plea for systematization was everywhere. The New Hampshire physician and farmer Daniel Adams, in his *Agricultural Reader*, asserted that “the ‘era of systematic agriculture’ has actually commenced.”²² Improving the moral structure and material capabilities of agricultural America was becoming a matter of method and system.

We can read the rural press as an extension of georgic writing.²³ It was dedicated to the dual georgic values— material and moral—of agricultural progress with the principle that it would “improve the soil and the mind,” as Albany’s *The Cultivator’s* masthead announced with each issue. It carried forth discussions about soil exhaustion and fertility that the georgic authors had made their *modus operandi*. And the press pursued with weekly and monthly attention the possibilities of improvement through system, method, rational practice, and science. Editors and contributors alike were promoters, prescribing certain modes of action and discouraging others as viewed through the lens of experience. To be sure, there was never a univocal voice in the press. (This lack of total unity, in fact, helps explain the continuing debates over book farming and the prevalent contestation of advice.) But despite a diversity of opinion, the various papers advocated a distinct value system in their form and content, one understandably favoring rural virtue and disparaging urban sophistry. The visible contrast, then, was not between an upper-class planter and a lower-class tenant, or an educated country squire and a day laborer. The contrast, rather, was georgic, between those who were connected to the land and those who were not. Despite the many differences in class status, education, and social power of the antebellum American populace—from tenants and yeoman to market-oriented gentleman farmers and

²² Adams, *The Agricultural Reader*, 33.

²³ Both Taylor’s and Peters’s work, specifically, offer clear bridges between the earlier prominence of agricultural treatises and later years of society minutes and addresses. They stand across the shift from georgic tours to book farming, using principles of agricultural science as their element of consistency. The press was a continuation of the earlier agricultural treatises, only more succinct and periodical.

plantation owners—the majority of the agrarian society shared the position of the non-philosophical citizen (later, non-scientists and, later still, lay people) wrestling with issues of new knowledge and advice from outside their community. The contrast of book farming debates was one of lived experience and contemplative inexperience.

In the forum of the rural press, the value of advice was understood through a georgic prism, a perception defined most clearly through the virtues of labor, discipline, and practice. Such attitudes came across clearly with the juxtaposition, time and time again, of the sun-browned, practical, observant, and experienced farmer to the closet-bound, fine-spinning concocters called philosophers, “chimical men,” or, eventually, scientists. Contributors to papers from South to North reinforced those contrasts, many times on the side of book farming, but just as often to the disparagement of such speculative practice. For example, Gideon Ramsdell, a local farmer debating the merits of botanical theory in the Albany’s *Genesee Farmer*, made the simple case that “the observing, practical farmer” was more suited to consider the issue than men more versed in eating than growing wheat.²⁴ Much farther south, an anonymous contributor in Virginia lauded an agricultural survey while noting that “knowledge...sanctioned by ocular demonstration...could have none of the disadvantages attributed to *book farming*.” Many others followed the same tack, indicating their awareness of the pitfalls of written works while forwarding the salience of local, lived experience.²⁵

²⁴ Ramsdell, “My Motto is—Wheat Will Turn to Chess,” *Genesee Farmer* 2 (October 13, 1832): 326

²⁵ Anonymous, “Letter to the Editor,” *The Farmer’s Register* [hereafter *FR*] 5 (March 1837): 659. There is an interesting sidebar to this expression of values, which is that it was often just that, an expression. Many Americans who participated in book farming conversations, for and against, were not even the real, quotidian farmers that the georgic ideal defined. Surely the wealthy planter who had the resources to hire overseers and maintain dozens of slaves – the traditional distinction between a farmer and a planter is that the planter had more than twenty slaves, the farmer, less – was not living the experience of working the land in any way comparable to that of the yeoman or tenant farmer. But, when fighting for ideals of improvement, they knew enough to aim for the georgic ideal in their argumentative strategies. In this real sense, the matter was more of perception than reality.

The georgic reference point so commonly evoked at the turn of the century eventually gave way to new language in the rural press—in fact, uses of the specific term “georgic” were rare. By the 1820s and 1830s, as the Jacksonian Age of public politics and democratic participation gained momentum, we can follow the same issues of experience and place by highlighting a different set of key terms. One prominent and contemporary way to formulate the issue was by juxtaposing the *homespun* ethic to that of the *dandy*, the former virtuous and true, the latter lazy and despised. The term itself—homespun—referred first to homemade clothes and had political significance in the years of the social movements favoring American-made products over imported ones. In rural discourse, it came more clearly to signify simple or plain. Noah Webster’s (1828) *American Dictionary of the English Usage* gave definitions for adjective and noun: “Plain; coarse;...as a *homespun* English proverb” and “A coarse, rustic, unpolished person.” In standard parlance, the values inhering in the label homespun were the same as the georgic—diligent, hard-working, industrious, practical. As a way to contrast against dandyism, the salient issues were still place-based. Homespuns lived where they worked; dandies connoted the negative image of urban sophistry (not to mention the more recognizable gender-based representation of the dandy as effeminate and dainty).

The concept of georgic science soon became one of homespun science, the homespun confirming the georgic salience of place—geographical and social—in the acceptance of agricultural chemistry. That is, what transpired in the agricultural press and throughout rural America was a shift away from the perception of an essentialized science as good or bad, useful or wasteful, to the reconceptualization of two kinds, good science and bad science. (See Figure 3, below.) That shift was echoed even in the mere language—science began to take on more

specialized meaning in rural communities just as it was in the broader context of the history of science. A few contemporary editorials illustrate the point.

Dandies and Homespuns, Virtue and Vice

Thomas Fessenden wrote a long editorial called “The Science of Agriculture and Book Farming” in the first volume (1822) of his *New England Farmer*. The very title is worth attention, since it shows that the two notions, science and book farming, were not the same thing. Fessenden’s purpose was to discuss just how they were related. In the editorial, he combined economy, fertility, morality, and scientific credibility and equated them with the merits of book farming. Unlike Ramsdell writing to the *Genesee Farmer*, or the anonymous contributor to *The Farmer’s Register*, Fessenden was a forceful proponent of book farming. He outlined existing qualms about the science of agriculture while carefully explaining its virtues in a commentary that urged prudence, reason, and dutiful observation. He said that while practical farmers could not be smitten with all the “theories not sanctioned by actual and repeated experiments,” nor afford to be “full of notions,” they should still seek to separate speculation from fact. His view, he suggested, was even-handed, allowing for the criticisms of skeptics while tempering them with appeals to dominant values. But he presented the equitable view to transcend it. Those farmers who “never knew any good result from what they call *book-farming*” had misplaced their criticisms. They could improve their land by recognizing that “*Book knowledge...is power.*”²⁶

Fessenden did not approach the merits of book farming with accusations of ignorance against anti-book farmers or claims for the unbridled acceptance of all novelties, but he did

²⁶ Fessenden, “The Science of Agriculture and Book Farming,” 15.

associate the merits of book farming with the value of a systematic science. Quite simply, he said, he did not want to “check enterprise, but [rather,] inspire caution, and teach us that every novelty may not be an improvement, altho' every improvement was once a novelty.” Despite towing the line so carefully in his effort to appeal to the range of his audience, his position was pro-book farming. It was directed at the proposition that anti-book farmers believe all theories and “whim-whams” derive from those “who know nothing about farming but what they get out of libraries.”²⁷ Farmer “B,” Fessenden’s foil, rejected book advice because it was “not worthy of the attention of real, genuine, practical farmers.” But if the knowledge observed and recorded in print was based on the testimony, observation, or experience of practical husbandman, Fessenden explained, absurdities would “fast [yield] to reason and the lights of science.”

Throughout his commentary, Fessenden emphasized that the sanctioning of these matters—who did it?—was what counted. His comments to that end were couched in a homespun framework. In so doing he presented a view of science where chemistry and philosophy, the terms he meant synonymously for “the science of agriculture,” were evaluated for their relevance to working farmers. His was not a strictly pro- or anti-science vision. Nor did Fessenden himself call for unbridled deference to the science of agriculture, but one which asked for the use of reason by average citizens, the practical husbandmen. Book knowledge would aid the georgic and homespun goals of social stability, morality, and truth if sanctioned by industrious farmers. In truth, he was saying nothing more than John Taylor and Richard Peters before then, but with a stronger awareness of the reasons for resistance among the practical, everyday farmers. The context of the rural press also made earlier appeals to science more

²⁷ “Whim-whams” were everywhere in the early nineteenth-century. See, for example, Washington Irving and James Kirke Paulding’s New York series, *Salmagundi; Or, The Whim-Whams and Opinions of Launcelot Langstaff, Esq & Others*, ed. Bruce I. Granger and Martha Hartzog (Boston, MA: Twayne Publishers, 1806-1808).

pressing and more frequently voiced and opposed, especially since the press itself was aimed at the same goals of improvement.

Solomon Southwick offered a similar view in Albany's *Plough Boy* during its brief four-year run. With an overtly moralizing tone, he tied his purpose of communicating agricultural knowledge to the promotion of a specific lifestyle.²⁸ From this publishing platform, he offered an ethical framework within which farmers could separate speculation from fact. "Henry Homespun," Southwick's pseudonym, conveyed an entire homespun ethic for the periodical, wrapping reprints and commentaries in a cloth of right living that valued industriousness and common sense while disparaging idleness and insolence. A writer using the common pseudonym "Arator" wrote to the *Plough Boy* about "the Science of Agriculture" suggesting that prudence and "industry in all our laudable undertakings" were within the "scope of moral possibility" entailed by improved agriculture.²⁹ Southwick agreed and used his paper to push the moral superiority of industriously practiced science. He wrote, like Fessenden, Taylor, and Peters before him and like "Arator" and other selected contributors, that those who were "careless and slothful" with "the sin of idleness" were always cast as the negative shadow to the positive frame of the farmer's virtuous lifestyle.³⁰

"The Moral Plough Boy" explained his purpose as aiming "at improving the moral, political, and economical condition of the people at large." The homespun rhetoric enabling this condition was defined most clearly in opposition to dandyism. "The Homespuns and the Dandies are

²⁸ *The Plough Boy* fit the common style of the rural journals by reprinting agricultural addresses from across the country (Mr. Madison's Address to the Albemarle Society; minutes from a meeting of the Agricultural Society of Virginia) and extracts from scientific works (Davy, as mentioned above), by pronouncing on the "Utility of Agricultural Societies and Agricultural papers," and in general by promoting the view that communication was crucial for the improvement of the agricultural lifestyle.

²⁹ *PB* (1819) 1: 75

³⁰ *PB* (1819) 1: 19; Madison's address on 23; meeting minutes on 37; utility on 75; idleness on 12.

antipodes,” Southwick wrote.³¹ Where Dandies were concerned with frivolous amusements, Homespun were hard working. “The Dandies indeed would be harmless, were it not for their idleness, which is always infectious” and so Southwick saw his mission as denigrating the one and promoting the other.³²

Southwick was leveraging a tradition in American culture defined by its contrast first to British dandyism and foppery and later to the element of impracticality found throughout the new nation. Fessenden was writing in much the same spirit, if not the same terms. A good deal of Revolutionary-era rhetoric had based its appeal on promoting independent, self-sufficient textile making—textiles spun from home-grown agricultural products, of course—not only as an economic plea, but for ideological reasons, giving deeper meaning to the homespun identity. As the historian Michael Zakim has observed of Timothy Dwight’s patriotic verse *Greenfield Hill*, there was a standard comparison between “American simplicity and European pretense, locating the former in that, ‘Farmer plain/ Intent to gather honest gain . . ./ In solid homespun clad, and tidy.’” Zakim further notes that the homespun tied “the productive efforts of the household to those of the nation—thus also becoming a most tangible expression of the citizen’s attachment to the public’s happiness.”³³ In the rural press, and with attention to land and improvement, that georgic-like expression of seeking moral and material goals was reinforced in the place-based requirements of science.

For example, in Southwick’s “The Fable of the Plough Boy and the Dandy,” a generic Dandy and a Plough Boy run into each other on the street. The Dandy gets knocked down, dirty and

³¹ *PB* (1819) 1: 23.

³² *PB* (1819) 1: 2.

³³ Michael Zakim, “Sartorial Ideologies: From Homespun to Ready-Made,” *The American Historical Review* 106 (2001): 1553-1586. Timothy Dwight, *Greenfield Hills: A Poem* (New York, 1794), part 1, lines 42–65. Lawrence Peskin, *Manufacturing Revolution: The Intellectual Origins of Early American Industry* (Baltimore, MD: Johns Hopkins University Press, 2003), 123-132, comments on the clearly gendered dimensions of the masculine homespun ethic. Peskin’s interpretive view is consistent with Southwick’s editorial perspective and adds to the dandy-homespun contrast a sense of a feminine-masculine split.

muddy, then tries to knock down the Plough Boy with a stick. But the farmer wards off the blows and drags the Dandy to a sign post to hang him up as a spectacle for the public. The warning was that Dandy's should "strike to homespun common sense...doff their peak of insolence, and practice better manners." Out of context, the caricature of the idle, disrespectful dandy stood only in juxtaposition to the esteemed, hard-working farmer. In the rural press context, the dandy was a recognizable contrast to the farmer's ethic of improvement and virtue.³⁴

When Henry Homespun, then, advocated the tenets of agricultural science, he was siding with a specific kind of systematic work, not a universal sense of "science." When he took an implicit stand in favor of book farming, he aligned himself not with science writ large, but science for the sake of the agricultural life. Southwick skillfully distinguished between a general sense of philosophy and a specific thing like homespun science, a practical pursuit that was good for farms, good for improvement, and right for a moral society. As we see with Southwick, Fessenden, and others, the criteria for defining science, in the antebellum context, was not internal to its practice, but external in that it was granted *by* farmers *toward* a science that was aimed at a moral understanding of right farming. Southwick's Albany paper was much like Skinner's in the Upper South and Fessenden's in Boston.³⁵ When those editors deployed the phrase "science" so loosely and often, they had in mind the use of systematic, diligent, observational methods of practice for the benefit of the community.

³⁴ *PB* (October 1819) 1: 169.

³⁵ With anti-Masonic and pro-temperance inclinations that undermined his claim that the paper would avoid factionalism or party-orientation and ideological stances that promoted certain values and denigrated others, Southwick in fact was much like Skinner and Fessenden – not that they were politically aligned with one another, but that their papers did carry subtle political intonations. These affiliations were stark moral commitments, which say much about the promotion of certain codes of proper living. John Skinner at the *American Farmer* had said that "Once and for all, then...not a word of party politics will ever be allowed to enter its columns" (5/14/1819). Fessenden's prospectus, on page 1 of the first *New England Farmer* claimed that "party politics and polemical divinity shall be...excluded" from its columns. Southwick's *Plough Boy*, to be sure, was already defunct by the time an actual anti-Mason party was formed, later in the 1820s, but Southwick's political character was still apparent in the paper.

Scholars writing about book farming have struggled to separate the uses of agricultural science from dominant narratives of progress, improvement, and rationality, falling prey to the same rhetorical constructs the calculating editors used. Their interpretation of book farming contrasts modernity with tradition and ignorance with innovation—those opposing book farming were ignorant and backward looking; those in favor were modernist and “scientific.” Such a view, however, uses the later credibility of science as its own explanation while concealing a far deeper debate about how and why tools like agricultural chemistry became part of American agriculture. More broadly, for those seeking to wed the science of agriculture to the nineteenth-century goal of improvement book farming stood as a precise example of the difficulties incumbent upon the contrasts of tradition and progress, rational and folk wisdom, almanac-based and scientific text-based information, locality and distance, and amateur and professional. Those pro-book farmers, of course, claimed that the future lay with quantified and systematic means for scientifically improved end, that the ubiquitous call to improve could be achieved with science. Unfortunately, the historiographical focus on rural science has generally treated the science-improvement bond uncritically, assuming that it was inevitable and unproblematically achieved. But in the fields of the early American Republic, it was not clear that the science of agriculture and agricultural improvement were synonymous.³⁶ The situation, as I am showing, was far more complicated.

³⁶ This scientific hagiography follows from the historiographical tradition set out by Avery Craven, *Soil Exhaustion as a Factor in the Agricultural History of Virginia and Maryland, 1606-1860* (Urbana, IL: University of Illinois Press, 1926), Lewis Gray, *History of Agriculture in the Southern United States to 1860*, Albert Demaree, *The American Agricultural Press, 1819-1860*, and Paul Gates, *The Farmer's Age*, as discussed in Chapter 1 (and note 1 above). Craven, for example, says that “such men as Washington, Jefferson, Madison, John Taylor, J.M. Garnett, etc., formed what might be called a school of gentleman farmers who had run counter to the general backward drift” (128). Recent scholars too, such as Cashin (1994), have continued to rely on these assumptions. Clarence Danhof (1969) provides a notable exception to this pattern by showing the rationality of resisting change, though his work still assumes a value-neutral model of science as progressive. McMurry (1989) also usefully questions the assumptions of prior analyses of book farming. She points out that “as sources of authority, the ‘book’ and ‘tradition’ have often been treated as polar opposites, by the farm journals themselves and by historians....But in the

The ubiquitous claims for industriousness over idleness, to “walk abroad in the majesty of virtue” and remain “strangers to vice,” were not difficult propositions to accept, then anymore than now. They were basic restatements of classic Protestant values: work was virtuous. Fessenden’s brief essay on book farming was meant to place the practice of rational agriculture into a framework the practical husbandman already understood, that of the cautious and informed use of new ideas. Science, then, had to fit the farmer’s ethic to be promoted, as it was one tool among many selected by the craftsmen.³⁷ Furthermore, and perhaps more consequentially, the agrarian community was starting to interpret nature, in the form of soil, crops, and landscape, with the instrument of science. As a new instantiation of georgic science, it was a homespun science.

nineteenth century, when the modern research system was not yet established, the evidence indicates that there was not such a tidy contrast” (15). Briefly stated, the basic difficulty with prior assessments of book farming has been the use of a reified science as a resource used to explain other issues of acceptance and resistance. As an additional problem, whether or not book farming was synonymous with agricultural science was not clear in the primary literature of the early nineteenth-century nor has it been clear in the historical work that describes that literature. Rossiter, *The Emergence of Agricultural Science* equated book farming with “the science of agriculture” (7); McMurry suggests that historical scholarship about book farming makes this equation neat, though she does not commit herself to such a synonymic definition; and some rural press editors, such as Thomas Fessenden, in his “Book Farming and the Science of Agriculture” (1822), do not assume the two are the same.

³⁷ The unease between speculative and fact-based advice and between repeating tired methods and accepting new ones was prominent not just from the view of the editors but also from small, practical farmers. Writing from Hagerstown (in western Maryland), an anonymous “practical” farmer was concerned that “our whole system of agriculture depends on the phases of the moon, and the signs of the zodiac, as marked in the large Dutch Almanac.” This opinion looked from tradition – “though we make excellent crops, every son treads in his father’s precise footsteps” – towards progress, but without direct or specific appeal to science or chemistry or book farming. It was merely encouragement to think beyond the pattern of agricultural practice by inheritance. (*AF* 1 [1819]: 68) Others wrote to report successes of using plaster and lime. Still others commented more generally on the possible benefits of chemistry, but also wondered what it would ultimately achieve for them. Eli Davis, a farmer of limited means in South Carolina, wrote to Skinner about “the importance of chemistry as connected with Agriculture” (*AF* 1 [1819]: 265). “A SUBSCRIBER” claimed to have “a little smattering of chemistry” with which he “had analysed cobs of corn,” hoping it would advance his cultivation (*AF* 1:335).

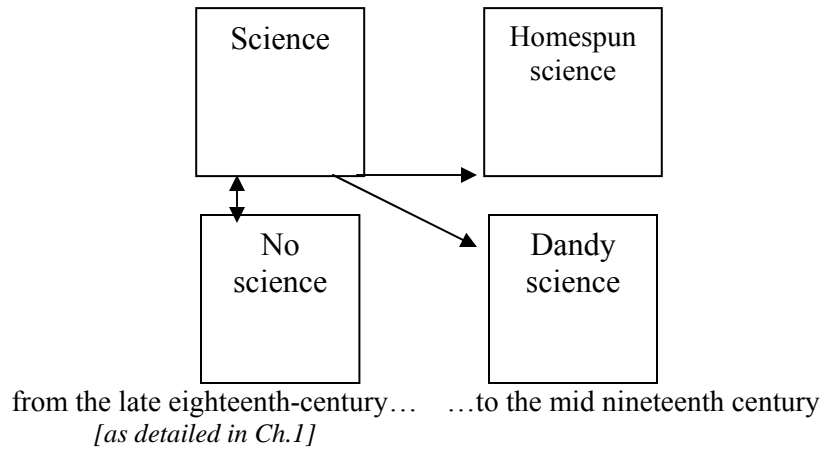


Figure 3. Making the Georgic Homespun. The transition highlighted here goes from (1) questioning whether or not science had a part to play on the farm to (2) questioning whether the science on the farm was homespun or dandy (georgic). The latter stage indicates an implicit acceptance of science’s place, where the differences being debated are based on the contrasting values inhering in the pursuits of science.

The above references to the agricultural papers were often prescriptive, saying how things should be done, but not ensuring that they were actually practiced as such. They show us the world those improvers wanted to create. These prescriptions even came about surreptitiously. Edmund Ruffin, the editor of *The Farmer’s Register* in Virginia, was a notable and unapologetically self-promoting book farmer. In the second volume of his paper, a contributor signing his name “A Book Farmer” wrote a piece called “An Apology for ‘Book Farmers.’” The author invoked the writings of Arthur Young, William Marshall, Humphry Davy, Richard Peters, and even Ruffin to claim that poor *practice* caused bad farming, not the book farming advice itself. He—for we can assume it was a he, as nearly all the contributors were—also cleverly took the time to compliment Ruffin and his “commendable” example of practice. The fault of bad farming lay with the “indolence and carelessness” of the practitioner, not the theory itself. “A Book Farmer’s” claims fit precisely into the georgic and homespun ethic that favored diligence and disparaged indolence. He understood that, considering the still unstable place of science in farmers’ lives, winning the argument for book farming meant casting it as morally

superior, not deferring to the still-untested principles of accuracy or prediction (values, that is, defined by chemists and philosophers). In other words, asking farmers to use chemistry to prescribe action on their lands had to follow from placing the values of that pursuit into the farmer's (perhaps idealized) homespun life.

Although readers at the time did not know it, the author was Ruffin himself, masquerading under a pseudonym—a practice not uncommon in the rural press—to further his own views about the merits of the science of agriculture and book farming.³⁸ Despite such wily propaganda, though, the case for introducing and accepting science or agricultural chemistry could not be made from editorial perches alone; the story also involved the testimony of farmers and planters dealing with the complexities of written advice and experience on a daily basis, those not just speaking the georgic ideals, but crafting them in their work. They offer more insight into matters of resisting and promoting book farming. They come into play in the next section.

Resisting and Promoting

In the first chapter, I placed the science of agriculture into a georgic improvement ethic. In this chapter, I have been moving that context chronologically ahead, out of individual treatise writers and into the rural press. But even the rural press presented its own biases, disproportionately presenting the view of elites and speculative writers who only preached the

³⁸ *FR* 2: 17-19; also see Ruffin, "Anonymous Contributions to *The Farmer's Register*." (In the 1950s, J.G. de Roulhac Hamilton found a document from Ruffin to Nathan Cabell, probably from the 1850s, where Ruffin listed the authors of all anonymous contributions to his journal, a plurality of which were Ruffin's own writings.) Ruffin studies have become a kind of cottage industry in Virginia history. The most recent of that literature includes William Mathew, *Edmund Ruffin and the Crisis of Slavery in the Old South: The Failure of Agricultural Reform* (Athens, GA: University of Georgia Press, 1988) and David Allmendinger, *Ruffin: Family and Reform in the Old South* (New York: Oxford University Press, 1990). Jack Temple Kirby provides a concise review of the interpretations given by Ruffin's principal biographers in his introduction to Ruffin, *Nature's Management*, xvii-xix. While recent work has been less hagiographical than biographies and studies earlier in the century, there is still a consensus that Ruffin, the *Farmer's Register* that he edited for about a decade, his work on promoting marl as a manure, specifically in his *Essay on Calcareous Manures* (1832), and his legend as the first to fire a shot in the Civil War mark him as a crucial antebellum figure.

cause of the hard-working, rather than illustrating it through their own example. However, the resistance or acceptance of book farming in the context of moral, political, and economic improvement was a matter of authority and belief. Who sanctioned the observations and reports? Who had the authority to tell a farmer what was good and right? These kinds of questions had to be asked and answered in community settings and within local and familial networks. The records of the working farmers in those communities are often difficult to follow and mostly avoid direct commentary on the value of science. The most telling of them, however, provide indications of perceptions of quantification, experimentation, and agricultural chemistry. On that point, account books, diaries, and letters prove very insightful. Below, I consider the examples of a few farmers both wealthy and of more humble means. Again, they are all outside the growing scientific community in the early American republic. And again, assessing the issues of authority and belief that underlay their perceptions requires attention to the contexts in which these farmers lived, contexts that I have elaborated above as georgic and homespun.

But first, given the rhetorical focus of book farming, I need to offer a word on literacy and rural press subscription rates. The problem here is that if tenant or yeoman farmers were not even reading or participating in these debates, then what can a study of the science of book farming really show? Answering this historical problem with reference to low literacy figures has been the basis for dispelling rumors of the widespread influence of the rural press, where some historians have pointed out that the circulation of science, theory, and mechanical implements may have been less significant than previously thought. (This issue is related to the matter of circulation statistics mentioned above.) Agricultural historians in particular have

grappled with the problem of influence for some time, deliberating on the meaning of agrarian and social life discernable by reading the rural press.³⁹

There are, however, three pertinent counter points to the concern that a view of book farming might overstate influence. One is to recognize the kinship networks into which the rural press was published. Given the local, familial ties in the antebellum period made even more prevalent in rural culture, subscription rates to the press cannot adequately gauge readership or influence, a point made by a number of antebellum scholars.⁴⁰ Book knowledge and tradition, as the agricultural historian Sally McMurry has pointed out, “intermingled among the same people,” people who “traded, went to church, and exchanged work.” The social dynamics of the early American rural citizenry, based on that strong collective nature of agricultural communities, made the conveyance of ideas and practices more widespread through informal avenues than can be measured by simple census and circulation figures. To be sure, “that someone *subscribed* to a journal does not necessarily mean that he or she *read* it,” McMurry points out. But, “on the other hand, it is safe to assume that copies of the journal reached more potential readers than the individual subscriber alone.”⁴¹

A second counter point is the bare statistic of literacy, which shows a readership far higher than might be expected from our modern retrospective view. In 1840 in Virginia alone, for example, census figures showed that over 85% of white males over 20—356,000 out of

³⁹ See references in note 34, above.

⁴⁰ For more commentary on the kinship context, see McMurry, “Who Read the Agricultural Journals?”; Carolyn Merchant, *Ecological Revolutions: Nature Science, Gender, and Science in New England* (Chapel Hill: The University of North Carolina Press, 1989); Claudia Bushman, *In Old Virginia: Slavery, Farming, and Society in the Journal of John Walker* (Baltimore, MD: Johns Hopkins University Press, 2002); and John Majewski, *A House Dividing: Economic Development in Pennsylvania and Virginia Before the Civil War* (New York: Cambridge University Press, 2000).

⁴¹ McMurry, “Who Read the Agricultural Journals?”, 4 and 15.

415,000—considered themselves literate.⁴² While this statistic still seems unreasonably high, indicating that the method for acquiring such data was likely flawed, it does suggest that the white male public sought or aspired to such literate status. The rates in New England, where literacy had always tracked higher, must have been as great if not greater. Even if we assume the statistics are misleading or overestimates, still the claims on readership were significant. The lesson here is not to assume the opposite—that everyone was in touch with and directly influenced by the rural press—but to suggest that taking subscriptions and influence as the same thing overlooks the strong social network context of the early republic. Put simply, the correlation of circulation statistics to influence will undervalue the importance of the rural press because it assumes a false one-to-one relationship between paper and person.

The third factor is to situate the prescriptive dimension of book farming advocates and their promotional rhetoric into the dominant cultural values of the time. As with studying advertisements, we can learn much by matching the marketing techniques of rural press editors and prominent advocates to the audiences they hoped to convince. Edmund Ruffin was quite adept at this, establishing several layers of promotion through his position as editor, anonymous contributor, and book author. In each case, he was appealing to the existing virtues of his farming neighbors while claiming that the pursuit of his improvement policies was an example of virtuous practice. Those homespun, place-based values were still dually directed at moral and material progress. The examples below, written from beyond the center of the rural press though sometimes still in contact with it, can be understood with the same model.

⁴² The 1840 census is the first to record literacy rates. Data for this statistics was gathered from census details at <http://fisher.lib.virginia.edu/collection/stats/histcensus>.

To the list of Presidents, wealthy planters (sometimes also Presidents), regional editors, and rural press commentators I have presented above as actively involved in forwarding systematic studies of the farm, I add one more wealthy planter, William Fanning Wickham. Wickham (1793-1880) was a Virginia book farmer. He experimented with different fertilizers, mined marl and other manures from his property, suggested methods and systems of analysis for the cause of improvement, considered the validity of new scientific or philosophical principles about agriculture, read and contributed to several rural periodicals, and even translated foreign articles for *The Farmer's Register*.⁴³ These activities were part of the farming practice to which he was devoted for decades. He was a well-educated and wealthy landowner of over 3000 acres at Hickory Hill in Hanover County, situated to the north of Richmond and east of Charlottesville. He was also a trained lawyer, owner of as many as 275 slaves by 1860, and son to a century-old family of southern gentry.⁴⁴ His social stature enabled him not only to examine chemically nuanced systems of improved agriculture (by virtue of his education), but to write about his experiences with those methods with some degree of social credibility. For him, book farming represented a tension between the activity of farming and the contemplation of theorizing, between observation and speculation.

⁴³ See the correspondences and diaries in the Wickham Family Papers, Mss1 W6326 c FA2, specifically Series 4, Boxes 5 and 6, at the Virginia Historical Society, Richmond, VA. Also, see the Virginia Heritage Database, <http://www.lib.virginia.edu/vhp/> (accessed 22 January 2004), for archival details about the Wickham collection. Joan Cashin, "Landscape and Memory in Antebellum Virginia," *The Virginia Magazine of History and Biography* 102 (1994): 477-500, especially pp. 493-496 and Gregg Michel, "From Slavery to Freedom: Hickory Hill, 1850-80," in *The Edge of the South: Life in Nineteenth-Century Virginia*, ed. Edward Ayers and John C. Willis (Charlottesville: University Press of Virginia, 1991) also discuss William Fanning Wickham. On Wickham's anonymous contributions, see Edmund Ruffin, "Writers of Anonymous Articles in *The Farmer's Register*," *Journal of Southern History* 23 (1957): 9-102, which references the contributions by Wickham.

⁴⁴ Wickham's father, John (1763-1839), had also been a prominent planter, a lawyer, and a participant in the rural press culture, contributing to Ruffin's *Farmer's Register* in the 1830s. Famous for providing the defense in Aaron Burr's treason trial, John Wickham was well known throughout the republic. He was also a former Loyalist, a southern Federalist, and an antagonist of Jefferson's political and agrarian skills. In *The Farmer's Register*, for instance, John Wickham commented in passing that "Mr. Jefferson's reputation does not rest on his knowledge of agriculture." (*FR* 3 (Jan 1836): 513-514) See Wickham Papers, Mss1 W6326 c FA2, Series 3, Box 1 at the Virginia Historical Society, Richmond, VA.

Wickham grew a diverse set of crops, including wheat, corn, and clover on a series of fields. He was fertilizing wheat with marl in systematic fashion by the 1820s. As early as 1828, as he recorded in his diary, he “began to haul marle into the low field from the old bank” using “3 to 400 bushels” to the acre. He later opened “a new pit in the hill side near the river on the low grounds” and from there planned “to cover all the low grounds in the barn field with marle and to fallow it in the autumn for wheat.” The corn that year was his best ever, though he did not indicate whether the fertilizer deserved the credit. “The season could not have been more favorable” was his only comment.⁴⁵ The next season Wickham concluded that “the effect of the marl...in the long field at the Lane is astonishing....” Opening up new marl pits, devoting more and more labor to the projects (from one horse cart per day to three), and ever increasing the bushels per acre, he was developing a kind of proto-industrial agricultural fertilization process. His experimental success was literally visible from afar—“The young clover in the wheat field looks well especially on the marled land which can be distinguished at a considerable distance.” By the late 1830s, Wickham’s fertilizer use was regular and predictable; he had plaster experiments underway as well.⁴⁶

With fertilizing techniques, crop rotation strategies, advanced mechanical implements, and even a steam sawmill by 1848, Wickham would be considered an “advanced” farmer. He was practicing and experimenting with the most up-to-date farm management and agricultural methods.⁴⁷ By then, he had extensive experience and trust in methods of fertilization and what he considered agricultural science. Still, Wickham did not always trust the dictates of scientific

⁴⁵ See Diary entries for 27 April 1828, 25 December 1828, 3 March 1829, 24 January 1830, and 25 March 1830 for early comments on quantities of marl in Wickham Papers, Mss1 W6326 c FA2, Series 4, Box 5, Diary Volumes I; also see correspondences in Box 6, all at the Virginia Historical Society, Richmond, VA.

⁴⁶ 18 April 1830; 17 June 1830; August 1832 (passim) in Wickham Papers, Box 5, Volumes 1 and II

⁴⁷ This view is seconded in Michel, “From Slavery to Freedom,” an exploration of the Wickham family’s experience with slavery before and after the Civil War.

methods gleaned from treatises, preferring the experience gained from his own land. His extant means of learning how to farm—from his father, from his neighbors, through the experience of his early years—were slowly being complemented by the science of agriculture. His interaction with the land was thus also changing.

Importantly, Wickham was considered a “methodical and observant man,” as another analysis of his diaries showed. As such, he was “an exemplary farmer.” He had likely shed his lawyer’s identity by the 1830s, having not practiced for a decade by that time. As a lawyer, he would have been castigated as a “vice-ridden” drone. As a methodical and observant man, he was capable of promoting the qualities of “virtue, serenity, and good health.”⁴⁸ Wickham fit the value model through which book farming was being judged, answering questions about virtue and vice through his attention to detail and patience for experiment. His lived experience guided his ideas about the land and suggested how to experiment for improvement. It helped that he was wealthy and had hundreds of slaves mining his marl, digging his ditches, and preparing his crops for market (a point I elaborate in Chapter 4). It helped too that he was the son of an improvement-minded planter; this erased the supposed contrast of tradition (or inheritance) versus progress. He thus offers a good example of a book farmer who took advantage of his escape from physical labor to concentrate on mental labor.

Wickham exercised his authority as a diligent practitioner in his community and through his self-representation (in his dairies and through the rural press). A debate in *The Southern Planter*, an agricultural paper published in Richmond, demonstrates the point. In 1841, he wrote to correct misperceptions he saw in print about ploughing techniques that encouraged farmers to till their manure underground in the fall instead of the spring. Different techniques were being advocated by the editor, by Wickham, and by at least two correspondents. First, an article from

⁴⁸ Cashin, “Landscape and Memory in Antebellum Virginia,” 487.

The Genesee Farmer in upstate New York had commented on the “scientific opinion” of a popular treatise of the 1840s, *The Practical Farmer*, noting that its method of fall ploughing was consistent with “established principles of philosophical agriculture.” The article was reprinted in the *Southern Planter* and, in response, Wickham wrote in favor of spring ploughing. He there questioned the wisdom of the “scientific” opinion because it conflicted with his experience, not because it was scientific. Then, in a further reply, a third participant entered the debate. “A Hanoverian,” as he signed the letter, wrote to the *Southern Planter* to question Wickham’s contribution and the “increased improvement which that mode of using effects.” The “Hanoverian”—writing from Wickham’s own Hanover County—wanted to understand the difference between the uneven sets of advice.

But who was to be believed? All parties agreed on the goals: improved crop yield from legitimately conveyed advice. Tilting the scales, the editor then re-aligned himself, siding with Wickham. To do so, he explained Wickham’s credentials—“not a man likely to make a mistake”; one who “has no theory to advance [but] only repeats the facts”; “we hardly know one upon whose judgment we would sooner rely.”⁴⁹ Wickham’s authority in the debate was understood at first from his reputation as a practical farmer. He then benefited from the sponsorship of the *Southern Planter*’s editor, who vouched for Wickham’s character. For our interest, the debate exemplified, first, that the *kind* of observation mattered (not whether there *were* reported observations or not) and, second, that the accepted authority of the observer ultimately settled the matter.

⁴⁹ *The Southern Planter* (hereafter *SP*) 1 (1841): 189, 190-191, 228-229, and 243. As it happens, yet another (anonymous) respondent attempted to arbitrate between “W.W” and “A Hanoverian” noting that he was persuaded to follow Wickham’s method “by personal observation” and that Wickham’s methods seemed to avoid losses of fertility. Wickham’s technique was “infinitely preferable” for reasons of convenience, so long as there was “no greater loss or expenditure of the fertilizing principles of manure.”

Wickham successfully cultivated the image of the diligent, georgic farmer. His descriptions of experimental practice did not rely on technical chemical language, but they did stand behind a planter of accepted social authority offering reports of his own positive experiences with systematic fertilizing experiments. He had tried marl, plaster, crop rotation, and clover in addition to the animal manure long used on the plantation; his later use of guano, in the 1850s, fit perfectly into this mode of operation.⁵⁰ All these efforts pre-supposed the goal of improvement and the value of book farming. On one reading, the ploughing debate could be interpreted as a matter of competing claims between the scientific opinion of *The Practical Farmer* and the local, non-scientific opinion of a practical farmer. But that would be to misread the subtleties of value and virtue. More centrally, the debate hinged on *what kind* of scientific opinion was being wielded, where fact-based testimony had merit based on the valued source of authority, where the place of the observation gave it credibility. Homespun virtue won out.

At the same time, another Virginian, John Walker (1785-1867), was a book farmer in a different sense. He wrestled more with the authority of agricultural advice at a personal, rather than philosophical, level. As Claudia Bushman has explained in her monograph detailing John Walker's antebellum diary, he was also less wealthy than Wickham, less educated, had fewer slaves (though he did have some), and more ambivalent about taking farming advice from books. Walker lived and farmed in King and Queen County, in what is called the northern neck of Virginia (the eastern peninsula between the Potomac and Rappahannock rivers). He owned under 1000 acres and just over 20 slaves.⁵¹ He was a devout Methodist, to which he had converted in 1818 while living in Kentucky. After his conversion, and after his brief foray as the model of a

⁵⁰ See Wickham Papers, especially Volumes I-III of his Diary, in Box 5, Series 4, Mss1 W6326 c FA2, at the Virginia Historical Society, Richmond, VA.

⁵¹ The traditional distinction between a planter and a farmer is the number of slaves owned, distinguishing planters as those with over 20. Although by simple numerical count Walker would thus be a planter, by virtue of his familial context he is more likely thought of as a farmer.

Virginian émigré, he returned to his family's land near Walkerton. His engagement with philosophical principles of agriculture—the validity of which was the bone of contention on his view of book farming—was more troublesome. He represents yet another tension in the concept of book farming, for him, between belief in an almanac or an agricultural journal, or between traditional approaches to farming and so-called modern ones.⁵²

In her comprehensive reading of John Walker's journals, Bushman implicitly takes as her theme the reoccurring issues of trust, authority, and belief. While reading "progressive materials," she finds that Walker was also seeking advice from other sources of epistemic authority like the almanac. He often tested his moon-farming methods against the recommendations of periodicals like *The Southern Planter*, indicating his "continuing concern about authority and trustworthy power." The "problem of whom to believe, [of] what was the best source of authoritative advice," dogged Walker as he weighed the suggestions from written articles against his own history.⁵³ He also fought with his neighbors, was at ease expressing opinions on county politics between Whigs and Democrats (especially as concerned internal improvements), lived in the Methodist minority, and experimented with Thomsonian medicine. Each of those traits placed him in tension with some form of authority, be it political, religious, medical, or some combination of these. All of those traits, taken together, characterized him as a farmer struggling with multiple questions about authority and belief.

As with Wickham, Walker was also using marl by the early 1830s. His diaries indicate that he read John Taylor's *Arator* and had at least a passing familiarity with issues of soil exhaustion. For him, being a book farmer meant reading the rural press and comparing moon lore against new methods of planting. In 1825, vexed by issues of authority and by the promise

⁵² Bushman, *In Old Virginia*, passim.

⁵³ Bushman, *In Old Virginia*, 52-55.

of new techniques, Walker constructed an experiment to compare almanac advice based on the stars against his own observations based in his fields. “Who should he believe?” Bushman asks. After all, “The competition between modern and traditional could be seen in his wavering but stubborn loyalty to planting seeds according to phases of the moon.” It seems that Walker used an array of available approaches. “Walker incongruously mixed the superstitions of the past. At the same time he was reading progressive materials, he consulted almanacs to monitor the progress of heavenly bodies.” But this is only incongruous if we take the inevitability of scientific success as the benchmark against which to judge Walker. In his own context, as part of his homespun life, his dual use of almanacs and the rural press was entirely consistent. He utilized the methods available to him and incorporated different techniques without recognizing the later clarity of differences in those methods.⁵⁴ Walker was like Wickham in the sense that he was in the midst of introducing newer methods to his agricultural practice, but differed in the scope and sophistication of his experiments.

In some cases, Walker saw a nice convergence between printed advice and his personal observations. Lime use, for example, was being widely promoted. Walker’s own experience with that fertilizer had been positive. He even bought a lime scatterer after seeing an advertisement in *The Southern Planter*. Bushman makes the valid point that Walker “likely did not understand its effect on the soil,” but that lack of understanding was typical and an artifact of a different *kind* of knowledge—georgic, or hands-on, or “practical”—not a complete lack of it.⁵⁵ Influenced by the press, he used a mixture of ashes, lime, and plaster to prepare the soil and his seeds for planting. (Often, the debate was about how best to roll seeds in fertilizer before planting them, not just about how to modify the soil conditions directly with the fertilizer.)

⁵⁴ Ibid., 52

⁵⁵ Ibid., 48

Consistent with his attention to the rural periodicals and to communication of agricultural practices, he even took note of the founding of the King William Working Agricultural Society in 1842. With Walker, we have a working farmer struggling to gauge the ideals of science and improvement against a long tradition of capable and successful planting.

Smaller-scale farmers also grappled with the issues of the authority of advice. Emblematic for the tension he felt when regarding plans for improvement was John Lewis (1784-1858), a Spotsylvania County, Virginia farmer of 85 acres who kept a diary throughout the 1810s. Living to the county north of Wickham, he noted his planting patterns, his seed treatment, and the prominent theories he chose to follow while simultaneously questioning the validity of philosophy and science. Lewis based his doubts about philosophy on justifiable points of confusion over whom to believe. He was literate enough to follow the papers and interested enough to entertain theories like those of the popular Virginian agricultural speaker and President of the Fredericksburg Agricultural Society, James Garnett.⁵⁶ But Lewis was also wise enough to wonder where the credit should be given for successful improvement. Growing potatoes, celery, turnips, radishes, cucumbers, lettuce, asparagus, tomato, corn, cabbage, and wheat, Lewis bought and used plaster and gypsum, in which he rolled his seeds. Wondering when to manure his fields, he followed a method of coverage in the Fall and tilling during the Spring, “in conformity with Mr. Garnett’s theory” (though not with Wickham’s later advice, apparently). He did not elaborate specific details, but did register doubt about the methods he had been advised to use. While the “plaister” seemed to work—“The red clover 9 inches high (plaistered) 4 inch where it was not plaistered”—he elsewhere questioned the cause of his success or failure. Was it the gypsum-rolled seeds or the unusually warm spring? Was it

⁵⁶ The Fredericksburg Agricultural Society met in the county east of Lewis’s Spotsylvania home. Garnett was also a longtime contributor to *The American Farmer* and in the 1840s the President of the Virginia Agricultural Society.

Garnett's theory or a favorable rain? Lewis tells us little more, though, leaving his questions open ended. One February day in 1820 it was 70 degrees at 7 am. Lewis noted: "Yet philosophers tell us that the greater heat of summer is produced by the greater perpendicularity of the sun's rays!" and then wondered what advantage the philosopher has when the farmer could use the same visual evidence to draw conclusions.⁵⁷

Questions of authority, trust, and belief were more overt for Walker and Lewis than for Wickham. This is not surprising, since confidence is another value often left unelaborated in discussions of social mores on the farm, and questions about authority and belief will have different answers for the self-assured, confident farmer than for the self-doubter. Wickham's social status certainly brought forth the confidence of a wealthy man. His wealth enabled him not just to try new experiments—some historians like to note that wealthy people had less at stake in failed experiments and that this defines differences in book farming—but to not question his approach and techniques.⁵⁸ There is no hint of deprecation or contingency either in his diary accounts or his published columns.

The matter of convincing average farmers that their writing held authority had been a problem from the early days of the rural press. Wickham was not part of this problem, but his neighbors were. The older generation of editors and agricultural society leaders made it clear that the timidity of small farmers was something to be overcome or assuaged with appeals to a greater good. We should read Richard Peters's call to "fear not to attempt an improvement or discovery" as an example of this concern. John Skinner editorialized in 1819 that "One of the greatest difficulties...in the execution of our humble undertaking [on] behalf of the farming interest, was the fear, that we should find it impossible to overcome the mistaken diffidence of

⁵⁷ See John Lewis Commonplace Book, Mss3 L7702 a 5, 1806-1823, Virginia Historical Society.

⁵⁸ See, for example, G.E. Fussell, "Science and Practice in Eighteenth-Century British Agriculture," *Agricultural History* 43 (1969): 7-18

agricultural gentleman.” Wilson Cary Nicholas said much the same the year before when speaking to the Albemarle Agricultural Society.⁵⁹ Walker, although not stating it so explicitly, was in a far more fragile, possibly diffidence-causing position. To be sure, psychological factors do not stand alone here, but it is probable, based on his diary and his pattern of experiment and doubt, that Walker was more likely to question his own approach. On the one hand, this led him to skepticism about book farming itself and, on the other hand, to skepticism about his own ability to refute book farming.

Lewis’s confusion over the credit for his field’s productivity was the bread and butter of rural uncertainty about book farming and the science of agriculture. Walker’s skepticism about and Wickham’s continued need to clarify and promote book farming were part of the same milieu of acceptance or resistance. Again, the core of the matter was authority and belief; Lewis and Walker stood unsure about whom to believe, while Wickham affected the character of one who was believable.



What does any of this say about resistance? And how could it be overcome? One important concern was that it was hardly clear to the practicing farmer how new ideas would work or where they would lead—that is, if they *were* progressive or destructive, if they were improvements or novelties, if they were fact or speculation. Indeed, there had been ample evidence to show that not all new ideas were good ones.⁶⁰ With respect to the role of science on the farm, those resisting book farming perceived a breach between their goals of improvement

⁵⁹ Skinner, *AF* (1819) 1: 62

⁶⁰ Undermining a simple faith in progress and novelty, Fessenden had said a farmer “should exercise his own good sense on every proposed improvement, and neither consider that it must be useful because it is new, and has the sanction of some great names, nor let its novelty be an insuperable objection to its adoption.” “Many...theories relating to agriculture...considered as very useful and meritorious, are now deservedly sunk in public estimation.” Fessenden, “The Science of Agriculture and Book Farming,” 15.

and the *value* of science. Southwick, Skinner, and Fessenden tried to redress this perception by connecting virtue and the political economy of agriculture to science. They worked hard to convince real, genuine, practical farmers that their concerns may have been justifiable against the dandies, but they were not justifiable against book farming.⁶¹ They did this by proposing that book farming, when right, was georgic or homespun science. Another dominant concern was that those who were already distrusted—the dandy, the insolent, the man of “whim-whams” who was “full of notions”—seemed to have undue influence on practicing farmers. So how could a practicing farmer tell the difference between valid improvements and dandy-esque novelties, between legitimate observations and contrived speculation? The early years of the rural press, then, fit into a preexisting climate of georgic interaction with the land, where resistance to book farming was resistance to science. The responses to these concerns, of course, were part of that same milieu, always emphasizing a specific moral *practice* that happened to be a right kind of science.

Given the prevailing lens of diligent and valued labor, these were questions not just about method and system, but about whom to believe and why. They were about trust and reliability. The level of discourse where discussions of book farming took place was filled with platitudes. Don't be a dandy, be homespun; be a stranger to vice, a friend to virtue. Within these terms, and lodging the authority in the hands of the farmer, whether one accepted the value of science was a matter of whether one saw the system or method as virtuously pursued and reported.

⁶¹ Southwick thought “sound and extensive science [is] acquired only by...laborious study and research.” *PB* (1819) 1: 19. Skinner asked his readers to “lay aside prejudice and listen to the suggestions of those experienced *in the thing, and then judge,*” as a general policy on interpreting results. Elsewhere he emphasized the direct connection between systematic attention and improvement. *AF* 1: 62; Skinner also said that “the *systems* pursued, if described in detail, could not fail to promote ...improvement.” *AF* 1: 68. An anonymous contributor to *Virginia Farmer's Register* thought the “most plausible reasoning upon the operations of nature, without accompanying proof deduced from facts, may lead to a wrong conclusion, and it is often difficult to separate that which is really useful from that which is merely visionary.” *FR* (1834) 2: 743

There is more to this, of course. I have been considering the ways agricultural science and chemistry gained the credibility to improve agriculture and could become a valid practice for working the land, questions whose answers cannot be deconstructed only with an evaluation of prevailing value claims. Broader philosophical, organizational, publishing, and cultural factors play important roles as well. For example, the increasing availability of texts like Davy's *Agricultural Chemistry* (1813) and, soon, Justus Liebig's *Organic Chemistry and its Relations to Agriculture and Physiology* (1840), has a place in the story. (In fact, that has been the basis for most stories about science and agriculture in American history.) But, when published and diffused into the hinterlands of rural America, those contributions would be perceived as *external* to the agrarian community. Because of that outsider status, the role the theories of Davy and Liebig played in defining their own authority—that is, in establishing their social credibility—would have to follow from a consideration of the farming class's values.⁶² If I were explaining the diffusion of Davy or the acceptance of Liebig, then, my story would have to consider the factors that existed in the so-called consuming community, a story that would show it was not in fact consumption of knowledge and practice but reproduction of knowledge within a pre-existing set of conditions.

My point, however, is that Southwick's "moral, political, and economical" goals were of a piece with the value of science, in just the same way that Americans like Washington and Jefferson in the eighteenth-century were promoting a multi-purposed georgic science. What began as an association of science with dandies, in the sense that science was speculative and

⁶² The fact that all of these conversations were taking place during the period between 1820 and 1850 of significant "clarification and consolidation" with respect to "improved analytical procedures...the growth of journals...[and] the rapid dissemination and criticism of results," as the noted historian of chemistry Aaron Ihde has written, would also help explain the cultural prominence of chemical method. But, again, those are all developments occurring *within* a social sphere of chemists and men of science and as such do not tell us much about how those developments were perceived from outside that sphere. See Aaron Ihde, *The Development of Modern Chemistry* (New York: Harper and Row, 1964), 420-421.

theoretical, became bifurcated into dandy science and homespun science. The former was still speculative, but not definitive of all science; the latter was fact-based and derived from agricultural experience.

Places Cultural and Geographic, By Way of Conclusion

“Agricultural theories, ...or *guesses*, for they are little better, are as plenty as black berries,” [anonymous], *The Southern Planter*, 1842

“Mr. Justus Liebig is no doubt a very clever gentleman and a most profound chemist, but in our opinion he knows about as much of agriculture as the horse that ploughs the ground, and there is not an old man that stands between stilts of a plough in Virginia, that cannot tell him of facts totally at variance with his finest spun theories.” [anonymous], *The Southern Planter*, 1845

“Let science, applied to the culture of the earth, go hand in hand with practical labor and let us still further encourage, protect, and elevate the noblest race of men God ever placed upon his footstool – *the laborious, free, and independent American farmer.*” James Campbell, 1856⁶³

Samuel Swartwood, a Maryland farmer, boasted gleefully in 1819 that “I desire, most ardently desire, that my favorite theory should obtain proselytes.”⁶⁴ Apparently, there were a lot of Swartwoods. With the agricultural press growing in number and diversity, theories of soil fertility were seemingly endless and proposable by anyone. James Garnett, speaking before the Agricultural Society of New Castle County, Delaware, in 1842, summarized that precise issue: “[C]ertain great theories and systems, promulgated from high places, like other humbugs, have their day, until some plain farmer declares, and proves too, that the author has been misled by his ignorance of the facts upon which he has attempted to reason.”⁶⁵ The anonymous epigraph above

⁶³ *SP* (1842) 2:186; *SP* (1845) 5: 23; and Campbell in *Congressional Globe*, 34th Cong., 1st sess., 17 April 1856, 958, 959 (as quoted in Sarah Philips, “Antebellum Agricultural Reform, Republican Ideology, and Sectional Tension,” *Agricultural History* 74 [2000]: 799-822, on 817-818)

⁶⁴ *AF* (1819) 1: 278

⁶⁵ As reprinted in *SP* (1842) 2: 257

about Liebig's ill-formed farming credibility points to the same contrast, in that case characterized as one between fine spun theories and farm-based facts.

The tenor of such remarks was reminiscent of late-eighteenth century, georgic-era rhetoric about locating improvement in the hands of the working farmer. However, the concerns by the mid-1800s fit into a context somewhat different over that of the early century. Those earlier arguments for the place of science on the farm—that science is good—had moved into new claims for the place of properly collected “facts” on the farm—that science is good if it is sanctioned by epistemic authority, a kind of legitimacy granted only to farmland-based facts, not disengaged speculation.⁶⁶ Put another way, the generality of claims for scientific studies of the land had become clarified inside the deeper social issues of trust and credibility. All those issues were approachable through the guise of virtue and, ultimately, the virtue of the fact.

A fact could be enlightened, strong, sound, pure and well-ascertained. “[U]nvarnished facts are very scarce,” another *Southern Planter* contributor wrote, “and yet, they are only foundation upon which sound theories can rest.” A report from the Hole and Corner Club of Albemarle on “EXPERIMENTS” proclaimed that “Science calls loudly now for well ascertained facts, from which she may deduce the laws of agriculture.”⁶⁷ Even when reviews of prominent European chemists appeared in the American rural press, they were delivered in a context of

⁶⁶ As an example of how the tension between a science of agriculture and actual chemists (scientists) was portrayed in the agricultural press, consider *The Southern Cultivator* in 1845. On one page the editor explained: “It would not be a very difficult task to make the *Cultivator* a scientific paper, filling it with speculations of philosophy, and extracts from Chaptal, Davy, Liebig, Johnston, Boussingault and others. But this is not what the country wants just now....What we want now, is a plain account of the experiments of men of plain common sense.” The claim for plain advice from plain men was meant to stand in opposition to philosophical or speculative advice. Yet, four pages earlier a column on the “Necessity of supplying the Soil with the Constituents of the Crops grown on it,” reported that “Chemistry, the patron-genius of agriculture, is now lending its aid...to dispel the darkness which has too long enveloped the farmer in his pursuit.” Chemistry could be shunned as speculative, while lauded as a patron genius. See *The Southern Cultivator* (1845) 2: 72 and 68.

⁶⁷ In another editorial, while applauding a speech of James Garnett's, Charles Botts defined the common tenets of natural philosophy and chemical science, saying that “Philosophy is the generalization of well ascertained facts, and without the facts, there can of course be no philosophy.” *SP* 1: 126. Another farmer writing from Virginia believed only in “well established principles deduced from facts.” *SP* 4: 77

practical farming that deferred to field experience. Negative reviews of Liebig, for example, again called attention to deficiencies in Liebig's fact-gathering skills. In this sense, when the average, non-specialized farmer wrote to the rural press, he was saying nothing too different with respect to the rhetoric of facts than the reports coming from scientific journals.⁶⁸

The widespread use of the laboratory metaphor for the field served only to strengthen the importance of place-based facts. Scholars are more accustomed to discussing field-based work and laboratory-based work in a later nineteenth-century context, after the so-called laboratory revolution of chemistry.⁶⁹ But those metaphors had already been developed in the decades before the Civil War. "The soil," said the president of the Maryland Agricultural Society, Robert Smith, "is the great laboratory in which the food of plants is prepared." The open field and the farmland were the places for agricultural chemistry development. By the late 1850s, Richard Eppes of Virginia could look upon his land and take the farm-as-laboratory observation farther to claim that "A farm is another name for a chemical laboratory. It is only another way of manufacturing."⁷⁰ Liebig too proposed such metaphors of farm and lab, but his contribution was hardly singular.

⁶⁸ As reprinted in *The Southern Planter*, French Professor Mohl wrote that Liebig had "not formed his conclusions on the detailed facts of vegetable phenomena, but on random observations, or vague operations on a large scale." In so doing, Mohl provided the critique a practical farmer would want to hear. *SP* 2: 257, 4:81, and 4: 27. See also Rossiter, *The Emergence of Agricultural Science*; William Brock, *Justus von Liebig: The Chemical Gatekeeper 1837-1987: In Celebration of the 150th Anniversary of the Society* (London: Chrysalis Books, 1987).

⁶⁹ For more on the development of laboratory chemistry, see William Brock, *Justus von Liebig*; Frank James, ed., *The Development of the Laboratory* (London: Basingstoke, 1989); Frederic L. Holmes and Trevor H. Levere, eds., *Instruments and Experimentation in the History of Chemistry* (Cambridge, MA: MIT Press, 2000); and William Brock, *Norton History of Chemistry* (New York: Norton, 1993), 194-207 and 427-435.

⁷⁰ As early as 1819, Eli Davis, a farmer of limited means in South Carolina, wrote that an Agricultural Society should be set up because, "By this means the great laboratory of nature would be gradually opened to the view of many who, perhaps, know but little of the very intimate connexion that subsists between chemistry and agriculture." *AF* (1819) 1: 265; R. Smith in *AF* (1820) 2: 228; Eppes, as quoted in Kirby, *Poquosin*, 37. In *The Southern Planter* of the 1840s, Charles Botts argued against book farming because the use of "laboratory" had lost its attachment to nature – "The philosopher must exchange his laboratory for the open field," in *SP* (1842) 2: 186. A local leader, Dr. Ezekiel Holmes, told the Lewiston Cattle Show and Fair that "The earth is the great laboratory and the farmer is the chemist" (as quoted in Merchant 1989, 210). This topic unfolds into discussion of laboratory versus field science, the full force of which I can only allude to, but not develop, here. For discussions of the lab-field border see Robert

Simply put, from the perspective of the farmer, the facts had to come from someone who worked the land.⁷¹ The ideas of soil and the material means for developing those ideas were not separate—what was known of the land was based on how one worked it. Culturally, social and epistemic authorities were also inseparable—the value of the fact was related to the virtue of the fact-gatherer. This emphasis on facts was tied to the place where they were gathered, further binding together two different senses of “place.” Social authority (the place scientific knowledge held) and geographical location (the place from which scientific knowledge was based) were intertwined.



Perhaps the most comprehensive way to look at the issue of book farming is by recognizing the georgic philosophy of praxis embedded within it: how those who labor in the earth know the land versus those who write in closets, speaking from disengaged speculation; the active versus the contemplative. The connection between this praxis-oriented approach to agricultural knowledge (that to work the land is to know it) and a practical philosophy of science (that science should be based on providing practical, and practicable, results) is the common value set of utility, diligence, and labor. It is not enough to say that Americans were practical, or that they promoted a Baconian fact-gathering philosophy of science. Despite the resistance to general theories in agricultural chemistry, what the opponents of book farming were really

Kohler, *Labscares and Landscapes: Exploring the Lab-Field Border in Biology* (Chicago: University of Chicago Press, 2002) and Henrika Kuklick and Robert Kohler, eds., “Science in the Field,” *Osiris*, Second Series, 11 (1996): 1-265.

⁷¹ To be sure, experimenting, quantifying, and observing had always been commonly used terms. Appeals to “ocular demonstrations” and the value of “collecting facts” had been consistently deployed for decades. John Binns’s 1803 *Treatise on practical farming*, so lauded by Thomas Jefferson and agriculture leaders, had argued for a strong method and for the value of experiment. It was just as Judge Peters knew when he suggested plastering old fields because the theory of its viability was credible, having been “tested by strong facts.” *PB* (1819) 1: 19. John Spurrier before that (1793) and Thomas Ewell after (1806) had likewise promoted method, observation, experiment, and the recognition that agriculture was a science to be pursued with diligence and by gathering facts (not to mention their Scottish and English predecessors).

concerned about was who provided those theories and from where the facts were found. There were theories, and they were everywhere. What mattered was whether or not they were wedded to the belief that “working is knowing.” James Campbell, a Pennsylvania Whig speaking with a neo-Jeffersonian voice before Congress in 1856, assumed and extended the argument that science was a tool to be applied to the farm, a set of practices and methods, by conjoining the nobility of agriculturalists with science. Let “science, applied to the culture of the earth, go hand in hand with practical labor,” he would say. In the process, he subsumed the earlier material and moral discourse of georgic virtues within his understanding of the role of science in society.⁷² His argument, he believed, rested on the virtue of the farmer, the “noblest race.”

Studying book farming in its contemporary context brings with it contradictions, inconsistencies, and vagaries, as the cases of Wickham and Walker highlight. Tensions abound in historical work as well: traditional versus progressive or modern, practical versus speculative, active versus contemplative, field- versus laboratory-based, market-oriented versus subsistence (macro-economically) or gentleman farmer versus practical farmer (in terms of economic class). Some of these, like market-oriented versus subsistence farming, seem to be historiographical constructs that have little to do with the actual nineteenth-century discussion of book farming. Others, while not constructed by historians, were politicized rhetorical maneuvers in their original use. To label an opponent of book farming “traditional” was to place him into an inescapable binary of forward or reverse. In an age of improvement, looking to the past ran against dominant social views. Similarly, but from the other side, to say that book farming was speculative and impractical set the book farmer on the wrong side of a common value set that cherished practical means and admonished “fine spun lubrications.”

⁷² See the *DAB*, vol. 3, 455

The different form of acceptance of agricultural science by the mid-nineteenth century—not *whether* science had a place on the farm, but *in what way* it had a place—speaks to the perception of a new authorized mediator between farmer and land. Questions about book farming, then, tie together several issues of the place of scientific authority. Why improve? Because improvement was not only a program of economic and social progress, but also a plan for cultural stability, of utilizing new methods and practices to maintain a stronger society. Why write? Because communication was the staple of improvement, the legible means by which agricultural improvement could take place. Why resist? Not just because of mindless ignorance or feet stuck in tradition, but for valid and rational reasons that hinged on the authority of those who prescribed change and the system of belief within which the acceptance or rejection of new practices were based. What mattered? Given the system of belief and authority, the important factor in debates about book farming was *who* as much as *what*.

The place of science and agricultural chemistry in the fields of antebellum America was diffuse, but readily observable. I have diffracted the notion of “place” in this chapter, speaking to authoritative (social), geographical (physical), and virtue-based (moral) places, as a way to understand how the conditions were created for chemistry to take hold in the cultural background of rural assumptions. In the next chapter, I limit my scope to the consideration of three agricultural texts spanning the 1820s and 1830s. Each forwarded ideas of chemical practice, each deferred to or deployed the works of Humphry Davy to various degrees, and each was written and published for georgic consideration outside the sphere of the chemical community but inside the world of rural economy. My goal, next, is to elaborate more directly the place of agricultural chemistry as a mediator of perceptions of nature.

Chapter 3

Knowing Nature, Dabbling with Davy

“Behold another volume on husbandry! exclaims a peevish man on seeing the title page: how long shall we be pestered with such trite stuff?” Henry Home, *The Gentleman Farmer*, 1776¹

Chapter 2 concerned the value of science. In it, I asked how that value was assessed by georgically oriented farmers, those Americans seeking to improve rural economy as a cultural and political foundation. My point, as seen with the example of book farming, was to show science gaining credibility as a farming practice—earning a place in rural America—by fitting into dominant and pre-existing rural virtues. In this chapter, I focus more specifically on the role of chemistry as a mediator between farmers and their land, or, between humans and nature. How was agricultural chemistry used to inform perceptions of cultivated or cultivatable nature? What did it take to “know” the land this way? And how did these questions fit within the tension between vitalist and materialist philosophies of nature then current in the Romantic era? I argue that agricultural improvers were adept at chemical philosophy and practice on their respective lands, formulating their own ideas in relation to the leading chemical theories of the day. Where the second chapter elaborated the place of science in the moral fabric of rural America, this chapter elaborates the place of chemistry in rural working philosophies of nature.

I approach these concerns by examining three agricultural treatises of the early American Republic. Each was written by a book farmer for the purpose of agricultural improvement. Each author used chemistry to some degree to give force to his strategies. And thus each work shows how chemistry was introduced as a window through which to see the land. Like a new lens, chemistry’s instrumental opacity caused the users—the farmers and book farming proponents—

¹ Lord Kames (Henry Home), *The Gentleman Farmer, Being an Attempt to Improve Agriculture by Subjecting it to the Test of Rational Principles* (Edinburgh: publisher unknown), vii

to comment on its presence and to explain its role between them and their goals of improvement. It had yet to gain the transparency that unquestioned legitimacy would later bring. The first example is Edmund Ruffin's *Essay on Calcareous Manures* (1832), published in book-length form in Petersburg, Virginia. The second treatise is John Lorain's *Nature and Reason Harmonized in the Practice of Husbandry* (1825), published posthumously by his wife in Philadelphia. The third text is one I referenced in the previous chapters, Daniel Adams's *The Agricultural Reader, Designed for the Use of Schools* (1824). Adams's work was published in Boston for distribution around New England.

The agricultural chemistry under consideration by Ruffin, Lorain, and Adams drew explicit connections between scientific analysis and nature. It was an early example of environmental science. Writing before 1840, the authors dabbled to varying degrees with the work of the foremost international authority on agricultural chemistry, Sir Humphry Davy. On that topic, Davy's name had been ever-present from the time of his *Elements of Agricultural Chemistry* (1813), though soon—at least by 1840—the German chemist Justus von Liebig would become the primary reference point for agriculturalists aligning science with improvement. In terms of the development of science, that transition from the 1810s through the 1840s now appears as a shift from the organic, humus theory of plant growth and soil fertility represented by Davy to the inorganic, mineral theory of Liebig. With respect to philosophies of nature, the bounded points of that transition also correspond to a change from viewing the land as an interactive, interrelated economy of vital components to one of individual, inorganic elements, each identifiable through analysis and replaceable in quantified measure.

Romantics bemoaned these developments. Samuel Taylor Coleridge foresaw them in the 1820s when he observed that “All Science had become mechanical.” It had been “given up to

Atheism and Materialism.”² Environmental historians and science studies scholars have made similar observations. Carolyn Merchant traced the change as the capitalist ecological revolution that brought a mechanized nature to the fore of agricultural consciousness. She writes of the replacement of those who *imitated* nature, the animistic, by those who *analyzed* it, the mechanistic.³ The instrumental character of sciences like chemistry, to be sure, played an influential role in establishing nature as that analyzable entity.⁴ It is telling that Davy’s theories were consistent with and also easily accepted into the more imitative organic worldview, while Liebig’s theories, in their mineral, inorganic framing, appeared to oppose vitalist philosophies of nature. (Liebig, in fact, was well known for his later opposition to the vitalist *naturphilosophie* setting into which he was educated.) The shifts between the two men are thus more than mere chemical stories, but also commentaries on philosophies of nature, as Romantics like Coleridge understood.

² As quoted in Trevor Levere, “Coleridge, Chemistry, and the Philosophy of Nature,” *Studies in Romanticism* 16 (1977): 349-379, on 358.

³ Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press, 1989), 147-231. Also see Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row Publishers, 1980).

⁴ Science in the Romantic era, if treated as a whole, appears as a confusing assemblage of competing metaphysical and conceptual commitments. See Andrew Cunningham and Nicholas Jardine, eds., *Romanticism and the Sciences* (Cambridge: Cambridge University Press, 1990); Evan Melhado and Tore Frangsmyr, eds., *Enlightenment Science in the Romantic Era: The Chemistry of Berzelius and its Cultural Setting* (Cambridge: Cambridge University Press, 1992); Robert Richards, *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago: University of Chicago Press, 2002); Peter Ramberg, “The Death of Vitalism and the Birth of Organic Chemistry: Wöhler’s Urea Synthesis and the Disciplinary Identity of Organic Chemistry,” *Ambix* 47 (2000): 170-195; and Ursula Klein, *Experiments, Models, Paper Tools: Cultures of Organic Chemistry in the Nineteenth Century* (Palo Alto: Stanford University Press, 2003). E. Benton long ago made the sensible presentation of vitalism as a label for a variety of positions, and I do not mean to reify the term to treat it as one doctrine. Benton, “Vitalism in 19th-Century Scientific Thought: A Typology and Reassessment,” *Studies in History and Philosophy of Science* 5 (1974): 17-48. Historians of chemistry have contributed widely to questions about popular chemistry in Europe and America and chemical education, but mostly without attention to agricultural chemistry or the farming classes and, in the best work, with use of Jane Marcet’s popular texts as the historical source. For suggestive accounts of these topics, see David Knight, “Accomplishment or Dogma: Chemistry in the Introductory Works of Jane Marcet and Samuel Parkes,” *Ambix* 33 (1986): 88-98, Susan Lindee, “The American Career of Jane Marcet’s *Conversations on Chemistry*,” *Isis* 82 (1991): 8-23, Greg Myers, “Fictionality, Demonstration, and a Forum for Popular Science: Jane Marcet’s ‘Conversations on Chemistry,’” in Barbara T. Gates and Ann B. Shteir, eds., *Natural Eloquence: Women Reinscribe Science* (Madison: University of Wisconsin Press, 1997) 43-60, and Bruce Lewenstein, “‘To Improve Our Knowledge in Nature and Arts’: A History of Chemical Education in the United States,” *J. Chem. Educ.* 66 (1989): 37-44.

For her part, Merchant tells a compelling story, but she glides over the morass of uncertainty and variety that defined the placement of science into the daily lives of those who actually exhibited agricultural consciousness. Along with Donald Worster, whose reference to the change from Arcadian and Imperial views outlined a similar transformation, Merchant has mapped out the broad shifts in perceptions of and modes of interaction with nature that defined an analyzable, mechanical world. The examples of Ruffin, Lorain, and Adams discussed below fit into the middle of the now-visible transition period between Davy and Liebig. My discussion of their work thus does not present a picture of stark change over time, nor does it resolve these tensions of organic and inorganic, or vital and materialist. My main purpose in this chapter is to draw out some of the complexity that underlay those accounts.

Ruffin, Lorain, and Adams were familiar with Davy's work and impressed by the contributions the Englishman had made to the agricultural life. As well, the authors, with different degrees of emphasis, represented nature as a living and organic system. Ruffin in particular blended vitalist and materialist concepts, while Lorain always demanded attention to "the vital economy of nature" as his basic mantra. Adams was similar to Ruffin and Lorain at different points, but was more forceful than either in conceptualizing the land as an improvable entity and in forwarding Davy as the preeminent authority on all matters of agricultural chemistry. Adams was an appropriator, taking Davy's word at all times and without criticism. Lorain was a refuter, rejecting Davy's testimony as much as Adams had accepted it. Ruffin split the difference, tempering the import of Davy's theories by reference to georgic practice while acknowledging the value of his laboratory-tested ideas. Each author's view of chemistry was consistent with his philosophy of nature. In the second half of this chapter, I will explore the

place of chemistry in the authors' improvement proposals. First, though, I look at the background and views of nature presented in the texts.

The Nature of the Agricultural Treatise

Farmer's knowledge in the early nineteenth-century was embodied as much in mental labor as the physical toil that dominates images of agriculture. Knowledge acquired through intensive experience fits within the georgic ethic of integrated physical and mental labors.⁵ Ruffin was born in 1794 into just this context, but with particular attention to the upper South. Lorain was more than a generation older than Ruffin, born in 1753 in the colony of Maryland. His insights are thus derived from a more senior analysis in the young Republic, though with the same goal of improvement. Adams, born in 1778, split the age difference but edged geographically north, having been raised in New England. He was devoted to improvement and agriculture inside the legacy of a Puritan social structure but outside the concerns of Ruffin's slave labor issues and Lorain's context of backwoods expansion. All three informed their works by appealing to the experience of the working farmer and tied the validity of their proposals to the authority of that experience.

A word or two ought to be said about my choice of these authors and sources. I focus on them not because they are definitive of the period, but because they are illustrative of views about nature, representations of chemistry, and the motivations for associating the two. Other writers on agriculture and science might have been used.⁶ The three authors hail from different

⁵ Deborah Fitzgerald makes a similar comment with reference to a later, early-twentieth century era of farming labor. See D. Fitzgerald, "Farmers Deskilled: Hybrid Corn and Farmer's Work," *Technology and Culture* 33 (1993): 324-343, on 327-328. Fitzgerald's discussion is directed at how the introduction of hybrid seeds deskilled farmers by removing the need for the thoughtful analysis of corn planting techniques. Her point about farmer's labor and knowledge is surprisingly relevant to the century before.

⁶ Among some of the other prominent farming class works that broached the subjects of chemistry, Davy, and improvement were Frederick Butler, *The Farmer's Manual: Being a Plain Practical Treatise on the Art of Husbandry Designed to Promote an Acquaintance with the Modern Improvements in Agriculture* (Hartford, CT:

cultural and economic regions of the antebellum era, making it difficult to understand their uses and views of chemistry without noting the distinct political atmospheres into which those uses and views were introduced. Thus, Ruffin, Lorain, and Adams differed in their stated purposes for writing (though not in their overarching themes of “improvement”), the approaches they took to utilizing science for the benefit of the farm, and their social outlooks. Each writer was more socio-economically privileged than the average working farmer and so it would also be incorrect to consider them representatives of the common social experiences of mass culture. But the three shared important features and, as such, I group them together for the similar formats they employed, their interest in utilizing chemistry, their concern for exploring the value of science for improvement, and their status as historical figures working outside the realm of a cohesive chemical discipline. They provide an opportunity to ask not exactly what the “common” person thought, but at least what the non-scientific agent thought.⁷ They offer a useful blend of diversity and unity in expression.

Samuel Goodrich, 1819) and William Drown, *Compendium of agriculture: or, The Farmer's Guide, in the Most Essential Parts of Husbandry and Gardening* (Providence: Printed by Field & Maxcy, 1824). Another popular account in the spirit of the georgic tour, written from travels in Nova Scotia and cited in, among others, Daniels Adams's book, is John Young, *The Letters of Agricola on the principles of vegetation and tillage* (Halifax, N.S.: Printed by Holland & Co., 1822). Jesse Buell, perhaps Ruffin's New York counterpart, published his (1839) *Farmer's Companion* as a compendium of his own experiences in the previous decades. Charles Squarey, a chemist, likewise sought to write a book “adapted for general perusal” in his, *A Popular Treatise on Agricultural Chemistry: Intended for the Use of the Practical Farmer* (Philadelphia, PA: Lea & Blanchard, 1842), iii. Squarey's work was published in the United States and London (by J. Ridgeway) in the same year. He leaned heavily on Liebig, though, and as such his treatment falls into a later era than I would like to consider here. Samuel Dana wrote a widely reprinted text based on his work in the later 1830s, published in the early 1840s and offering theories and advice in tension with Liebig, but his text was highly technical and could not have had the audience that the other books referenced here did; see Samuel Dana, *A Muck Manual for Farmers*, 3rd edition (Lowell, MA: James P. Walker, [1842] 1851). Thomas Fessenden compiled decades of his own observations and writings from *The New England Farmer* and beyond, including his many satirical accounts of science and agriculture from earlier in the century, in Fessenden, *The Complete Farmer and Rural Economist; Containing a Compendious Epitome of the Most Important Branches of Agriculture and Rural Economy* (Boston: Lilly, Wait, and Company, and G.C. Barrett, 1834)

⁷ The distinction between these three and the dominant scientific authors of the time is not one of upper versus lower class; rather, it is the difference between those who were “men of science” and those who were men of agriculture. It is the burden of my three examples to associate those two realms of thought and practice in the direction *from* agriculture *to* science, not from science *to* agriculture.

Ruffin's Virginian Nature

Background

Edmund Ruffin had several identities. He was a Southern rural editor, a fertilizing experimenter, an agricultural treatise author, an amateur chemist, and a rabid pro-slavery secessionist. Each identity, in common, was based in rural economy and part of a worldview related to perceptions of the land. Ruffin saw that land as alive, filled with powers, subject to injury and healing, and analyzable for its discrete parts. In his twenties, he had a Eureka moment when reading the fourth book of Davy's (1813) *Elements of Agricultural Chemistry*. Based on comments Davy made, Ruffin surmised that exhausted soil had become so because of increased acidity. He proposed, then, to alter the acidity of his land by adding calcareous manures—marl, or fossilized shells, found on the riverbanks of his eastern Virginia land. Chemistry, on Ruffin's reading, had proven valuable as a diagnostic tool. He found the use of that tool consistent with his vitalist perceptions of the land. That is, chemistry became a lens through which Ruffin could see nature because it too interpreted the land as alive and analyzable. For him, and as a complement to his various personas, both nature and chemistry fit within the tension of vital and material concepts.

Ruffin has been the subject of many studies, his life's work being variously cast as remarkable, tragic, highly influential, and deeply problematic.⁸ He founded, edited, and published *The Farmer's Register*, which from 1833 ran to ten volumes under his guidance. In addition to writing the *Essay on Calcareous Manures*, he served briefly as a state senator,

⁸ Jack Temple Kirby provides a concise review of the interpretations given by Ruffin's principal biographers in his introduction to Edmund Ruffin, *Nature's Management: Writings on Landscape and Reform, 1822-1849*, ed. Jack Temple Kirby (Athens: University of Georgia Press, 2000), xvii-xix. In addition to the general biographical overviews, the historian of chemistry Aaron Ihde long ago wrote of Ruffin's chemical acumen. See Aaron Ihde, "Edmund Ruffin, Soil Chemist of the Old South," *Journal of Chemical Education* 29 (1952): 407-414.

delivered countless addresses to local agricultural societies, was the state agricultural and geological surveyor of South Carolina, and, in the 1850s, published at least four books promoting slavery.⁹ Even with the fame from these efforts, two events of the 1860s were Ruffin's most notorious: his reputed status as the man to fire the first shot of the Civil War, at Fort Sumter, and his life's suicidal end with a shotgun following the defeat of the Confederacy in 1865.

As for Ruffin the agricultural reformer, he was contributing to a tradition of rural authorship defined in part by John Taylor earlier in the century. His georgic work made frequent reference to the eighteenth-century improvers common to Scottish, English, and Colonial American planters. The *Essay* he wrote as part of this tradition had a long publishing cycle. It began as a brief presentation of soil fertilizing experiments in *The American Farmer* in 1821, expanded with unpublished revisions throughout the 1820s, and reached its first book-length publication in 1832. That 242 page text was reprinted and revised in supplements to Ruffin's own *Farmer's Register* in April 1835 (2nd edition) and December 1842 (3rd edition), then published in a fourth edition in 1844 and as a 493 page book, the fifth and final edition, in 1852. The 1832 edition I refer to below met with popular approval in both domestic and foreign reviews. It has since been hailed as a landmark in nineteenth-century soil science.¹⁰

The main argument in Ruffin's text is three-fold. First, he makes the case that vegetable acid in soil causes "natural sterility," thus rendering it exhausted and unproductive. (At the time, soil exhaustion was widely recognized as a problem, but explaining its cause by reference to

⁹ See William Mathew, *Edmund Ruffin and the Crisis of Slavery on the Old South: The Failure of Agricultural Reform* (Athens: University of Georgia Press, 1988); David Allmendinger, *Ruffin: Family and Reform in the Old South* (New York: Oxford University Press, 1990); Kirby, ed. *Nature's Management*; Kirby, *Poquosin*, 61-91; and Stoll, *Larding the Lean Earth*, 151-159.

¹⁰ J. Carlyle Stitterson, in a 1960 reprint of the *Essay* estimated that 5000-6000 copies were ultimately printed. See "Editor's Introduction," in *An Essay on Calcareous Manures* (Cambridge, MA: Harvard University Press, 1961).

acidic levels was a still-unelaborated idea.) Second, he shows that “The fertilizing effects of calcareous earth are chiefly produced by its power of neutralizing acids” (21).¹¹ That is, the application of calcareous earths like marl to exhausted soil can neutralize such acidity. Third, he explains that the then-neutralized soil can be improved with standard manures, such as putrescent animal and vegetable matter. His premise is not that the simple addition of marl to exhausted soil will restore its productive abilities. It is, rather, that marl is a useful means to another end, a necessary additive that aids the ultimate goal of soil improvement but does not directly cause it.

Ruffin presents a seventeen-chapter exposition to lay out his argument, with chapters describing the types of soils, their different capacities for improvement, and his proof for the assertions about soil properties and causes of exhaustion—proof garnered by “chemical examination,” conclusions drawn from field observations, and logically constructed counter-arguments set against opposing views. Five propositions, each then expanded and confirmed, structure the bulk of the *Essay*:

- “1. Soils naturally poor...are essentially different in their powers of retaining putrescent manures.
2. The natural sterility of the soils of Lower Virginia is caused by such soils being destitute of calcareous earth, and their being injured by the presence and effects of vegetable acids.
3. The fertilizing effects of calcareous earth are chiefly produced by its power of neutralizing acids....
4. Poor and acid soils cannot be improved...by putrescent manures without previously... correcting the defect in their constitution [by using calcareous manures].
5. Calcareous manures will give to our worst soils a power of retaining putrescent manures equal to the best” (21-22).

He follows the proof of these proportions with direct instructions and commentary on the expense, profits, and requirements for digging and carting marl. His goal was to sustain the

¹¹ References to Ruffin’s *Essay on Calcareous Manures* are so frequent in this section that I note the page citation parenthetically. In the next section, on John Lorain, the parenthetical page citations refer to his work; in the third section, on Daniel Adams, they refer to Adams’s work.

Virginian political economy by achieving material gains in crop yield and productivity afforded by marling.¹²

Ruffin's view was a novel contribution to antebellum conceptions of fertilization, especially in its clarification of how and why marl worked.¹³ His thoughts on exhaustion made sense in part because they were tied to extant notions of a living earth available for dissection. His views offered a fluid combination of organic and mechanistic elements, as he conceptualized the cultivatable land of Virginia as having powers, capable of injury, subject to analysis, and available for healing.¹⁴

Characterizing the *Essay on Calcareous Manures* in any singular fashion will slight its overall ambition and appeal, but my reading is specific to the concepts of nature it offers and the role chemistry plays in defining those concepts.¹⁵ What makes his work most relevant in my analysis is that Ruffin believed the problems of soil, society, and crop growth could be solved by an analysis of the chemical and mechanical modes of plant life. Finally, it is notable in retrospect to assess Ruffin's view relative to Davy before him and Liebig after, for he seems to fit perfectly in between, holding Davy-like vitalist and Liebig-like materialist commitments simultaneously and unproblematically.

¹² While later in his life Ruffin devoted many addresses to the tenets of slavery, in his *Essay* he was less concerned with the economy of slaveholding, for the sake of the slaves, than with the cause of increased food production to sustain increasing slave populations (see 162-164). Just as he sought to improve soil to keep free white Virginians comfortably at home, he also thought nothing could address "the forced emigration of blacks, and the voluntary emigration of whites, except increased production of food, obtained by enriching our lands" (164).

¹³ Marl, lime, quicklime, and other calcareous agents had long been used as manures, so the specific mention of marl alone was not the notable aspect of Ruffin's thesis.

¹⁴ In the following I do not emphasize the health metaphors Ruffin subscribed to in his own life and as applied to his land, although such investigations have recently proven insightful in environmental and science studies. In particular, for more on the depth of the health metaphor in antebellum concepts of nature, see Conevery Bolton Valençius, *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books, 2002).

¹⁵ For example, the land Ruffin sought to improve near the falls of the James River was already being planted in wheat, oats, and corn as Virginia's famed tobacco crops were already shifting to the South and West by the early 1800s. Nonetheless, the legacy of tobacco's soil exhausting tendencies remained the primary culprit for the sense of decline in Upper South agriculture for decades to come—and the story of tobacco cultivation is also an important backdrop for Ruffin's work.

Representing Land

We can read the *Essay* for its representation of the land. Ruffin, for his part, portrays a landscape understood for its ability to provide marketable products. He sees that the land can become more productive by studying it more thoroughly. “It is a remarkable fact,” he argues, “that the difference in the capacities of soils for receiving improvement, has not attracted the attention of scientific farmers...” (24). To establish that he is just such a scientific farmer, Ruffin embeds his argument for fertilization within a view of nature that is improvable and recognizable to his readers. In other words, he appeals to his audience. To the planters of the South reading his work, Ruffin argues for a specific course of action to affect improvement, something narrower than a general farming method and more specific than the call to “fertilize.” His representation of the land is thus policy-driven and politically motivated.

The policy of progress-by-systematic-investigation (the call of the book farmer) is most basic in Ruffin’s appeal. Improvement, Ruffin believed, will come about by “correcting the defect in [the exhausted soil’s] constitution” (22). The order of nature that enables this view is one of discrete parts and interchangeability. While the *laws* of nature governing soil component combinations are immutable—such as with the universal need to neutralize acidic soil with calcareous manures—nature *itself* is mutable. How best to cultivate? he wonders, because while his nature is complex and interrelated, it is also elemental and extractable. Although governed by a natural order, Ruffin believes the elements within that order can be manipulated and rearranged. It is through that perspective that his integration of vital and material concepts is plausible. To get a sense of how Ruffin views the land and expresses his policy directives, we can read him as answering three questions: What does he see as he looks around his farmland?

How does he envision differences across place (the state of Virginia) at one time? And how does he relate human-caused changes over time in one place?

When establishing the status of the “soils and state of agriculture” in his native Tidewater region (14-20), and then later when touring Virginian lands to the west (37-52), Ruffin offers a georgic-like topographical and geographical overview of the state defined through his own travel.¹⁶ His panoramic views of the land are sometimes elegant, sometimes bland. The tidewater region in eastern Virginia is “generally level, poor, and free from any fixed rock, or any other than stones apparently rounded by the attrition of water” (15-16). On the ridges of the landscape that “separate the slopes of different streams,” different kinds of pines cover the silicious soils, while oaks are mixed throughout, also covering clay land. Young pines thrive on these soils when exhausted by cultivation, growing “with vigor and luxuriance” (16). Ponds of rain water fill shallow basins where whortleberry bushes grow. And while the lands of this area have not been cleared and cultivated very often, those that have were done so unsuccessfully; their “worthlessness, under common management” is evident from even the few examples Ruffin sees. He also highlights zones of fertility within that panorama—primarily the slopes between the ridges and streams—commenting on their once prized but now depleted status.

¹⁶ In this section dealing exclusively with Ruffin, and in the later section dealing exclusively with Ruffin’s chemistry, I will refer to the page numbers in the 1961 edition of *Essay on Calcareous Manures*, which is a reprint of the 1832 edition. By late in his career, Allemdinger notes, Ruffin was comfortable with the georgic genre of the agricultural tour, but this familiarity and interest in the Arthur Young-like style was evident already in select passages from his *Essay*. The similarities were not random – Ruffin had read Young’s agricultural Tours and was familiar with the more recent and similarly styled writings of William Cobbett.

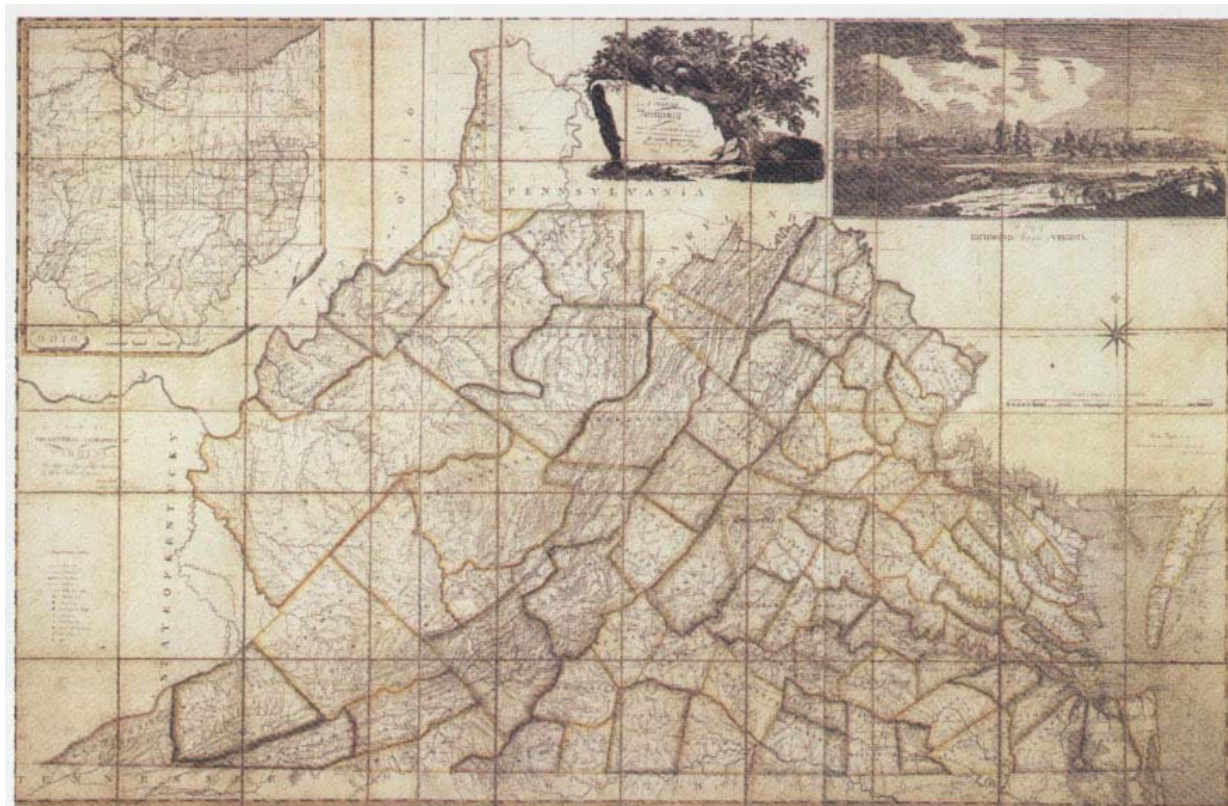


Figure 4. Bishop Madison’s Map of Virginia, 1807. This popular map of the Commonwealth provides more than the span of Ruffin’s travels, while showing the relative lack of development in western Virginia (today the state of West Virginia) as evident by the large counties that had yet to be populated and thus redistributed. Ruffin’s home and primary experimental site was in the eastern third of the state; the extent of his travel, as recorded in his *Essay*, was to the portion of Virginia in the south central (lower middle) part of this map. Reprinted by permission of the Library of Virginia, Richmond, VA.

In his chapter on the “Chemical Examination of Rich Soils Containing No Calcareous Earth,” Ruffin describes trees, soil types, ridge lines, plant varieties, and patterns of successive plant growth (though he does not use the term succession) (46-50; also 37-52, *passim*). His tour from the fall line of the James River (just west of Richmond) to the Shenandoah Valley in the west is presented by reference to a series of soil samples he has had analyzed for calcareous earth (or lack thereof). The land in the Shenandoah Valley, between the Blue Ridge and Alleghany Mountains, was covered with mineral waters from active springs and was “remarkable for its productiveness and durability” (47). Other samples in the Valley were variously black,

yellowish, brown, loamy, and “first rate.” The “soil of first rate fertility” of Fluvanna County, splitting the geographical distance between Ruffin’s home and the Valley, was a dark brown clay loam, both “valuable and extensive” (47). Sample “9,” from present-day West Virginia, offered more variety: “High land in wood, west of Union, Monroe County. Soil a black clay loam, lying on, but not intermixed at the surface with limestone rock. Subsoil yellowish clay. The rock at this place, a foot below the surface. Principal growth, sugar maple, white walnut, and oak. This and the next specimen are from one of the richest tracts of highland I have seen” (48).

Though it is difficult to form a mental image of Ruffin’s tour, his numbered descriptions, totaling nineteen samples, are intended to show variety. The differing color, richness, and compositions of fertile soil were coupled with varying degrees of manageable and tillable land. Complementing his technical attention to cultivation potential, Ruffin the naturalist offered descriptions of gentle slopes, “excellent” soils, and rich black loam full of “nutmeg”-sized limestone (49).

Ruffin’s lifelong devotion to experimentation was impressive and always geared toward redefining the land. His eye for the detail of a naturalist lent itself to an experimentalist’s detail as seen above, but also in his more “scientific” reports of fertilizer trials. In his quest to convince readers that marl was the panacea farmers were looking for, he reported the success of sixteen fertilization experiments performed over thirteen years (1818-1831). In the three chapters describing them, Ruffin provides a view of changes in place over time. “Experiment 15,” for example, took eight acres under second growth and produced a success story of calcareous manuring (108-109). Over five seasons, a thick pine stand was converted from sandy loam covered in “dropped and unrotted leaves” through a crop of wheat and then a planting of corn, which “excited the admiration of all who saw it.” Logs, boughs, and bushes were heaped, and a

wooden-toothed harrow was used to pull down furrows. The “improvement [had been] so remarkable, as to induce belief that the old fields...on every farm” could be made profitable. The experiment’s success, Ruffin was quick to point out, could be credited to the 500-600 bushels of marl spread on each acre.¹⁷ For him, the ability to transform the landscape was exciting and positive, while the methods for doing so were put under increasing degrees of technical and quantitative specificity. On this reading, it was a story of transforming the earth with scientific principles, making the unproductive productive by new modes of georgic improvement. On another reading, this was a textbook example of cultivating the land, a how-to manual for mid-Atlantic farmers. Ruffin had taken wild earth and made cultivatable, and profitable, land.

Ruffin consistently offers views of a mutable landscape that must continue to change through the guidance of “experiments” and further “agricultural research” (3). He has a kind of physician’s view, recognizing the organic whole of the living earth, but seeking to alter it with the aid of reductive medicines like marl. Indeed, throughout his career Ruffin “argued for a notion of expanded human control over soil fertility,” as one of his biographers has noted.¹⁸ This observation is both telling and underexplored. The issue for Ruffin was undeniably one of control, but his form of control promoted the human aspects of a natural order by attempting to understand, manipulate, and thus improve the non-human aspects of it.¹⁹

¹⁷ As another example: “Experiment 16” took a 39 year-old stand of pines that was cut down for fence rails in 1824 and marled it with 600 bushels per acre in 1825. By 1831, the wheat was “so heavy a crop” that Ruffin was in near disbelief (110).

¹⁸ Allmendinger, 23.

¹⁹ In his editing of Ruffin’s writings on landscape, Jack Temple Kirby seeks to place Ruffin as a proto-conservationist, identifying nature’s course so as to better emulate it. But this is only part of the story, since Ruffin’s “sensitivity to the ‘wisdom of nature’ extended only to questions of efficacy, not to intent,” and as such Ruffin’s relationship to the land is more complicated and harder to gauge than the imposition of a later environmentalist framework can do. See Ruffin, *Nature’s Management*. The quote is from David Spanagel, “Review of Edmund Ruffin, *Nature’s Management: Writings on Landscape and Reform 1822-1859*,” H-SHEAR, H-Net Reviews, October, 2001 <<http://www.h-net.msu.edu/reviews/showrev.cgi?path=274641002733673>>

Lorain's Backwoods Nature

Background

John Lorain also wrote glowingly about the use of chemistry for knowing the land and making it productive. He was a Pennsylvania gentleman who lived half his life in the backwoods, clearing and cultivating the earth while writing about his techniques for doing so. Lorain, like Ruffin, saw nature as a vital economy, a living, organic system of interconnected parts. In fact, he was far more forceful on this point than his younger neighbor to the South. And Lorain too had read Davy's work. But he was much less impressed than Ruffin by Davy's qualifications for dictating chemical theory to agriculturalists, concerned that Davy had not based his theories on the daily experience of the farming life. Lorain provides another example of an individual who promoted the instrumental value of agricultural chemistry. He, however, demanded that such a chemical lens be fit to the dynamics of a harmonious organic earth, eschewing any basis in materialism.

Details about John Lorain's life and work are scant. Most of the information we have comes by inference from his published books and through scattered remarks from local archives in Pennsylvania. He was born in Maryland, of English farming immigrants, and moved to Philadelphia later in life.²⁰ There, in the early 1810s he joined the Philadelphia Society for Promoting Agriculture (PSPA), putting himself inside contentious debates about promoting

²⁰ Even this fact is not without dispute—the *Encyclopedia Britannica* claims he was born in England, though records from the Historical Society of Pennsylvania indicate he was born in Maryland. Stoll (2002) notes that he was born on the Eastern Shore of Maryland from recent English immigrants (97). For more biographical commentary see Sweet, *American Georgics*, 110-119; Jehlen, *American Incarnations*, 66. The *Encyclopedia Britannica* summarizes Lorain's life work by the mere mention of corn hybrid experiments he reported in *Nature and Reason*, calling him a pioneer in cross-breeding seeds. Many of the details I include about Lorain are borrowed from Stoll, *Larding the Lean Earth*, 96-108.

agriculture in his contributions to the PSPA's *Memoirs*.²¹ He then moved to the front border of the backwoods at Philipsburg, almost precisely in the geographic center of the state. From his backwoods home, Lorain's first book, *Hints to Emigrants*, was written and published in 1819. (Even the bare title of *Hints* intimates the expansionist and improvement-minded focus and purpose of his writings.) After he died in 1823, his wife Martha had *Nature and Reason Harmonized in the Practice of Husbandry* published from Philadelphia. John Skinner saw fit to republish two chapters in *The American Farmer*, accompanied by a ringing endorsement. One scholar, evaluating Lorain's work as related to developing market conditions, puts *Nature and Reason* into a context of the class stratification being clarified with westward expansion. Another scholar, environmental historian Steven Stoll, places Lorain's contributions into a culture of commentary on the dichotomy between gentleman farmers and backwoodsmen and characterizes *Nature and Reason* as "a major treatise on American land use in the 1820s."²² Lorain's mere suggestion to harmonize nature and reason on the farm, it seems, goes some way in setting the stage for the georgic-like combination of science, improvement, and nature.

Summarizing Lorain's "main" argument is neither possible nor practical, since he has a series of points to make and popular theories to refute. His text is over 550 pages long, broken into fifty-two chapters and four different books. "On Manures and Vegetation" (Book I) is followed by "On Cultivation" (II), "On Various Subjects" (III), and "On Gentleman Farming" (IV). While the first Book treats manures and vegetation for their chemical attributes, the second book focuses more on the mechanical aspects of farming, such as crop options, irrigation, and mounding techniques. In each case, Lorain presents the "economy of vegetation" within a

²¹ See *Memoirs of the Philadelphia Society for Promoting Agriculture*, 2 (1811): 200-205, 319-324, and 330-349 and 3 (1813): 84-119.

²² Skinner's reprint of Lorain's work appears in *American Farmer* 7 (May 6, 1825): 49-50. Stoll, *Larding the Lean Earth*, 102.

system of “vitality or animation” (1-34).²³ If Lorain has one line of consistent attention throughout his work with which we can understand his views of nature, like Ruffin’s strategies of calcareous manuring, it is his commentary on the vital force that guides the growth of crops and requires reasoned observation and evaluation.²⁴ And while the third book’s “various subjects” range from hedges, cats, and sugar trees to a comparison of Pennsylvania backwoods farmers and Yankee cultivators, the final book is a social historical commentary. In it, Lorain offers his motivation for improvement in its most georgic light, connecting the rational pursuit of farming with moral dictates of labor and “genuine principles of rural economy” (412). Throughout the work, Lorain cautions against book farming if it yields advice “opposed to reason,” but approves of it if “derived from observation, reflection, and calculation” (405).²⁵ He consistently argues for a subtle appreciation of the economy of nature, one that would aid the cause of cultivation by approaching fertilization and improvement within an over-arching natural order. For him, that order was vitalist, organic, and interconnected.²⁶

²³ To reiterate my citation style (pointed out in note 11, above), the parenthetical citations in the section refer to page numbers in Lorain’s *Nature and Reason*.

²⁴ This is not to say Lorain comments only on vitalism, or that his work is reducible to just that point. Rather, given the immense scope and length of the book, Lorain’s discussions of vital principles serve as a useful focal point with which to touch on the many ways he describes and conceptualizes nature and, specifically, the soil. It also provides a reference point against which Ruffin’s views on nature and soil can be compared and contrasted.

²⁵ This fourth book, along with chapters 33 and 34 in Book III, bear the most resemblance to Lorain’s (1819) *Hints to Emigrants*. See Stoll, *Larding the Lean Earth*, 96-102.

²⁶ When Charles Dickens wrote about the “quite sad and oppressive” view of central Pennsylvania in his *American Notes*, that the “eye was pained to see the stumps of great trees thickly strewn in every field of wheat,” he was lamenting the same destruction that Lorain had forewarned against just two decades before. Dickens, *American Notes* (New York: St. Martin's Press, [1842] 1957), 152-153.

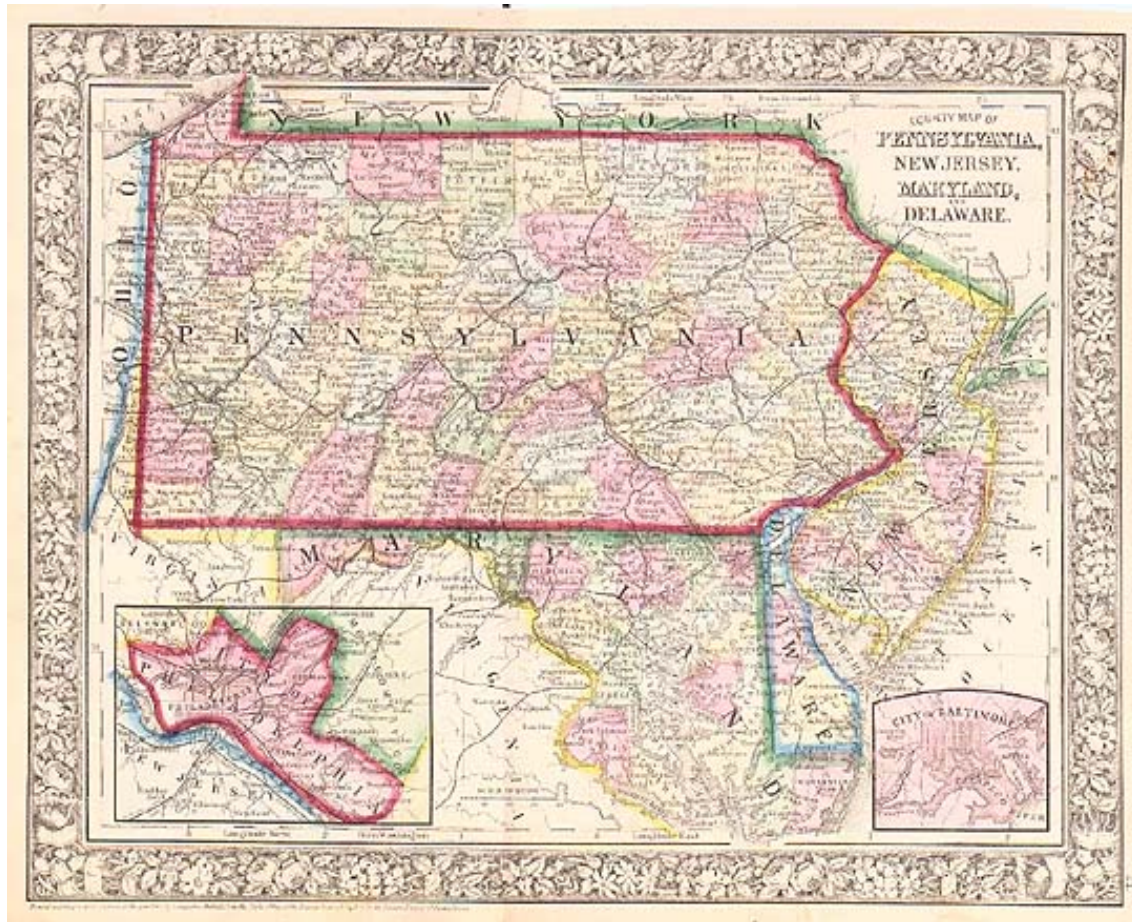


Figure 5. 1860 map of Pennsylvania. Philipsburg, from where Lorain wrote his book and observed “the vital economy of nature,” is near the “L” and “V” in Pennsylvania. At the time of writing in the 1820s, this was the eastern border of the developing Backwoods region.

Lorain wrote as part of a tradition of market-oriented farmer-merchants, those who formed the core membership of the Philadelphia Society for Promoting Agriculture and traced their economic and political heritage through Philadelphia and its hub-like status for goods, services, and ideas within Colonial America. That Lorain wrote about the expanding settlement of the state was not unusual. His actual residence on the borders of wild Pennsylvania, however, provided an extra degree of credibility over the more urban-bound members of his social sphere. In his comments on the practice and viability of turning uncultivated wilderness into viable agricultural land, he emphasized the need to recognize and follow the vitalist economy of nature

as an argument against those urban-bound associates, gentleman farmers who were proposing measures insufficiently attentive to nature's order. Judge Richard Peters was prominent within that social sphere. As I discussed briefly in the previous chapter, his 1797 *Agricultural Enquiries into the Use of Plaister*, written as part of the georgic tradition, was widely circulated and praised.²⁷ Although Lorain found himself combating Peters a number of times, the problems that both he and Peters met turned equally on transforming untended soil, be it clear meadows or forested stands, into productive, manageable agricultural land. His concerns from the start, then, had a different social alignment than his southern counterpart Ruffin's. He concluded, as it were, that improved agriculture would *eliminate* the need for slavery, a point that stood in direct opposition to Ruffin's conclusion several years later. But his point was not meant as a warning to Ruffin and the slave-holding states. Instead, it came as the logical conclusion to an assessment of labor requirements and possibilities for more efficient cultivation on the borders of western expansion (525-551).

Representing Land

Lorain's work offers us another example of representing land. His *Nature and Reason* is, very basically, about the correct way to promote the progress of cultivation. In this sense, his view is quite similar to Ruffin's and we might expect his representations to be similar in kind. But Lorain argues that the combination of "Nature, reason, and observation... should be the farmer's guide" to cultivating his fields (196). In this he differs from Ruffin's appeal to put nature under human control. Lorain strikes a more harmonious, organic tone. To be sure, the differences are subtle, since Lorain does eventually want to control nature and Ruffin does claim

²⁷ On Peters's consideration of Virgil's *Georgics*, see "Usefulness, to Husbandmen, of attending to natural Phenomena, by Richard Peters," read before the PSPA, February 8, 1814, and reprinted in the *Memoirs of the PSPA*, 3 (1814): 337-352.

to be controlling it by deciphering the guide provided by its laws. But the order of understanding how to interact with nature, with Lorain's entry point being participation and Ruffin's being manipulation, sets their natural representations apart. Overall, to assess his sense of the land, we can read Lorain as answering these questions: how are fields and farmland governed by a vital economy of nature, including human and non-human nature alike? And in what way is the interference of human art a legitimate aid to natural, that is, non-human, processes of growth and change?

"Nature" is the non-human component and "reason" the human contribution to improvement. Lorain's purpose is to observe and promote their combination. In this, the forest provides him with a kind of experimental control, "where neither art nor ignorance has materially interfered, with the simple but wise economy of nature" (24). He watches the changes in his Pennsylvania forest as "age, disease, tornadoes, or any other cause" bring it into a new phase of existence so that he can draw lessons and apply them to his own practice of husbandry (25). Wherever vegetation can exist, it does, Lorain notices. Trees fall, their wood decays, plants grow around them, and they eventually subside into the soil below. The spacing of those trees defines the spread of smaller plants and the population of animals large and small. "The fermentation and decomposition that take place within this thick body of manure furnish nutriment for the plants, and enrich the grounds." Here, Lorain points out, the new generation of plants and trees occurs without damage to roots or without forming "injurious ridges or mounds...or furrows." Larger animals as well as "reptiles... together with feathered tribes" find shelter in those trees. Leaves and crevices are also thick with insect life. Decaying animal and vegetable matter "affords living" for "incalculable tribes of animalcula." The smaller animals make do by eating the plants other animals ignore; the "manure dropped by smaller animals"

fertilizes soil, returning nutrients to their source. There are so many kinds of animals, plants, and forms of nutriment that this variety “seldom seriously infringe[s] on the sustenance of each other” (26).²⁸ The interchange among all of these members of the forest points out a system of necessity and cooperation within which Lorain, the observant farmer, can operate.

Beyond defining a vision of symbiotic nature, the general pattern of Lorain’s example is to show how a forest could be changed by the natural action of plants and animals. Together, those plants and animals take healthy stands of trees and turn them into populated and thickly vegetated patches of earth. When “the agriculturalist” enters the picture, that farmer can aid “nature” with art and increase fertility by continuing the general pattern of nutrient recycling already evident with natural patterns (25-26). Elsewhere in his treatise, Lorain shows that his cherished vital economy accounts for patterns of succession and development. He adduces those long-term shifts from the observations he makes on local-scale and seasonal activities. The details are often vague, and Lorain’s full picture of transformation is drastically underdeveloped. It is far less dramatic than Ruffin’s woodlands clearing, coming across as gentle and peaceful. (Even though he shows that “the most thrifty plants” outlast and overrun “the more feeble ones,” giving fodder to the historian looking for proto-Darwinian antecedents, this is clearly not the contentious, struggling, Darwinian microcosm of nature that someone like Stephen Forbes, for example, would later describe with the example of a lake.)²⁹ But the point Lorain draws from his survey is that the natural order perpetuates itself for the benefit of its constituents.

²⁸ Other descriptions of nature’s economy abound in Lorain’s work. He elsewhere describes how seeds are dispersed, by wind, water, and as scattered by “birds and quadrupeds” (72). He also tells a story of his season of sowing wheat on newly cleared land. That endeavor required him to divert water through furrows and to find that ditching was unnecessary and costly (193). He was glad to have decided against cutting “off the springs” to form a ditch for irrigation, because his later success proved that was unnecessary.

²⁹ See Stephen Forbes, “The Lake as a Microcosm,” *Bulletin of the Peoria Scientific Association* (1887) 77-87. Forbes’s work has been the subject of much attention in the history of science. For a recent analysis, see Daniel Schneider, “Local Knowledge, Environmental Politics, and the Founding of Ecology in the United States: Stephen Forbes and ‘The Lake as a Microcosm’ (1887),” *Isis* 91 (2000): 681-705.

What matters for Lorain is that the effect of “this perfect system of economy” is equally evident in “glades and prairies, as in our forests, where nature is suffered to pursue her own course.” When humans interfere with this well-tuned economy, “a new order of things takes place: the living as well as the dead vegetation found in this way is destroyed and the grounds are cultivated” (26). Lorain wants farmers to allow nature to be “assisted by art” *within* its perfect economy, not transgressed by it. Backwoods farmers generally ignore this credo, he argues, since they clear the necessary grasses and remove required root systems and decaying wood. Even the clearance of weeds could be counter-productive, as the “perpetual war against them” by humans counteracts some of the natural advantages those pests provide (28). With examples like this the purpose of Lorain’s social commentary becomes clear—to denounce common backwoods practice and suggest more enlightened methods.

Glades and prairies, like forests, undergo changes both natural and as assisted by the art of humans. This classic pastoral assessment of the contrast between human and nature, between cultivated and wild, is enhanced into the georgic as Lorain places the labor of the farmer at the nexus of those contrasts. Change in the land itself is not opposed to the economy of nature, of course, but that which is not changed with reason, common sense, and observation—by “cultivation,” in Lorain’s examples—indeed opposes nature. Despite the detail of four long books and the often rambling and repetitive nature of his writing, Lorain manages to convey a consistent point. He brings together the social concerns of expansion, its material requirements, and the vital economy of nature that structures both. In the second half of this chapter I will discuss how chemistry acts as the art through which humans know nature. But first, I introduce Adams and his view of the land as my third example.

Adams's "Naturalized" Nature

Background

Daniel Adams was a 1797 graduate of Dartmouth College, author of numerous school books, “an eminent physician,” teacher, lifelong farmer and community leader. He was born in 1778 and died in 1864, living to see the birth and near dissolution of the nation. Except for a brief stint in Massachusetts in his younger years, he lived and farmed in New Hampshire throughout his life. *Appleton's Cyclopaedia* found him sufficiently famous to include him in its 1887 compendium, highlighting his civic duties as president of the New Hampshire Bible Society and New Hampshire Medical Society. He also edited the short-lived *Medical and Agricultural Register* from 1806-1807, was the President of the Hillsborough Agricultural Society in the 1820s, and served as a member of the New Hampshire state senate in the early 1840s.³⁰ Among Adams's fifteen entries in the current Library of Congress catalog are his widely read and frequently re-issued *Adams New Arithmetic* (1827, 1st edition), the *School Atlas to Adams Geography* (1823), and his *Agricultural Reader, Designed for the Use of Schools* (1824).³¹

In the first section of *The Agricultural Reader*, the “Explanation of Terms,” Adams suggests that readers memorize the seventy-nine terms he defines, as one would do with geography and grammar. After that long introductory exercise, the book proceeds roughly in thirds. In the first third, he tackles what were then standard topics for an agricultural treatise—soil, nutrition, plant growth, manure, and crop varieties. In fact, there are eight separate chapters on various kinds and uses of fertilizing manure. In the next third, he offers commentary on

³⁰ See *Appleton's Cyclopaedia*, 1 (1887-1889): 13 and *DAB* 1: 54-55. Also see *Triennial Catalogue of Dartmouth College*, 62; and *The Biographical Encyclopædia of Ohio of the Nineteenth Century* (1858), 158.

³¹ In addition, Adams had already put his *Scholar's Arithmetic*, through a third edition in 1805. *The Scholar's Arithmetic*, 3d ed. (Leominster, MA: Printed by Salmon Wilder); *School atlas to Adams' Geography* (Boston, Lincoln & Edmands); *The Agricultural Reader* (Boston, MA: Richardson & Lord)

weeds, insects, livestock, fruit trees, and horticulture. However, he suggests no common lesson to be learned from each example and provides no clear connection to his earlier comments on political economy.³² In the rest of the book, he presents overviews on topics as wide-ranging as the purpose of Agricultural Societies and the parable of “The two apple trees” (where one son treated his gift of a tree with care and attention, and it blossomed; another son neglected his tree, which bore no fruit). Five rural poems end the work, and this after a series of excerpts from Benjamin Franklin. Adams quotes (without citation) the British improver Lord Kames’s optimistic and propagandist statement on the moral and material value of agrarian political economy, that agriculture “is perhaps the only firm and stable foundation of national greatness.” In brief, that tone of Scottish, georgic, and civic improvement pervades the *Reader*, giving it the political justification and moral foundation necessary for general use.³³

³² Regardless of his goal for clarity, Adams seems to lose focus after leaving behind the more common topics. While he begins with a sustained, instructive, didactic, and interrogatory style, the book soon devolves into an assemblage of extracts, losing pedagogical focus as it goes.

³³ In his presidential address to the Hillsborough Agricultural Society he excerpts Kames as follows: “In a political view, [agriculture] is perhaps the only firm and stable foundation of national greatness. As a profession, it strengthens the mind without enervating the body. In morals, it has been well observed, it leads to increase of virtue, without introducing vice. In religion, it naturally inspires devotion and dependence on Providence” (Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” 148).

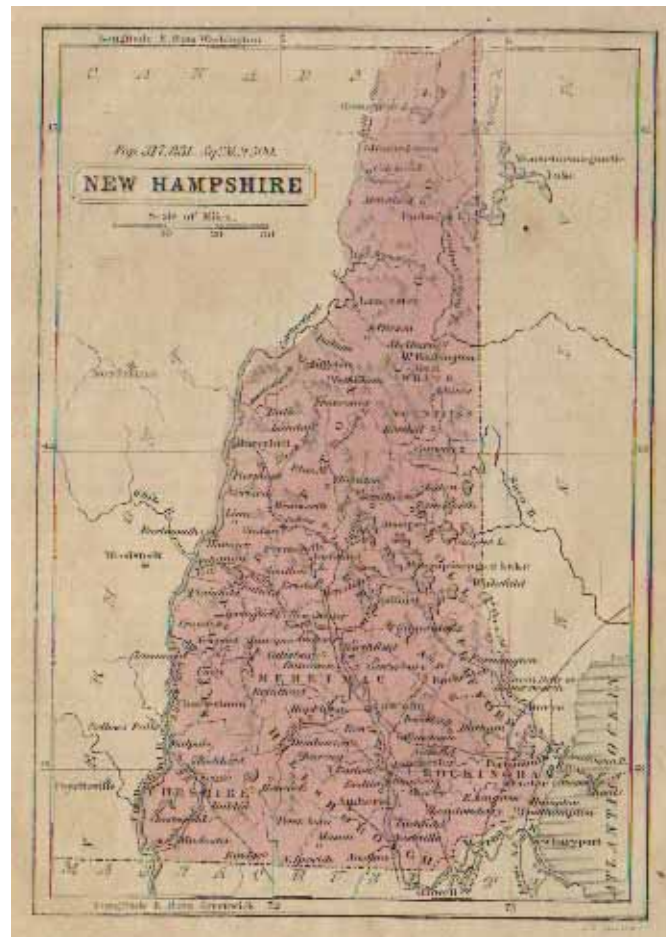


Figure 6. New Hampshire in 1840. Adams lived and wrote from in Mount Vernon, in the southern central part of the state. Although his treatise has less site-specific commentary than Lorain’s and Ruffin’s, it is still born of the experience of a New Englander.

Adams wrote *The Agricultural Reader* to utilize his educational skills for the sake of teaching agriculture. Although circulation statistics are not available, we know his textbook writing success already preceded *The Agricultural Reader* as all of his works were reissued frequently throughout the antebellum period. Ostensibly, and as evidenced by the very subtitle, his readership consisted of regional schoolchildren. But that audience was far wider, Adams knew, as he detailed matters in his book too “difficult for school boys to understand” though “important...to the farmer” (46). His grander appeal to farmers, rural press readers, and members of the county agricultural societies of New England, makes his audience the same as that already

targeted by *The New England Farmer*. His georgic context is implicitly set by tone and argument and explicitly defined by specific reference to works like Samuel Deane's *Georgical Dictionary* (see 112, 114, 119, 131, 138, 188, and 189).

The format of the text is deliberate and orderly. Each of the sixty-two chapters, ranging from one page to sixteen, is written with numbered paragraphs to facilitate ease of reference and clarity of expression. This style was not uncommon for texts of the era, though Adams was forgoing the popular catechism model of the question-and-answer format.³⁴ Adams's text, rather than falling into the more general category of a schoolbook, was agriculturally specialized. It was explicitly meant to address the science of agriculture by detailing facts, opinions, and definitions. Inside this presentation, his work was ordinary, advocating neither radical chemical notions nor controversial advice about landscape and improvement. Adams simply reports and then advocates his perception of the current issues concerning agricultural progress. He has neither an explicit argument to advance, nor a thoroughly explained philosophy of nature to describe. By standardizing the basics of agriculture and codifying them in his schoolbook, as with the disciplining tendencies of textbooks in general, he is in a sense "naturalizing" the idea of improvement and his representations of nature.³⁵

Representing Land

³⁴ Other contemporary chemical textbooks for schoolchildren, ones specifically scientific though not agricultural—like Jane Marcet's *Conversations on Chemistry, Intended more Especially for the Female Sex*—followed that question-and-answer format. By the 1830s, though, this style was losing favor, as can be seen with John Lee Comstock, *Elements of Chemistry* (New York: Robinson, Pratt & Co, 1839). For more on textbooks and shifts in science education, see Kim Tolley, *The Science Education of American Girls: A Historical Perspective* (New York: Routledge Falmer, 2003).

³⁵ For more on the disciplining tendencies of textbooks, see Anders Lundgrens and Bernadette Bensaude-Vincent, eds., *Communicating Chemistry: Textbooks and Their Audiences, 1789-1939* (Canton, MA : Science History Publications, 2000).

In brief, three aspects of Adams's view of nature are of particular interest: his perception of nature as distinct from artifice, as an economy of interrelated parts, and as alterable through the action of agriculture for the betterment of humanity. These views at times coincide with Lorain's or Ruffin's and at times differ in their emphasis and purpose. Later in this chapter, I characterize Adams as an appropriator for taking on Davy's chemistry without discussion or even a modicum of skepticism. The same is true, though less starkly, for the ways in which Adams represents nature. His views on the role of agriculture in society and the ways that agriculture changed the landscape were drawn from popular sources and typical for the time. He merely appropriated the less controversial notions of vitalism while introducing non-offending elements of materialism.

Adams presents the natural, "artless" value of the land as understood in contrast to the civilized, human-built environment of the city. In this traditionally pastoral outlook, "Happiness," he writes, "seems to have fixed her seat in rural scenes" (28). There are humans in both locations, the city and the country, but guaranteeing virtue and fulfillment through "divine providence" depends on the rural scene. The same contrast of idle and industrious virtues that was evident with the homespun rhetoric of my Chapter 2 is embedded in Adam's text. In his case, those virtues could be understood as defined by God, as visible in Nature, as cultivated in the countryside, and thus, as exemplary. "The spacious hall, the lighted assembly, and the splendid equipage," he contends, "do not soothe and entertain the mind of man in any degree like the verdant plain, the wavy field, the artless stream, the enameled mead, the fragrant grove, the melodious birds, the sportive beasts, the open sky, and the starry heavens" (28). Nature is the source of virtue and prosperity; with such a commonplace perspective, Adams was on familiar ground in his appeals. As the opening to his work, these passages are meant both to justify the

value of the book and to set the moral stage for further arguments about how to properly conduct agriculture. Of course, other “arts and employments may serve for the *embellishment* of human life, [but agriculture] is requisite for its *support*” (28). Those other arts rely on the understanding and promotion of the natural order evident in the countryside. In this construction, Adams provides the well-rehearsed distinction between nature and artifice as one between the human-made and non-human-made properties of the world.³⁶

Adams’s view was not unlike natural theology, though he makes no explicit reference to the doctrine in his work.³⁷ His references to “Nature” refer to that which is designed by God, differing from his use of the term from Lorain and Ruffin, who seem to treat “Nature” as personified shorthand for “the order of Nature.” Adams’s penchant for natural theological constructions was not meant to say humans should avoid improving upon the natural order, that tampering with God’s design, for instance, was sacrilegious. It was, rather, to suggest that improvement of the land would come about by closer attention to the processes of an active nature, a form that could be understood and followed. “Nature,” he writes, “is continually holding out intimations of her designs would men but regard them. Her operations are always correct, and never directed to deceive; and he who follows nature, watches her intimations, seconds her efforts, and studies her designs, will unquestionably become the most successful cultivator” (149). Like Lorain, Adams instructs his readers that this process is defined through interactions among existing parts of the soil and atmosphere. “[T]he economy of vegetation, the

³⁶ His tone smacks of the tension between civilization and nature. Adams does in fact comment on the civilizing mission of Christian missionaries in the western part of the country who bring the natural benefits of husbandry to the “savage tribes” and quotes a “discourse on the prophesies” that seeks to treat Agriculture as the only art capable of bringing barbarism into civilization and prosperity (31). The contrast between city and country, then, is not the same as a contrast between civilized and barbarian. It is the contrast between an agricultural life and a non-agricultural one that is important.

³⁷ For a concise review of the history of natural theology, see Peter Bowler, *Evolution The History of an Idea* (Berkeley: University of California Press, ([1984] 2003), 3rd edition, and Bowler, *The Norton History of the Environmental Sciences* (New York: Norton, 1992).

nature and application of manures, and the rotation of crops” would provide the basis for a systematic agriculture that demands attention to the interrelations of nature’s components (35). Putrescent manures, for example, exemplify the actions of the economy of nature by returning to the earth “something...which makes it richer.” “Everything which has possessed life, whether animal or vegetable, having undergone putrefaction and being returned again to dust, becomes food for the support of vegetable life” (32). Matter is “entering continually into new forms and new combinations”—it is always being recycled as it finds its way into new life forms.³⁸

The active dimension, the agency of nature, is presented time and time again through Adams’s representations of nature-as-process. For him, the constituent parts of plants, soil, and all of rural economy are merely reshuffled from one part of nature to another. His economy of nature asserts that the basic particles of plants like carbon, hydrogen, oxygen and azote (nitrogen) simply move from one living being to another. Action comes about through the putrefaction of dead animals and decaying vegetable matter. Adams suggests that this active basis is another way to interpret vitalism. However, with his emphasis on the process and changes of rural economy (instead of the simple insistence that it is alive) his work bears a slightly different character than Lorain’s.

This goal of improving and changing nature in Adams’s work is consistent with that of Lorain and Ruffin. Adams’s metaphors of process and activity for nature lend themselves to the actions of humans for changing the environment in a clear manner. “[N]ot one particle,” Adams writes, “probably has ever been added to or taken away from the great mass of matter since the

³⁸ I presented Adams’s belief in a divine intelligence and his perspective on the economy of nature as if they were unrelated, but of course the two fit together. Adams quotes the Letters of Agricola again to say that “I know of no indication of greater skill in the Divine Intelligence, nor a more indubitable mark of his care and goodness, than the contrivance of resolving all dead animal and vegetable matter into elementary principle; that, in the first place, he might relieve the earth of such loathsome incumbrances, and in the next place, be supplied with fresh materials out of which to form and sustain the new and successive families of plants” (50).

creation of the world” (47). Nature “herself” changes, not by addition, but by redistributing the existing components of the world; humans are thus justified in altering the landscape too. In fact, though they can change nature, they cannot do so destructively. Adams tells his readers to study the design of nature first, but then to apply systematic studies of plant growth and nutrition to the land. The role of those systematic studies, the work and goal of “gentlemen of science,” was to inform tillage, rotation, and manuring. Adams maintains that these were standard approaches, but insists that their capability as agents of improvement depend on alliance with natural processes. The strictly human ability to conduct experiments, analyze soil, and manipulate the texture and quality of that soil guaranteed that the landscape could be changed for the better (37-44).



Neither Ruffin, Lorain, nor Adams explicitly sought to provide descriptions of their landscapes for pastoral appreciation even though many passages portray images of verdant fields, lush forests, gentle slopes, fertile ridges, and idyllic streams. Each of the works presented a georgic ethic and each proposed variants of book farming as positive contributions to agricultural society. What is more, a certain underlying assumption of agrarian identity pervaded each text.

Adams identified himself as a farmer in the sense that most early Republic Americans—farming as a state of mind, a notion of identity which included virtually all Americans, as I noted in Chapter 1. He shared John Adams’s view that “The Enthusiasm for Agriculture like Virtue will be its own reward. May it run and be glorified.”³⁹ (There is no evidence, however, that he

³⁹ As quoted in Rodney Loehr, “Arthur Young and American Agriculture,” *Agricultural History* 43 (1969): 43-67, on 46.

corresponded with [or was related to] the elder statesmen.) Lorain was a farmer in a more direct sense, living the later years of his life on the land and for the purpose of cultivating both his food and his lifestyle, even though he was also described as a merchant. Ruffin, like Lorain, fit the description of a farmer in the sense we commonly think of today. He too made his living from the land and based his life and viewpoints from the site of the cultivated field. But he too was more than a subsistence farmer as the second half of his life kept him to publication schedules, geological surveys, and public speaking engagements.

The views of cultivated and cultivatable land in the treatises offer us a map of the 1820s and 1830s that is at once unified—all three were rural economists, concerned with improvement, and commenting on the tenets of agricultural chemistry—and diverse—their writings presented differing degrees of specificity, assumed different emphases on vital or material concepts, and reviewed different characteristics of nature. Each writer saw nature as an “it,” as something governed by laws that were immutable but identifiable, and through a georgic sense of improvable material and moral sustenance. But where Lorain saw the land as participating in a wider economy of nature, Ruffin saw an extractable and analyzable material substance. Lorain’s plant nutrients were exchanged with other animals and through interaction with the atmosphere and the vegetable manure that came from leaves and compost; Ruffin discussed the individual, isolatable properties of soil and the particular means to act on those properties. This contrast between the seemingly organic and holistic and the elemental and reductionist should not be overdrawn. To be sure, Ruffin did not deny the wider natural context of animals, vegetables, and minerals, but instead saw *improvement* as deriving from specific attention to particular components of the soil, while Lorain saw improvement as following the use of human aid as part of, not opposed to, the economy of nature. Both men were at once grappling with Romantic

philosophies of nature consistent with a humus-based *organic* theory of plant nutrition and aware of the *inorganic* basis for recipe-like fertilizer strategies like Liebig's dream of manures "prepared in chemical manufactories, exactly as at present medicines are given for fever and goiter" – add a quantity of X, then some of Y to the soil, and the plants will grow more ably.⁴⁰

Adams balanced the complexity and reducibility of natural components, but in his presentation he advocated the pursuit of rational principles of agriculture. It is possible that we can learn more about antebellum attitudes towards cultivated land from Adams's standard-fare presentation than from Lorain's disputatious or Ruffin's theoretical contributions. He was less interested in confronting authority figures or proposing novel practices and theories, and so he was more apt to present a conventional perspective. If that is so, then those of the era truly were comfortable mixing vital and material, organic and mineral concepts in their daily efforts towards improvement.

In working out their respective conceptions of the land, the authors were in large part establishing a criterion of knowing nature. That is, as with Lorain, vitalist predilections were the marker for a kind of experience; with Ruffin, an acknowledgment of soil properties served the same role; for Adams, recognizing the exchange of existing components within nature's design signified the right knowledge. But what is "knowing nature" in this context – how does one know nature? What kind of nature is there to know? Only farmers, people who knew the land from daily interaction, could come to this kind of knowledge with their kind of experience. The authors thus define nature in such a way that "agriculturalists *in the field*" are the authorized

⁴⁰ This was quite similar to the "law of minima" expressed later by Liebig, meaning that there is a minimum quantity of specific and detectable elements necessary for plant growth and that by providing those specific components, the requirements of plant nutrition could be met. See Brock, *Justus von Liebig*; and Charles Black, *Soil Fertility Evaluation and Control* (Boca Raton, FL: Lewis Publishers, 1993)

agents for knowledge of the field.⁴¹ Hence, as we will see, their naturalist-like descriptions lead to discussions of chemistry as, most effectively, a tool in the right hands. In the texts, this comes across as a sort of expert's regress. The only right way to use chemistry is one that operates in concert with how nature really is; the only way to know how nature really is requires intimate experience with it, vitally, in the field.⁴² Therefore, chemistry works as a valid tool if the right people—"right" understood within the georgic context—use it. To get a better sense of this, I next explore the authors' awareness and use of chemistry *as part of* the representations of nature I related above.

Representing Chemistry

As I have already indicated, Edmund Ruffin tempered his acceptance of Davy's chemistry. He referred to Davy often and claimed that his chemical inspiration came from reading Davy's work. But he was not uncritical in that reception. He questioned many of Davy's insights and sought to improve on his work rather than accept it wholesale. John Lorain, however, was a refuter of Davy's work. He was at pains to devalue Davy's theoretical acumen and show that Davy's experimental reasoning was flawed and misleading. On the opposite side of this spectrum was Daniel Adams, whom I have already defined as an appropriator. This identity as an appropriator was true in a strict literary sense, since Adams' textbook was comprised of scores of excerpts from others for the purpose of representing his views (i.e., major

⁴¹ To make a common science studies reference, the agriculturalist in the field becomes the obligatory passage point for knowledge of nature. For chemistry to be that passage point it must be aligned with the field worker. See Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Briec Bay," in John Law, ed., *Power, Action and Belief. A New Sociology of Knowledge?* (London: Routledge & Kegan Paul, 1986), 196-233, and actor-network theory in general, as developed by Bruno Latour, John Law, and Callon.

⁴² I suggest "expert's regress" as a play off the "experimenter's regress" developed by Harry Collins and used in Harry Collins, *Changing Order: Replication and Induction in Scientific Practice* (Chicago: University of Chicago Press, [1985] 1992) and H. Collins and Trevor Pinch, *The Golem: What You Should Know About Science* (Cambridge : Cambridge University Press, 1998)

portions of his book was cribbed from a great number of other sources). It was also true in a more interpretive sense, since he used those references without critical filtering, choosing to import the view of his source without questioning its soundness. In line with this, Adams merely appropriated Davy, taking at face value the definitions of soil, theories of plant nutrition, and expressions of vitalism that came from his work.

In the rest of this chapter, I present the various ways in which chemistry was used to mediate those authors' views of nature—Ruffin the Temperer of Davy, Lorain the Refuter, and Adams the Appropriator. Davy stands in as the main figure of reference, but the point of my discussion is to generalize from his example. It is beyond the scope of my work to assess how well or how closely the authors understood Davy. Rather, I ask what the authors thought of his work, what they assumed chemistry was and what it was useful for, and how chemistry acted as the lens for their perceptions of the land.⁴³

Ruffin the Temperer

*“[Chemistry is the] true philosophical mode of examining questions of agriculture...” (40).*⁴⁴

Ruffin engages an eclectic array of chemists and agricultural improvers both foreign and domestic. His work refers not just to Davy, but to the European chemists Richard Kirwan, Torbern Bergman, and Frederick Accum; the British agricultural improvers Arthur Young, John Sinclair, and Archibald Cochrane (Lord Dundonald); the American geologist and chemist Parker Cleaveland; and various mid-Atlantic public figures like John Skinner, John Taylor, John

⁴³ Lorain did not focus on nature itself as rational; rather, he saw the human study of it as a rational pursuit. Ruffin and Adams were less explicit on this point, but at least cast their studies of the land as efforts in rationality. Indeed, the mantra of rationality was not explicitly or always a mantra of science. It is worth nothing too that there were two different ways to deploy the rhetoric of rationality. The first was by proposing a rational method of studying the economy of nature; the second was by defining that order itself as rational.

⁴⁴ I here return to citing Ruffin's *Essay on Calcareous Manures* with parenthetical page references.

Bordley, and the wealthy Virginia statesman John Hartwell Cocke. The *Essay on Calcareous Manures* is a chemical work in that it is based on Ruffin's diagnosis of the chemically determined properties of soils, his theorization of the action of calcareous matter to neutralize acidic earth, and his enrollment of chemical theory and experimental reasoning to carry his argument. In fact, unlike Adams, though like Lorain, Ruffin is explicitly proposing an argument in his work that is presented as chemical.

Ruffin directs and orders his chapters to define what actions farmers can take to improve the quality of their soil. His guiding premise, then, is that such quality can be assessed, compared, and then acted upon. In many parts, he distinguishes between mechanical and chemical means for soil improvement, parsing the two approaches to show that his solution is chemical. Though without extensive formal training in chemistry, he read widely and was confident enough to apply his reading in practice. His wide range of technical references thus lends support to the tenor of his work which suggests, with word choice and with the posture of a working farmer, that his is a work of chemistry for the "practical" farmer.

Ruffin speaks more about chemistry as a form of inquiry, a process to be pursued, than as a set of theories. Not surprisingly, he offers no simple definition of what he means by chemistry. Rather, he indicates his understanding of the field by reference to its analytical and investigative role. The constituent parts of soil have been "obtained by chemical analysis"; "chemical tests" indicate calcareous presence (34, 35). The analytical results of "The Chemical Examination of Various Soils"—the basis for an entire chapter—"completely establish [the] general rules" of the primacy of calcareous soil as the basis for soil fertility (44). Thus, chemistry is understood instrumentally in two senses: first, it is an investigative way to understand agriculture, it is the "true philosophical mode of examining questions of agriculture"; second, in a more direct

material sense, the instruments of analysis are “another means for knowing” the properties of the soil and thus the key to solving problems of soil exhaustion (40).⁴⁵

In another way, what Ruffin means by chemistry is the work of Humphry Davy. Although he refers to a wide range of chemical treatises, his main influence and reference point is Davy, whom he considers “the highest authority.”⁴⁶ For one, picking up Davy’s *Agricultural Chemistry* in the late 1810s gave Ruffin his original inspiration to investigate calcareous manures.⁴⁷ For another, Davy’s influence was consistent with Ruffin’s view of the instrumental role of chemistry as a tool useful for agricultural, and thus social, ends. On theorizing the action of lime, for example, Ruffin accepts Davy’s view because it directs him to practice manuring in a specific way. The explanatory power of Davy’s theory of lime is understood in this case less for its academic value than for its power to “deduce proper practical use” (182). The pneumatic apparatus Davy constructs in the fourth lecture of *Agricultural Chemistry*, whose “accuracy is almost perfect,” also appeals to Ruffin’s sense of the role of chemistry for the farm. The instrument relies on “well established facts in Chemistry” (41). In the context of his *Essay*, Ruffin’s concept of “well established” is guaranteed through “the practical value of an analysis” (40; also see 36).

But Ruffin does not accept Davy uncritically. For Ruffin, the chemist’s taxonomy of soils and definitions of soil varieties are particularly problematic, a flaw not unreasonable given

⁴⁵ The reference to “true philosophical mode” comes from William Boulware’s biographical sketch of Ruffin in “Edwin Ruffin, of Virginia, Agriculturist, Embracing a View of Agricultural Progress In Virginia for the Last Thirty Years, With a Portrait,” *DeBow’s Review* 11 (1851): 431-436, as reprinted in Edmund Ruffin, *Incidents of My Life: Edmund Ruffin’s Biographical Sketches*, David Allmendinger, ed. (Charlottesville: University of Virginia Press, for the Virginia Historical Society, 1990), 171. Boulware is responsible for misstating Ruffin’s first name as “Edwin” instead of “Edmund.”

⁴⁶ Edmund Ruffin “First Views Which Led to Marling in Prince George County,” *Farmer’s Register* 7 (1839): 659-667, on 665.

⁴⁷ Ruffin would have read the 1815 American edition of Davy’s 1813 collection of lectures. Humphry Davy *Elements of Agricultural Chemistry* (Fredericksburg, VA: William F. Gray, 1815)

Davy's occupational distance from actual field conditions.⁴⁸ Another disparity in views is the men's respective attributions of mechanical or chemical explanations to the action of marl. The prevailing view of the chemistry community at large was that "Chalk and marl and carbonate of lime *only improve the texture of a soil*" (40). But the differences between mechanical and chemical action were central to Ruffin's own thesis of the action of calcareous matter (11; 69-77). Ruffin proposes that lime and acids are attracted to one another through laws of affinity and, thus, by processes he believes are only describable as chemical (8-13, 39). Therefore, despite his acceptance without question of analytical results, he rejects Davy's mechanical grounds. Ruffin was on firm conceptual ground, in his own mind at least, when questioning the "men of science" who considered marl's value mechanical because he understood its use through experience, not speculation.

Ruffin's concepts of soil and nature as seen through a chemical lens are clearly expressed in his experimental reports. "Experiment 10," in particular, stands out for its combination of health metaphors, vitalist views, and materialist diagnoses. The story of Experiment 10 is cautionary since it answers concerns that marling can destroy crops, rather than improve them. Marl can be "over-dosed," causing "injury" and "disease" even though the "recurrence of evil" that can be "inflicted" by using too much marl is avoidable (100-102). Like medicine, it must be applied lightly at first, and then increased if the symptoms of unproductive soil continue. The corn Ruffin describes was ravaged by forces as destructive as insects. The "gloomy prospect" of the crop's yield sent a pall over the fields. Leaves shriveled and died from "injury." "Remedial measures" were necessary for the corn to be "relieved of the infliction." The "ill effects" of

⁴⁸ With the belief that "Nothing is more wanting in the science of agriculture than a correct nomenclature of soils," Ruffin listed six extant definitions of "loam," his own and Davy's included, to demonstrate its inconsistent definition (Appendix B, 160-162). That is, Ruffin understood that soil taxonomy was a problem greater than he alone could solve.

calcareous manures were everywhere apparent, but they were fortunately confined (120-121). For Ruffin, chemistry was the diagnostic tool used to identify that soil's poverty.

Ruffin's underlying assumptions cast the soil as both an active agent, working either to turn against improvers or to help promote the improvement "it" should by all rights want, and as a passive vessel into which measured quantities of fertilizing agents can be poured. To avoid "the recurrence of evil," Ruffin suggests moderating quantity. In a tradition common to domestic labor and medical chemistry alike, he invokes a recipe view of fertilizing, one that follows partially quantified instructions in a step-by-step manner. He also infers that the field is a kind of laboratory where soil serves as the beaker, or the body, to be filled or emptied per instructions.

Ruffin's belief in universal and timeless laws of nature was applied not just to nature in the abstract, but to actual physical soil. "[T]he component parts of calcareous earth *always* bear the same proportion to each other" (namely, 43 parts carbonic acid to 57 parts lime; italics added); one ounce of water was *always* equal to the amount of carbonic acid in two grains of calcareous earth (41). Thus, chemistry was also useful for revealing the immutable conditions of agriculture, even if a primary difficulty for the science of agriculture had been reconciling the always local factors of climate, labor, and soil with such universality.

Ruffin positions his work as both theoretical and practical, though he avoids developing a full theoretical edifice and eventually moves away from the practice of farming in his later years. He fit into the social space between the farmer who required testimony from other practicing farmers and the chemists who lacked the practical experience to recognize the action of manures in the soil. Tempering Davy's full import, Ruffin's work bridged two worlds, both conceptual and practical. As a sort of boundary object, chemistry could be invoked in the farming world for

its practical value and in the world of the chemists for its commentary on non-mechanical aspects of manuring strategies.⁴⁹

Lorain the Refuter

“[The] facts are...very contrary to [Davy’s views] in the backwoods” (530).⁵⁰

Lorain was not satisfied with the prevailing assumptions of agricultural chemistry he encountered, mainly for their lack of attention to knowledge gained through practical engagement. He refers to the standards from Britain—Lord Dundonald on connecting chemistry to agriculture, Lord Kame’s then seventy-year-old work on English gentleman farming, and Arthur Young—as well as American sources like John Bordley. He also writes an extended review and comment on John Taylor’s *Arator* and draws heavily on Erasmus Darwin’s *Phytologia* (1803). His tone is acerbic. For example, finding fault, Lorain considers Darwin’s observations well summarized but insufficiently attentive to actual agricultural practices. Davy, the most popular chemist of the day, is subjected to scrutiny and ridicule more than any other as his work is frequently introduced only to be quickly refuted. The vitalist science that Lorain promotes not only coincides with broader Romantic conceptions of nature, but indicates how he considers the twin themes of nature and science: he is not opposed to science, but more specifically to non-vitalist representations. This position places chemistry into a more diffracted light, containing and representing multiple meanings and uses that defy simple categorization.

Lorain’s overall dissatisfaction with connections of chemistry and agriculture is methodological, claiming that those like Davy and Darwin have used inadequate methods when

⁴⁹ On boundary objects, see Susan Leigh Star and James Greisemer, “Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39,” *Social Studies of Science* 19 (1989): 387-420.

⁵⁰ I here return to citing Lorain’s *Nature and Reason as Harmonized in Husbandry* with parenthetical page references.

developing their ideas. He devotes nearly the entirety of the first book of *Nature and Reason* to refuting Davy's work – theories about the value and action of marl (4-6), the effects of gypsum on vegetable decomposition (15-16), the source of plant nutrition (23), the source of moss (29-30), the action of sap (41-42, 530), and the living components of trees (61-69). But Davy is not only methodologically unsound. Lorain finds him contradictory and obfuscating as well. By refuting Davy, Lorain's tack is to recognize and promote the value of chemical investigations while remaining skeptical about the value of the chemists. Davy is the foil against which Lorain distinguishes between chemistry as rational observation and chemists themselves as credible observers.⁵¹

Davy's distance from actual agricultural conditions, Lorain suggests, accounts for his errors. The Englishman is wrong because "Some of his theories are not in unison with the economy of nature" (526). While "Sir H. ought to have recollected" what "every schoolboy" knows about the life of trees, for example, "it would seem [he] suffered his imagination to soar too high" (43). That is, he goes beyond the facts of the farm to formulate his ideas. The quip further denigrates Davy since "experiments prove nothing more than every man who has been conversant with trees, has known for time immemorial" (69). The value of chemistry in this instance is to further what every schoolboy and practicing farmer already knows, not to contradict it. Crucially, chemists negating common knowledge – the common sense observations, in Lorain's terms – are putting forth proposals which opposed the economy of nature.⁵²

⁵¹ Yet despite this, and as with Ruffin, he was still appreciative of and trusting in Davy's experimental analyses.

⁵² Whether or not Lorain was warranted to speak as a practicing farmer—since he had been a merchant and was new to farming only when he moved out of Philadelphia—is interesting in hindsight. It would have been irrelevant, though, when considering Lorain's rhetorical purpose of contrasting Davy's lab-based theory with field-based truth.

The purpose of Lorain's work was to offer rational insights without the detriment of distance from the farm and to do so by tying his perception of chemistry (as a form of reason) to his view of the land (as a vital economy). He seeks to "make nature, reason, common sense, and observation alone his guides" in agricultural improvement. This means he uses experientially gained insights to formulate a strategy for improvement. That strategy combines the identification of natural laws with the unique human capacity to learn from reason and observation to make nature better. Chemistry, the example of that human capacity, is respected as the method by which the combination of nature, reason, and observation could be achieved.⁵³

Lorain's representations of soil, like Ruffin's, are based on metaphors of life. With those, we get another example of how his views of the land and representations of chemistry found common ground. Plants grown on "rich soils" resist more easily "the various injuries to which vegetation is subjected" because those plants and their soil have been enriched by natural animal or vegetable matter (17). "Life gives a peculiar character to all [nature's] productions: the power of attraction and repulsion, combination and decomposition, are subservient to it" (13). Therefore, farmers should first recognize "the living principle" of the soil and the various members of the economy of nature before attempting to improve their lands (50). Vital chemistry is the only worthy kind; any practicing farmer would know this.

Because Lorain understands soil as alive and participating in nature's design, he ultimately proposes different schemes for improvement. For example, Ruffin writes to explain

⁵³ Lorain further defines that clear distinction between chemistry as a body of theories (which must be questioned before being relied upon) and chemistry as an aid to nature, or a practice of analysis, when he uses analytical results from Davy's *Agricultural Chemistry*, such as ash analyses, without qualms or skepticism. To be sure, Lorain's understanding of chemistry for studying and then improving nature was complex, a fact I do not want to conceal with the above synopsis. For most of his work, he treats it not as a thing to be used, a material and diagnostic tool, but as a form of reason to be invoked. Yet at times he did rely upon it as a theoretical approach to understanding the economy of nature. He overplayed his hand when debunking others' theories, claiming that Davy was wrong because he denied the vital principle, when in fact Davy did no such thing. He was also unclear and contradictory about the relation between science and reason, at times equating them (see 8, 10, 31, 33, 196, 362), at other times claiming the two were distinct (see 62, 70, 170, 352).

how calcareous manures can neutralize existing soil properties to allow for the successful addition of further fertilizing agents. Lorain, however, believes that using what he calls stimulating manures (like marl) is mostly unnecessary if farmers allow naturally produced vegetable and animal matter to do its work. Nature knows what it is doing. The role of human interference is to promote, not circumvent, knowledgeable nature.

Lorain and Ruffin show their common appreciation of chemistry, but with different senses of its place in the scheme of improvement. The two emphasize chemistry as a form of inquiry – a methodological example of how to harmonize nature and reason – more often than as a body of theoretical dictates. But whereas Ruffin’s instrumental use is invoked mostly with chemistry as a system of analysis, Lorain’s instrumental use is more as a form of argument. Thus, the reason and common sense he seeks is that which is aided by the georgic art of chemical inquiry.⁵⁴

In the first half of this chapter, I discussed Lorain’s attention to the role art should play in altering nature. By elucidating his views of science, we see that chemistry acts as that art with which humans know nature. Additionally, we see with *Nature and Reason* that, no matter the difficulty of sustaining a consistent theory of agricultural chemistry, the georgic goals of improvement – social, economic, material – were being entrusted to some combination of nature and reason. Lorain’s vitalist chemistry coincides with broader Romantic conceptions of nature, while underscoring his consideration of nature and science. “Science” was not the target. Non-vitalist representations were. His criterion of knowing the land, then, was defined not only through the practice of farming but by recognizing the vital economy of nature.

⁵⁴ This distinction between Lorain and Ruffin is not entirely rigid and I don’t mean to say Lorain discounted the value of chemical analysis – in the first place, he at times contradicts himself in his long treatise and refers to chemistry in several different ways so that we cannot say he had just one clear and distinct view of chemistry’s value; in the second place, he does rely on chemical analysis as part of his larger arguments, though as such he does so to indicate his trust in analysis but not in the analysts themselves.

Adams the Appropriator

“[I]t will be necessary [that the farmer] should have some acquaintance with the principles of natural philosophy, and especially of agricultural chemistry....”⁵⁵

Adams engages a narrower range of authors on the science of agriculture than either Ruffin or Lorain. What is more, many of those references come about second-hand. He frequently quotes and excerpts lengthy passages from other treatises (in many cases without citation or quotation marks), accepting and importing the views of those authors without any degree of translation, critical filtering, or analysis. In addition to Davy, other references in the *Reader* (predictably, by this point in my chapter) include Richard Peters, Arthur Young, and Samuel Deane (and his *Georgical Dictionary*). In several instances Adams copies material from the similarly uncritical lens of Thomas Fessenden at *The New England Farmer*. Overall, while his range of scientific references is narrower and his discussions of the value of chemistry for the farm are vaguer than either Lorain or Ruffin, he is more optimistic about the promise of chemistry for agrarian culture.

Adams provides a basic and general definition of chemistry in the list of terms that begins his text, calling it “the science which enables us to discover the nature and the properties of all natural bodies” (15).⁵⁶ Beyond the semantic definition, he views chemistry technically in three ways. First, it is a specific example of the general approach of science, that type most applicable to the farming classes. Second, and more specifically, chemistry is that kind of science which, with its analytical techniques, can inform farmers about the composition of their soil. And third,

⁵⁵ Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” 149

⁵⁶ I here return to citing Adams’s *Agricultural Reader* with parenthetical page references.

chemistry, which “threw light on the subject” of agriculture, is the resource of the most enlightened and improvement-minded farmers, those he calls the practical scientific farmer (103). Tying together local material gains and broader social gains, Adams restates the grand hope of Enlightenment progress by quoting the geologist Samuel Mitchill: “as the ingenuity and invention of man may increase to an unknown and inconceivable degree, so may the improvements and arrangements of husbandry keep pace therewith, until the most fruitful spot that now exists, may produce a tenfold quantity, and the land which now supports a hundred men, give equal enjoyment to a thousand” (33). His case was unique in that such improvement and progress are enabled by chemistry.

All writers on chemical method, and not just the most popular professional chemists, are worth the attention of aspiring farmers, according to Adams. What matters is the social status of the proponent, not the mere fact that there are chemical ideas being proposed – that is, of course, as long as they are georgic proponents, having gathered their advice from field experience. In this style, Peters, Fessenden, and Arthur Young are as valid as Davy and Priestley. To be sure, Davy, the “celebrated chemist in England,” is Adams’s most common reference point, providing the basis for his views on the number of elements (according to Davy, Adams writes, there were 47), analysis of the abilities of soil to retain moisture, and details about the fermentation of manure and what this means for fertilizing fields (16, 43, 59). Adams provides no indication that he disagrees with Davy, nor any evidence of dispute with the practical payout of chemistry as an agricultural science. But all told, Adams writes outside the burgeoning tradition of connecting chemistry to agriculture, co-opting mainstream arguments rather than contributing to them.⁵⁷ He

⁵⁷ His sense of chemical history is noteworthy, in some parts, since Adams clearly writes in the post-pneumatic phase of chemical research, giving reference to Priestley’s 1780s work on the chemistry of the airs. (This, in fact, provided an important signpost for the science of agriculture since it indicated attention to the atmosphere for plant nutrients.) He also introduces concepts like “chemical affinity” and “caloric” to his students, though in those

thus is less concerned with Davy's scientific credentials as with his reputation for approaching agricultural problems with chemical methods. He is also far less critical than Lorain when interpreting the theoretical basis for Davy's views.

Like a craftsmen selecting a tool, the place of chemistry within Adam's work is defined through use value, focusing on how it can best be used to achieve the improvement he seeks. As with Ruffin, analysis, as the best example of aiding practice with method, is the way to gauge use value. (Again, then, where Lorain finds fault in the methods of Davy, Adams appropriates Davy and chemistry because it is at least *a* method.) Adams's assessment of analysis, in this instance, is not meant to demarcate who can do it, but that it can be done. It is consistent with this view that he allows his authorities to speak for him, leveraging their social status along the way – Peters the Pennsylvanian gentleman, Fessenden the New England editor, Young the respected British agriculturist and improver, and Davy the famed chemist of England.

Adams's views of improvable nature and the role of the farmer in that process are further underscored in an address he delivered to the Hillsborough Agricultural Society as its President in 1825. In that address, he reemphasizes that to become a practical scientific agriculturalist “it will be necessary [that the farmer] should have some acquaintance with the principles of natural philosophy, and especially of *agricultural chemistry*.”⁵⁸ He delineates the identity of a

definitions falls decades behind the accepted theory of chemists themselves (15-21). Furthermore, when introducing his theme on lime and the action of quick lime as a fertilizer, Adams lists four separate views on the matter – that of Davy, Peters, Robert Smith of Maryland (then President of the Maryland Agricultural Society), and Fessenden – before avoiding a final conclusion on the issue. Instead of that conclusion, he broadens his theme to discuss Arthur Young's belief in the value of manure in general, thus escaping a commitment to any one theory (59-61). As a textbook author aiming for wide and uncontroversial appeal, the superficial appropriation of standard works is surely not extraordinary. In fact, the opposite, if Adams had introduced agricultural works for the point of refuting them, would be more unlikely. His book is a primer on agriculture, not specifically or only a text on agricultural chemistry. At once, then, Adams's views and uses of chemistry can be read as somewhat typical – considering the uncontroversial to be typical, in this instance – while it also places his representations of chemistry and soil as overly general and perhaps uninteresting.

⁵⁸ Daniel Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” delivered as president of the Society, reprinted in *The New England Farmer* 4 (no. 19) (2 December 1825): 148-150, quote on 149. The address was, not surprisingly, a pastiche of the extant

theoretical farmer as “the worst of all farmers,” distinguished by their promotion of theory *without* experience (148). In contradistinction to this social outcast, Adams (and, by extension, the most authoritative figures of the age) advocates practical scientific farmers because they most properly practice agriculture “in the light of science” (149). For Adams, chemistry fits in precisely at that conjunction of the rhetorical (as with his speech and text) and social (by deference to legitimate practitioners).

As I indicated earlier in the chapter, Adams believes in a regulated and God-given economy of nature. As a tool, chemistry is the means by which to identify the laws of that economy. One such conclusion is that the earth “not only retains moisture in itself, but has the power of attracting it from the atmosphere; and, what is still more wonderful, *attracts it in exact proportion to its fertility*” (43). Nature knows what it is doing. That is, in this specific case, the duty of the farmer is to avoid contradicting nature’s laws or overcompensating with fertilization (often understood as the means to promote the retention of moisture), and to allow for the amount of moisture in the soil that the earth already knows it needs. How can he be so sure? A study by Professor Davy confirmed it (43 and 51). Chemistry, through this channel, is meant only to assist farmers in helping the soil achieve its natural fertility. (In this, we should recognize, he evokes the conceptualization of chemistry offered by Lorain.)

Adams’s descriptions of soil fit within his notion of the agency of nature and humans to alter the landscape that I summarized above. Through chemical investigation – or investigation by proxy – he has come to understand that the soil is active, just as nature in general is. It “attracts” moisture, has a “power” to decompose matter, and actively “promotes” putrefaction (37-43). Since he begins with the view that different soils have different “powers” to retain

agricultural works of the day again borrowing heavily from Fessenden, Lord Kames, and even the letters of George Washington.

moisture and since he conveys the view that moisture and putrescent matter are the staples of plant growth, his plan for “improvement” is to promote the moisture- and putrescent matter-retention abilities of the soil. Borrowing more from Davy, Adams categorizes the soil in four types, clay, sand, lime, and magnesia (36-38). This matches Lorain’s taxonomy of soil types and duplicates the categorization that Ruffin sought to modify.⁵⁹ (Ruffin did not consider magnesia a type of soil despite Davy’s definition of it as such.) Adams spoke of the life and death of soil, of how one could “impregnate the soil” with manure, but beyond that did not force the vitalist position as often or as clearly as Lorain had (63).

Although Adams at times obscures the pastoral-georgic distinction I have drawn, he still aligns himself with georgic inclinations by coming to know the abstract economy of nature, and the even more abstract natural laws governing it, through the direct and concrete practice of agriculture. Like Lorain again, he understands and highlights the role of human intervention in the processes of nature.⁶⁰ But whereas Lorain enforces a distinction between those who practiced chemistry and those who practiced agriculture, Adams introduces the element of chemistry to make a precise distinction between two *types* of agriculturists: the practical farmer (“who practices agriculture as an art...but who has never studied it as a science”) and the practical scientific farmer (“who, with the *practice*, unites the study of agriculture as a science”).⁶¹ He glosses over Lorain’s precise clarification between a good method – chemistry – and the one

⁵⁹ This is not to say that Adams was copying Lorain (whose text preceded his). In fact, most of Adams views of the soil were copied from his peer Thomas Fessenden, editor of *The New England Farmer*. Fessenden was not critical of Davy and so Adams’s use of Fessenden to present Davy was twice as glossy, two steps removed from an individual expression of the ideas about soil.

⁶⁰ A third comparison to Lorain deserves mention: Adams sees the use of reason, when expressed through the practice “of natural philosophy and especially of *agricultural chemistry*,” as the most viable guide to agricultural and thus social improvement. He too wants to harmonize reason and nature in the practice of husbandry.

⁶¹ Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” 148-149

who offered the method – the chemist – since he was engaging with the tenets of scientific improvement in a far more general way.

With chemical analysis, farmers could identify ingredients and from that calculate and measure the missing components of their soil. By encouraging the replacement of missing ingredients, Adams tends toward an inorganic, reductionist view of a soil made of individual and discrete components. Since improvement was achievable by attention to soil conditions, the fertility of soil, it follows, could be understood by regulating its components.⁶² As it happens, Adams at once offers conflicting views of the land, both vital and material. But this too, rather than representing a contradiction, is another comfortable mixture of the vitalist and materialist perceptions of nature, in this case as evidenced with the soil.

Adams also recognizes the distinctly human capacity for such scientific investigations, placing that ability into a context of georgic science by associating the labor of experiment and experience with enlightened study. The best scientific agriculturists “have not only studied agriculture in the closet, but have contemplated it in the field,” he says (156). And, as he later clarifies, “It is not the circumstance simply of being *employed* in the labors of the field, as some seem to suppose, which makes the accomplished farmer, for then the ox might aspire to this character as well as his master.” Rather, “it is *viewing those operations in the light of science*,” that matters.⁶³ Thus, his criterion of knowing nature rests on georgic measures just as Lorain’s and Ruffin’s did, though his concern is to nudge the farming class away from rejecting chemistry as simply a practice of others. While he dabbles with Davy by appropriating him without doubt,

⁶² But while at one point he claims that analysis is “the business of chemists,” suggesting deference to an established group of professional philosophers, he indicates more broadly, as I said above, that agricultural chemistry is a tool that can be used by any farmer interested in improvement.

⁶³ Adams, “An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825,” 149

this uncritical citation serves to represent chemistry as a legitimate aid to the practice of agriculture, not a replacement for it.

Conclusion

Much of Part I of this dissertation relates to the intersections of place, practice, and science not in terms of defining their distinct identity, but, foremost, in terms of who is doing the intersecting. People can use chemistry, but not just anyone—only those who have the right kind of experience and the right kind of instrumental application. In the American agrarian culture, agricultural chemistry did not yet represent experience as it would later. Instead, it was a tool *for* the agriculturally experienced. Reflecting on these works as presenting criteria for knowing nature can thus anchor two transitions: one, for the authors themselves, the “means for knowing,” as Ruffin said, moved from studying the land to studying and using chemistry; and two, for my own analyses, a final comment on criteria of knowing nature ties the present chapter to the georgic discussions of the previous two chapters.

Adams says, in essence, nature knows what it is doing. Chemistry is meant only to assist the farmers in helping the soil achieve its natural fertility. Lorain believes that as long as the vital economy of nature is respected, not transgressed, by scientific and chemical interaction, he supports those forms of practice. Ruffin characterizes chemistry as the “true philosophical mode of examining questions of agriculture,” though mainly for its analytical purposes in deciphering the conditions of the soil. In each case, the important factor, the gatekeeper between the primary world of agriculture and the secondary world of chemistry, was the basis from which the chemical insights or instruments were developed. In each case, theory with or without experience was the criterion for accepting or rejecting the proponent. Representing chemistry

and representing land were consistent goals for these men. We can see the place of chemistry in their texts, in those efforts to know the land, because it was not yet transparent. Like a new lens, chemistry's instrumental opacity caused the users to explain its role between them and their goals of improvement. It did not fit invisibly between user and land, because it was not yet the unquestionably legitimate tool it would later become. Its place in improvement schemes was thus evident and tenuous, while being useful and multifaceted.

Ruffin, Lorain, and Adams were all members of a robust agrarian society, no matter that the age of industrialization would soon be upon them or that they spanned the geographically diverse eastern seaboard from New Hampshire to Richmond. Their view of cultivated and cultivatable land was thus defined through everyday cultural and individual experience. True, Adams was not even a farmer, Lorain only devoted his full attention to cultivation later in life, and Ruffin eventually left behind daily management of his plantation by the time he first published his *Essay on Calcareous Manures*. Yet, the means by which they described, defined, and conceptualized the land was based on their lives within agrarian culture. They were not just members of that society; more crucially, their moral and environmental ethic was geographically defined through interaction with the land that gave foundation to that society. For this reason, I discussed their representations of nature first, before beginning to fully address their own perceptions of the value of chemistry and their own uses of chemistry to see the land around them.

The nature John Lorain represents is all-encompassing, less defined by opposition to other terms, such as human or artifice, than as facilitating them. "Nature understands [how to operate]," Lorain says, "where art has not interfered with her simple but perfect system of

management.”⁶⁴ It is the connection between practice and theory expressed in the feature of georgic labor that distinguishes, in the abstract sense, the natural from non-natural and, in the concrete sense, nature from artifice. He even emphasizes his own practical concerns as distinct from a sense of pastoral leisure. “Poets,” he explains, “attribute to rural pursuits, all the rational pleasures which constitute the chief happiness of man. In doing this, they, however, appear to have forgotten that these beautiful scenes which they so elegantly describe, are the effect of immense labour and fatigue.”⁶⁵ Ultimately, Lorain “endeavors to make nature, reason, common sense, and observation alone his guides” toward improvement.⁶⁶ Ruffin introduced his views of the land for the purpose of defining the action of particular soil components in it. Lorain, in a different direction, introduced his views of the land for the purpose of establishing a system of interaction with a visible natural economy.

Edmund Ruffin represented nature as a typical nature writer—say, a rural tourist, or a local naturalist—might have in the early nineteenth century except that his view of the beauty and stock of nature was subordinated to his interest in bringing it into better, more productive cultivation. “Driven by necessity,” Ruffin says, “a spirit of inquiry and enterprise has been awakened, which before had no existence.” He noticed the various features of the landscape, commented on the different geographical, geological and topographical regions of Virginia, and further explained just how uncultivated land, or exhausted land, could be made productive and alive again. The apparent near epiphany he had when reading Davy’s fourth lecture in the *Elements of Agricultural Chemistry* placed chemistry in his argument as the solution to the mechanisms of exhaustion. Because it could assist his goal of improvement, he valued chemistry as a way to view nature.

⁶⁴ Lorain, *Nature and Reason*, 99

⁶⁵ *Ibid.*, 403

⁶⁶ *Ibid.*, 62

Ruffin is concerned most directly with re-establishing natural fertility and assessing degrees of difference from that natural state, setting the stable reference point of nature in contrast not to human intervention but to the possibility of human-guided improvement.⁶⁷ Yes, he wants to return to a prior state of nature, but no, not for Romantic, primitivist ideals; instead, he wants to return only for the ability to improve and progress. Calcareous manures stand at the crossroads of those confusing directions. There is a natural state where all land is equally fertile and, conversely, where soil can be described by its absence of sterility, he believes. Calcareous manures are the agent used to diagnose that fertility-sterility spectrum. Again, they serve an instrumental purpose as part of the broader tool of chemistry. The naturalist-like descriptions Ruffin offers in his *Essay* tell of a Virginia landscape that can be understood by its soil composition. In essence, Virginia is just so many samples of analyzable earth. Differences between eastern tidewater lands and the Shenandoah Valley are recognizable by the soil properties. Slopes, ridges, tree stands, streams, mineral springs, marl pits, limestone hill sides, and the falls of the James River define only the contours of his landscape. Silicious, aluminous, calcareous earths and various vegetable acids define the actual land.

Daniel Adams shows us a “naturalized” vision of nature, wording that I recognize is odd, but which seems to capture his uncontroversial and uncritical stance fairly well. By representing nature through the re-presentation of other’s views of nature, he furthered the common perception of the land within the didactic, pedagogical milieu of his schoolbook. His treatment was more overtly religious by reference to God’s design and with his sermonizing tone, but as a

⁶⁷ In fact, there are degrees of soil life outside the influence of human interaction, Ruffin will explain, as measured by relation to their original “natural” state of fertility. (“Life” and “fertility” are synonymous for Ruffin.) That natural state is not necessarily, or even often, the completely uncultivated virgin soil we might expect. “Natural fertility” is measurable against the productive abilities of the soil after it has been cultivated for a few seasons. (Before then, “several temporary causes...operate either to keep down, or to augment the product,” such as the leftover roots and consequent bad tillage that follow the first clearing of woodlands (22).) Thus, improvement is the ability to make unproductive land alive again.

biblical studies and community leader in Protestant New England, this would not be unusual. Thus, identifying the place of chemistry in his text reveals its position as an obvious example of the means to align scientific investigation with agricultural improvement. In retrospect, we would want to say that Adams saw the future of farming, and it was science. In his own setting, we recognize that the authority for defining how to improve was not wedded to the scientific community (for there was none at the time), but to the method of chemical analysis and the use of chemical reasoning. The chemical lens filtering Adams's perception of nature is just that, a methodological artifact that fits between farmer and land.



The first half of the nineteenth century ushered in stark changes in views of nature. The front half of that shift from an earlier, uncoded promotion of systematic means for agricultural ends puts us in the late Enlightenment and early Romantic period. That world, as Carolyn Merchant notes, was still managing animistic and organic theories of nature. Those theories were slowly being displaced by materialist doctrines that aided an increasingly commodified environment. The back half of that shift to more mechanistic views of agriculture puts us into an industrialized society that treated nature primarily as a mine-able resource and improvement as a fundamental value. In the domain of agricultural chemistry, the shifts between those two historical worlds can be mapped by noting the differences between Humphry Davy and Justus von Liebig, the former vitalist and organic, the latter materialist and mechanical.

The early American republic, roughly from the 1790s through the 1840s, overlays the same spectrum crossed by Davy and Liebig. In political terms, it also takes us from a world of uncertain national origins to at least a modicum of stable cultural identity. In that time, aligning the virtue of the farming classes to the moral authority of the national psyche dominated social

discourse, rural and urban alike. Thus, the above analysis has been set inside the context of the multi-faceted goal of improvement. Improvement had cultural, moral, epistemic, and environmental connotations. The georgic spirit, as I have understood it, combined many if not all of those facets.

A few other conclusions return me to my opening theme of the conditions of possibility for the production of a scientized nature. Quite simply, Liebig's analyzable world of elements and individualized soil components was neither his innovation nor was it revolutionary. Likewise, Davy's vitalist nature of the 1810s was neither unique nor uncontested. And subsequently, the shift between the two was not instant, without warning, or complete. For the authors under consideration in this chapter, concepts of nature, be they vital, material, or both, were understood through the sometimes tentative, sometimes deliberate use of chemistry. Rural Americans were quite adept at debating and formulating the tenets of agricultural chemistry. By deliberating on the value of experiment, systematic study, rationality, and method for the improvement of their lands, they were developing their own sense of agricultural science and their own views of progress and science. Liebig's entrance onto the world stage was not as singularly revolutionary as is usually claimed; Davy's contributions were not as novel as some have thought; and georgically minded Americans were more involved in assessing the social value of science for understanding their lands than has before now been shown. The moral and material place of science in agrarian America was defined by its circulation amidst values of practical farmers and practices with the valuable tool of georgic science.

Part II / The Science of Place

“Virginia—poor Virginia furnishes a spectacle at present...her Agriculture nearly gone to ruin from a course of policy which could not well have been worse destructive if destruction had been its sole objective....” James Mercer Garnett, 1827¹

How was science used to interpret the land? From advocates like the agricultural improver James Garnett, we can see *why* it was used—to effect change, to improve Virginia’s lot. The first half of this dissertation, though, showed that the association of science with improvement was not always easy or obvious. I foregrounded the circulation of the science of agriculture and agricultural chemistry in the Part I, discussing the moral, social, and instrumental place it held in schemes for scientific improvement. It was not a foregone conclusion that the two, science and improvement, would easily be combined. It did not have to turn out that way. This second half of the dissertation will look at the “how” question, examining the mechanisms by which science was actually produced on the farm to achieve improvement. Here, instead of the cultural standing of the sciences of agriculture, I foreground how scientific measures were used to define land and landscape. Part I addressed what people thought of science; Part II considers how they used it to mediate their interactions with the land.

We find from the stories in the following chapters the continuing impact of the transition in soil identification between two tendencies: earlier, Virginians understanding their dominion over the land as granted by proximity and hands-on experience, potentially augmented by scientific practice; later, Virginians achieving dominion over the land by systematic, universally valid principles of soil identification derived from science. The cases of Part II are in the zone of transition between these two tendencies, with improvement the ever-present goal.

¹ James Mercer Garnett to John Randolph, 16 October 1827, quoted in David Hackett Fisher and James C. Kelly, *Bound Away: Virginia and the Westward Movement* (Charlottesville: University Press of Virginia, 2000), 204.

To circumscribe my cases geographically, socially, economically, and politically, I focus on Virginia alone. Virginia was diverse in each of those four respects, with a mixture of political and cultural identities often fitting into specific topographical regions. This diversity helps give the next two chapters a degree of context-specific focus while still allowing broader themes of science and place to take on meaning beyond that region. In Chapter 4, I ask about local, county-based agricultural societies in Virginia, their member's activities, and their logistics of experimentation. In Chapter 5, I examine the first Geological Survey of Virginia as an example of redefining landscape on a state scale with scientific means and for political and epistemic purposes.

Virginia in particular offers a good case for environmental and scientific historical reasons. While the health of the former was thought to be declining, as measured and understood by agricultural parameters, the latter was considered a possible solution for that negative change.² Put another way, Virginia's history is particularly relevant to narratives of improvement. The same James Garnett who blasted "poor Virginia" thought that the science of agriculture, if practiced correctly, could help stave off further decline. In 1816, Virginia's House of Delegates established a Board of Public Works to provide measures for reversing, they said, "familiar scenes of poverty and decline." The Board was authorized and funded to employ an engineer, to conduct surveys, and to patronize organizations deemed worthy of support—the State Geological Survey, begun in the mid-1830s, was one of its most visible scientific endeavors. At Virginia's 1830 constitutional convention, Benjamin Watkins Leigh, later Virginia's Whig Senator in the United States Congress, noted a "tripartite decline" in his state: "a

² Sources on the environmental history of Virginia are also sparse. See note 15, in the Introduction.

loss of ‘Genius,’ a loss of wealth, and a loss in population.”³ All of these proclamations suggested the state’s eagerness to identify new means for improvement.

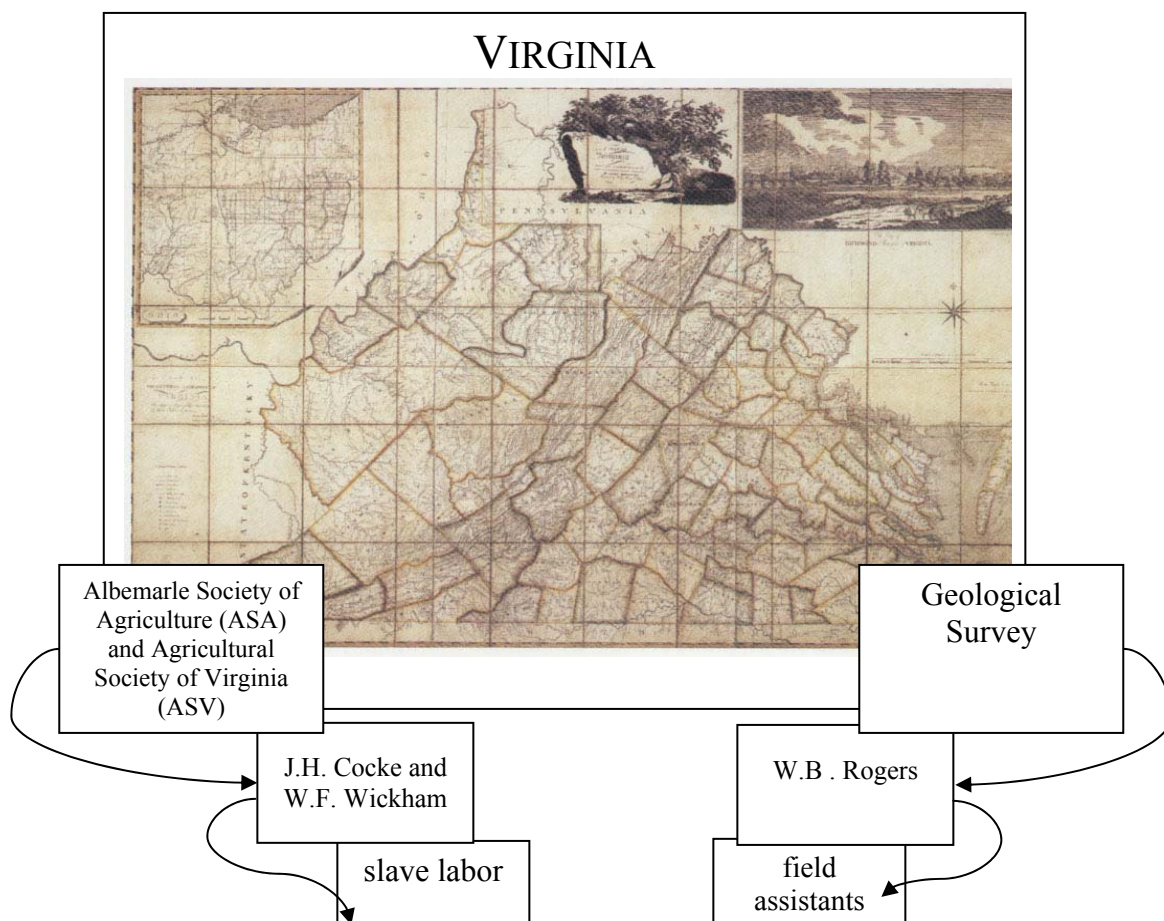


Figure 7. A schematic of Part II, showing the geographical area of focus—Virginia—and the basis for the parallel structures of chapters 4 (dealing with agricultural societies) and 5 (dealing with the state survey). Each chapter funnels down to the laborers working on the respective projects from the wider, more general level of the organization.

³ See Fischer and Kelly, *Bound Away*, and William Shade, *Democratizing the Old Dominion: Virginia and the Second Party System* (Charlottesville: University Press of Virginia, 1993) for more on the spirit of Garnett’s critique. The Virginia Board of Public Works is referenced in John Larson, *Internal Improvement: National Public Works and the Promise of Popular Government in the Early United States* (Chapel Hill: University of North Carolina Press, 2001), 94-95; Benjamin Watkins Leigh is quoted in Wayne Rasmussen and Robert Tilton, *Old Virginia: The Pursuit of a Pastoral Ideal* (Charlottesville, VA: Howell Press, 2003), 68.

Virginia's historians have long maintained that the commonwealth has had a unique identity as a member of the Union. Territorially, it was the largest of the original states. In his 1780s-era *Notes on the State of Virginia*, Jefferson was commenting on land that had until recently ranged from the Chesapeake Bay to the Great Lakes. Although Virginia had ceded present-day Kentucky by the time of independence, the state still remained the most geographically expansive of the former colonies. After the revolution, Virginia's stature was further enhanced by its position as the most populous and most politically powerful. The Virginia Dynasty of Jefferson, Madison, and Monroe held the United States Presidency for the first quarter of the century. Except for John Adams's single Presidential term, by the 1820s the nation had been guided by Virginians for nearly its entire existence. All of this speaks to a clear historical uniqueness based on political heritage.

As a southern state, Virginia also offered a picture of cultural uniqueness. It pursued genuine agricultural reform within a political economy of slave labor that demarcated it from the northern states. The dynamics of local political power structures also differed relative to states like Pennsylvania and New York. State-funded support had already come to agricultural reform societies in those areas by the 1820s, where the flow of capital expenditures often derived from urban capitalist politicians.⁴ In Virginia, however, most of the agitation for reform developed locally and county-wide with the support and impetus of powerful planter elites.⁵

⁴ For Pennsylvania, see Simon Baatz, *"Venerate the Plough": A History of the Philadelphia Society for the Promotion of Agriculture, 1785-1985* (Philadelphia: PSPA, 1985); for New York, see Michele Aldrich, *New York State Natural History Survey, 1836-1842* (Ithaca, NY: Paleontological Research Institute, 2000)

⁵ The cultural "Virginia"—often referred to as "Old Virginia"—was that which was dominated by planter elites, old tobacco grounds, and slave labor dynamics. The geographical "Virginia," on the other hand, extended far to the west and in fact received many of the émigrés from the east. But the Scots-Irish, Germans, and Quakers of the Valley and west who had moved south from Pennsylvania to fill the Shenandoah Valley lived different lives and told different foundation stories. Their impetus for improvement was tied to material agricultural goals more than deep cultural ones.

Yet, even though many of Virginia's historians have characterized the commonwealth for this uniqueness, for better (as a source of pride) or for worse (as a site of decline), the Old Dominion was in fact similar in many ways to other states of antebellum America. Virginia's concerns over promoting population, stability, and agricultural economy were common to all the eastern states; the state's patterns of political development, as with early party systems, were consistent with other regions; and, as the historian William Shade has argued, "the same dynamic economic and social development that characterized the country as a whole" after the War of 1812 was evident in Virginia.⁶

From the earliest days of settlement, from the tobacco of the Jamestown colony to the fields of George Washington's Mount Vernon estate, Virginians had looked across the countryside to understand their landscape as a site of work, as governed by God, and as comprehensible through the guidance of paternal wisdom, local lore, or the direction of an almanac. This was a common approach (but for the tobacco) and a shared experience among the states. But, as James Garnett so ably put it, those lands were clearly declining by the early nineteenth-century, leading to widespread efforts in recovery. Agricultural improvement was perhaps more central to the policies of Virginia's governance than any other matter. Other important issues—slavery, culture, and economy—were also issues of agricultural policy. Reform was the keyword of the day. While almanac, tradition, and family still held sway over daily land management, those practices were being complemented by increased attention to scientifically determined possibilities of reform. Uncodified, local knowledge, on the view of reformers, lacked the rigor to guarantee progress. Perhaps those book farmers might have the answer.

⁶ Shade, *Democratizing the Old Dominion*, 3. Shade argues that "the commonwealth [was] less exceptional and more commonplace than either its hagiographers or critics have conceded" (3).

None of this critique of Virginia's station in the Union means that the Commonwealth lagged on reform. On the contrary, some of the most influential agricultural societies of the early Republic were active in Virginia; their interest in and promotion of scientific solutions merits our attention. With a delicate interplay between unique and shared attributes that probably relies more on historiographical commitment than the ideal of objective historical truth, Virginia offers an example of science and improvement speaking in two directions: on one side, it complements the general sense of improvement practices in the entire Union; on the other, it stands as a context-specific case of political economic decisions and knowledge-making practices.

Chapter 4

The Agricultural Society, the Planter, and the Slave: Producing Scientific Views of Virginia County Lands

“The first main step towards [the work of recovery], is to make the thieves restore as much as possible of the stolen fertility.” James Madison, 1818¹

In the fields of Virginia, science sat at the nexus of soil, fertility, and improvement. This chapter explores how Virginian improvers used field-based experimentation, a particular kind of science, to re-envision those fields. Such a process of conceptualizing soil was implicit in new ideas about fertility and explicit in new practices of fertilizing and land management. I argue that the members of Virginia’s county agricultural societies were acting in scientifically meaningful ways to produce new concepts of their land. By conducting experiments, pursuing systematic fertilization plans, and reporting and debating the validity of each, the Virginians I discuss used science to interpret the agrarian nature that defined their lives.

The main issue in this chapter, underlying Virginians’ efforts to use science for land improvement, is that of soil identity; thus, the perceptions of those doing the identifying are central to our understanding of shifts toward scientific views of tillable land. The historian David Allmendinger, for example, explains that as Edmund Ruffin was promoting reform he “became aware that marling demanded not only a new way of thinking about the soil, but also a new way of farming.”² I agree with Allmendinger, but note a redundancy in his summary—to manage the land in a new way is to think about it differently and to think about soil differently necessitates thinking about land management differently. James Madison carried certain

¹ James Madison, “Address to the Albemarle Agricultural Society,” [no pagination], available at http://www.jmu.edu/madison/center/main_pages/madison_archives/life/retirement/ag.htm <accessed 25 April 2004>

² David Allmendinger, *Ruffin: Family and Reform in the Old South* (New York: Oxford University Press, 1990), 32. While also a member of the ASA discussed below, Ruffin founded yet another contemporary agricultural society in 1818, the Agricultural Society of Prince George. See *ibid.*, 25.

assumptions with him when he gave his Presidential Address in 1818 that would also necessitate thinking about soil and managing land differently. By seeking to recover “stolen fertility,” Madison provided a view of a replaceable store of fertile elements in that soil, a view that assumed the earth was material and depletable in quantified measure. He was an adept farmer, so these views were not developed from nothing. Madison was also an interested party in pursuing the best possible strategies for agricultural improvement in all the georgic senses I elaborated in Part I. To be precise, by referring in his speech to science and “the latest chemical examinations of the subject,” he indicated to his audience how the twin problems of soil fertility and agricultural improvement could be approached.

It was not as President of the United States that Madison argued at length for increased attention to the causes of sterility, urging “improved” processes of land management. Madison had recently been chosen President of the Agriculture Society of Albemarle (hereafter, ASA) near his native central Virginia county, one of the very many civic organizations directed at making local improvement that sprouted in the early Republic.³ As an indication of his agricultural identity, he cherished that election as much as any previous one. Thomas Jefferson, another visible figure during the ASA’s early days, considered Madison the “person who unified with other science the greatest agricultural knowledge of any man he knew....He was the best

³ James Madison was chosen first president of the Agricultural Society of Albemarle on October 7, 1817. See “Minute Book of the Agricultural Society of Albemarle,” Mss4 Ag832 a 1, at the Virginia Historical Society [hereafter, VHS], Richmond, VA. Note that the society was sometimes referred to as the “Albemarle Agricultural Society” [AAS] and other times as the “Agricultural Society of Albemarle” [ASA]. The original Minute Book of the Society, located at the VHS, gives its name as the “Agricultural Society of Albemarle,” and I retain this reference as “ASA.” However, a more accessible version of the Minutes was reprinted by Rodney True and labeled, confusingly, “Minute Book of the Albemarle Agricultural Society.” See True, “Early Days of the Albemarle Agricultural Society,” *Annual Report of the American Historical Association for the Year 1918* (Washington: Government Printing Office, 1921), 222-240. While I refer to the ASA in my text, I mainly refer to True’s reprinted version of the Minutes, in the footnotes. The citation above to Madison’s election appears at pages 263-271 in the True reprint.

farmer in the world.”⁴ One historian of Madison’s home county notes that the ex-President was one of “the most active and best known local reformers.”⁵

In his first address, Madison the famed statesman and planter preached to the choir that “the study and practice of [agriculture’s] true principles have hitherto been too generally neglected.”⁶ This was not entirely true, as a century of treatises, tours, and addresses attested. Surely Madison knew that. But if the problem was a loss of fertility, the solution was to restore it. And if restoration of sterility or reversal of exhaustion was possible, then identifying the true principles of its cause was necessary. To achieve this, Madison and his ASA believed, required detailing “a mode of conducting agricultural experiments with more precision and accuracy.”⁷ The identity of the soil, again, lay at the root of the problem—soil as something improvable; as an entity governed by principles; as matter that could be studied, analyzed, and experimented upon; and thus as something that could be made more productive.

In the following, I foreground the scientific and experimental measures used to define rural lands in Virginia, using agricultural societies like Madison’s ASA as my entry point. In a broader view of things, this attention to specific practices shifts my emphasis away from assessing the cultural standing of those scientific measures, the central thread of previous chapters. My questions here focus on the mechanisms used by Virginian improvers to interpret their lands in a scientific way: how did county-based agricultural societies organize their activities to produce a generalized, instead of merely localized, interpretation of their lands? What did individual planters do to introduce quantified and systematic studies of their lands?

⁴ Thomas Jefferson to John Quincy Adams, November 3, 1807

⁵ John Schlotterbeck, “Plantation and Farm: Social and Economic Change in Orange and Greene Counties, Virginia, 1716-1860” (Ph.D. Diss., Johns Hopkins University, 1980), 260.

⁶ James Madison, “Address to the Albemarle Agricultural Society” [no pagination]

⁷ “Minute Book of the Albemarle Agricultural Society,” 289.

And what labor was actually involved in performing those field-based scientific fertilization experiments?

I use a common approach in this and the next chapter, starting with a wide spatial view (here, the region under consideration by an agricultural society) and funneling down to individual studies of soil and fertility (the site of a single plantation). In the first section I examine the plans of the agricultural societies. Those organizations were arms of the reform movement; their activities were intended to impose a finer lens, a more focused gaze, on the lands of their regions. Like the rural press, with which they were integrally related, the agricultural societies created another important condition of possibility for scientizing the land. In the second section, I put the examples of specific planters under consideration. The personal land surveys and experimental activities of people like John Hartwell Cocke and William Fanning Wickham (whom we met in Chapter 2) offer us descriptions of how land could be perceived through scientific lenses. And then, third, I discuss the specific logistics of experimentation on the land, pointing to the use of slave labor—perhaps the ultimate example of an invisible technician—for the actual mechanics of the surveys.⁸ Lastly, I pull back to assess what those efforts towards scientizing the land meant for the recurring trope in each of the sections, namely, soil identity—how increased scrutiny, in terms of accuracy, precision, experiment, and system, offered new views of the land and what those views were. All told, I mean to show that the activities of these Societies and the planter class writ large across Virginia added to the cultural conditions of possibility fostering the legitimacy of scientific agriculture.

⁸ My use of the term “invisible technicians” is a reference to Steve Shapin, “The Invisible Technician,” *American Scientist* 77 (1989): 554-563

Improvement and the County Agricultural Society

“Americans...constantly form associations...religious, moral, serious.... If it be proposed to advance some truth, or to foster some feeling...they form a society.” Alexis de Tocqueville, 1835⁹

In Virginia, planter elites took a leading role in organizing county-based agricultural societies that brought issues of soil property identification to the fore in at least three ways: first, by providing a forum for organizing and directing increased attention to principles of land improvement; second, by advocating a series of measures that defined specific land management practices; and third, by making systematic and experimental identification of measures of fertility the centerpiece of these first two efforts. “Fertility” was code for “soil status” and the common plea to restore fertility and alleviate exhaustion was, in subtle ways, a call to identify soil properties with more scientific attention. It is not clear that the societies themselves changed concepts of soil either instantly or directly. However, through direct action, such as surveying soil conditions, and indirect action, such as promoting systematization and encouraging communication to others, they put a significant focus on the importance of defining the land anew. In this section, I review the county societies’ activities toward identifying soil properties and, consequently, of improving soil.

Madison’s ASA was in fact one of two groups of reform-minded planters forming in Virginia nearly concurrently, each exemplifying the collective spirit Tocqueville noted in his travels. Besides the ASA, there was the more ambitiously named Society of Virginia for the Promotion of Agriculture or, as it was more colloquially known, the Agricultural Society of Virginia (hereafter, ASV). The ASA, founded in the Spring of 1817 and the ASV, founded the next year, shared only a small overlap in membership, though a large overlap in geographical

⁹ Alexis de Tocqueville, *Democracy in America*, Vol. II, edited by Andrew Hacker (New York: Washington Square Press, [1835-1840] 1964), 181

focus. While the original thirty members of the ASA hailed from five counties in central Virginia, not just Albemarle County, and met in Charlottesville, the more than 200 from the ASV came from as many as fifteen counties to meet in Richmond.¹⁰



Figure 8. A county map of Virginia, circa 1770. Albemarle County, near the center of the full map, bordering to the east the first line of ridges, is designated as “2.” The ASV was based in Richmond, Henrico County, designated as “26.” This map gives little indication of the settlement patterns in the Shenandoah Valley, just over the ridges that mark the western border of the colored counties, nor the region even farther west (here designated as the massive Augusta County—“5”—and Hampshire County—“24”) that later became West Virginia. It does, however, indicate the breadth of the piedmont and the dominant populated regions of Old Virginia. Source: *A New and Accurate Map of Virginia; Wherein most of the Counties are laid down from Actual Surveys. With A Concise Account of the Number of Inhabitants, the Trade, Soil, and Produce of that Province.* By John Henry. Engraved by Thomas Jefferys Geographer to the King. London, Thos. Jefferys, 1770, G3880 1770 .H4 Vault. Library of Congress, Geography and Map Division. (<http://memory.loc.gov/ammem/repehtml/repecomp.html>)

¹⁰ The membership list for the ASV can be found in the *Memoirs of the Society of Virginia for Promoting Agriculture* (Richmond: Shepherd and Pollard, 1818), xii-xiii. The membership list for the ASA can be found in “Minute Book of the Albemarle Agricultural Society,” 263 and 269.

The membership of these groups was impressive, to say the least, lending the necessary social credibility to their efforts in refashioning mid-Atlantic farming practice. Both the ASA and ASV boasted community leaders, state senators, governors past and future, United States Senators, and even ex-Presidents as members. For example, the ASA chose James Madison as its first President in their inaugural meeting, as I noted above. Jefferson, a seemingly ubiquitous presence during periods of agricultural reform, was also on hand for the first ASA meeting. In 1825, the ASA's second president, James Barbour, was then the Secretary of War in John Quincy Adams's administration. In Richmond, the larger ASV elected John Taylor—former US Senator, georgic author of *Arator*, and respected state-wide leader—as its first President. The ASV's Vice-President, Wilson Cary Nicholas, would soon be Virginia's Governor.

The ASA and ASV understood the pressing problem of unproductive soil. By 1818, their members had been fighting the problems for decades by altering the physical demands on the land. In terms of physical techniques, simple practices like crop diversification, field rotation, and the use of newer mechanical plowing implements helped in this regard. Each of those measures, the planters knew, had been a staple of eighteenth-century agricultural treatises. They were, as Carolyn Merchant has described them, core elements of the nation's agroecological system.¹¹ The planters were aware that monoculture was detrimental to their land, having come to understand through decades of experience that diversity in planting was the key to sustainability. Of course tobacco had been the staple crop of the state, the original purpose for Virginia's existence. But by the early nineteenth-century the monoculture tobacco paradigm, recognized as harsh on the soil by all who worked it, had already shifted into diversified

¹¹ Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press, 1989), 163-166. Merchant refers to New England, but her comments are relevant to the mid-Atlantic as well.

planting. Even Madison noted that “Tobacco...though of great value, covers but a small portion of our grounds”¹² Michel Chevalier, the 1830s French tourist whose historical significance has been obscured by his more famous countrymen Tocqueville, found Richmond’s “flour markets” impressive, not its tobacco.¹³ All over, a variety of grain crops, like oats, rye, wheat, corn, and other cereals were on the rise. Livestock and poultry also flourished across the state. The important point, based on the planter’s view of their land, was that by the antebellum period, with tobacco acting as neither the sole nor economically dominant crop it had been, Virginians had gained significant experience in changing soil productivity by increasing their crop diversity.¹⁴

The planter’s experience with physical measures of manipulating ecological conditions—with crop rotation, plowing, new varieties, and so on—underscored their know-how as they gathered to discuss further improvement efforts. They took their view of the land and systematically augmented it with more direct attention to soil conditions. They shared a common view of their landscape, one visible as a patchwork of crops, defined through experience, and measured qualitatively and mostly in an ad hoc fashion. The georgic social credibility of those community leaders, furthermore, gave local legitimacy to any proposals they might put forth.

¹² James Madison, “Address to the Albemarle Agricultural Society” [no pagination]

¹³ Michel Chevalier, *Society, Manners, and Politics in the United States: Letters on North America* (Gloucester, MA: P. Smith, [1839] 1967), 316

¹⁴ To be sure, this diversity varied across the regions of the Commonwealth. The Great (Shenandoah) Valley, for example, became the prime producer of wheat, outpacing the Piedmont, Tidewater, and the western coal field regions, while still integrating corns and grasses into its crop layouts. See Kenneth Koons and Warren Hofstra, eds., *After the Backcountry: Rural Life in the Great Valley of Virginia, 1800-1900* (Knoxville: The University of Tennessee Press, 2000), for further analysis of the many nineteenth-century contexts of the Valley of Virginia, including several discussions of the place of wheat in the social dynamics of that region. See also Warren Hofstra, *The Planting of New Virginia: Settlement and Landscape in the Shenandoah Valley* (Baltimore: Johns Hopkins University Press, 2004).

The ASV convened their premier meeting in Richmond in March 1818 to direct increased attention to principles of land improvement. This, the simple fact of organization, would be the first of three means for bringing issues of soil property identification to the fore. At the Richmond meeting, they put their static views of the land into a dynamic historical trajectory, offering an origin story that traced the history of Virginia from English settlement through the recent stage of exhausted soil. Upon settlement in the seventeenth century, they observed, all the land was “wilderness covered with thick forests.” With increasing trade opportunities and the concomitant growth in population, though, “cultivation...produced by necessity” soon became the hallmark of the colony. Finally, the legacy of cultivation led directly to “exhaustion,” an “unavoidable consequence.” The situation, the members contended, was understandable: “New lands invited and rewarded the labourers; and cutting down and wearing out became habitual.” Although the pattern had been inevitable, the ASV officers believed the trend was not irrevocable. “Intelligent... citizens have appeared in different parts of our country whose judicious exertions have demonstrated that our lands are capable of recovering their original productiveness.” It was even possible, they dared suggest, to achieve “increased fertility.”¹⁵

That first meeting of the ASV allowed members to understand their current state by narrating the action that led them there. They had written a soil exhaustion origin story. “The land of our ancestors which nourished our infancy, and contains the bodies of our fathers,” the officers noted, “must be improved or abandoned.” The options were simple, either leaving the Old Dominion behind, a common decision as the expansionism in Monroe’s Doctrine codified, or finding the means to stick it out. The ASV planters were already committed to local improvement, so their reference to abandoning the state was merely a rhetorical flourish. To this end, those at the ASV’s meeting would of course be an enthusiastic audience for Madison’s view

¹⁵ *Memoirs of the Society of Virginia for Promoting Agriculture*, iii-iv.

at the ASA on the value of “chemical examinations,” a view that moved beyond older mechanical practices that already underlay land management across the state. The opportunity afforded by the mere fact of organization would bring better techniques to the fore, combining the older mechanical approaches with newer, more methodical chemical and scientific ones. The payout for ASA and ASV members was a belief that more systematic attention to practices would make their soil more fertile, fertility being the very metric of improvement.

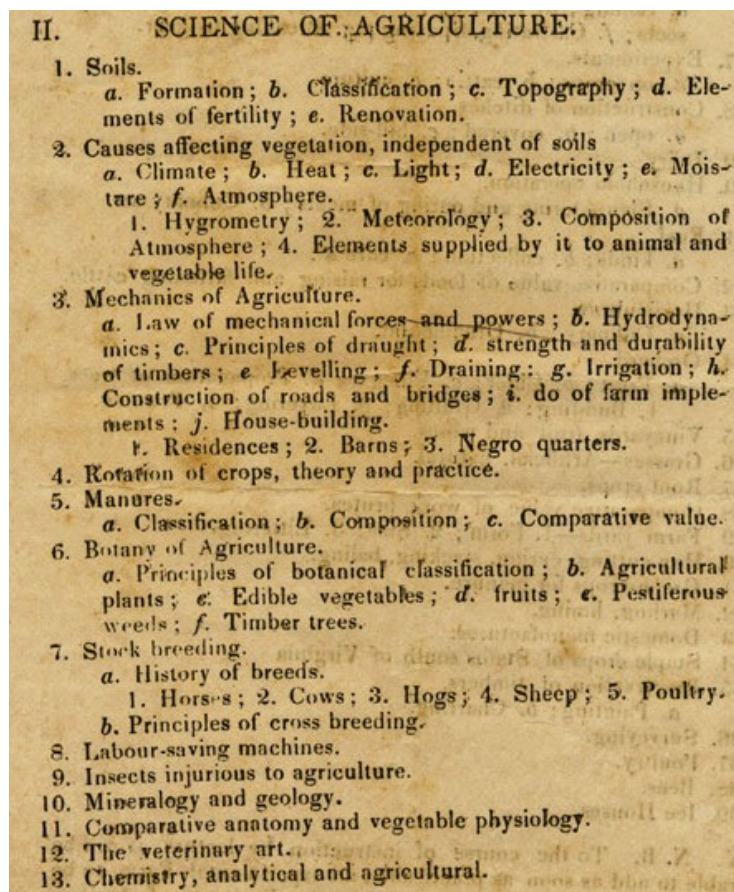


Figure 9. “Synopsis of Subjects to be Embraced in a Course of Agricultural Lectures (Agricultural Society of Albemarle) 1822.” The ASA’s efforts to improve soil conditions were evident in the educational plans they proposed. This “Synopsis” provides the basic course of study necessary, in their view, to align science with agricultural improvement. Broadside 1822 .A475, Alderman Library Special Collections.¹⁶ Reprinted by permission of the University of Virginia Alderman Library Special Collections.

¹⁶ The broadside is also at <http://www.lib.virginia.edu/speccol/collections/cabell/digitalarchive/1822/recto.html> <accessed 15 November 2003>

Once the organizational constitutions of the ASA and ASV were established, complete with origin stories, patriotic charters, and the georgic credibility to hold it all up, the planters moved on to the second of the three means for bringing issues of soil identity to the fore—advocating specific measures that defined explicit land management practices. The officers stated their premise clearly: “In every science, and none more than in agriculture, theories should be tested by experiment and systems founded on facts.”¹⁷ The reformist improvers recognized that “habits of attention to, and observation on, all the daily operations of a farm” were essential to their goals.¹⁸ Thus, they proposed a series of specific activities, ranging from the conceptual and theoretical to the practical and political. They would not speculate, but rather report empirical observations from actual farming practice.

At a more practical level, the Society’s proposals included several aspects of literary production. One example would be writing for the press, as evident with the ASA and ASV’s publishing agreements with Skinner’s *American Farmer* and Thomas Ritchie’s *Richmond Enquirer*.¹⁹ The ASA had noted that “former attempts to establish Agricultural Societies” failed in Virginia not for lack of valuable information, but because they had not followed through on timely “communication to the public.”²⁰ The new opportunity for collaborative improvement afforded by organization was meant in part to correct those prior flaws in poor communication.

Reports of members’ land-management practices offer another example of literary production. This, in fact, was part of the third of the three means for bringing issues of soil

¹⁷ *Memoirs of the ASV*, iv.

¹⁸ *Memoirs of the ASV*, as quoted in Schlotterbeck, “Plantation and Farm,” 271.

¹⁹ This was discussed in Chapter 1. Also, by way of clarification: in Chapter 2, I based my discussion on the rural press and noted the participation of the Societies. In this chapter, I base my discussion on the Societies and note the participation of the rural press.

²⁰ “Minute Book of the Albemarle Agricultural Society,” 249

identity to the fore, namely the systematic and experimental identification of measures of fertility. At this most direct level, the Society's proposals included typical organizational activities. In addition to the commissioned reports, to which I will return below, these included awarding prizes for demonstrations of best farming practices, holding annual fairs to exhibit examples of good cultivation, keeping extensive and quantitative accounts of practice in personal diaries, promoting the trading of seed varieties to enhance diversity in crops, and acting as special interest groups before Congress. Each example was an instance of encouragement in the pursuit of improvement; all of the activities together were intended to introduce measures of soil property identification to farm practice for the sake of agricultural progress.

The ASA brought together the general and practical when they outlined ten "Objects for the Attention and Enquiry of the Society" in October 1817, a list that ranged from animal care, crop rotation strategies, fertilizing options, and mechanical implements to calendars of work, building structures, and a "succinct report" of rural economic practices by members. This last was the most appealing of the ten statutes, promising that "a judicious execution of this article alone might nearly supercede [sic] every other duty in the society."²¹ It was a clear example of going beyond the traditional pillars of their agro-ecological system, to paraphrase Merchant again, and into new realms of codified and systematic studies. The members followed up on the idea of the report in their subsequent meeting, recommending that "each member of the Society be required to make a report of his own practices in Agricultural and Rural Economy." They asked questions about rotations of crops, number of acres under the course of cropping, quantity and description of manure carried out yearly, quantity of plaster used, general description of the soil, and the labor-saving implements used. Chemistry, as evident through the case of fertilization experiment, was understood as a practice on the farm, making observations of the

²¹ "Minute Book of the Albemarle Agricultural Society," 265

micro-identity of the soil as important as reports on its macro-manipulation. On the face of it, the reports would give a synopsis of cultivation strategies. They indicated how members treated their property, what they expected from it, and how their practices were either exhausting or resorting fertility. More deeply, the ASA was evaluating soil content and identifying the degree of local exhaustion, in the process promoting the view that the earth was subject to codifiable scrutiny and analysis.

| Heads | Answers. |
|---|----------|
| Rotation of crops. | |
| Average produce of each crop p acre. | |
| Number of acres under the course of cropping. | |
| Quantity of Land cleared yearly. | |
| If any, what proportion of worn out Land. | |
| Number of Hands, Horses and Oxen employed. | |
| Quantity and description of Manure carried out yearly. | |
| Quantity of Plaister used—at what rate—and with what effect. | |
| General description of the Soil of the Farm. | |
| Number and description of Labour saving machines | |
| Number and description of wheel carriages used in the operation of Husbandry. | |
| [22] Heads | Answers. |
| Number of cattle Sheep and Hogs. | |
| How raised in summer, and kept in Winter. | |

Figure 10. The Survey—questionnaire—issued by the ASA at its 4 November 1817 meeting. By this “subjoined Formula,” the officers wrote, “each member of the Society [will] be required to make a report of his own practices in Agricultural and Rural Economy.” See “Minute Book of the Albemarle Agricultural Society,” 273-274.

The scientifically literate men of the ASA also offered prizes for outstanding essays and experiments and hosted fairs to showcase successes in animal breeding and plant growth. John Craven won the 1828 prize for his exemplary land management skills. William Meriwether came in second because his report, though adequate, was not quite as indicative of a broad fertilization plan.²² The society created standards of writing and experimenting—though uncodified—through the formats it encouraged and the prizes it awarded for meeting those standards. Over in Richmond, the ASV also encouraged members to become diarists, tabulating the results of their practices for personal advance, not just as instances of local surveillance for the organization’s benefit. Many of those members, such as Dabney Minor, a planter from Orange County (bordering Albemarle County to the northeast—given as “42” in Figure 8) followed suit by recommending the keeping of an agricultural diary to the readers of the rural press. Minor noted in an article to *The American Farmer* that by maintaining records and observing soil properties “we shall derive both satisfaction and improvement. We can mark distinctly the results of various improvements and experiments;...[it will] banish those loose, haphazard, careless, and guess work habits, but too prevalent among us, and unquestionably the bane of all good husbandry.”²³ Joseph Cabell, a Richmond-based planter, member of the ASA, and longtime friend of Jefferson, was similarly inspired to keep detailed records. The papers of scores of other planters repeat the same example. Planters like Minor, Cabell, and their neighbors were empirics, though attentive to theories of plant nutrition and soil composition.²⁴

²² See “A Report of the Committee of the Agricultural Society of Albemarle, on Farms, made to the Society at their Show and Fair, the 21st October, 1828,” as reprinted in the *American Farmer* 12 (August 20 and 27, 1830): 177-178 and 185-187.

²³ Dabney Minor, “On the Importance and advantages of keeping a regular diary of operations of Husbandry,” *AF* 2 (December 1, 1820): 285, as quoted in Schlotterbeck, “Plantation and Farm,” 271.

²⁴ See Joseph Cabell’s agricultural diary in the Cabell Family Papers, MSS 38-111, Box 3, the U.Va. Special Collections Library. The diary is also on-line at <http://www.lib.virginia.edu/speccol/collections/cabell/digitalarchive/index.html> <accessed 5 November 2004>.

Seed trading was yet another example of the Society's attention to altering soil, because with it the members were changing the demands of the soil's food supply to the new plants. That is, introducing new seeds to the fields was not only about bringing in new products; it was simultaneously about more efficiently extracting the nutrients of existing soil by leveraging the different nutritional needs of foreign seeds. In that simplest economic sense, introducing new seeds from different lands could increase the variety of crops available for market and, thus, create new markets and specialty products. The trade was not only international and inter-regional, but also intrastate. In its first seven years, the ASA exchanged seeds of rare crop varieties from China, France, Portugal, and several South American countries.²⁵ John Hartwell Cocke was a dealer of sorts for the Fluvanna County region, supplying White May and Mexican Wheat to interested parties.²⁶ He used his influence as the Second Vice-President of the ASA (as well as a former military and current political leader) to manage the traffic of seeds and crops. In the second sense, related strictly to plant health, those seeds might provide disease-resistant strains of common crops, like wheat, which had been hit hard by insects, weather, and other destructive forces. The story of the Hessian fly in revolutionary era America stands as one popular episode in this vein, where planters sought disease-resistance from various wheat strains

²⁵ To be sure, seed trading was not new. As I mentioned in Chapter 1, exchanging plant seeds had been a mainstay of trans-Atlantic correspondence from the later eighteenth century, notably between George Washington and Thomas Jefferson in the US and Arthur Young and John Sinclair in Britain. But, as with almost all matters, the forum of the Society allowed far greater coordination and promotion of the activity. Some representative examples from the "Minute Book of the ASA" include wheat seeds from the Black Sea, at the 10 October 1820 meeting, 290; from Paris, at the 4 February 1822 meeting, 296; from the Pacific Ocean, at the 7 October 1822 meeting, 298; from China, at the 11 October 1824 meeting, 304.

²⁶ Fluvanna County was formed out of the western half of Goochland County in 1777. It borders Albemarle County to the South and East, as designated by "22" in Figure 1. See letters from John Moody to JHC, 15 June 1824, William Shepard to JHC, 28 June 1824, General J. Swift to JHC, 10 July 1824, H.E Watkins to JHC, 12 July 1824, John Tandy to JHC, 3 August 1824, and David Patterson to JHC, 13 September 1824, all in Cocke Family Papers, Accession Number 640, Box 41, Alderman Library Special Collections, University of Virginia, Charlottesville, VA. [Hereafter referred to JHC Papers]; also see Edmund Wickham to JHC, 29 June 1825, in JHC Papers, Box 43 and George Love to JHC, 31 Jul 1834, in JHC Papers, Box 41.

sent from afar.²⁷ Cocke, in fact, offered several reports to the ASA on that very subject.²⁸ In a third sense, one both scientific and historical, trading seeds was simply a way to fight against agricultural problems (like Hessian flies), providing a common object of attention for agriculturalists, botanists, and the various members of nascent county societies. They all shared a reliance on recognizing the value of soil properties and the value of manipulating those properties. The new seeds offered a way to investigate changes in soil productivity with precise experiments on specific plots of land.

Finally, the ASV and ASA sought to influence economic and social policy, promoting their networks of influence in the process. These were not simply groups of men who wanted better farming for farming's sake; they were powerful political entities that sought to control the sanctity and future of the Southern plantation system and, as such, were overtly political. While defined by the goal of improving agriculture, they were simultaneously driven by the desire to maintain economic (read: slave labor) power. As ever, the strong political and cultural component of the societies could not be divorced from their agricultural goals. John Taylor, in his addresses to the ASV, advocated using reports of experience and the testimony of farmers as a basis for legislation in congress. Others used the Society as a platform from which to oppose Northern attempts at industrial inroads to the South that could "lead directly to an insurrection of our Slaves." John Hartwell Cocke, as a central figure in the ASA, was asked in 1819 to call a special meeting of the Society to oppose the Society for the Improvement of Domestic Industry's attempted inroads to the South. Perceiving them as a group of "Northern Abolitionists"

²⁷ See Philip Pauly, "Fighting the Hessian Fly: American and British Responses to Insect Invasion, 1776-1789," *Environmental History* 7 (2002): 485-507.

²⁸ See the meetings of November 3rd and 4th, 1817 and March 2nd, 1818 in "Minute Book of the Albemarle Agricultural Society," 248, 271, 275, and 277-78. See also J.H. Cocke "On Hessian Fly—No. 1," *American Farmer* 1 (1819): 296-297, for the first in the series of reports that were also published, as noted in that *AF* article, in the *Richmond Enquirer*.

scheming to unsettle the slave population, the Albemarle Agricultural Society was positioned to advance its own memorials in congress. The “Northern Projectors, are taking measures in a clandestine manner to obtain signatures to their Memorials (at least in favor of additional taxes to us), in the Southern Section of the Union.”²⁹

The members agitated explicitly for political reform and policy creation through the many “remonstrations” and “memorials” prepared and sent to state and federal assemblies. There were many less hostile examples as well. The ASA’s 1825 call to the Virginia General Assembly asked for support of river improvements that would encourage trade and market viability; later, the treasurer was authorized to put any “disposable funds” into the stock of the Rivanna River Navigation Company. An 1820 Memorial outlined the argument against protectionism, with reference to Smith’s *The Wealth of Nations* and counter-arguments to Alexander Hamilton’s seemingly pro-monopoly policies.³⁰ Another clear demonstration of exerting social influence for political action was the ASA’s fund for “the Establishment of a Professorship of Agriculture” at the new University of Virginia. Members considered the professorship a necessary component of “the march of Agricultural Improvement already so happily commenced.” The fund was not entirely unexpected, perhaps, since many of the ASA’s well-connected members, Cocke among them, were on the new school’s governing board.³¹ These efforts tied together local attention to soil conditions with national attention to economic policy, again making the georgic’s multivalent notion of improvement—of individual,

²⁹ See James Garnett to JHC, Letter of 11 December 1819, in JHC Papers, Box 30.

³⁰ On the Rivanna River projects, see “Minute Book of the Albemarle Agricultural Society,” 312, 324, 325, and 333-334. Also, see Minnie Lee McGehee, “The Rivanna Navigation Company,” *Bulletin of the Fluvanna Historical Society* 5 (1967): 1-201; and John Majewski, *A House Dividing: Economic Development in Pennsylvania and Virginia before the Civil War* (Cambridge: Cambridge University Press, 2002), 28-32. Yet another example of partisan political agitation was Edmund Ruffin, “An Address to the Public from the Delegation of the United Agricultural Societies of Virginia,” read at the May 8, 1820 meeting. It was published in *American Farmer* 2 (May 19, 1820): 57-59.

³¹ “Minute Book of the Albemarle Agricultural Society,” 253. Meeting of December 16, 1826. See also Majewski, *A House Dividing*, 31, note 71.

community, nation, and land—explicit through the activities of the agricultural societies. With Virginia still standing as the most influential and populated state into the 1810s, such agitation for programs of political economy were directly relevant to assessing the cultivated landscape of rural America more broadly.

The members of the ASA and ASV were certainly not unique in the early national period. Both the forum provided by agricultural societies and the cause of their formation were already widespread. Pennsylvania, New York, Massachusetts, and Connecticut, to name a few, all had regional groups devoted to advancing agricultural causes.³² The Philadelphia Society for Promoting Agriculture had originated in the 1780s when a group of urban elites—“men of property and education,” founder John Beale Bordley called them—sought to improve agricultural productivity and thus economic power.³³ By the turn of the century the PSPA’s activities were temporarily subsiding, only to be rejuvenated into the second decade of the 1800s at the same time the ASA and ASV were forming within Virginia. By the time Tocqueville toured the countryside, his observation about the flurry of “society” activity was easy to make. A mere review of Tocqueville’s list in the epigraph to this section—on reasons “religious, moral, serious” for organizing—shows that the agricultural societies were especially potent: they pulled together so many of the ostensible reasons for association including the diffusion of books, community education, and the promotion of a moral and near-religious spirit. They exemplified the “religious, moral, [and] serious” purposes of civic associations. Like an early actor network, they combined ideas, people, and material to produce specific actions on the land, providing the

³² The institutionalization of county-wide agricultural societies took hold far more readily after the end of the War of 1812, when the political environment became more stable. See Margaret Rossiter, “The Organization of Agricultural Improvement in the United States, 1785-1865,” in Alexandra Oleson and Sanborn Brown, eds., *The Pursuit of Knowledge in the Early American Republic* (Baltimore: Johns Hopkins University Press, 1974), 279-298 and Baatz, “Venerate the Plough”.

³³ Bordley quoted in Peskin, *Manufacturing Revolution*, 123.

forum for re-assessing issues of soil identity. As is evident through the activities of the ASA and ASV, the general outline of organization and systemization provided necessary pre-conditions for further codifications of the soil. Their work resulted in the encouragement of experimental and quantified techniques for defining soil so as to alter that identified entity.

Surveying Estates/Plantations

The mere organization of efforts to improve agriculture added only so much to specific changes in perceptions of nature. But the ASA and ASV did more. They offered the means and the forum for scientizing the land, as much as forwarding the idea of it. Their contribution should be seen as promoting attention to soil identity and as increasing the nexus of practices *on* and changing views *of* the land. The “succinct report” of rural economic practices I mentioned above goes farther in exemplifying precisely what went into introducing newer views of the land. Those reports were localized agricultural surveys, neither strictly cartographical, natural historical, geological, nor chemical, but nearly all of these at once. Though the responses were, in reality, rarely “succinct,” the ASA and ASV helped pioneer the questionnaire format in their reports (surveys), asking their members to provide personal assessments of their landscape, crops, and soils. Those estate surveys offer us a site with which we can examine the short list of parallel and overlapping efforts in society activity —surveys, experimenting, and manuring—I present below. Each was an effort to re-identify and re-define the estate’s soil, indicating how specific individuals were following in the spirit of the agricultural societies to re-vision nature.

In this section, I provide two cases of how land could be perceived with scientific lenses that begin within the scope of these society-influenced surveys. The first is the example of John Hartwell Cocke (1780-1866), the prominent ASA member and influential Virginia statesman.

His case shows a planter moving from qualitative and systematic accounts of soil identity to quantitative and technically specific ones. The second case is that of William Fanning Wickham (1793-1880), who was indirectly involved in society activity through correspondence and kin (more so than involvement by direct society administration, as with Cocke). Wickham too shows us a planter applying increasing scientific strictures to land management over the decades of his life. Cocke and Wickham worked and lived within the geographical and organizational scope and intellectual ethos of the societies, even though their practices were not simply directed by the societies alone.

General John Hartwell Cocke had his hand in nearly every antebellum reform in the state. I can only begin to account for his role in agricultural reform in the paragraphs that follow. He was a founding member of the ASV and ASA and a longtime Second Vice-President of the latter organization. His voluminous correspondence records indicate the pivotal role he played in seed trading (and thus crop diversification) around the mid-Atlantic. In the 1820s, he was an original member of the Board of Rectors at the University of Virginia. He was also the head of the state Board of Public Works for many years, steering scientific projects such as the State Geological Survey (to which I return in the next chapter) and transportation projects like the James River and Kanawha Canal. He transmitted this spirit of civic involvement to the next generation as well. By the 1850s, his son Philip St. George was the Superintendent of the Virginia Military Institute, where some of the earliest efforts at academic agricultural chemistry were taking place.³⁴

³⁴ There are no substantial biographical works on Cocke, though there are treatments of his estate at Bremo and his involvement in founding slave colonies in Africa (for freed slaves). See Randall M. Miller, ed., *“Dear Master”:* *Letters of a Slave Family* (Athens: University of Georgia Press, [1978] 1990); Muriel Brine Rogers, “John Hartwell Cocke (1780-1866): From Jeffersonian Palladianism to Romantic Colonial Revivalism in Antebellum Virginia” (Ph.D. Diss., Virginia Commonwealth University, 2003); and Catherine Helliard-Symons, “John Hartwell Cocke and Bremo: A Study of Plantation Life” (M.S., University of Wales, Swansea, 2003). Cocke’s canal ambitions, I should add, were spurred on through correspondence with another wealthy antebellum political figure, DeWitt Clinton of

Cocke's land management practices changed over time to incorporate more technically quantified measures of soil conditions and properties. His progress appears to fall into three phases—first, early adulthood to about 1820; then the 1820s and 1830s; and finally the 1840s and beyond. His first surveys, encouraged by the newly organized ASA, are general and qualitative, even if systematic and orderly. He then adds more quantitative and experimental depth to his approach. At that point, in a third phase, his notions of soil identity and improvement practice were becoming analytically determined with the combination of instrumental analysis, experimental practice, and systematic quantification. The differences between the two management tendencies, qualitative and quantitative, were considered by the ASA and the broader population to be the differences between less scientific and more scientific. My characterization of Cocke's land management practices is thus a reproduction of the positivist-based association at the time between quantification, science, and modernity.³⁵

As chair of the first and second meetings of the ASA (before Madison was elected President), Cocke explained the "Objects for the Attention and Enquiry of the Society," before volunteering to report on his own personal survey at a subsequent meeting. In May 1818, he read that report, noting his crop rotation techniques, manuring policies, and description of the soil. This was the overview of the "Agricultural and Rural Economy" at Bremo, his estate in Fluvanna County, that the members sought. Cocke explained in his report that his lands were of various quality, the better of it "composed entirely of James River bottoms," with other soil of "inferior quality" set higher up and away from the river. In one field under review, he estimated

New York, who was contemporaneously building the Erie Canal. See Clinton to JHC, 20 July 1824, in JHC Papers, Box 41.

³⁵ The role of quantification in the establishment of a "modern" scientific world has been studied with great complexity and I cannot do the subject proper justice with a singular footnote. For two works that offer more insight into quantification and science see Ted Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1995) and Mary Poovey, *A History of the Modern Fact: Problems and Knowledge in the Science of Wealth and Society* (Chicago: University of Chicago Press, 1998).

that he cleared five acres a year and worked 75. The survey asked “what proportion of worn out land” he dealt with. He estimated fifteen acres. On that particular field, he manured heavily—“about 20 loads” carted out—but used no plaster. On another, far larger area that was divided between “low ground” and “high ground,” he cleared twelve to eighteen acres annually, grew crops on about 550 acres, and considered none of them “worn out.” He manured that land with up to 600 loads and there used plaster liberally, “as recommended by *Arator*.” However, though he saw the direct efficacy of the manure, “in all those experiments” using plaster, he said, he doubted whether he “derived any advantage from its use.”³⁶ The same was not true on the “High Grounds” planted in wheat, where he “experienced the most wonderful benefits from its use.” He estimated that the differences in outcome were due to the different soils. “Upon the red soil” he saw that plaster helped. On the “gray soil mixt [sic] with gravel” it was less helpful. These assessments—based on recognizing different soil types and recording the results of direct experiments—were just the thing the ASA was looking for and just the thing that would encourage a planter to seek even better means for soil identification and experimental acumen.

Cocke’s planting techniques were rather uncontroversial and, in kind, his report was not contentious. He was qualitative and general in his assessments. Yet, he insisted upon the systematic attention he gave to the questions in the survey and to the practices underlying his answers. “System and order,” he said, “are the grand secrets of using our little span of time to best account.”³⁷ The degree to which his practices were sophisticated or “scientifically” informed was less important to the ASA audience than the fact that Cocke had acted georgically; that is, that he used a system, was diligent, and appeared methodical. He actively crafted this ethos, as his testimony in speeches and reprints in *The American Farmer* indicates.

³⁶ Cocke’s report was delivered to the ASA in May 1818, per the Minute Book, which does not include the details of the report. The actual details can be found in “Albermarle Agricultural Society Report,” JHC Papers, Box 182.

³⁷ JHC to JHC Jr., January 2, 1836, JHC Papers, Box 84.

His local agricultural survey was a model. It showed farmers how they could improve productivity by systematically investigating and manipulating soil conditions and properties. In one instance a decade later, he was called on to answer the Secretary of the United Agricultural Societies of Virginia's request for a similar survey of Bremono. That Secretary was Edmund Ruffin; the organization was founded in the 1830s as a collaboration between various county societies. Cocke exercised his authority as he explained to Ruffin and the UASV that wheat soils were best for fallowing and sandy soils best for deep ploughing. For the best fertility on light soils, Cocke explained, use "18-20 loads" of manure. By the time of this later survey, into the 1830s, Cocke's increased attention to the questions of soil identity led him to recognize the diversity of soil. From light to dark and sandy to coarse, he delineated the character of his lands with an increased systematic attention and with greater precision so that fertilizer recommendations were tailored to more precise soil conditions.

In his second phase of increasing attention to soil identity, Cocke moved beyond providing general commentary on the status of his land. He actively sought to introduce the latest models of scientific practice into the management of his estate. He even started to treat scientific reform as an article of faith, speaking of it as a hallmark of the age. Writing to his son, John Jr., in 1836, he claimed that to promote "scientific principles is one of the few Monuments of our day and generation."³⁸ As the historian John Majewski has noted, Cocke "wanted nothing less than the rejuvenation of the Old Dominion founded upon new respect for work, discipline, and science."³⁹ But Cocke's science was still imprecise and, while he was steadily introducing more quantitative measures, his use of it for defining the soil was still in part qualitative.

³⁸ JHC to JHC Jr., 2 January 1836, JHC Papers, Box 84.

³⁹ Majewski, *A House Dividing*, 32

Cocke's science, in fact, fit well within the same transition period between Davy and Liebig that I highlighted in Chapter 3 with the examples of Ruffin, Lorain, and Adams. He was hardly an innovator or a leading theorist. His views of the soil at times tracked along with the rise of a materialist agricultural chemistry, at times lagged behind. For instance, in other matters of estate management he mostly put forth an older but more familiar recipe-like style of chemistry. Cocke took advice from his old copy of *The Farmer's Pocket Guide*, a French book of agriculture from his school days in 1804. The *Guide* recommended preparing seeds "for poor sandy soil" by a sequential process that included mixing portions of ingredients in a sort of fertilizing stew, taking "twelve or thirteen pounds of sheep dung" and salt petre to a boil and then, adding wheat seeds to the broth, boiling again for "eight hours a bushel," and then drying the treated seeds and sowing as required.⁴⁰ In a process for detecting adulterated wines, as a later example, he applied a laborious and complex technique that took "equal parts of calcined oyster shells and crude Sulphur in fine powder" and put them in a crucible under heat for fifteen minutes. Then he was instructed to "take it out, let it cool, beat the ingredient to powder, and out them into a corked bottle." This was only the half of it, since his recipe listed a full eleven more steps.⁴¹ The processes were nonspecific, forgoing precision in detail—"twelve or thirteen pounds;" drying "for about an hour"—though referring to quantified measures.

For all his social prowess and decades-long leadership capacity in central Virginia, Cocke was not a remarkable chemist or philosopher. The influence of his ideas was less impressive than the example of his practices. (To be fair, the same assessment of unimpressive practical

⁴⁰ "Extract from *The Farmer's Pocket Guide*," 21 Aug 1804, JHC Papers, Box 4.

⁴¹ "Recipe for detecting adulterated wines," 21 Nov 1822, JHC Papers, Box 37.

chemical facility had been levied against Virginia's most famous son, Jefferson.)⁴² Despite the fact that he contributed innumerable reports to *The American Farmer*, gave many addresses to the ASA, and acted as a focal point for the trade in foreign seeds and, thus, a leading spokesman for experimentally derived planting practices, his own proposals were sometimes ill-informed. In "An Essay on Agriculture," for example, Cocke proposed a new system of husbandry based on horizontal terracing and justified by the view that water is "the chief element of fertilization." This foray into theorizing fertilization strategies and plant nutrition fell short, and quickly, as his friend and fellow ASA officer Nathan Cabell pointed out. In a reply to the essay draft, and putting it gently, Cabell noted that "every farmer knows that water is indispensable to the growth of plants," but whether it was "the greatest of fertilizers" was unclear. "Agricultural chemists" were working on such problems, Cabell noted, and they had advanced beyond the theory of water as the universal and basic fertilizer.⁴³

In his third and last phase of increasing scientific attention to the farm, Cocke was demanding more systematic reporting along with more precise analysis. Both were features of his land management practice for decades, but both had come in for increasing technical specificity over that time span. By the 1840s and 1850s, his references to scientific improvement were couched in terms of system, communicability, and translatability. In one case, he wrote to *The Farmer's Register* to suggest that in "the whole circle of the science of agriculture I

⁴² MM Robinson wrote to Cocke that Jefferson "is an ornament to his country, as a gentleman and a man of letters, but in whom, as a practical man, either in state affairs or in common concerns of life, I have no confidence." Robinson to JHC, 22 February 1822, JHC Papers, Box 33.

⁴³ See Nathan Cabell to JHC, "Cabell's opinion of John Hartwell Cocke's Essay on Agriculture," in JHC Papers, [no date], Box 182. Given the other documents in Box 182 and the tenor and goals of Cocke's essay, it is likely from the 1820s. Cocke was in fact proposing nothing more than the theory of Van Helmont two centuries earlier, where Van Helmont proved the source of plant nutrition with his famous tree experiment, showing that his tree gained 164 pounds in five years with the addition of nothing but water (see William Brock, *The Norton History of Chemistry* [New York: Norton, 1992] xxi).

presume...[that there can be no subject] of more importance than the best rotation of crops.”⁴⁴

While he provided only minimal quantitative evidence for the three-field system in that particular letter, he insisted that systemization was the key to improvement. In this case, though, he emphasized to the readers that quantitative measures were necessary and stated clearly that science, for him, was the practice of quantifying observations systematically. By creating a reproducible system of crop placement, and by recording the results of the benefits from such rotation, the farmer would improve his lot. The proposal was not much different than earlier ones espoused by the ASA and ASV; it put Cocke’s earlier enthusiasm for system back to the fore. But his comments were significant in that they were a comment on everyday practice, not abstract theory. He indicated that action on the land was always pursued best when it was grounded in scientific agriculture. His letter was a statement of standard practice, not one meant to introduce new ideas.

A retrospective re-creation of scientific agriculture’s path from the 1810s to the 1850s—from Davy to Liebig, as I characterized it in the prelude to Part I—would highlight the increasing presence of chemical analysis given credibility by scientific theory. Cocke’s example allows us to follow the same path as it developed in the personal context of a wealthy improvement-minded planter—here, the planter of Virginia, slowly instituting scientific principles on his land as the very idea of a scientific principle was coming into modern clarity. By the 1850s, Cocke was relying on official chemical analyses to define his soil and guide land management. He structured his plantation management around definitions of the soil that came from laboratory equipment. In the 1840s, he used the services of Robert Rogers, then a chemistry professor at the University of Virginia, to analyze his soil. By the 1850s, he was receiving analytical reports

⁴⁴ “Draft of a letter to the Farmer’s Register, April 15, 1835.” JHC Papers, Box 1.

of guano to two decimal points from the new official state agricultural chemist, David Stewart.⁴⁵ Cocke's was a scientific agriculture.

The example of John Hartwell Cocke is not so much revolutionary as evolutionary. His case does not show a distinct switch from the complete absence to dominant presence of scientific agriculture. Instead, he was a planter gradually shifting land management over a half-century period with newer and more popular scientific techniques, from qualitative to quantitative, from mechanically systematic to chemically scientific. Cocke's initial survey report to the ASA noted estimates of acreage and fertilizer usage, suggesting his awareness of the value of fertilizers with a parallel search for more specific knowledge about how they could be applied. Noting the specificity of soil types, he soon sought to complement his lands with formulated batches of fertilizer based on soil types understood through analysis. Later, as his discussions about the Bremono estate came into increasing technical specificity, his actions on that land followed suit. We have no evidence from the estate itself that would indicate its actual chemical composition, such as one might seek today, so I cannot say to what degree and with what results his changing views of the land led him to alter the physical constitution of it. Nevertheless, my broader point is to indicate that over a five-decade span, Cocke was introduced to new, increasingly technical, and quantitative techniques for land management. As his concepts of the soil began to change, so too did his practices. By the 1850s, he treated his soil as a scientifically analyzable entity because he understood it as such.

William Fanning Wickham was also an estate surveyor and nascent scientific enthusiast. He, like Cocke, began to interpret his soil with technical precision and analytical specificity over

⁴⁵ Robert Rogers to JHC, "Soil Analysis of Bremono Soils," Box 117, June 1846 and "A report on Guano, by the MD State Ag Society Chemist, David Stewart," Box 157, 9 Feb 1859, JHC Papers.

the course of the antebellum period. He was too young to help found the first wave of agricultural societies in Virginia, but his life was suffused with their activities and ethos of science-based improvement. His father, John, was a founding member of the ASV and frequent correspondent with members of both the ASA and ASV.⁴⁶ Edmund Wickham, an older kinsman of William's, corresponded with Cocke in the mid-1820s. The two gentlemen exchanged ideas on cultivation techniques. Edmund also requested the apparently popular Mexican wheat from Cocke's store of seeds.⁴⁷ William's father-in-law, Robert Carter, was another prominent piedmont planter and likewise had strong ties to the agricultural societies. Two other Carter family members, Hill Carter and Williams Carter, were also founding members of the ASV.⁴⁸ William benefited from the society activities such as seed trading and estate surveying, while growing up in the context of improvement his father, father-in-law, and cousins helped foster. His case, then, is indirectly related to the societies' survey efforts, but directly related to the spirit of scientific improvement they advocated.

William inherited the "Hickory Hill" plantation from Robert Carter upon his marriage to Ann Carter in 1820, further cementing his place as a planter of regional prominence. For five decades at Hickory Hill, his shift in views of the land was more distinct than Cocke's, a transition more revolutionary than evolutionary as seen in three examples: one, his quantified accounts of fertilizer experiments; two, his estate surveys; and three, his technological enthusiasm. He began his career as a lawyer, only taking to farming after marriage. That earlier

⁴⁶ For brief commentary on John Wickham, see Charles Turner, *Virginia's Green Revolution: Essays on the Nineteenth Century Virginia Agricultural Reform and Fairs* (Waynesboro, VA: Humphries Press, 1986).

⁴⁷ See note 25, above.

⁴⁸ The Carter family is well-known in Virginia history. Beginning with Robert "King" Carter and his son, Landon Carter, they were large landholders, prominent slave owners, and, giving us the means to study it all, thorough diarists. "King" Carter's holdings at the time of his death included more than 300,000 acres and 700 slaves. See Rhys Isaac, *Landon Carter's Uneasy Kingdom: Revolution & Rebellion on a Virginia Plantation* (New York: Oxford University Press, 2004) for a detailed exploration of Landon Carter's diary and times. Also consult the Carter Family Papers, listed as the Sabine Hall Papers, Accession Number 1959 and 2658, Special Collections Dept., University of Virginia Library, Charlottesville, Va.

legal career was outside the realm of engaged agriculturalist so that his views of the land based on direct interaction were not yet formed. His later work, however, was suffused with references to scientific interest, quantified accounts, and technical demands. He was an especially active planter of georgic character, as we saw in Chapter 2 with his contributions to *The Farmer's Register* and with his public identity in debates from *The Southern Planter*. He was engaged in daily management by walking the fields and conducting personal surveys of experimental progress even though he employed overseers.

Wickham's quantified accounts of field management and labeling stand as a first example of his developing character as a scientific agriculturalist. The former lawyer took to experiments and systematic planting quickly, soon preferring the precision of numbers over the uniqueness of physical signifiers. As I noted in Chapter 2, he was fertilizing with marl in systematic fashion by the 1820s, along the way leaving behind records of an increasingly industrialized marl-mining operation. By 1828, his fields were being scrutinized for the bushels of marl they held; their productivity was calculated with consideration of cartloads of marl, bushels used per acre, and tons per harvested acre of wheat. (I will return to these details in the next section). Even the naming convention for his various fields reflects the mindset Wickham developed. By the later 1830s, numerical references came to replace the older place-based referential terms. In his surveys, we find that what was the Lane Field, through which Hanover Court House Road ran, became Field No. 1. (Figure 11, below, shows the field still named The Lane, though diary and account book records refer to Lane as Field No. 1.) The "Low ground field" that abutted the Pamunkey River became Field No. 3. References from the early years of his diary to the Shop Branch Field, The Lane, South Wales, and the farm pen became codified in later years as Field

No. 1, No. 2, No. 3, and No. 4.⁴⁹ The change from place-based to numerical naming was a distinct indication of how Wickham viewed his land. The particularity of the Shop Branch field, named for the stream that ran by his workshop, became disembodied as a numbered place, devoid of identifying features beyond its code. Such changes in viewing the land were consistent with Wickham's preference for the quantified and systematic treatment of it: his technical management of the fields was guided by his perception of the quantified and systematized identity of that land.

⁴⁹ See Wickham Diary entries for 9 June 1837, 10 May 1838, 17 June 1840, 15 March 1841, in Volume III, Box 5, Series 4 of the Wickham Family Papers, Mss1 W6326 c FA2, Virginia Historical Society, Richmond, VA [Hereafter Wickham Papers]. Also, see Chapter 2, note 42, for further references to works on the Wickham family.

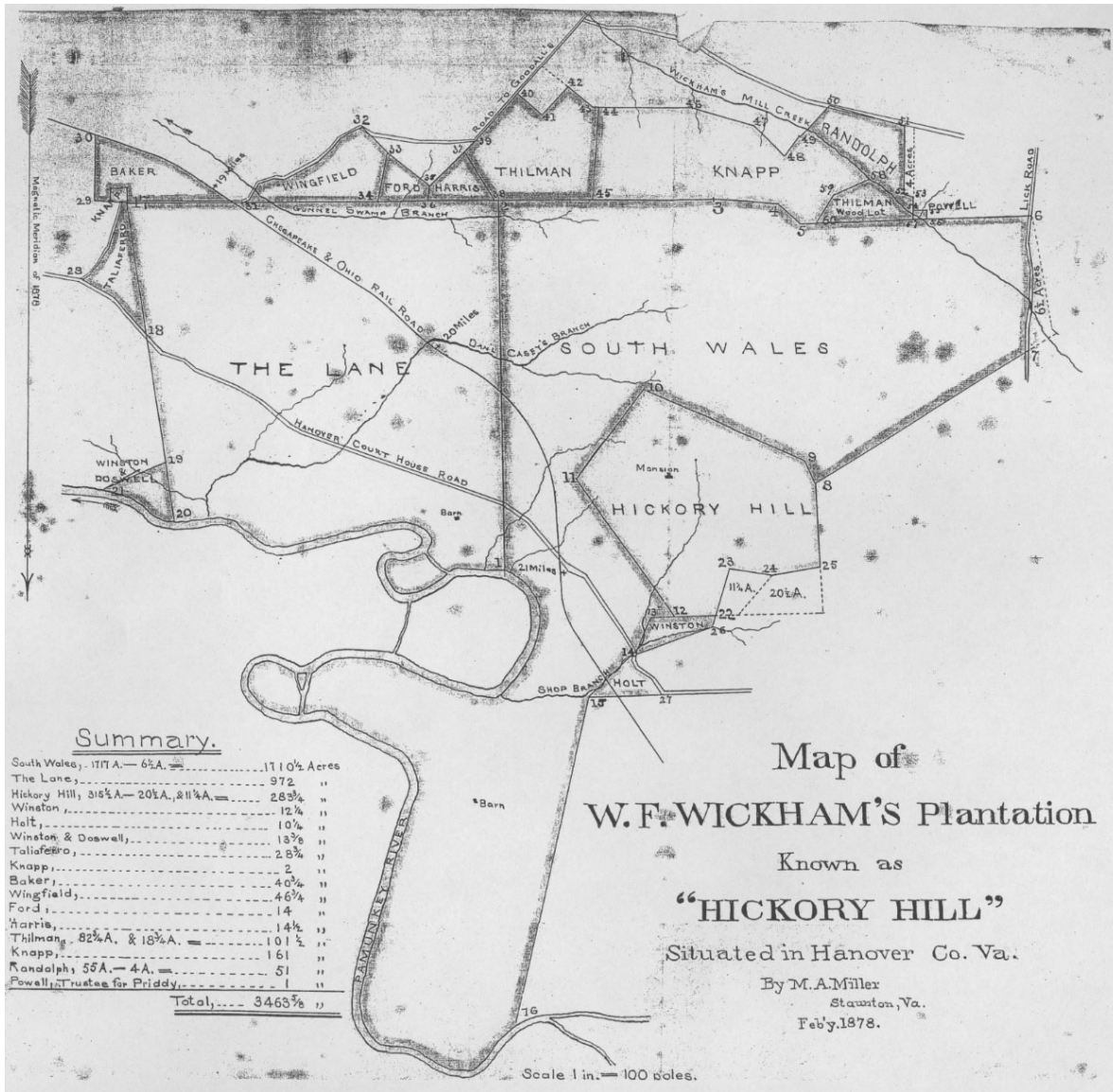


Figure 11. Wickham’s Hickory Hill Estate, including all of his fields. This platte was commissioned in 1878 and shows the many expansions beyond the original Hickory Hill property of a half-century earlier. Reprinted by permission of the Virginia Historical Society, Richmond, VA.

Several senses of estate surveying stand in as a second example of Wickham’s management style. Later records of the Hickory Hill estate show surveys conducted in the more traditional cartographical sense—a map of the property showing boundary lines, angles of

intersections with roads and rivers, and field locations.⁵⁰ But the survey reveals more than cartographical details; it also demonstrates the ramifications of Wickham's decades of scientific management. For example, an 1878 survey Wickham commissioned, made by chains and measured in poles, offered a unique and telling historical retrospective on fifty years of environmental change at Hickory Hill. That survey indicates how the scientific schemes of a half century participated in altering the landscape. The surveyor, M.A. Miller, had trouble on at least a half dozen of the sixteen parcels locating the original corner markers. Where a "Spanish Oak" had been called for in 1825 there was "none now found." Red oaks, dogwoods, pines, hickory, sweet gum, and birches once stood to define the parcel corners, but were long gone by the 1870s, either felled by time and decay or by axe and miscellaneous clearance techniques. The loss of specific trees itself is not remarkable and could be easily accounted for by the "natural" processes of landscape aging. But in Wickham's case, the changes on his property were a hallmark of active engagement and alteration promoted from within and by specific planning. He had opened a series of marl pits over his career, a new one every few years, shifting from river banks to field pits as he went along. He had expanded fence lines frequently, reordering the clear and naturally delineated boundaries (by trees) with decades of experimentation. The result was that his property eventually had to be resurveyed based on artificial, disembodied numbers. The re-survey represents a new fashion of identifying landscape that contrasts with the earlier, uncoded system. In one final mention of lost place-names, Miller, after a dozen parcels before, noted that he had "found the cherry tree with the axe marks in it." However, it was "dead and fallen."⁵¹

⁵⁰ There are no records of Wickham having completed a questionnaire from one of the regional societies or other local reconnaissance efforts.

⁵¹ M.A. Miller, "Report on Survey of 'Hickory Hill' plantation, Hanover Co., VA, 1878," Wickham Papers, Box 5.

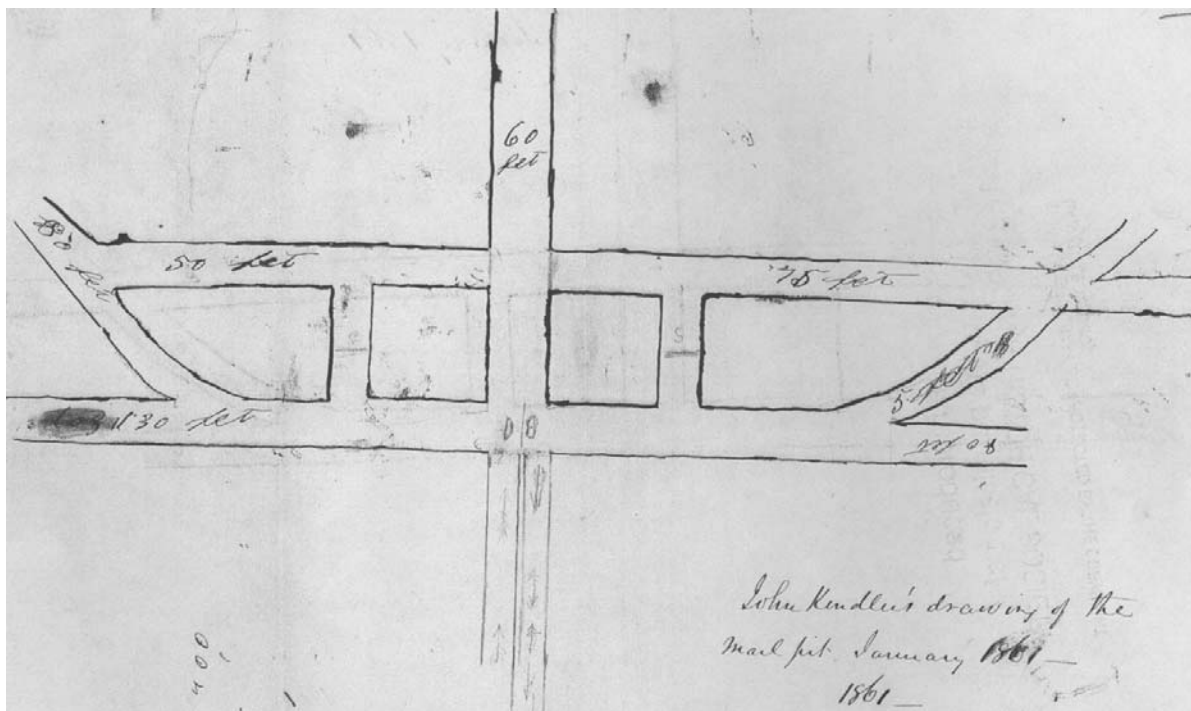


Figure 12. Wickham's Marl Pit Schematic, as of 1861. The hand-drawn map offers a visual example of the deliberate and rationalized approach to mining marl, with perpendicular lanes and avenues of transport out of the pit and toward the fields. Wickham does not provide commentary on the map; its visibility, though, helps emphasize the routine and experience of marling. Reprinted by permission of the Virginia Historical Society, Richmond, VA.

Living within the milieu of society-based agricultural improvement, Wickham's examples of quantified experiments and the substitution of place-based names with numerical signifiers show us a planter involved in producing new views of the land. The soil of Hickory Hill over the decades of Wickham's management was identified differently as understood through those new management practices.

Wickham's technological enthusiasm stands as a third and final example of how he treated his land. Throughout the decades before the Civil War, Wickham rushed to get the latest mechanical implements. He utilized mechanical implements as often as possible, operated a watermill on his property, and even petitioned to dam his stream further—Wickham's Mill Creek, it was called—to enable still more power. The technological artifacts and quantified

surveys were rooted in the same conceptual framework as his earlier experimental operations. His contributions to *The Southern Planter* (see Chapter 2) about plowing techniques were quintessential examples of the worldview he was then bringing to his land. In his rural press contributions, it was “scientific opinion” that underlay his proposals. His own experience walking the grounds of Hickory Hill confirmed them. Wickham’s story of using science for agricultural improvement, then, becomes one exemplified through quantification, experimentation, and systemization. He changed the way he managed his land because he introduced new ways to see it.⁵²

The examples of Cocke and Wickham show a delicate association of intellectual and physical labor, conveyed within the legacy of a georgic ethic. What these planters think about the soil is reflected in what they say, of course, indicating their ideals and prescriptions. But words are tenuous and liable to insincerity. What they believe, however, is also reflected in how they act, indicating their priorities to the causes of improvement and profit. Many more planters fit the role; Cocke and Wickham offer but two clear and accessible accounts. They offer us a view of how planters were taking the directives of the agricultural societies—either by creating those directives personally, as with Cocke, or by growing up in the context of their development, as with Wickham—and re-envisioning their land in kind. Instead of fields named for streams, they were labeled numerically; instead of soil analyzed with qualitative measures, it was

⁵² Wickham, of course, was not alone in these endeavors. He was, rather, representative of a more general shift in ways of seeing—representing—the land. For other examples, see the papers of Robert Baylor, in particular, cf. his commonplace book, detailing experiments on “Lime, Magnesia, Plaster” and his “Address circa 1840 to the Agricultural Society of Essex County.” Baylor Family Papers, Mss1 B3445 e FA2, Series VIII, Boxes 5 and 6, at the VHS. Also cf. records of Richard Eppes, in particular, the details he offers of two decades of marling experiments. Richard Eppes Diary, 1840, pp. 160-161, in the Eppes Family Papers, Mss1 Ep734 d353, at the VHS. And, finally, see the Papers of Robert Wormeley Carter, another member of the famous Carter family descending from Robert “King” Carter, into which Wickham married. Carter tabulated the cart-loads of marl brought to his fields, contributed (though anonymously) to *The Farmer’s Register*, and had his crops chemically analyzed to identify the “constituents of different grains.” Robert Wormeley Carter Papers, Mss 1959-a, Boxes 2-3, at the VHS.

subjected to specific technical instrumentation; instead of improving crop productivity by simply and almost passively adding fertilizer, it could be augmented through methodical, systematic, and well-documented experiments as guaranteed through direct attention, recorded quantification, and technological assistance. In the next section I will look even more closely, burrowing down one level further, to ask how soil was redefined with specific experimental practices.

The Labor of Experiment

I ask how the work was actually done—what labor went into producing a scientized land—because a looming question stands above this entire discussion about working the fields and organizing experiments. Who actually did it? If my theme is the production of scientific understandings of place, then what were the mechanisms by which such practices occurred? If the underpinning of the entire improvement ethos was “collecting...facts and experiments,” to quote the ASV, then who did the collecting?⁵³

In antebellum Virginia, the answer is somewhat obvious: slaves. The farmlands from the Tidewater, across the Piedmont, and, to a far lesser degree, the Shenandoah Valley, were structured by a slave-labor system. The amount of labor required to procure, transfer, and manage marl for tests of restoring soil fertility provides an interesting subtext to the practice of

⁵³ *Memoirs of the Society of Virginia for Promoting Agriculture*, iv. For a study in general of the actual labor performed by slaves, see Ira Berlin and Philip Morgan, eds., *Cultivation and Culture: Labor and the Shaping of Slave Life in the Americas* (Charlottesville: University Press of Virginia, 1993); for slave labor in the environmental history of the Georgia coast, along with an extensive bibliography on race and labor in socio-historical context, see Mart Stewart, “What Nature Suffers to Groe”: *Life, Labor, and Landscape on the Georgia Coast, 1680-1920* (Athens: University of Georgia Press, 2002); for an entry into the vast field of indigenous knowledge studies, especially as related to the southern agricultural knowledge, see Judith Carney, *Black Rice: The African Origins of Rice Cultivation in the Americas* (Cambridge, MA: Harvard University Press, 2001); for slave labor in southern industry see Charles Dew, *Bond of Iron: Master and Slave at Buffalo Forge* (New York: W.W. Norton, 1994); for the slave labor of an area cutting across agricultural and industrial regimes, the naval store, see Robert Outland, “Slavery, Work, and the Geography of North Carolina Naval Stores Industry, 1835-1860,” *Journal of Southern History* 62 (1996): 27-56.

science in Virginia's fields. Marl and plaster experiments were widespread throughout the state, so the use of fertilizers as agents of improvement provides us with a good example of how labor, science, and place were integrated. Understanding slaves as agents of the work of that science helps explain how it was done. They were, it seems, the ultimate invisible technicians, the ones who actually did the work to identify and then change the soil.

Slave labor was the assumed bedrock of land management and a defining feature of the southern agricultural landscape. When I noted the epistemic differences between the chemistry of Ruffin, Lorain, and Adams in Chapter 3, I glossed over the practical differences in each advocate's application of chemistry. Those variations are especially evident with the differing regional uses of labor to change the land. It would be impossible in the context of Virginia's agricultural societies, though, not to take further note of the labor on the farms. The 1818 membership survey conducted by the ASA—the same one I referred to above with John Hartwell Cocke—asked planters to report the “Number of Hands, Horses, and Oxen employed.” It also asked about the “Number and description of labor saving devices” used on local plantations.⁵⁴ Both questions were meant to gauge how many laborers the planters had and how best the planter could avoid using them. The same questions in John Lorain's Pennsylvania would have been referring to hired laborers. In Albemarle County, “hands” and “labor” were most often euphemisms for slaves, terms that removed the direct human element of the work, instrumentalizing human labor in the process. In Pennsylvania, Lorain suggested that the purpose for improvement was partly to abate justifications for slave labor. In Virginia, Ruffin spoke to the contrary, suggesting that agricultural improvement could save the slave society. Societies like the ASA and ASV were essentially Ruffin's source and outlet for those notions.

⁵⁴ “Minute Book of the ASA,” 274.

The ASA's "Show and Fair" of 1828 carried forth their questionnaire system in the form of physical, not just literary, presentation. John Craven was the first place award-winning planter at that year's show, having demonstrated the most improvement on his lands as evident through the twenty-two answers he prepared for the prize committee and by visual inspection. Two of the questions, numbers 10 and 22, dealt with human labor. Question 10 asked, "How many labourers do you work regularly on your farm, and of what description?" Craven noted that he worked "eleven men, six women, and one boy, with the addition of three watermen." He scarcely hired day laborers, he added, not even in heavy harvest and planting days. A mere \$30 a year from his budget was devoted to overseeing the labor force. Question 22 asked, "What is your mode of managing your negroes?" The hardest part about "negro management," Craven explained, was "obtaining from them their due and necessary portion of labor." Speaking as if they were mechanical implements, Craven fit the laborers necessary for managing his land into the framework of maximal efficiency. That machine mentality, I would add, preceded his full use of mechanical implements. His use of mechanical implements—because he was adept at using available farm machinery—and his ideas about a strictly managed labor force, in Craven's case, were part of one common view of the land.

The ASA assumed in its prize-judging format that the best means for improvement included careful application of fertilizer in controlled and systematic ways. Two other questions, numbers 17 and 18, alluded to the details of fertilization. Question 17 was two-fold, asking, "What quantity of manure is annually made on your farm? [and] at what season carried out and in what manner applied?" Question 18 asked specifically about plaster. Craven, in fact, did not specifically say how much manure or plaster he used that year in the main body of his answers. But in his general improvement plan he made clear that his farm labor was devoted to a well-

planned combination of rotating, tilling, and fertilizing. The judges were sufficiently impressed by Craven's use of his twenty-one slave laborers. He demonstrated enough, it would seem, by indicating that a fertilization plan was central to his land management.⁵⁵ Rotation schedules, plowing techniques and times, and fertilization plans were all integrated into the practice of agricultural improvement, a system that owed its viability not just to Craven's awareness of systematic principles of soil management but also the slave labor that mediated that awareness.

William Meriwether placed second that year. He was another ASA member, one of their officers, and the owner of 900 acres and a team of slaves in Albemarle County. He used "seven men, three boys, and one woman" to manage his land, but employed an overseer to implement the systematic fertilization plan and so could not comment directly on the details of manure and plaster usage.⁵⁶ Perhaps we can understand Meriwether's second-place finish, and perhaps the judges justified it this way, by recognizing his disengagement from daily management.

Wickham also hired men to oversee his labor force. Unlike Meriwether, though, he still walked the land himself, despite the fact that he owned many more slaves than either Meriwether or Craven. Wickham knew exactly how much manure was being spread, in what places, at what time, and with what amount of labor. When he began mining marl in earnest by the early 1830s, he was tallying the hands per cart, carts per day, and bushels of marl per acre. In 1830, he had an "inventory" of 142 slaves, not all dedicated to the field, but at least several dozen working to plow, plant, and fertilize. When Wickham wrote to *The Farmer's Register* or traded stories with his extended family, he was observing the results of hours and days of work to dig and carry marl from the span of his more than 3000 acres. With distances from pit to field of up to three miles, this traffic in marl manuring was both difficult and impressive.

⁵⁵ *AF* 12 (1831): 177

⁵⁶ *AF* 12 (1831): 186. For more on Meriwether, see Majewski, *A House Dividing*, 31.

Over the years, Wickham had his slave force vary the use of marl between 300 and 1500 bushels per acre. He generally had it applied to 18 to 100 acre plots. A modest estimate of marl used per acre—say, of 600 bushels on each of 20 acres—would suggest that his slaves were carting and applying 12,000 bushels of the fertilizer for one application. In the earlier years of Wickham’s over-enthusiastic marl application, between 1828 and 1829, his usage quadrupled from “3 to 400 bushels” to “1000 to 1200 bushels.” The young enthusiast claimed that his “quantity... varie[d] from one to two thousand bushels per acre” by 1831, but it seems he hit a peak at about 1500 bushels per acre on “about 30 acres” that year. “All hands are now getting out manure on the marled lands on this side of the shop branch,” he noted without elaboration in his diary. In 1839, it took a month to marl twenty acres, running four carts every day. Wickham’s earlier careful allocation of work duties, assigning specific slaves to work particular plots around the plantation, gave way to all out efforts by 1834. By then, “everyone [was] scattering marle and fencing.” It is still unlikely that all 137 slaves (the amount on record just a few years later) were devoted entirely to marling, and that he more likely was referring to all of his field slaves, but these episodes show that Wickham clearly had a dedicated interest in this new systematic mode of improvement.

This was a tremendous amount of work, requiring a large, healthy labor force, able horses and oxen, well-constructed carts, and the roads, tools, and supervision to manage it all. What is more, even this basic summary glosses over the full degree of physical labor, since running one “cart” meant digging it out, loading it up, transporting it across the fields, and delivering it to the experimental field to be adequately spread. Four times a day was a lot. Carts were heavy. Fields were hot. When the process was put in motion and not just reflected upon, as Wickham did in his daily diary, we might appreciate better how much work went into the fertilization

experiment of an antebellum plantation. Wickham explained his 1832 procedure for application: “[one] marle cart runs and a three horse plough follows.” It was this process, honed by a dozen years of practice, that he advocated in the debate in *The Southern Planter* ten years later. To facilitate these practices, he wrote excitedly about opening up new marl pits in 1833, 1834, 1838, and 1841. Underneath Wickham’s efforts to develop Hickory Hill was his desire to redefine the soil, to bring it under dutiful observation and direct management by methodical planning. The continued use of a healthy work force guaranteed the possibility of his experiments.

Wickham’s peer Ruffin had insisted in his *Essay on Calcareous Manures* that “Whoever uses marl, ought to know how to analyze it.”⁵⁷ But missing from Wickham’s account is a pattern of marl analysis. He reports generic assessments of the fertilizer’s properties in many instances—of a new batch in 1841, he commented that “The quality seemed good.”⁵⁸ Wickham likely read Ruffin’s *Essay* after its 1832 publication, but his papers show no record of having purchased the requisite analytical equipment or of hiring the analysts who were available just a decade later. (If he followed Ruffin’s advice, he would have used a version of Davy’s equipment, including glass bottles, a stop-cock, a bladder, and muriatic acid.) His own personal experience, though, born of years of supervising digging, carting, and spreading, undoubtedly aided his successful assessment of the various qualities of marl. Wickham’s slave laborers most definitely became more proficient over time, identifying marl pits more readily, spreading the marl more easily, and noting its success or failure more quickly. Such evidence is not directly forthcoming in Wickham’s papers, though the range of his records about the centrality of fertilization experiments suggests that his invisible technicians were becoming quite skilled.

⁵⁷ Ruffin, *An Essay on Calcareous Manures* (Cambridge, MA: Harvard University Press, [1832] 1961), 150-151. This line is also quoted in Allmendinger, *Ruffin*, 33.

⁵⁸ Wickham Diary, 13 January 1841, in Wickham Papers, Volume III, Box 5, Series 4.

After years of the near perfunctory use of marl to alter his soil properties, Wickham's daily comments on experimentation eventually indicate less attention to the mechanics of the process and less curiosity as to its success or failure. Marling had become routine and, with it, the experimental groundwork with which he began his career became transparent to his daily practice. What began as an effort in agricultural experimentation—in part as influenced by his father's own ASV and also with the lead of Ruffin—became the normal pattern of life for Wickham and its own explanation for the activities of and need for slave labor. It is no wonder that he switched to numerical names for his fields by the later 1830s; such technical detail was consistent with his developing view of the land as a site to be measured, processed, and manipulated. Inside that detail, the soil of Hickory Hill had become identified as a site of quantified matter.

Wickham's example complements that of his elder statesmen, John H. Cocke. It also fits with the view of the land Ruffin was producing. Ruffin, in fact, had confessed as early as 1821 that "The Labour required for using shell marl, is now the greatest obstacle to the practice."⁵⁹ We know the two men were peers and correspondents, so this similarity is not surprising. David Allmendinger has reviewed Ruffin's labor schedule and demands, reporting that Ruffin followed Smithian ideals of economy to permit "the division and specialization of labor for different categories of slaves." As Allmendinger notes, an episode in 1824 had Ruffin using nineteen slaves—nine young men, six young women, two boys, one girl, and one old man—over a four day period just to clear the land so that marl *could be* dug and carted away. That digging and carting of course, as with Wickham, required even further labor. Marling had to become part of the daily management of the farm if it was to succeed. Just as with a scientific experiment, "the slave forces had to be devoted to specific tasks routinely or they made mistakes through

⁵⁹ Ruffin, "On the Composition of Soils," 319, as quoted in Allmendinger, *Ruffin*, 33.

inexperience and forgetfulness.” Thus, a modicum of training and a great deal of supervision was required. The general point that scientific agriculture took work must become central to any account of the practice of scientific improvement in Virginia.⁶⁰ The slave laborers worked without recognition but were still visible as the machinery driving fertilizer from river bank to lush field, acres and sometimes miles away. That point also serves to help distinguish patterns of land treatment in the South versus the North and to suggest the particular tensions of local and universal that came about through the use of science for southern improvement.

Issues: changing perceptions, local/global tensions, augmenting a sense of place

“In proportion to man’s advance in natural knowledge, and his consequent superiority over outward physical forces, is his emancipation from...local causes.” George Perkins Marsh, 1860⁶¹

In attempting agricultural reform with scientific means, the members of Virginia’s agricultural societies, as with almost all other states, lived with frustration and contradiction. Politically frustrated, they advocated regional identity while working within an atmosphere of increasing sectionalism. Madison’s 1818 address was overtly devoid of sectional strife, but contemporaneous memorials to congress, the pursuit of funds for agricultural professorships, and remonstrances against the imposition of pro-manufacturing tariffs stand as easy examples of the growing disparity between political economies of the South and North. The Virginian basis of a slave-labor agricultural economy suggested a distinct attention to local identity. Intellectually frustrated, Virginians sought to introduce purportedly universal principles of soil identity into visibly local contexts of agriculture, defined as much by climate and labor as the soil underneath

⁶⁰ This paragraph owes its basis to Allmendinger, *Ruffin*, 32-34.

⁶¹ G.P. Marsh, “The Study of Nature,” *The Christian Examiner* (January 1860), as reprinted in D. Worster, ed., *American Environmentalism: The Formative Period, 1860-1915* (New York: John Wiley and Sons, 1973), 16.

them. Was Marsh's view true, that more knowledge of nature would lead to an "emancipation" from local constraint? Virginians thought so, although they balanced that hope with their concurrent plea to remake and strengthen a unique Virginian cultural identity. On the one hand they sought emancipation from local constraint; on the other, they cherished it.

John Taylor, speaking as the President of the ASV in 1818, had laid out the problem of, and possible solution for, introducing science into local reform practices. "Sciences, universally the same," he said, "enjoy the great advantage of reaping harvest from very clime, and of being enriched by the contributions of every language. But, the subjection of agriculture to the climate, soil and circumstances of the position, upon which she must exert her talents, renders her unable to extract a system from foreign compositions suitable to dissimilar meridians; and exposes her to errors and disappointments, from incongruous imitations of foreign practices."⁶² Planters like Cocke and Wickham, following Taylor, worked through the tensions of political and intellectual frustration I noted above by introducing systematic studies of soil. Through the use of unnamed slave laborers, they sought to redefine their land and reinvent their management practices. The entire brunt of the agricultural society movement, and not just the scientific reforms advocated from within them, was aimed at unifying differences. Collective action for agricultural improvement was exactly the morally binding benefit that georgic advocates like Jefferson and Taylor had trumpeted for decades.

Taylor's observation on what he considered a science that was universally equal and an agriculture that was always local brought out the possible inconsistencies of combining the two. Yet, his was only an instance of the recognition of tensions between locality and universality. His fellow ASV members—and the very premise of the organization he justified through its local

⁶² John Taylor, "Presidential Address to the Agricultural Society of Virginia, June 8th, 1818," *Memoirs of the ASV* (1818): 28-29

attention—were indeed turning to the supposed universal tool of science as a way to eliminate the constraints of physical locality (even while promoting political distinctiveness). In his report to the ASV, James Garnett made sure to tie his proposals to the distinct local nature of the soil, “neither stiff nor very light,” on the Rappahannock River banks where he lived. In the process he avoided generalization yet presumed that his insights would be applicable beyond just his land.⁶³ Nearly concurrently at the ASA’s meetings, Madison was noting the variety of kinds of soil and plants while simultaneously holding out hope for the discovery of “true principles,” by which he meant universal principles, of agriculture. This tone of ambivalence remained common throughout the era of internal improvements. The erasure of local specificity for universal relevance may have been the goal, but tensions between local and global were persistent, not transcended.

A series of factors worked together to promote the common identity of soil necessary for generalizations from the local to make sense. First, the context of local improvement in Virginia was built by the exchanges of a strong social and kin-based network of planters, the interdependent character of which worked to generalize approaches to reform. The agricultural societies were social clubs, gathering places where men could trade stories, complaints, and suggestions. Like the church, the courthouse, or the family dinner, the societies provided a forum for exchange. I discussed the dimensions of kinship with respect to the influence of “book farming” in Chapter 2, noting that the spread of information and advice went beyond mere individual proclamations. Here, again, the society stands as another example of the same, offering a nexus for disparate views and the clearing house for unifying them. Second, as a common meeting place, the groups also provided an organizing force for people, practices, and knowledge. Meetings offered the opportunity for face-to-face interaction; in print, with the

⁶³ James Garnett, “Agricultural Notices, September 8, 1818,” *Memoirs of the ASV* (1818): 116-119.

addresses published in *The American Farmer* and in state-wide newspapers, the comments and opinions of members could spread beyond the meeting room. The distribution of experimental reports and advice on improvement strategies that came from afar were considered equally relevant everywhere. And third, the societies circulated books on agricultural theory and labor-saving devices that aimed similarly. They acted as minor publishing houses in and of themselves and used their influence to coordinate regional publications.⁶⁴

The encouragement of knowledge and practice came from inside the dynamic forum afforded by the societies. That social order began with certain virtues, as I discussed in Chapter 2. As evident in the societies of central Virginia, that order was predominantly paternalistic, an outlook consistent with the similarly paternalistic concept of slave-ownership writ large. Jefferson had perceived this in the decade before the ASV and ASA's founding. "No sentiment is more acknowledged in the family of Agriculturalists," he argued, "than that the few who can afford it should incur the risk and expense of all new improvements, and give the benefit freely to the many of more restricted circumstances."⁶⁵ Wilson Cary Nicholas, as the Vice-President of the ASV, repeated the line, though with specific emphasis on both intellectual and financial advantages: "The establishment of agricultural societies offers...a cheap and permanent channel of communication to those who have skill and knowledge to impart."⁶⁶ They offered an opportunity for the planters to exercise moral distinction while promoting material practices.

⁶⁴ The longtime ally of Virginia reform, John Skinner, later expanded his publishing ambition to promote a series of monographs, the *Farm Library*. The *Book of the Farm* (1845) was the first of this series, with *Lectures to Farmers on Agricultural Chemistry*, by Alexander Petzholdt, following the next year. Daniel Webster and Horace Greeley had their hands in those efforts. Webster offered well-worn advice to Skinner that he should republish European sources but note their differences in practice, since "In addition to difference of soil and climate, the higher rate of wages, which, fortunately for the general good, exists with us, must itself make a material change in all agricultural calculations." These exchanges only reinforced a sense that tensions between local and global were only heightened through the confluence of science and agriculture. See Letter of 4 November 1841, from Webster to Skinner, in the Papers of John Stuart Skinner, Mss2 Sk352b, at the VHS.

⁶⁵ As quoted in Schlotterbeck, "Plantation and Farm," 282.

⁶⁶ W.C. Nicholas, "Vice-Presidential Address to the Agricultural Society of Virginia, March 18th, 1818," *Memoirs of the ASV* (1818): 26.

They also were able to utilize their prevailing social standing as pillars of influence. Thus, the activity of a few wealthy planters could be advertised to a wide geographical readership.

Not unrelated to the tension between local and universal was the issue of scale and extrapolation. The ASV claimed from the start that scientific improvement had demonstrated “a most beneficial influence in neighborhoods,” but that a full state-wide scale was still “necessary.”⁶⁷ Their claim for state representation, even from the rhetorical move of naming their society to suggest a statewide scope, was one way to assist this increase beyond the local scale. But they never represented all of Virginia and the core of their members resided in the same Piedmont counties as those of the ASA. As for daily farm management, though, they wanted to generalize local techniques into state-wide practices. The ploughing and irrigating measures of Albemarle County were meant to be equally applicable to other counties. The best manuring techniques were worth reporting because they could be adopted by any reader of the *Farmer’s Register* or the *Memoirs of the Society*. This suggested the desire to generalize from the county to the state. To strengthen these overtures, they developed intellectual and conceptual arguments, improving cultivation in local settings by reference to scientifically informed and universal concepts of soil composition and nutrition. The entire trajectory of scientifically informed agricultural improvement, as envisioned by Taylor, Cocke, Wickham, Ruffin and the societies writ large, was to expand from local practices to universal applicability. In the next chapter, I examine the larger scale example of the state agricultural and geological survey. That case illustrates the logistics necessary for producing a scientized place on a larger, statewide scale.



⁶⁷ *Memoirs of the ASV*, iii-iv.

As a final point, we can see with the activities of planters and regional societies that the confluence of science and reform was working to change views about soil and what it could be.⁶⁸ The seed trading, reports of observations, questionnaires, and forums for strategizing animal and land care were all elements of an experimental approach. They acted as mechanisms for people to interpret place scientifically. The goals of unifying technique were ultimately intended to define a unified agricultural world. Fields, no longer understood simply as plots of individual property, could become treated and managed as experimental places.

We often look to later eras for evidence of a scientized landscape, thereby taking for granted the scientific and environmental developments that the societies highlight for us. But important and wide-ranging effects derived from the activities of reform in antebellum Virginia, even if the scale was more local, the institutionalization less concrete, and the skill and adeptness at chemistry and science less lauded than with the largely federal and institutional examples of later that century. One Virginia historian notes the “emphasis on rational land use, increasing productivity, and detailed accounting procedures” prevalent by the 1840s; I point to the activities of the prior decades that established that rational land-use mindset.⁶⁹ I see the county society activities as producing necessary preconditions for further scientization of the land. In terms of long-term legacies, how we later came to see the environment as a place defined by science owes a conceptual debt to mechanisms developed by improvement societies like the ASA and ASV.

⁶⁸ Organizations alone, of course, did not cause the changes, but the introduction and credibility of scientific improvement brought through their socially credible forum had an impact on how farmers saw the land around them.

⁶⁹ Majewski, *A House Dividing*, 22

Like the much commented upon gentlemanly science of Britain, these groups exemplified the social integration of the values of scientific inquiry with economic purpose.⁷⁰ Although this combination of scientific and economic gained form from social networking, its legacy extended beyond the social and into the natural. The degree to which such integration played out on the land was fairly significant in Virginia, probably far more so than in Britain. The mechanisms employed by agricultural societies and their members, even if not caused or guided entirely from within the group—witness Wickham’s work at a distance from the official organizations—provide us with an example of how planters were changing their views of the soil.

Through the continued efforts of making a *science* of place, the planters were also augmenting their *sense* of place beyond the confines of individual property lines to some larger level of sameness. Yes, Wickham’s property was still Wickham’s property, but his understanding of that land, as witnessed by his changing practices on it, was defined by methods and terms common to all of his neighbors. From the record of the press, personal papers, and account books of Virginian farmers and planters, we find that Virginians used the language of “the science of agriculture” to create a sense of place beyond their own boundaries. The common terms, language, methods, and mechanisms helped situate science as an instrument for that change. Because those changes were developed intentionally through the era of reform, they were understood as improvements.

⁷⁰ On this large body of literature, see Ann Secord, "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," *History of Science* 32 (1994): 269-315; Roger Cooter, "Separate Spheres and Public Places: Reflections of the History of Science Popularization and Science in Popular Culture," *History of Science* 32 (1994): 237-267; and Steven Shapin, "Nibbling at the Teats of Science": Edinburgh and the Diffusion of Science in the 1830s," in *Metropolis and Province: Science in British culture, 1780-1850*, ed. Ian Inkster and Jack Morrell (Philadelphia: University of Pennsylvania Press, 1983), 151-178. For the amateur tradition in America, see Sally Kohlstedt, "The Nineteenth-Century Amateur Tradition: The Case of the Boston Society of Natural History," in *Science and its Publics*, ed. G. Holton and W.A. Blanpied (Dordrecht-Holland: D. Reidel Publishing Company, 1976), 173-190 and Elizabeth B. Keeney, *The Botanizers: Amateur Scientists in Nineteenth-Century America* (Chapel Hill: University of North Carolina Press, 1992).

Virginians, as well as their neighbors to the North and South, had produced the opportunity for quantification and analysis. However, the path emanating from this set of conditions was neither definite nor inevitable. That is, the story of the local survey and the endeavors of agricultural societies is not a strictly causal one that shows county activities leading to and defining state efforts, and then later federal ones or, put another way, a progression from redefining backyard soil to redefining nature all around. Besides, because mechanisms existed for scientizing the land does not mean those efforts were produced just for that purpose. In fact, I argue otherwise here, showing that the efforts to quantify and analyze were meant to achieve goals of reform and improvement that were as much social as physical, aimed as much at promoting extant cultural conditions as at creating new concepts of land. The fact that these mechanisms helped create the conditions for scientizing the land must have been an afterthought. But those are grander points that should not obscure the more directly relevant ones: that there were consequences and ramifications for the association of science with improvement. The important lesson of local and regional mechanisms is that they helped produce the experience, familiarity, trust, and awareness—the cultural conditions—within which later developments could make sense.

In the next chapter, I continue to address the ways with which Virginians produced mechanisms for making a science of place. There, I look toward the greater geographical scale and increasing political coordination of the first Geological Survey of Virginia of 1835-1842. There are numerous similarities between the efforts of local organizations to produce mechanisms for analyzing their lands and the state efforts to geologically, chemically, and agriculturally survey the entirety of the state. The participation of local farmers in the project, emphasis on marl and fertilizer, tension between local conditions and universal measures, and

ambition to overlay the entire region with one consistent set of analytical techniques stand as a few of those likenesses. But there are also important differences, not the least of which is the institutional authority with which the project was vested by virtue of its professional leader, William Barton Rogers, and the team of assistants he employed over the years.

The state survey was not created from nothing. Virginia's decision to support the project was consistent with other states' efforts nationwide. In fact, the period between 1820 and the 1840s has been called the first era of the scientific survey in America. The local surveys I discussed above did not cause or lead to the state survey in a direct organizational sense, a point easy to understand when we recognize that agricultural society activities, though predating the 1830s, also ran concurrently with the state survey efforts. However, the circulation of scientific and quantitative measures for identifying the soil provided important precedents for doing the same at the greater state scale. The state survey, rather than starkly introducing scientific systemization to Virginia, was able to leverage the planter's pre-existing willingness to redefine their land for the sake of improvement. The examples of the ASA, ASV, Wickham, Cocke, Craven, Meriwether, and thousands of uncredited slave technicians stand with the example of the Geological Survey, not as followers of it.

Chapter 5

The Geological Survey, the Professor, and his Assistants: Producing Scientific Views of the State of Virginia

“Whilst engaged in the improvement of the State...the great wealth which lies buried in the earth...only requires examination of men of science to bring before the country, and make known its value.”
Governor John Floyd, 1833

“On the subject of a geological and chemical survey [Virginia] would behold, spread out beneath her soil, the rich earths, which [are] soon to diffuse fertility over the hills and plains...” William Barton Rogers, 1834¹

In Chapter 4, I presented the scientific ambitions of Virginia agricultural societies and the farmers in and around their sphere of influence. The practices of those planters, aided by their slaves’ experimental labor, highlighted the growing antebellum circulation of agricultural chemistry. Those practices made evident Virginia’s increasing reliance on science to inform new ways of thinking about soil; they also led to new ways to farm. This chapter, about the Old Dominion’s first state geological survey (1835-1842), addresses the same theme of scientific mediation but on a larger socio-political and geographical scale.

The Survey was an agricultural, chemical, mineralogical, and geological inventory of the state’s natural components, despite its sparse geological moniker. In Virginia, the state legislature, along with their interest in mineral wealth and coal interests, structured it to contribute to questions of agricultural improvement and soil identity. John Hartwell Cocke, the influential agricultural reformer, was for a time the head of the Board of Public Works that oversaw the project; Edmund Ruffin publicized the early Survey reports in his *Farmer’s Register* and made clear their benefit to farmers. The *Richmond Whig* editorialized retrospectively that the

¹ John Floyd, “Address to the State Senate,” *Journal of the Senate, of the Commonwealth of Virginia, [1833-1834]* (Richmond, 1833), 10; and William Barton Rogers, “Report from the Select Committee of the General Assembly of Virginia, To Whom Was Referred Certain Memorials From Morgan, Frederick, and Shenandoah Counties, Praying for a Geological Survey of the State, With a View to the Discovery and Development of Its Geological and Mineral Resources,” in *Geology of the Virginias*, in *A Reprint of Annual Reports and Other Papers, on the Geology of the Virginias* (New York: D. Appleton and Co., 1884), 754-762 [Hereafter cited as *Geology of the Virginias*].

primary object of the survey was “the better development of the State’s Agricultural resources,” while William Barton Rogers, the survey’s chief architect and supervisor, argued that his work would garner “the attention of the agriculturalist.”²

During the era of internal improvements, as Steven Stoll has recently argued and as Governor Floyd and others in his constituency exemplified, practices of land improvement “blended ecology with ideology, practice with politics, nature with the future of the Republic.”³ Nowhere was that more true than in Old Virginia. With its agro-economic dimensions, the role of the scientific survey as an agent of internal improvement extended beyond the geological realm.⁴ The survey gives us a deeper picture of how to gauge developments in knowledge of the

² *The Richmond Whig*, 11 March 1854, Richmond, VA, as quoted in Adams, “Old Dominions and Industrial Commonwealths,” 251. W.B. Rogers, “Report on the Geological Survey for the Year 1837,” in *Geology of the Virginias*, 172. See also Michele Aldrich and Alan Leviton, “William Barton Rogers and the Virginia Geological Survey, 1835-1842,” in James Corgan, ed. *The Geological Sciences in the Antebellum South* (Tuscaloosa: University of Alabama Press, 1982), 83-89.

³ Steven Stoll, *Larding the Lean Earth: Soil and Society in Nineteenth-Century America* (New York: Hill and Wang, 2002), 9.

⁴ This is true despite a general approach by historians to study the state scientific surveys mainly for their contribution to the history of geology. The surveys, as embedded in the era of agricultural improvement, can also be examined for their part in producing new ideas about agrarian land. On the broader state survey movement see Michele Aldrich, “American State Geological Surveys, 1820-1845,” in Cecil Schneer, ed. *Two Hundred Years of Geology in America* (Hanover: University Press of New England, 1979), 133-144; Anne Millbrooke, “State Geological Surveys of the Nineteenth Century” (Ph.D. diss., Univ. of Pennsylvania, 1981); Arthur Socolow, ed., *The State Geological Surveys: A History* (Association of American State Geologists, 1988); James X. Corgan, ed., *The Geological Sciences in the Antebellum South* (Tuscaloosa, AL: University of Alabama Press, 1982); Sean Patrick Adams, “Old Dominions and Industrial Commonwealths: The Political Economy of Coal in Virginia and Pennsylvania, 1810-1875” (Ph.D. Diss., University of Wisconsin-Madison, 1999); and Michele Aldrich, *The New York Natural History Survey, 1836-1842* (Ithaca, NY: Paleontological Research Institute, 2000). Two other articles offer additional context with their focus on, respectively, the Pennsylvania (organized by Henry Darwin Rogers) and North Carolina surveys: Francis Boscoe, “‘The Insanities of an Exalted Imagination’: The Troubled First Geological Survey of Pennsylvania,” *The Pennsylvania Magazine of History and Biography* 127: (2003): 291-308 and Michael S. Smith, “The Conflict between ‘Practical Utility’ and Geology: Denison Olmstead, Elisha Mitchell, and the 1823 to 1828 Geological Surveys of North Carolina,” *Southeastern Geology* 38 (1999): 145-154.

Earlier compendiums on geological surveys include George Merrill, *The First One Hundred Years of American Geology* (New Haven, CT: Yale University Press, 1924), 127-208 and Merrill, ed., *Contributions to a History of American State Geological and Natural History Surveys*, Smithsonian Institution, Bulletin 109 (Washington, DC: Government Printing Office, 1920). Hugh Slotten, *Patronage, Practice, and the Culture of American Science: Alexander Dallas Bache and the US Coast Survey* (New York: Cambridge University Press 1994) provides a good example of surveys as aiding the growing cultural authority of science in American society by offering places of employment, opportunities to refine technique, and venues in which to develop and test theories. The U.S. Coastal Survey serves as Slotten’s example in this regard. Stephen Turner, “The Survey in Nineteenth Century American Geology: The Evolution of a Form of Patronage,” *Minerva* 25 (1987): 282-330, examines the survey as the first legitimate source of patronage for American scientists. In environmental history, the surveys have been studied more broadly in their federal form, and as part of the story of the development of the West. See, for example, Donald Worster, *A River Running West: The Life of John Wesley Powell* (New York:

environment. As such, it offers the scope and scale of a state for discussing many of the same issues introduced in Chapter 4.

Studying the survey allows us to consider the differences in scale it had with county society activities; that, in turn, points by default to the following differences and similarities between the two enterprises. The similarities between the two examples, county and statewide alike, are evident in their common conceptualization of science as a practice useful for agricultural improvement.⁵ In addition to the many instruments and technologies embedded within the process of the survey, the surveys themselves were tools used to better the land by more systematically defining it. That is, they relied on what I have called georgic science to guarantee their acceptance; they also utilized nascent environmental sciences for the betterment of their communities and regions. However, instead of the wealthy planters of the agricultural societies, the Virginia Survey was organized and operated by Professor William Barton Rogers, a socially credible agent whose experience was chiefly chemical and whose character was widely respected. Instead of the fairs, prizes, and meeting reports that facilitated the system of measuring and reporting for those county improvement activities, the Geological Survey detailed the state's soil composition with a system of correspondence between Rogers, his field technicians, and numerous local contributors from across the Commonwealth. And instead of the local contributors of county efforts, the state survey included that roster of paid assistants and unpaid local farmers from all across the Old Dominion who did much of the actual work of

Oxford University Press, 2001) and William Goetzmann, *Exploration and Empire: the Explorer and the Scientist in the Winning of the American West* (New York: Knopf, [1966] 1993).

⁵ Improvement and the survey were more intimately related than most historical studies reflect. For example, the 1843 report *Improvements in Agriculture and Arts* authored by the commissioner of patents “only once mentioned machines or implements in connection with improvement; instead, [it] named geological surveys, agricultural societies, rural periodicals, and sobriety as pillars of improvement,” as noted by Stoll, *Larding the Lean Earth*, 192.

science, taking measurements, recording observations, and mailing soil and rock samples to Rogers.⁶

Considering the statewide scope of the survey, what was even more substantial than just distance was topographical and agro-economic variety. Albemarle County, for example, had a generally cohesive set of agricultural products. When the officers of the Albemarle Society of Agriculture pursued surveys of local estates, they were dealing with a relatively narrow range of results; their diversity in crops and natural features was circumscribed by the local bounds of the county. The entire state, on the other hand, had varying climates, altitudes, forest cover, and other environmental features. To pursue a statewide survey conducted with the same conceptual basis as the county surveys required attention to a far greater range of results. Consequently, the tensions of local and universal introduced with scientizing the land were again brought to the fore.

In what follows, I ask how the survey, with its organizational, rhetorical, and other technological features, worked to help produce scientific views of the state's land. In the first section, I place Virginia's internal improvement project into its national and historical context. Then, narrowing down politically and geographically, I describe the organization of the Survey and the leadership of Rogers himself. I then look even more closely, in the third section, to examine the specific practices of Rogers and his assistants as they worked the seasons of the project, from Spring through Fall, from 1835 through 1841. There, I address social and material dimensions of surveying the state, drawing out the technological and scientific practices that defined the process of the survey itself. The story all told provides several clear messages: one,

⁶ The role of slave labor in the survey is difficult to track, since the official records of the project, at best, relate details of conversation between farmers and the Survey staff. We can presume, though, given what we know about the labor used to actually extract samples and prepare fertilizers from Chapter 4, that behind the many local contributors who offered rock, soil, and water samples to Rogers there were slaves who actually did the uncredited work of sample preparation. The difference between the county and state surveys in this regard appears more as a contrast in the scholar's access to information than in the slave's participation in the scientific activity.

that by the 1830s, the Virginia legislature wanted a scientific survey of the resources available to the Commonwealth; two, that Rogers and his staff successfully provided the view resulting from such a project through an always arduous, sometimes tenuous, coordination of field-based examinations and lab-based processes; and three, that the project indicated an openness to new ideas and a budding interest in and acceptance of science as a valid means to understand the environment.

Improvement and the State Survey

Scientific surveys were among the wide set of projects defining the era of internal improvements in American history. Like canals, railroads, and turnpikes, the more popular of that set, the scientific survey was a site of coordination between private and public individuals aimed at creating progress for state entities. For advocates like James Garnett—who thought Virginia’s agriculture was “nearly gone to ruin from a course of policy which could not well have been worse destructive if destruction had been its sole objective,” as I referenced in the prelude to Part II—probably any change in policy would have been an improvement. The state-based scheme of a survey was surely welcomed. Almost all of the improvement projects of the 1820s and 1830s were state efforts, since support for federal projects was limited in the strong states rights milieu of the early Republic.⁷ State projects fit neatly into the pre-existing climate of agricultural improvement. They forwarded the georgic ethic, in spirit if not name, by virtue of their relation to agriculture—either in their goals of extending beyond mere agro-economic means or by attempting to strengthen them—and their integration of goals. As with the georgic,

⁷ John Lauritz Larson, *Internal Improvement: National Public Works and the Promise of Popular Government in the Early United States* (Chapel Hill: University of North Carolina Press, 2001) provides an excellent review of state and federal political dynamics of improvement projects. He notes, in particular, that “Madison’s veto of the [1817] Bonus Bill [proposed by John Calhoun to use money from the new National Bank to support Federal Internal Improvements] effectively spread the burden of internal improvements, at least for the moment, on the backs of the states or private enterprise” (69).

or homespun, ethic, economic and political aims were conceived of in kind with moral and social goals. Virginia's role in the history of those projects, as I discuss in this section, was on the one hand typical of the era, with its concept, timing, and goals; on the other hand, it was locally unique, with the Commonwealth's own waning economic place in the Union, its own notions of locality, and its own particular dynamics of agro-economy guiding the specifics of the project. From the start, the tension between local (here I refer to the state level as local) and universal was visible and apparent to those who would leverage systematic science for local gain.

Virginia's decision to organize a scientific survey was not novel.⁸ In fact, the period between 1820 and 1840 has been called the era of the state survey.⁹ When Virginia voted to fund the project in 1835, they were the fifth such state to do so, after North Carolina, South Carolina, Massachusetts, Tennessee, and Maryland. Within the next few years, New Jersey, Connecticut, Ohio, and New York followed suit. All of these states had their eyes on cataloging and cultivating all manner of nature's resources within an agrarian milieu; they all still operated in a time of agricultural dominance in the political economy of the union. Their surveys were economic projects funded to provide a record of natural resources that could be tapped, mined, and developed.

That nature was a resource, a set of products that could be identified, mined, and sold, was a point already established through agricultural improvement writ large. Governor John Floyd offered the typical view on nature's resourcefulness, explaining to the Virginia House of Delegates in 1833 that a survey would find "the great wealth which lies buried in the earth." Speaking in negation, Jefferson had already repeated the premise of poor soil by mingling

⁸ For the official wording of the legislation, see "An Act to Authorize a Geological Reconnaissance of the State, With a View to the Chemical Composition of Its Soils, Minerals, and Mineral Waters," as reprinted in Rogers, *Geology of the Virginias*, 762.

⁹ The era has acquired many names: Charles Sellers calls it *The Market Revolution*; before that, George Rogers Taylor called it *The Transportation Revolution*. Millbrooke and Aldrich, among others, note that it was the era of scientific surveys. What is more, all of these fall under the broad political category of Jacksonian America.

financial and nature-based metaphors of wealth, observing that “the earth is readily impoverished” when planters work “beyond the power of nature.”¹⁰ Their perspective here was common not just to Virginia, but to the entire country. That view, as I have presented in the previous chapters, was made uncontroversial by decades of attention to identifying soil properties in ever increasingly systematic fashion.

Just as northern entities—Albany’s *The Cultivator*, Boston’s *The New England Farmer*, Pennsylvania’s John Lorain, and New Hampshire’s Daniel Adams—had participated in the common cause of agricultural improvement and soil identification with Southern papers like *The Farmer’s Register* and planters like William Fanning Wickham, John Hartwell Cocke, and Edmund Ruffin, so too were the different states of the Union venturing into deeper geological detail with common enthusiasm. In New York, for example, the conversation about identifying resources under the earth was simultaneously drawing to a close in the mid-1830s as they too, basking in the success of that other famous improvement project, the Erie Canal, funded a Natural History Survey for six seasons beginning in 1836.¹¹

On the other hand, Virginia had a unique set of political and cultural concerns motivating encouragement for its Survey. Looking to James Garnett’s dismal appraisal of a Virginia “nearly gone to ruin” from destructive agricultural policies, a view common at the time, brings that

¹⁰ Floyd quote, 1833. Jefferson, as quoted in Siegel, *The Roots of Southern Distinctiveness*, 63. There is nothing new in my observation. See, to start with, Donald Worster, *Nature’s Economy: A History of Ecological Ideas*, 2nd Edition (Cambridge: Cambridge University Press, [1977] 1994) and many of the collected essays in Worster, *The Wealth of Nature: Environmental History and the Ecological Imagination* (New York: Oxford University Press, 1993). As for Floyd’s view, it was likely influenced by his correspondence with Peter Browne, the Pennsylvania Geologist, who had made a tour of Virginia in 1833 as a way to pitch the idea of a Survey, organized by him of course, to the Governor. Browne noted that the state could be “greatly enriched” by his geological reconnaissance. Quoted in Boscoe, “‘The Insanities of an Exalted Imagination’,” 291.

¹¹ Connections between New York and Virginia were more than just abstract. Leaders from both states were in correspondence about the opportunities and plans for improvement schemes like canals and surveys. John Hartwell Cocke, as it happens, was a frequent correspondent with DeWitt Clinton, one of the champions of such improvement projects, in New York. Their letters show the Virginia planter eager to replicate the Erie Canal’s success with his state’s nascent James River and Kanawa Canal project while introducing all manner of improvement schemes throughout the state. Clinton to JHC, 20 July 1824, in JHC Papers, Box 41.

regional uniqueness to the fore. First, the dual desires to preserve the strength of an *economically* viable Old Dominion (by growing the agro-economy) and redevelop a *cultural* concept of Old Virginia (the one being defined by the eastern planter elites with reference to productive soil from centuries before) went hand in hand. Put another way, the political economy of Virginia was being restructured with attention to social capital and environmental health. The Old Dominion was on a downward trend from its former status as the largest, most populous, and wealthiest state at the beginning of the century, when tobacco guaranteed its profitability and from which time, for the first quarter of the century, the entire nation's political direction had been guided by the Virginian Dynasty of Jefferson, Madison, and Monroe. The survey offered a way to address not just the dual preservation ethic, but also two temporal facets of improvement: it would strengthen the future political economy by systematically cataloging nature's resources, while replenishing the past by making exhausted soil fertile again with agricultural chemistry.

The slave economy that underlay most agricultural production, a large underpinning of Virginia's social capital, was a second factor distinguishing Virginia from other states. That slave-based political economy obviously distinguished the state from its neighbors to the North. In Chapter 3, I noted the competing aims of improvement by John Lorain, who thought the greater efficiency of fertilized soil would reduce the need for slavery, and Ruffin, who argued that fertile soil would stabilize and then promote a slave-labor culture. The same difference in argument fit the schemes of state survey advocates. That is, Virginians were arguing for the fact of a survey, just as their brethren to the North were, but they did so for the purpose of promoting a unique goal, that of the cultural Old Virginia. State advocates believed that a survey could "arrest the flood of Emigration [to western states by] unfold[ing] our natural resources," as the *Richmond Enquirer* reported in 1837. As the historian Steven Stoll has shown, other southern

states, such as South Carolina, shared this perception that decreasing fertility encouraged emigration to the south and west and, thus, increasing fertility would encourage the population base, and by extension the slave culture, to remain near the coast.¹²

To be sure, the thought of systematically analyzing the natural features of Virginia was neither new nor unique in 1835 when legislation for the first survey was officially passed. In the 1780s, Thomas Jefferson had compiled a state survey of sorts with his *Notes on the State of Virginia*. There, he assessed the status of the natural features of the state in categories such as rivers, mountains, and “productions mineral, vegetable and animal.” Despite the patriotic purpose and tone of the book, he was still left to bemoan the fact that, among other things, “none of [the medicinal springs have] a chemical analysis in skilful [sic] hands, nor been so far the subject of observations.”¹³ As my discussion of the georgic ethic in Chapter 1 showed, Jefferson had mixed feelings about the science of agriculture but ultimately made his concern one of practical use. His comment on the glaring lack of analysis was aimed at highlighting just where such controlled observations might be useful. And as my discussions in the previous chapters

¹² The quote is from *The Richmond Enquirer*, 2 February 1837, Richmond, VA. This political impetus for the survey is consistent with the justifications of others eastern states, as shown in Millbrooke, “State Geological Surveys of the Nineteenth Century,” 32-133 and Stoll, *Larding the Lean Earth*, 69-169. Also, see Michele Aldrich and Alan Leviton, “William Barton Rogers and the Virginia Geological Survey, 1835-1842,” in Corgan, ed. *The Geological Sciences in the Antebellum South*, 88, for a map of county voting patterns on funding the survey. See Shade, *Democratizing the Old Dominion*, passim, for extended commentary on Whigs and Democrats in 1830s Virginia. Philip Aylett, “To the Voters of King & Queen, Gloucester, Matthews, Middlesex, and King William,” a broadside (28 March 1837), available at the Virginia Historical Society [hereafter VHS], Richmond, Virginia, offers a good example of a Whig view of internal improvements, with Aylett expressing his opinion that “public money should not be used except for public benefit in shape or other – and much of it has been thrown away at the expense in part of those not locally interested.”

See Stoll, *Larding the Lean Earth*, 13-66 and passim, Shade, *Democratizing the Old Dominion*, 30-49, and Kirby, *Poquosin*, passim, for more development on the general political and economic context. Each author refers to and moves beyond Avery Craven, *Soil Exhaustion as a Factor in the Agricultural History of Virginia and Maryland, 1606-1860* (Urbana, IL: The University of Illinois, 1926) as an early source on the relation of soil exhaustion to demographic shift. Shade in particular tempers the “decline” hypothesis -- that decreasing soil fertility led directly to emigration -- by giving attention to increases in agricultural diversity. Also, see Roger Kennedy, *Mr. Jefferson’s Lost Cause: Land, Farmers, Slavery, and the Louisiana Purchase* (New York, NY: Oxford University Press, 2003) for more detail about the tensions in economic planning on and for the land of Virginia after Jefferson’s presidency.

¹³ Thomas Jefferson, *Notes on the State of Virginia* (New York: Penguin, [1787] 1999), 36.

addressed, Jefferson was part of the many organizational efforts to introduce systematic examinations of the state's soils for some time before the 1830s.

Virginians, and early Republic citizens all told, agreed with Jefferson on the need for more diligent studies of natural features. They believed that particular knowledge of nature's identity could be useful for the state. “[We want] more minute details of the soil, climate, vegetable productions, local advantages, and progressive improvement,” wrote an anonymous contributor to Petersburg's *Virginia Argus* in 1816.¹⁴ The record of the early agricultural press only furthers this point. Nearly a decade after the rise of the rural press, twenty years after the Petersburg contributor summarized the issue so succinctly, a half century after Jefferson's *Notes*, and with the examples of near-by states standing clearly before them, Virginians voted to fund an official, systematically organized scientific survey intended to benefit their region in georgic fashion, that is, economically, politically, and socially. The first Geological Survey of Virginia, then, rather than being a mere exploration of geological features or a singular project aimed at identifying rich coal deposits—aspects for which the Surveys are generally studied—was more broadly a way to take stock of the state's resources, develop and improve its agro-economy, and identify new means to strengthen that environmental resource.

Rogers's Survey and the Dynamics of Virginia's Territory

By the 1830s, the General Assembly's vote in favor of a survey was an effort to remake the Old Dominion economically, politically, and quantifiably.¹⁵ My purpose in this chapter is not to provide the definitive exegesis of this first Survey and, in any case, broader details of the

¹⁴ *The Virginia Argus*, 1 February 1816, Petersburg, VA.

¹⁵ Kennedy, *Mr. Jefferson's Lost Cause*, 55-59, provides a fair summary of these differences.

survey have already been described in several short articles elsewhere.¹⁶ I aim, rather, to use it as another example of how Virginians were introducing scientific mediation into their lives to produce knowledge of the land, of how land could be perceived with scientific lenses. Within that framework of associating science and environmental knowledge, I review these salient questions in this section: who actually coordinated the survey and how was it organized?

As dictated by the legislature, the first year's work would be a reconnaissance providing "a view to the geological features of our territory, and the chemical composition of its soils, minerals, and mineral waters." To accomplish this feat, an official surveyor would be appointed by the Board of Public Works and an annual report authored by that surveyor would provide evidence of the value of the work.

William Barton Rogers, the state's foremost natural philosopher, had a hand in drafting early proposals for a survey. His appointment as the official state surveyor in early 1835 was thus not surprising. Then a professor of natural philosophy at the College of William and Mary, he would move to the relatively new University of Virginia (founded in 1819) by the time the survey began in full in the Spring of 1836. The mid-Virginia geography of Charlottesville was more amenable to his recurring health problems—Rogers, apparently, did not fare well in Williamsburg's humidity—and to the organization of a state-wide survey because of that more centralized location. (He remained there until leaving for Boston in the 1850s to work on founding MIT.) At the request of several counties in the northern Shenandoah Valley, Rogers

¹⁶ Details of the Rogers survey appear in the reprints of the annual reports published by his widow Emma Savage Rogers later in the century (1884), cited above as Rogers, *Geology of the Virginias*. Archival material for the survey is available at the Library of Virginia (LVA) and the MIT Institute Archives and Special Collections, MC-1 (hereafter cited as *Rogers Family Papers*, MIT). Emma Rogers edited and published William's letters in *Life and Letters of William Barton Rogers*, 2 vols. (New York: Houghton Mifflin, 1896). The Virginia survey, with cursory biographical details of Rogers, has been discussed by William Ernst, "William Barton Rogers: Antebellum Virginia Geologist," *Virginia Cavalcade* 24 (Summer 1974): 13-21; Aldrich and Leviton, "William Barton Rogers and the Virginia Geological Survey, 1835-1842"; Robert Milici and C.R. Bruce Hobbs, Jr., "William Barton Rogers and the First Geological Survey of Virginia, 1835-1841," *Earth Science History* 6 (1987): 3-13; and Sean P. Adams, "Partners in Geology, Brothers in Frustration: The Antebellum Geological Surveys of Virginia and Pennsylvania," *The Virginia Magazine of Biography and History* 106 (1998): 5-34.

had co-authored a “Report from the Select Committee of the General Assembly of Virginia... Praying for a Geological Survey of the State” put before the Richmond politicians in 1834. Even more directly, he acted as the survey’s key advocate when he spoke directly to the General Assembly at the February 1835 legislative session.¹⁷

Rogers had the chemical knowledge to understand how to analyze the samples he would be collecting. His prior experience had been mainly analytical and developed through laboratory-based instruction to students. That is to say, he was no farmer and made no claims to be directly acquainted with the daily travails of soil management. His ability to analyze soil samples, though, was legitimized by his professional academic standing. It helped too that Ruffin was publishing Rogers’ work in *The Farmer’s Register*, thereby giving him a reputation among farmers as someone interested in practical pursuits and someone vouched for by a rural press editor.¹⁸

Rogers was himself a graduate of William and Mary, having studied chemistry first at home under his father, Patrick Rogers, an Irish immigrant who had studied medicine and first made his name in America with a popular series of public lectures on chemistry. William then furthered his studies at the College of William and Mary, where his father had become a Professor of Natural Philosophy and Chemistry by the 1810s. (William inherited the appointment after his father’s death in 1828.) His strictly scientific publishing record to that point was confined to reports on chemical analyses and instrumentation. His geological experience was tied to this chemical familiarity—his interests, again, being primarily chemical before the survey—but the fact that the two kinds of sciences were so interwoven at the time meant that

¹⁷ The “Report from the Select Committee of the General Assembly of Virginia...” is available in Rogers, *Geology of the Virginias*, 754-762.

¹⁸ See W.B. Rogers, “On the Discovery of Green Sand in the Calcareous Deposit of Eastern Virginia, and on the Probable Existence of this Substance in Extensive Beds near the Western Limits of our Ordinary Marl,” *The Farmer’s Register* 2 (1834): 134-137; *ibid.* “Apparatus for Analyzing Marl and Carbonates in General,” *The Farmer’s Register* 2 (1834): 364-365; and *ibid.* “Further Observations on the Green Sand and Calcareous Marl of Virginia,” *The Farmer’s Register* 3 (1835): 68-71.

credibility in one field meant credibility in the other. Governor Littleton Tazewell, prefacing Rogers's first-year reconnaissance report of January 11, 1836 to the House of Delegates, claimed that it was Rogers's "reputation as a geologist and chemist [that] induced the board without hesitation to appoint him to make said reconnaissance." Henry Darwin Rogers, his younger brother, was a wayward Owenite recently returned from an immersion in geological debates in London. It was from him that William learned of the newest European theories of mountain formation, stratigraphy, geological nomenclature, and technique.¹⁹

Given Tazewell's view of the matter, William's appointment to the post of State Surveyor was neither unexpected nor contentious. With that appointment, the project gained currency from not just the economic and political quarters that funded it, but the educational and scholarly ones too since Rogers had patrons in academic, political, and scientific circles. As for the political patronage of the broad bill, Michele Aldrich and Alan Leviton studied the county-wide voting pattern for the Survey, but could not identify any guiding pattern of aye/nay votes between eastern and western regions or Whigs and Democrats.²⁰ In general, Virginia politics were strongly localized, county-wide decisions and party affiliations mapping onto geographical features, as I will note again below, as well as pockets of religious denominations. It would appear from this that the Survey Bill was an effective political article, including enough material to appease disparate constituencies without presenting too many measures of strictly local benefit. With a nod to agriculturalists, coal mining advocates, canal beneficiaries, as well as grain and tobacco market agents from east to west, the Survey was acceptable financially. With support

¹⁹ Littleton Tazewell, "To the House of Delegates" (11 January 1836), as reprinted in Rogers, *Geology of the Virginias*, 22. For a biographical sketch of William Rogers, see Emma Rogers, ed., *Life and Letters of William Barton Rogers*, 1-10. On Henry Darwin Rogers, see Patsy Gerstner, *Henry Darwin Rogers, 1808-1866: American Geologist* (Tuscaloosa: University of Alabama Press, 1994).

²⁰ Even so, the county delegate votes do show variations in economic bases across the state. The counties of heavy agricultural society involvement—including Albemarle and her neighboring counties—voted for the survey, although many Tidewater and peninsular counties did not; several large counties in the western coal region voted in favor, although many did not cast a vote at all. See Aldrich and Leviton, "William Barton Rogers and the Virginia Geological Survey, 1835-1842," 85.

from various cultural outlets across the state, including the academic center of Rogers himself and the wealthy planters who were already invested in county surveys of similar organization, the Rogers Survey had the opportunity to influence more than just the scientific readers of his work or just the economically-minded politicians seeking a return on their investment.

Temporally, the Survey season was planned to run from mid-Spring to mid-Fall, allowing for long days and the time outside of the University's academic year to coordinate and manage the process. This latter point was significant, since Rogers was tied to his professorial duties throughout the duration of the project. Spatially, the project covered nearly all corners of the state at some point in its years-long duration. In terms of land-use, those regions were themselves uniquely defined. Whether a region was distinguished primarily by agricultural, coal, or other market interests depended on the particular topography of that region, meaning that there was a reciprocal relationship between geography and economy. Generally speaking, the larger plantations of the east, central, and south-side counties sought more agricultural attention and market opportunities, while those representing the western coal fields and unearthed coal deposits around Richmond—the “wealth buried in the earth” of which Governor Floyd spoke—of course sought the geological knowledge of rocks, minerals, and ores.

Virginia's topographical variety lends itself to a more precise environmental history than I can offer here, especially as it provides an excellent example of the co-production of social and ecological legacies. That is, Virginia shows us the interdependence of land management practices and social fabric: the dynamics of slave labor were often tied to elevation (basically, slave culture was limited above the thousand-foot line); patterns of emigration were connected to soil conditions; the problems of tobacco-caused soil exhaustion, so often used to explain the impetus for Virginians to enact programs of statewide revitalization, were less substantial in the west than in southern counties; and older geological strata were tied to the differential

availability of fertilizers like marl and lime. Even the central Piedmont counties, as we saw in Chapter 4, were already diversifying their economic basis by the early nineteenth-century. Given my interest in the role science played in offering new means to know the land, requiring specific attention to each region, these differences are certainly important.²¹ I will only repeat here that the diversity of Virginia makes it a unique case while also allowing that an exegesis of the state can speak for regions beyond just its own.

Over the span of the five years after the reconnaissance year of 1835, Rogers focused on these different areas of the state, as evident in the concentration and development of each year's reports. The first year emphasized the eastern tidewater and the peninsular marl regions and coal deposits near Richmond, ending with a brief glance towards southwest counties down the Shenandoah Valley. (See Figure 13, abovebelow.)²² The second year was spent finishing up the eastern observations, and then stressing "all of the region lying between the Blue Ridge and the first escarpment of coal-bearing rocks of the Alleghany proper."²³ The third year, 1838, bore down on the same western arena as the previous year, with greater detail and a larger set of samples. The fourth year saw additional attention to the wide piedmont between the Blue Ridge and the counties near the capital of Richmond, while the fifth and final year related "chiefly to the marl region between the Potomac and Rappahannock rivers, the northern district east of the Blue Ridge, and the great western coal region."²⁴

²¹ See note 1 of the prelude to Part II of this dissertation. One easy example of the co-produced social and agro-economic relationship comes during the Civil War, when many western counties in the state voted to remain in the Union while present-day Virginia counties voted to secede. Those non-seceding counties were admitted to the Union 1863 as the free state of West Virginia.

²² Interestingly, the geological demarcations of the map follow fairly closely with the political regions of the 1830 state constitution. See Shade, *Democratizing the Old Dominion*, 20.

²³ Rogers, "Report of the Progress of the Geological Survey for the Year 1837," in *Geology of the Virginias*, 156.

²⁴ *Ibid.*, 412.

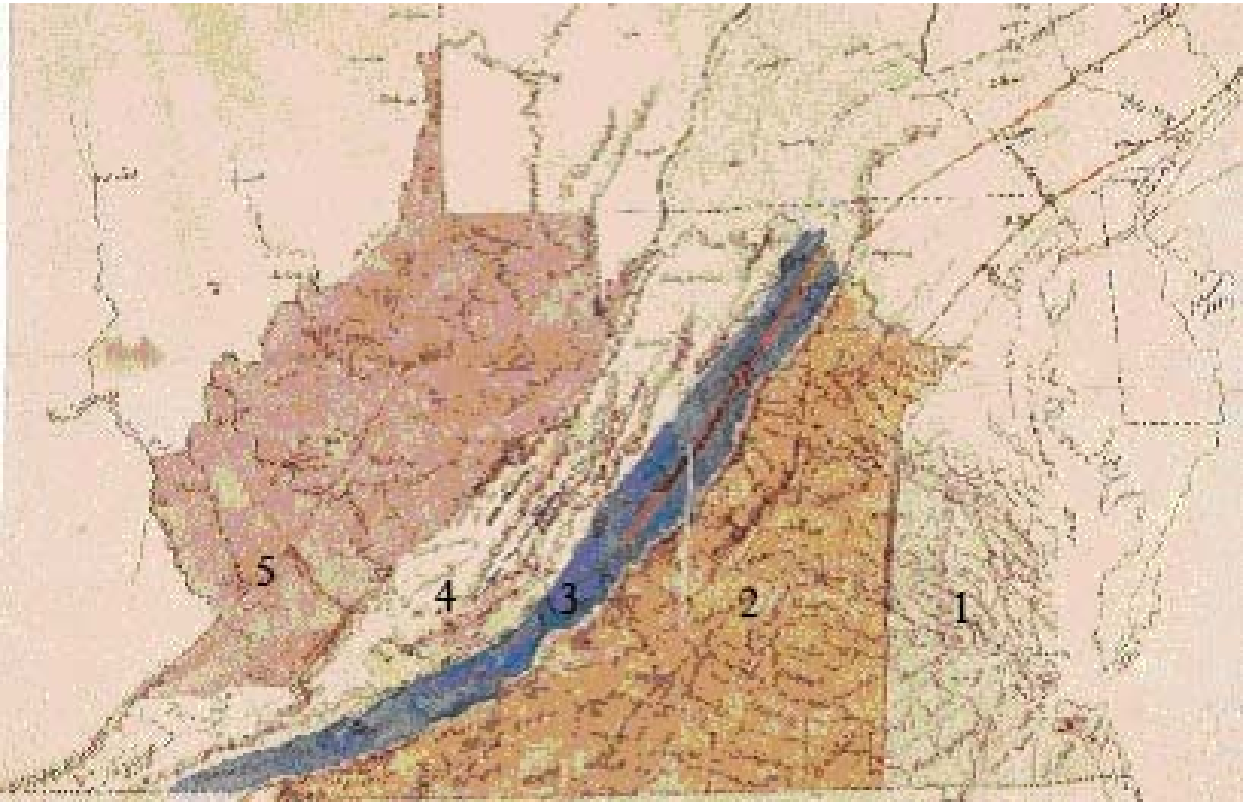


Figure 13. A partially completed geological map of Virginia, showing basic zones of the state, 1835 (modified with my numerical annotation). The eastern section represents the tidewater and peninsular marl regions, here labeled “1”. The piedmont (“2”) extends from the marl region to the Blue Ridge Mountains in the middle of the state. The Shenandoah Valley (“3”), the slim diagonal on the map, is in between the Blue Ridge to the east and the Allegheny to the west. That Allegheny region is divided into two parts – “4” on the eastern half, and “5,” the western coal fields. (Source: Richard Stephenson and Marianne McKee, eds., *Virginia in Maps: Four Centuries of Settlement, Growth, and Development* [Richmond, VA: Library of Virginia, 2000], 178. Reprinted by permission of the Library of Virginia, Richmond, VA.)

Rogers hired as many as five assistants at a time to cover such a wide expanse. His younger brother, Henry, was the first assistant on board, helping out during the initial reconnaissance year of 1835. (Thereafter, Henry would be too pre-occupied running the Pennsylvania and New Jersey surveys.) The rest of the team dispersed to study the geological features of the Appalachians, the fertile agricultural Valley of Virginia (the Shenandoah), the coal regions, the marl and clay regions of the eastern peninsulas, the mineral springs of the Valley, and the various features of the piedmont.²⁵ At times, the survey seemed like a Rogers

²⁵ See Aldrich and Leviton, “William Barton Rogers and the Virginia Geological Survey, 1835-1842,” 92-93 for a synopsis of the assistants to the survey.

family affair. Henry helped that first year; Robert, their youngest brother and a noted chemist, helped out on field trips and with analytical laboratory support; and James Rogers, the eldest brother who was also trained as a chemist, assisted on and off—paid and unpaid—over the entire span of the survey. William Aikin, George Boyd, Caleb Briggs, Charles Hayden, Thomas Ridgeway, and Israel Slade rounded out the cast. Their prior experiences ranged from the freshly trained Briggs, having just completed his studies at Rensselaer Polytechnic Institute, to the veteran, William Aikin, a former worker on various New York surveys.

For 1836, Rogers was allotted \$3000 to fund himself and just one assistant, thereby doubling the amount authorized for the 1835 reconnaissance. Over the years, though, Rogers paid out of pocket for several of the positions since there was never just one assistant helping out. As might be expected, money was always an issue and the tense letters between Rogers and his contact at the Board of Public Works, James Brown, Jr., speak clearly to this. He did receive a modest increase in funding in 1837, but never anything to match the grand designs of some other states—New York, in particular, estimated costs for their ambitious Natural History Survey at \$109,000 and employed seventeen paid scientists. By the end of the project, Rogers had collectively spent \$40,000 in just over six years. Since the state only authorized a total of \$26,500, Rogers's personal investments were significant.²⁶

The “annual report” written by Rogers, from information provided by his assistants and from his own field travels, was a key end result of the survey for the state's General Assembly.²⁷ Roger's annual reports provided the means by which his direct observations, filtered analyses of samples, and collated assessments of rock, water, and soil quality made their way to the Virginia legislature and ultimately the general public. The report represented the public face of the

²⁶ See Rogers, *Life and Letters*, 179 and Merrill, *Contributions to a History of American State Geological and Natural History Surveys*, 511.

²⁷ Another legislative mandate was to “collect and catalog specimens of rocks, fossils, ores, mineral, compounds, and organic remains [to be distributed to] principal institutions of learning in the State,” as quoted in Merrill, *Contributions to a History of American State Geological and Natural History Surveys*, 509.

survey. Along with the mineral cabinet that Rogers amassed, it was the visible proof that the assembly's money was well spent. Likewise, the report was a document of value which could be transported anywhere; the basis for printing and disseminating it was that the information inside was distinct, real, stable, and beneficial. The information the reports contained were rhetorical representations of the nature of Virginia, expressed in the idiom of scientific analysis. What occurred through the process of surveying the state was a transformation of the land from a site individually experienced, and uniquely conceptualized, to a series of "specimens," each identifiable in a codified, universalized way.²⁸

The Logistics and Labor of Surveying

From the start, Rogers, his assistants, and the roster of contributors to his efforts from across the state were mutually charged with the task of organizing and deploying a scientific and technological apparatus for the purpose of measuring, assessing, and defining the land. This task further cemented the model of science as an agent of improvement—blending notions of "practice" together, so that science was a practice, an activity, of practical import—in the eyes of Virginians. But it was not easy to coordinate the everyday logistics of the survey since such features had to be created and then produced over the years of the project. In this process, Rogers had the help of preceding and contemporaneous projects from other states, most directly those of New Jersey and Pennsylvania, where his brother Henry was the State Surveyor. The

²⁸ 1000 of the 1837 report were printed in 1838. See James Brown to W.B. Rogers, 18 April 1838, Geological Survey Papers, LVA. The next year, Brown tells Rogers that the 1838 reports have been printed and are in hand, though he does not specify how many. James Brown to W.B. Rogers, 15 April 1839. (Details are unavailable for the other years.) While the annual reports were printed, the final report, into which Rogers had promised to provide a more substantial and comprehensive document, was never funded. Rogers recognized the value of the summary statements in the reports, so, anticipating problems with final funding, he would include past year's data in the new year's reports. See, for instance, Rogers, "Report of the Progress of the Geological Survey for the Year 1839," in *Geology of the Virginias*, 384-385. As another end-around to publication problems, the predominantly agricultural focus of the first year's report was also reprinted, in its entirety, in *The Farmer's Register* 4 (April 1, 1837): 713-721, Virginia's main rural periodical.

different scale and geography of Virginia's survey, though, tempered the impact of such concurrent examples. The pioneering aspect of all the surveys, as well, made all the work somewhat tenuous. In this section, I discuss the scientific and technological measures by which those survey results were produced. In the first half, I address the social dimensions of Rogers' enterprise. In the second half, I address the material dimensions of the survey. All told, these social and material features speak to the devil-filled details required to produce a project that could define and improve nature.

Correspondence, Observation, and Report

The social dimensions of the survey work included establishing effective correspondence networks with assistants, developing a reliable network of sample collectors, and accomplishing the rhetorical feat of producing a report to suit the needs of the state.²⁹ Those facets were akin to the work being done concurrently in county-based improvement societies. The differences, in Rogers' case, were his position not as a farmer, but as an academic, and his audience of not just similarly minded neighbors, but political constituents with various reasons to support his efforts. The real burden on Rogers and the survey personnel was to create a space—the Survey—where disorganized, uncollated information could be fashioned into codified, polished data. The establishment of a cohesive social organization was a central component of such a space. From his home base in Charlottesville, Rogers thus immediately had a series of organizational wrinkles to iron out.³⁰

²⁹ The problems of travel, coordination, and geography have been addressed by geographers and historical geographers with great detail. For an entry point to those discussions, see David Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003).

³⁰ These issues – of enrollment, standardization, and network creation and deployment – have been prime territory for science studies scholars, especially within the purview of laboratory studies and the notion of metrology. See Bruno Latour, *Science in Action* (Cambridge, MA: Harvard University Press, 1987) as a standard reference. More directly for the present paper, see Latour, *Pandora's Hope* (Cambridge, MA: Harvard University Press, 1999),

In the first case, it would seem that developing a system of written correspondence between Rogers and his assistants would be unproblematic. Just write; they will get the instructions and then write back with questions and answers. Yet the record of letters from the survey shows that the assistants experienced a consistent and irritating pattern of communication. Letters arrived late, or not at all; goods were damaged in the mail; instructions were unclear to those gentlemen in the field. (Keep in mind that the very roads that would later enable a more efficient postal service were still then but a part of the agenda of internal improvements for intrastate infrastructure. As the historian of transportation technology George Taylor has observed, the roads were “invariably poor.”³¹)

Assistants often awaited their instructions in the field. Sometimes they had moved to the next town before finding out, with the next letter, that they overlooked a key observation at the last site, or mistook one measurement location with another. The matter of the mail was thus a daily problem. The record of one assistant in particular, Charles Hayden, is nearly comical in Hayden’s consistent appeal for more mail. Barely a letter goes by without him making note of a package not received or instructions late in arriving. Several letters are sent that seem predicated entirely on wondering whether or not a previous letter had been received. The other assistants—Briggs, Slade, Boyd, Aikin, and even William’s brother James—made similar complaints over the years, almost never failing to devote a part of every letter to the very matter of the letters and to the problems they encountered because of miscommunication.³²

chapter 2, where he explicates more thoroughly the processes of transforming physical soil into words and concepts and then back (or, “circulating references”). Also see Joseph O’Connell, “Metrology: The Creation of Universality by the Circulation of Particulars,” *Social Studies of Science* 23 (1993): 129-173, for its own sake and for further references. Each of those studies, however, generally starts with the premise that the scientific success of redefining nature needs to be explained. My concern starts with the premise that science has already been represented as succeeding, leaving us to wonder what this means for what we think of nature.

³¹ George Taylor, *The Transportation Revolution, 1815-1860* (New York: Harper Torchbooks, 1968), 15-16.

³² See letters from C. Hayden to W.B. Rogers, for example, 23 May 1836, 9 May 1837, 23 May 1838, and 25 August 1838, in Geological Survey Papers, LVA, Box 1. The letters of Briggs, Slade, Boyd, Aikin, and James Rogers are spread throughout the Survey Papers.

On the face of it, this problem might strike us as one of reliable transportation. That has to be true to some extent. But more than that, it was a problem of connecting the safe haven of the tamed city, Charlottesville, with its university and laboratory, to the more rustic country, where horses and letters and packages had to contend with inclement weather and mountains and thick brush across trails. Charles Hayden complained of heat and bugs, and their part in preventing his work. Israel Slade had similar experiences and obstacles, lamenting his lame horse and the trunk he lost. William Aikin could not pass certain roads because of mud and exhausted horses. James Rogers experienced bad weather, poor health, a lame horse, and a broken piece of equipment all at once. William Rogers addressed the problems often in his annual reports, talking about “the fatigue and privation” to which they “were frequently exposed.” Of course, he sometimes observed the pastoral experience of it all, noting that their troubles were now and again “a little lightened by the animating influence of scenery, at once wild and beautiful and sublime, rich in subjects for the artist’s pencil...”³³ To be sure, the fatigue, privation, and roadless miseries are the classic problems of field scientists. But part of establishing a viable survey system was being able to acquire information from the field and incorporate it into a presentable report at the home base, a process that gave no attention to the work of the assistants, nor their travails, that accompanied data acquisition. On the one hand, this process of backwoods work then becomes a story of the development of field sciences in America and of how published scientific data is borne of the labor of uncertainty. On the other hand, this is a story of how the knowledge of the land is augmented in an agrarian world from georgic experiential knowledge to knowledge produced through disengaged analysis.³⁴

³³ See Rogers, “Report of the Progress of the Geological Survey for the Year 1838,” in *Geology of the Virginias*, 157.

³⁴ Charles Hayden to W.B. Rogers, 25 August 1838; Israel Slade to W.B. Rogers, 20 June 1839; W.E.A. Aikin to W.B. Rogers, 11 June 1838; and James Rogers to W.B. Rogers, 4 and 5 June 1839, all in Geological Survey Papers, LVA, Box 1. Adams, “Old Dominions and Industrial Commonwealths,” 238-240, provides a concise overview of these field problems. Also, I do not want to downplay William Rogers’s role here as a field worker too – he also

In the second case of ironing out organizational wrinkles, there was the matter of identifying reliable rock, soil, and water sample providers and then using them as implicit partners in the survey enterprise. Unlike the county improvement societies, where membership rolls defined the range of contributors, Rogers had to develop a roster that extended across the entire state. His annual survey reports list pages of tables of analytical results for samples of marl, soil, rocks, and water from the Tidewater of the East to the mountains of the west. But where did all these sample providers come from?

In part, the official Survey was leveraging a system of sample analysis acquisition that already existed throughout the Commonwealth. Even before the survey began—before it was even suggested, in fact—Rogers was receiving and analyzing samples from local farmers. In 1834, he wrote to his brother Henry that “Letters are coming to me every mail asking advice on the subject of marl or some other thing.”³⁵ He would later write in the annual report for 1837 that “[t]he high value of these researches, manifested by the eagerness with which the chemical details in the annual reports are referred to practical objects, is still more strikingly indicated by the numerous enquiries addressed to me, and the numerous specimens transmitted for examination from various quarters of the state.”³⁶ We find, then, that samples were somewhat easily accessible as the Survey in short time gained a reputation for its expected utility.

What is more, once the official Survey was underway some contributors were brought to it by contact with the traveling field assistants; many learned of it in the rural and urban presses. The papers often broadcast news of surveys. *The Farmer’s Register*, for example, reprinted the survey’s first year’s report in its fourth volume and made occasional comments on it. Local papers, like those in Richmond, also published comments and editorials about the survey and its

traveled the state – but his final responsibility was centered around his home base, so that his role in redefining the land was more complex, as both the organizer of and a contributor to the survey’s data bank.

³⁵ W.B. Rogers to H.D. Rogers, 30 November 1834, as reprinted in Rogers, *Life and Letters*, 113.

³⁶ Rogers, “Report of the Progress of the Geological Survey for the Year 1837,” in *Geology of the Virginias*, 186.

associated legislation. Rogers proudly told his brother Henry that the “daily papers of Richmond have lauded my efforts in a very complimentary style.” Some contributors knew of the survey by their relationship with Rogers, the University, or the State government directly. Joseph Cabell, for example, was a prominent state senator, Lancaster county planter, and marl sample contributor to the project. He knew of the survey because he was both a personal friend of William Rogers and associated with the University.³⁷ Finally, a small percentage of those samples were taken directly by Rogers himself and the survey assistants. The process of locating contributors, then, was less fraught with difficulty than that of establishing a system of correspondence.

In the third case requiring organizational skill, Rogers’s rhetorical accomplishment that followed the receipt of field data deserves our attention. The legally mandated reports to the Board of Public Works provide but a gloss on the field workers’ training, assignments, and results. This gloss enabled field results to appear problem-free when presented in the report. In a positive light, we see that Rogers’s management ability was solid enough to compose a clear report even though the avenues of communication were fraught with difficulty. In a more skeptical light, we learn that the transformation of raw, “natural” data from the field might not have been as unfiltered as a mere perusal of the report would lead one to believe.³⁸

³⁷ See W.B. Rogers, “Report of the Progress of the Geological Survey of the State of Virginia, for the Year 1836,” *Farmer’s Register* 4 (April 1, 1837): 713-721. For W.B. Rogers to Henry Darwin Rogers, see 27 February 1835, in *Life and Letters*, 118. The *Richmond Compiler and Semi-Weekly Compiler*, 16 January 1836, *Richmond Enquirer*, 2 February 1837, and *Richmond Whig and Public Advertiser*, 3 February 1837 devoted print space to reports about and comments on the survey, as noted by Adams, “Old Dominions and Industrial Commonwealths,” 220 and 227. See also Ernst, “William Barton Rogers: Antebellum Virginia Geologist,” 15 for Rogers’s friendship with Cabell.

³⁸ Rogers began each season by issuing assignments to his assistants, either by correspondence (if they were already in the field) or direct communication (if they were in Charlottesville). See Rogers, “Report of the Progress of the Geological Survey for the Year 1838,” in *Geology of the Virginias*, 248, for one – there he explains the assignments of his assistants for the 1839 season; also *Ibid.*, 539-41 outlines the assignments for the 1841 season. Information about these assignments comes to us through the annual reports, documents written “in compliance with the law requiring...an account of the progress of the geological survey.” See *ibid.*, 247, 413, and 539.

As an example, one field assignment was to “ascertain by accurate barometrical observations the height of the principal mountains in the State.”³⁹ Having now seen the difficulty in coordinating instructions and assignments by way of mail, we might better appreciate the challenges present in achieving this task. The assistant has been hired, the assignment given, the travel to the mountains made, the boiling point thermometer—used to measure altitudes by comparing relative boiling points of water at different heights—in hand, and the measurements recorded and then communicated by mail back to Rogers.

I return to the issue of thermometry later, but here it is worthwhile to see how the process turned out. Not surprisingly, and citing “sufficient evidence,” Rogers reports the “accuracy of the heights computed” from altitude measurements with great satisfaction.⁴⁰ Yet we find from the survey’s correspondence records that repeat measurements were few and usually inconsistent. Thomas Ridgeway took nearly fifty pages of boiling point measurements, never once providing more than two measurements per peak, and often just one.⁴¹ It may be that the problems of altitude measurement did not matter in the long run, that Rogers’s answers were good enough. But even if that were so, we see the contingent nature of scientific processing in practice – the data might easily have turned out differently; the resulting quantified picture of the land could have been different.

Before addressing the more strictly material components of surveying in the next section, I want to draw out here one more example of survey activity, that of marl sample analyses. This example combines the three social dimensions outlined above—correspondence, network creation, and rhetorical output—while placing the process of the geological survey back into its

³⁹ “An act to provide for a geological survey of the State, and for other purposes, passed February 29, 1836,” as reprinted in Merrill, ed., *Contributions to a History of American State Geological and Natural History Surveys*, 509.

⁴⁰ Rogers, “Report of the Progress of the Geological Survey for the Year 1838,” in *Geology of the Virginias*, 193.

⁴¹ See, for example, the field notebooks of Thomas Ridgeway in Box 3 of the Geological Survey Papers, LVA.

agricultural basis. Marl samples were mailed to Rogers in Charlottesville; the contributors who sent them thus became involved in the process of the survey; and the annual reports distributed the analytical results that had been sought.⁴²

Marl analysis again frames the agricultural work of the geological survey. The map of Virginia in Figure 13 indicates four basic regions (or five, if we break the western region into north and south), the first two of which were heavy marling territory. The marling activity of the Survey was set against a pre-existing background of fertilizing experimentation. Edmund Ruffin's advocacy of marl, highlighting its benefits for improving soil and society in his *Essay on Calcareous Manures*, had first been published in 1832 just three years before the Rogers Survey.⁴³ The story of "book farming" that I examined in Chapter 2, with its basis in the value of systematic studies of fertility, was also playing out. Rogers had contributed an article on marl analysis to *The Farmer's Register* in 1834. (I return to this later.) And a prime motivating factor for authorizing the survey had been to identify and thus provide better access to the fertilizers already available across the state. These too—marl, lime, and other fertilizers—were as much on John Floyd's mind when he asked to look for the "wealth buried in the earth" as ore and coal.

That task of unearthing fertilizing wealth, Rogers believed, was relatively easy. He argued in his 1837 report that from "the extent of its exposures in many places, from its great richness in carbonate of lime, and from the facility with which, without any previous preparation, it can be applied to the soil," the only thing left "for the attention of agriculturalists" was to identify the location of the marl and to evaluate its quality. After several years of survey results had been loosely compiled, Rogers proudly presented a comprehensive table of "every variety of

⁴² For a compilation of Rogers's early analyses, see William Barton Rogers's one volume, 43 page notebook, "Analyses of Marl, Sand, and Soils," (1835) in Box 4, Folder 2, Geological Survey Papers, LVA.

⁴³ Edmund Ruffin, "On the Composition of Soils, and Their Improvement by Calcareous Manures," *American Farmer* 3 (1822): 313-320; Ruffin, *An Essay on Calcareous Manures* (Petersburg, VA: J.W. Campbell, 1832). See references in Chapter 3 for more on Ruffin's biography and legacy.

marl met with” in the eastern farming district of the state in his 1839 report.⁴⁴ There had been scattered tables in the previous volumes, so the 1839 version was but the tabulated culmination of the fertilizing arm of the survey. Those summaries of the description and composition of samples included in the annual reports (a detail of one, from 1837, is shown as Figure 14) illustrate a process that began with soil, in the countryside or on a farm, and ended with an analyzed scientific specimen.

⁴⁴ Rogers, “Report of the Progress of the Geological Survey for the Year 1837,” in *Geology of the Virginias*, 172; and *ibid.*, “Report of the Progress of the Geological Survey for the Year 1839,” in *idem.*, 385-389.

| MIOCENE MARLS. | | |
|----------------------------|--|--------------------|
| <i>Localities.</i> | <i>Observations.</i> | <i>Carb. Lime.</i> |
| LANCASTER. | | |
| Capt. Ja's. Robinson's,... | Small fragments of shell in a ferruginous sand—green sand a trace,..... | 42.0 |
| do. | ditto, ditto, | 37.5 |
| Mr. Yerley's, | ditto, ditto, rather compact,... | 30.6 |
| do. | Yellow—aluminous—green sand a trace,... | 12.2 |
| do. | Yellow—consisting of shelly fragments partially cemented—green sand a trace,..... | 21.0 |
| Mr. Cabell's,..... | Shells decomposed and partially cemented, | 42.0 |
| do. | ditto, | 46.5 |
| Mr. Callaban's,..... | Yellow—fragments of shell in ferruginous sand—large grains of green sand in considerable quantity, | 21.5 |
| Mrs. Palmer's,..... | Yellow—small shells and fragments—green sand a trace, | 32.9 |
| Benj. Walker's,..... | Blue—green sand a trace, | 18.0 |
| Warner George's,..... | Blue—shelly fragments—green sand a trace, | 14.7 |
| Col. Palmer's,..... | Light—conglomerated fragments of shell—slightly compact—green sand a trace,.... | 57.0 |
| do. | Shells decomposed and partially cemented, | 37.5 |
| Dr. Jones's, | ditto, porous, | 86.8 |
| Union mills,..... | Yellow—small shells in ferruginous sand,.. | 23.8 |
| do. | Light—quite compact—shells small—green sand a trace, | 62.5 |
| Col. Phil. Branam's,..... | Blue—tenacious—small shells—green sand a trace, | 21.5 |
| KING & QUEEN. | | |
| Piedmont,..... | Blue—containing fragments of shell—green sand a trace, | 33.6 |
| do. lower bank,..... | Blue, ditto, ditto, | 22.2 |
| Mr. Bagby's, | White—shells finely decomposed and partially cemented, | 80.6 |
| do. | Blue—containing fragments of shell,..... | 30.6 |
| Mr. Mann's,..... | Light—nodular, | 78.4 |
| do. | White—containing small fragments of shell, | 80.6 |
| Mr. Burton's,..... | Light—shells decomposed—occasionally cemented, | 85.2 |
| Mr. Atkins's,..... | Small fragments of shell, | 76.1 |
| Mr. Ryland's, | Shells decomposed, | 46.5 |
| Mr. Motley's,..... | Blue—small shells and fragments—green sand a trace, | 14.7 |
| Mr. Pollard's,..... | Blue—fragments of shell—green sand a trace, | 21.5 |

Figure 14 Detail of a Miocene Marl table of analytical results. The first column indicates the marl contributor; the second column offers a verbal description of the sample; the third column provides the analytically determined carbonate of lime composition of the marl. Rogers, "Report of the Progress of the Geological Survey for the Year 1837," in *Geology of the Virginias*, 151.

A large number of the letters and samples came from the marl region labeled "Miocene"—region 1 on the map. This area included the counties of Surry, Essex, Middlesex, King and Queen, Isle of Wight, Northumberland, Lancaster, Nansemond, and others to the east (labeled area "1" in Figure 13). In the case shown in Figure 14, the likes of Mr. Bagby and Mr.

Pollard of King and Queen County and Mr. Cabell of Lancaster County—this was Joseph Cabell, the friend of Rogers' mentioned above—were members of that new network of sample contributors. They too were participants in the Geological Survey. From them, Rogers collected, analyzed, and collated the marl samples, creating a classification. There were white, blue, and yellow marls, yellow, green, and light sands, for example. While organizing these different types of fertilizer, the contributors to the Survey also complemented the technical quantification with verbal descriptions of those samples. Some shells were “finely decomposed and partially cemented” while others were but “fragments of shells.” Some were “tenacious” while others were “in nodules.” In sum, interested parties could review the output of the survey for details on marl quality as understood by the quantity of carbonate of lime—the active ingredient—and as compared with samples from adjoining lands. When Rogers took geological samples across the state, checking the rock strata at various points along a traverse line, he would then generalize from those selected points to a view of the state as a whole. When he collected these marl samples he was doing much the same, generalizing from the local to the state scale.

The results of the analyses served the professor well, as they helped solidify ideas about the relative ages of layers of earth examined with geological interest. (I do not mean to downplay the geological significance and strengths of the survey for the sake of focusing on the agricultural.) Henry Rogers had already done work in New Jersey identifying “green sand” as a constituent of the marl beds. Together, the brothers extended this work into geological considerations of the Appalachian chain. The results also served the state constituency well by proving “useful to individuals interested in knowing the value of their marls,” as one annual review put it.⁴⁵ And as if to make this point more salient in the reports, Rogers would remind those who were authorizing the work that “further detailed information in regards to [the

⁴⁵ Ibid., 150.

analyzed] rocks [was] so important in their application to agricultural and architectural purposes [sic].”⁴⁶ In the process of analyzing marl, Rogers actually performed a subtle and helpful maneuver: by taking the work of marling farmers into the state-wide authority of the survey, he had reconfigured the sense of “value” to the benefit of both him and the citizens of Virginia. Marl analysis, by appealing to Rogers own theoretical designs, the farmers pursuit of economic benefit, and the state delegates demand for political utility, represented an integration of geological, agricultural, and political goals.

I noted that a necessary condition of success for the survey was identifying reliable sample providers. But, given the roster of contributors and the various means by which the dirt from their land made it through Rogers’ analytical equipment, merely providing a sample was the basis for reliability. There was little more to it so that everyday planters, farmers, and merchants were elements of the scientific survey just as the paid staff was. Rogers was not choosy about accepting or rejecting the specimens. In fact, the issue of sample “quality” had little meaning before the very process of scientific analysis had taken place. There were no error bars given in the annual reports, of course. There were no footnotes commenting on the quality of the sample. It was only after the fact, after the compositions of marl were analyzed and published, that they became firm results. By that process of collection, analysis, collation, and report-based reproduction the individualized, particular marl, water, or coal samples that Rogers received became collected into a generalized portrait of the state.⁴⁷ The interesting story here, given this process of translation, is one that shows the survey as a process of redefinition: on the front half, there is Colonel Branam’s piece of marl from Lancaster County; on the back half,

⁴⁶ Rogers, “Report of the Progress of the Geological Survey for the Year 1838,” in *Geology of the Virginias*, 169.

⁴⁷ Rogers, “Report of the Progress of the Geological Survey for the Year 1839,” in *Geology of the Virginias*, 153. John Pollard’s Account Book for 1830-1843, with details of farming activities, is available at the VHS, Richmond, Virginia, Accession Number Mss5:3 P7624:2. Also see the Bagby Family Papers, Accession Number Mss1 B1463 at the VHS.

there is a 21.5% carbonate of lime specimen of blue, tenacious, small shelled Miocene marl, with traces of green sand.

The above details about field work help us appreciate the work the survey assistants performed. They also illustrate the crucial role county-wide contributors played in producing a successful survey. Their collection and distribution of samples were central, not auxiliary, to the logistical coordination of Rogers's project. The logistical problems overcome by Rogers were part and parcel of producing that surveyable environment – and the issue at stake was more than merely the creation of successful science. These same details about sample collection – or, specimen creation – obscure the labor required to extract, manipulate, and make meaning of “specimens.” Rogers was first responsible for taking “information” from the field and making meaningful data from it. He also had to define meaningful data to a governing body not as competent in terminology and technique. This was a process of translation from the idiom of field studies to lab manipulation to public report. The details of analysis—of soil, altitude, marl, or rocks—also serve to smooth over the rough spots of sample collection, quality, and definition, revealing that the chemical quality of nature had no meaning *before* it was analyzed. It is noteworthy too that the goal of the surveyed definition of land is to smooth over the actual daily details of interacting with it. Another central element to the survey's success, to which I turn next, was the use of instrumental and analytical equipment in the field and in the lab to produce quantified representations of the natural features of the state.

Instruments, Measurement, and Analyses

The materially interactive aspects of the survey work entered into the same process of creating environmental knowledge characterized by the social elements above. They included the general use of chemistry and geology as tools for inquiry across the state, the deployment of

field-based instruments, like thermometers, for examining features of the natural landscape, and the use of specific analytical instruments, like the marl analyzer, to study compositions and qualities of soil and fertilizers. (Rogers and his assistants, of course, were also analyzing a broad range of geological features along the lines of identifying rock formations, directions, strata, and age.) Each of these aspects defined the active, mediating character of the survey.⁴⁸ That is, it was not just the analytical equipment itself that characterized the material dimensions but the basic use of scientific inquiry; the sciences themselves, in the sense of georgic science I elaborated in Chapter 1, were conceived of and then used as a tool for studying the state. Given the practical bent of the scientific surveys, their various goals and audiences, and their basic object of the land of Virginia, the sciences defining these surveys are recognizable as the evolution of that georgic science I characterized from earlier in the century.

An appendix to the 1837 report indicates the primary and multi-faceted (georgic) role chemistry played for the practical benefits of the research to the state citizenry:

The amount of chemical investigations thus bestowed upon the materials of economical value, collected in our explorations or forwarded to us from localities not visited, though not mentioned in the annual reports, forms a very important item in the yearly operations of the laboratory, furnishing useful facts and valuable suggestions in relation to the nature and appropriate application of our marls, limestones, iron ores, and other important mineral resources, and thus silently, but largely and continually, diffusing information of immediate practical utility to persons in every district of the state.⁴⁹

Rogers is speaking to several issues here, reinforcing many points I see in other work on the Survey. In the first case, he indicates that there is more material being sent to and analyzed in his lab than he can report on, since he still receives more and more specimens from “localities not visited.” In the second case, chemical analysis is the tool being used to achieve his goals.

⁴⁸ I am using the term “material” liberally here to connote forms of interaction between humans and the land, to suggest that the sciences were kinds of tools that the surveyors used to interact with the land. I do not intend for my use of material to generalize too far—to suggest that any form of inquiry in general can be materially understood—but in the sense that the active process of inquiry is a tool. “Material,” then, is meant to fit into the georgic ethic as espoused in the first half of this dissertation.

⁴⁹ Rogers, “Report of the Progress of the Geological Survey for the Year 1837,” in *Geology of the Virginias*, 186.

Furthermore, the information “of immediate practical utility” is being diffused not just from Rogers to the state constituents, but between local areas amongst themselves—“silently” and thus invisibly. And finally, all of these activities are presented as useful and directly beneficial to the citizens of Virginia. This is a classic statement of “improvement,” the kind that takes old land and makes it new and better in just the same way and for just the same reasons as the overtures to agricultural and state improvement in the previous decades.

Consider specifically the process for analyzing water samples. Many of the water “specimens” came to Rogers from spring operators in the mid-Shenandoah Valley—Hot Springs and Warm Springs, White Sulphur Springs, Red Sulphur Springs, Sweet Springs, etc. The contributors, aware of Rogers work and tapping into the possibilities of commercial advance, wanted to capitalize on the association of mineral springs and health.⁵⁰ John Sites of Rawley Springs, William Seymour of Howard’s Lick Spring, and Samuel McCamant of Grayson Courthouse—each in the Shenandoah Valley or west, each an unknown historical figure—sought analytical assistance for their springs. Hezekiah Daggs, another farmer living in the Shenandoah Valley, wanted to leverage all manner of analysis from Rogers, asking for a chemical examination of not just his spring water, but also limestone and other field rocks. At least one gentleman, from the Black Sulphur Springs Company, sought mineral water analysis in what he thought was compliance with a law that required official measurement of mineral content for spring operators. It may be that the businessman was misled or misunderstood state law (or that

⁵⁰ For an interesting examination of the social milieu of the Virginia springs in the antebellum period see Charlene M. Boyer Lewis, *Ladies and Gentlemen on Display: Planter Society at the Virginia Springs, 1790-1860* (Charlottesville, VA: University Press of Virginia, 2001). There is much more to say about the topic of analyzing mineral springs. For brevity, I note here only that the Rogers brothers were involved heavily in scientific studies of the properties of the springs. Henry Rogers tells William that Dr. Daubeny, the English geologist, chemist, and Fellow of the Royal Society, insisted on forwarding a copy of Daubeny’s “Report on the Present State of our Knowledge of Mineral and Thermal Waters,” when he heard William was about to work on the mineral springs of Virginia. H.D. Rogers to W.B. Rogers, 11 December 1837, as reprinted in Rogers, *Life and Letters*, 149.

I cannot find the legislation to back it up), but either way water samples made it to Rogers from a variety of sources.⁵¹ The traffic of mineral water samples was, in any case, fairly heavy.

To analyze these samples, Rogers combined field work with lab work. At the Springs, his assistants measured temperatures while he ran evaporations on boiler plates in Charlottesville. Their purpose was to define the chemical proportions of the resulting precipitate: sulphate of lime, sulphate of magnesia, carbonate of lime, chloride of sodium, and so on. He also calculated the volume of the gases let off from the process: nitrogen, carbonic acid, oxygen, and sulphuretted hydrogen, for the most part. (Figure 15 is one example).

⁵¹ Hezekiah Dags to W.B. Rogers, 23 March 1837, Geological Survey Papers, Accession Number 24815, Box 1, Folder 2, Board of Public Works Records, Record Group 51, Library of Virginia, Richmond, VA [hereafter cited as Geological Survey Papers, LVA]. The letter from Black Sulphur Springs is to W.B. Rogers, 4 February 1836, *Rogers Family Papers*, MIT, MC-1, Box 13. Although they do not reference any possible legal statutes, see also the letters from John Sites to WBR asking for a Spring Water analysis, 26 May 1838, and William Seymour to W.B. Rogers asking for the same, 30 May 1838; and a letter from Samuel McCamant to W.B. Rogers asking for chemical analysis results for “Grayson Sulphur Springs Company,” 3 June 1838, all in Box 1 of the Geological Survey Papers, LVA.

Hot Springs, Bath Co., Va.

BOILER BATH.

Temperature, 106°.

Solid matter procured by evaporation from 100 cubic inches, weighed after being dried at 212°, 13.25 grains.

Quantity of each solid ingredient in the 100 cubic inches, estimated as perfectly free from water:

| | |
|---|------------------|
| Sulphate of Lime, | 1.750 grains. |
| Sulphate of Magnesia, | 0.890 " |
| Sulphate of Soda, | 1.487 " |
| Carbonate of Lime, | 6.557 " |
| Carbonate of Magnesia, | 1.153 " |
| Chloride of Sodium with traces of Chloride of Magnesium and Calcium, | 0.570 " |
| Silica, | 0.703 " |
| Peroxide of Iron, | 0.020 " |
| Organic Matter, | in small amount. |

Volume of each of the gases contained in a free state in 100 cubic inches of the water:

| | Cubic inches. |
|------------------------------|---------------|
| Carbonic Acid, | 11.007 |
| Nitrogen, | 1.790 |
| Oxygen, | 0.220 |
| Sulphuretted Hydrogen, | a trace. |

Figure 15. Selection of analytical results from mineral springs analyses, as tabulated in the annual report. Rogers, "Analyses of Waters of the Principal Mineral Springs of Virginia," as reprinted in *Geology of the Virginias*, 555.

The details are many, as Rogers includes the analytical results of some thirty springs. (His reports include an eighteen-page section devoted just to the mineral water analyses.) The details are just as great for analyses of soil and rocks, samples of which were examined for reasons similar to water, even if unrelated to health. The analytical procedure Rogers used on rock and soil was fairly straightforward, generally treating the soil with hydrochloric acid, then with ammonia, and then drying it to leave a mineral precipitate.⁵² Dozens of pages of results for iron, lead, soil in general, limestone, and the marl referenced above also complement the point I have already illustrated with spring water, namely, that Rogers had taken samples from their

⁵² See notebooks of William Rogers and Robert Rogers (his youngest brother, a chemist), from the years 1836-1839, in Box 4 of the Geological Survey Papers, LVA.

sources, collected them in a laboratory, placed them under analysis, and reissued them as lists of chemical constituents.

Two more brief examples—first thermometers and then a marl analyzing apparatus, both alluded to earlier—help delineate the ways material elements of the survey worked to produce knowledge of the land. Overall, the strictly physical artifacts on the survey were less than ideal or pristine, as plates, glassware, heating elements, receptacles, and soap dishes made difficult travel companions. Thermometers too were well-used and often broken. They were used to measure altitude (by relative comparisons of the boiling point of water) and to gauge evaporations and distillations. Rogers reported that the boiling point thermometer “promises to afford us great facilities...and enable us to continue our tracings with all the accuracy and expedition that could be desired.”⁵³ He estimated that “*altitude* [boiling point] thermometers... from their portable form, and the ease of observing with them, were found to be particularly valuable especially in districts of a very rugged topography.”⁵⁴ Furthermore, he claimed that the “employment of the thermometer” was able “to facilitate some of the most difficult explorations” the team was called upon to make.⁵⁵ The thermometers were a crucial piece of measuring equipment for the work of the survey.

But it was not so easy. In 1839, James Rogers wrote to his brother and boss not only that his horse was sick and the weather was bad, but that his boiling point thermometer was broken. In consecutive letters he pleaded with William for shipment of new thermometers. In May 1840, the youngest survey assistant, Caleb Briggs, made special mention of the successful transport of his boiling point thermometer to the northern part of the Western zone, while another assistant, Israel Slade, a month later and farther south, was forced to call for a new one when his broke.

⁵³ Rogers, “Report of the Progress of the Geological Survey for the Year 1839,” in *Geology of the Virginias*, 346-347.

⁵⁴ *Ibid.*, 193.

⁵⁵ *Ibid.*, 416.

Briggs's luck was limited though, since a year later he too broke his thermometer. Twice.

Thomas Ridgeway, yet another assistant, outright bemoaned the state of his fragile "Boiling Point Thermometer," but perhaps his irritation was understandable since the instrument broke after a hornet had stung Ridgeway on the ear, causing him to knock it over.⁵⁶

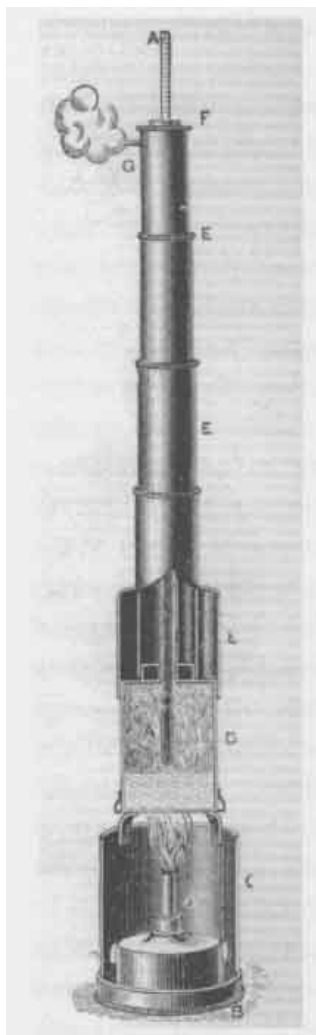


Figure 16. A hypsometer, or boiling point apparatus. This is not the exact one used by Rogers, but is much like the boiling-point equipment used on the Virginia survey. It is, rather, from the Royal Geographical Society's *Hints to Travelers*. From David Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003), 151.

⁵⁶ James Rogers to W.B. Rogers, 4 June and 5 June 1839; Caleb Briggs to W.B. Rogers, 28 May 1840; Israel Slade to W.B. Rogers, 29 July 1840; Briggs to W.B. Rogers, 1 June 1841; Thomas Ridgeway to W.B. Rogers, 27 June 1841, all in Box 1 of the in Geological Survey Papers, LVA. See also a letter, undated, where Briggs and Ridgeway, who were working together at the time, are concerned about their broken thermometer (Letter 156, undated, in Geological Survey Papers, LVA, Box 1).

Besides visualizing the everyday problems of field workers in the backwoods of Virginia that belie Rogers' easy gloss on their ease of use, it is important to see how the meaning of the survey as a space between instruments and the landscape was produced. To do so, the troubles with thermometry were gracefully smoothed over in the annual report (yet another rhetorical accomplishment, of course) as above, with claims to "ease," "accuracy," and "expedition." Rogers' distanced review of the value of instrumentation is ironic and misleading not just because the claim to "accuracy and expedition" were deceptive, but doubly so because in rugged topography thermometers would be especially difficult to use—a hornet's stinger might cause equipment to tumble and break up there, while on level ground this would be less likely. In the process of translating instrumentally acquired field data to tabulated useful fact, Rogers was attempting to justify the scientifically mediated merits of survey work. The thermometer, as a mundane instrument of analysis, provides just one example of the problems of using instruments in the field. Those problems not only required the same invisibility Rogers took note of with the excess of sample analyses, but were unavoidable in order to transform local soil, rock, and water into simple sources of analysis. A specimen from the Valley might be unique to that region, as John Sites of Rawley Springs assumed when he asked for a water analysis, but its composition was defined by universally defined components. (We saw the same tension between the local view of soil and the general basis for the soils identity with Edmund Ruffin's travels across the state in Chapter 3.)

As commonly used as the thermometer was the marl apparatus that, Rogers said, was designed specifically for convenience, ease, and accuracy. To be sure, the apparatus was aimed at different purposes than the thermometer; it was also based at Rogers's lab, a location more amenable to glassware than the field. As I noted above, the annual reports are rife with lengthy

tables of analytical results of marl examinations.⁵⁷ From Figure 14, above, we see that the tables of analyses give the correspondent's name ("Col. Phil Branam's"), a verbal description of the appearance of the marl ("Blue—tenacious—small shells—green sand"), and the percentages of carbonate of lime in the specimen ("21.5").⁵⁸ There is a story here worthy of more attention than I can give about the development equipment to analyze fertilizers in general, especially showing how analytical techniques tracked along with the rise of materialist theories of fertility into the 1840s and 1850s. Very briefly, though, over the decades of the first half of the nineteenth-century, earlier qualitative assessments were eventually supplanted by increasingly technical and quantitative methods. The rural press frequently carried articles and letters that elucidated some technique or other for identifying the quality of marl, often based on horticultural indicators. One farmer, for instance, wrote to *The Farmer's Register* about using a plant of known genus, *Veronica*, but unknown species—the author recommended a new name, *Veronica Ruffinia*—whose growth was an indicator of nearby high marl quality.⁵⁹ Humphry Davy had devised his own equipment for doing the same, which Ruffin used, although it presented numerous problems. Ruffin noted these problems, mainly that it was "complicated" and "expensive," in the editorial footnotes written to accompany the publication of Rogers' apparatus in 1834. That Rogers' apparatus was convenient, easy, and accurate made it an attractive and superior substitute for Davy's method.⁶⁰

⁵⁷ See Rogers, *Geology of the Virginias*, 31, 42, 46-48, 151-156, and 385-389.

⁵⁸ Rogers, *Geology of the Virginias*, 151.

⁵⁹ As reprinted in Dr. William Westmore, "The Marl Indicator," *The Southern Planter* 4 (1844): 221-223.

⁶⁰ W.B. Rogers, "Apparatus for Analyzing Marl and Carbonates in General," *The Farmer's Register* 2 (1834): 364-365. The report was republished nine years later in the *Southern Planter* 3 (1843): 203-205 and again decades later as part of *A Reprint of... the Geology of the Virginias*, 9-11.

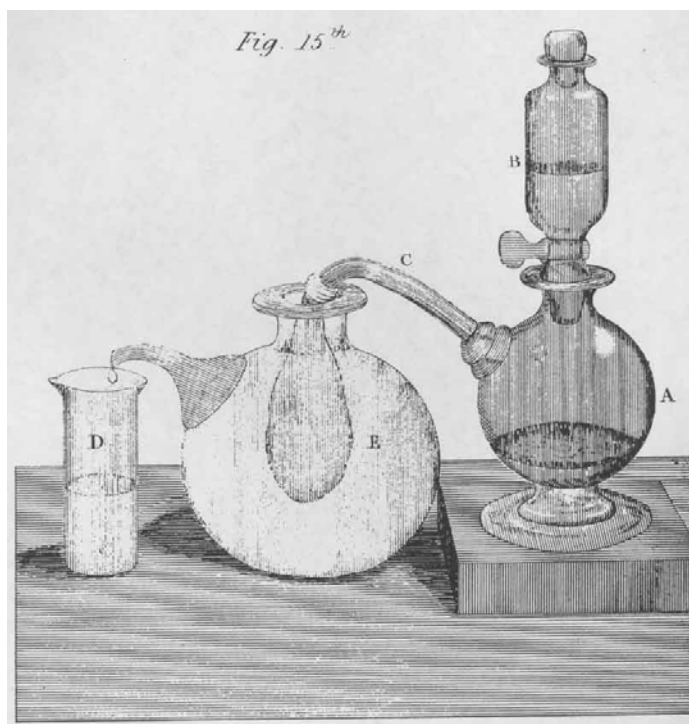


Figure 17. Humphry Davy’s Marl Analysis Apparatus. This is the equipment Ruffin would be familiar with from his early years of analysis. From Humphry Davy, *Elements of Agricultural Chemistry*, in ed. John Davy, *The Collected Works of Sir Humphry Davy*, Vol. VII (New York: Johnson Reprint Corporation, [1813] 1972), 311.

Rogers used the apparatus of Figure 18 for his marl analyses. It consisted of a bulb of light glass (“A”) into which the sample was placed, a piston-like cork (“C”) used to inject acid to drive off the gaseous components (carbonic acid) locked into the marl, and a third tube (“B”) extending from the bulb to filter escaping gas. The entire apparatus was countered by a balance which would gauge the change in weight affected by the escaped gas. After performing the procedure, Rogers or “any farmer who uses calcareous manures” could calculate the amount of carbonate of lime (See Figure 18). The operator would put a known quantity of powdered marl into the glass bulb with “a little water.” Gas was then injected into the bulb drop by drop via the cork—Rogers used muriatic acid, or hydrochloric acid, as it is known today. The effervescing sample was left to rest for an hour or until all the gas had escaped into tube “B”. By measuring

that weight loss from the original marl sample, one could back calculate how much carbonate of lime had been in the original marl sample.⁶¹

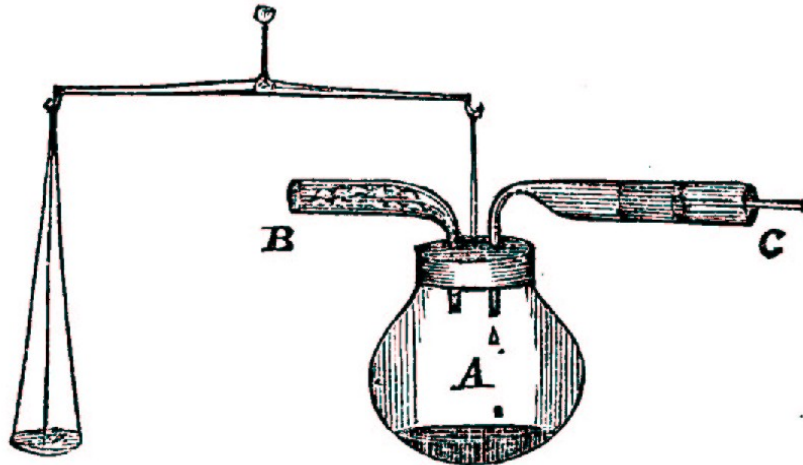


Figure 18 “Apparatus for Analyzing Marl and Carbonates in General,” first presented in an 1834 article for *The Farmer’s Register* by W.B. Rogers and reprinted in Rogers, *Geology of the Virginias*, 10.

The apparatus under Rogers’s domain was laboratory equipment. But as an agent of the state assembly, the university, and the agriculturalists who had sent him samples, Rogers was not studying nature in a disembodied, abstract sense. Science, in its most general definition, is the study of nature, but describing it with such generality loses the direct, physical referent of “nature” and drifts into an idealized level. Rogers, however, was studying nature as physical matter, as samples in his lab that were the source of agricultural production, the very basis for Virginia’s political economy. His technique and instrument were self-advertised as enabling “the operator [the farmer] to proceed with great accuracy and despatch [sic],” values that fit the ethic of agrarian citizens and, in a georgic context, lent themselves to equal suitability in the

⁶¹ Rogers, “Apparatus for Analyzing Marl and Carbonates in General,” 364-365. One would do the calculation by assuming, first, that carbonate of lime is comprised of a constant ratio of lime and carbonic acid, at 56-to-44. This means that if 2.91 grains of carbonic acid were driven out of the sample, knowing that carbonate of lime contains a fixed percentage of 44% carbonic acid meant that multiplying 2.91 by 100/44 would result in, for this example, 6.61 grains of carbonate of lime (about 66% of a 10 grain sample).

barnyard or the lab.⁶² Here Rogers tends towards blurring the two senses of nature, the abstract idea and the physical material.

This might be a story more centrally about the development of science were it not for the concrete object of inquiry, the land of Virginia, and for the inherent and foundational involvement of actors from around the state, local farmers, businessmen, and politicians who participated in and received the results of the survey. The mobilization of social elements with the use of material tools worked to define the meaning of the survey; that survey became a tool for agricultural improvement predicated on the value of scientific inquiry and the goal of state-wide improvement. My point is not that all Virginians became scientifically inclined, nor that they accepted wholesale the authority of technical mediation as a solution to farming problems, but that it was now possible for these things to happen. And so I am back to the issue of political economy and even political ecology because my point is that the politics of science (how does it work, and what can it do) and the politics of nature (what is nature, and who can tell us) were joined together in this antebellum case to address the politics of georgic agricultural improvement.

Legacies Practical and Conceptual

The Survey offers a multi-faceted site of analysis useful for furthering my points about how and why antebellum Americans were developing a science of place. As with the examples of the previous chapters, this is a case situated at a specific time and location in American history. Its product, an account of the geological, agricultural, and mineralogical details of Virginia's land, fits into the narrative I have already developed about increasing the circulation of scientific means for attaining and communicating environmental knowledge. Its operation by

⁶² Rogers, "Apparatus for Analyzing Marl and Carbonates in General," 364.

William Barton Rogers and his team of assistants illuminates the process by which scientific work produces new views of the land. In this case, the samples of water, soil, and marl sent by farmers for analysis came back as scientific specimens, quantified, catalogued, and subsumed as part of a greater mission of systematically defining the land.

Virginia's Geological Survey, through its organizational, rhetorical, and other technological features, exemplified a process by which scientific views of the state's land could be produced. Governor Floyd, the General Assembly, and Rogers intended their project to provide a grid of known or unknown territory for the purpose of controlling, developing, and improving that land. In this endeavor, the survey cannot be understood without dual reference to the scientific practices developed with it and the ecological effects of that development. We have seen that the era of internal improvements, into which this project was set, was an effort in strengthening the nation morally, materially and economically. Nature and her resources lay at the root of nearly every one of those georgic improvement schemes and the knowledge of that nature was essential for the success of the improvement plans. The scientific surveys aided this cause by producing new scientific descriptors of at least three different agrarian forums: one, land already cultivated but improvable; two, land not yet cultivated but capable of being so; and three, land bearing theretofore unknown wealth under its surface. Acting as a lens onto the landscape, survey science provided an essential condition of possibility for an understanding of the Virginia environment as a site of systematic and quantifiable analysis. This case also shows that the Virginians themselves, the non-authorized everyday practitioners who helped Rogers and his team, were active agents in the production of scientific means for georgic improvement ends.

The legacy of Virginia's survey cannot be characterized in a straightforward manner. It is best to evaluate that legacy in two senses, the first logistical and practical, the second conceptual. In practical terms, there is a distinct dénouement to the first Geological Survey. The

state assembly voted in its 1841 session to repeal the survey's funding as of January 1st, 1842. This abrupt end was indeed harsh for Rogers and his patrons in the state assembly. The finality to the near seven-year project was not, however, unexpected. Rogers knew from constant conversation with his brother, Henry, busy running the Pennsylvania and New Jersey surveys, that surveys all around the Union were in as much danger by the later 1830s as they were in favor earlier that decade. The 1837 recession had a lot to do with this, as funding was tight in all state budgets and science was not quite the secure investment it might be later in history. The Ohio survey was cut their survey short in 1838; Indiana and Massachusetts suspended theirs in 1839.⁶³

The issuance of a final, comprehensive report was clearly the most desired legacy of the survey in Rogers' mind. He considered it "the crowning work of the survey, from which alone a just estimate of its high economical and scientific value can be formed." Historians of geology have assessed his tempered success with that metric of achievement, noting that the survey's "failure" was its lack of that final report.⁶⁴ Throughout the execution of the geological survey Rogers was also involved in a constant campaign of funding requests through the Board of Public Works in anticipation of having the resources to write that last report, always aware of the tenuous status of each year's allocation. His annual reports alluded to the hoped-for final one, though in his pleas was the implicit awareness that it might never arrive. That hope persisted, though, as his 1841 report—the last annual one—began with a tone of determination. He kept it short, just eight pages that year, as compared to the 125 pages of 1840; four of those eight were devoted entirely to the case for extended funding. Emphasizing the "value," the "labor," and the "patriotic" purpose for both that were the cause and result of the survey's importance to the state,

⁶³ See Socolow, ed., *The State Geological Surveys* and Corgan, ed., *The Geological Sciences in the Antebellum South*.

⁶⁴ See note 4 above.

Rogers also explained that he was actually \$5000 under budget for the six-year duration and that he would need at least two years to properly finish the comprehensive report. He was granted an additional \$2500 for that year, but it was not enough. Increasing tension at the University in Charlottesville—student riots plagued the campus in the early 1840s—and long-term planning with Henry that would eventually take him to Boston prevented the authorship of that report.

A second practical measure of the survey's success would be how much actual land improvement was afforded or caused by the survey itself. Census figures from the antebellum period recorded the acreage of farmland along with acreage of "improved" farms, data that might be useful for assessing such scientific influence. But tying the improvement of an acre of land to the work of the survey would be a very difficult task; no amount of statistical exegesis could persuasively link the two factors in a cause-effect binary. It would be wrong in any case, I think, to claim that the survey caused Virginian agrarians to change immediately and irrevocably the way they worked their land and, furthermore, that the legacy of the survey was to impose a standard scientific protocol onto land management. Clearly that was not the case. This is not to denigrate the Rogers Survey or shade my own argument that the scientific surveys offered something new and lasting to the American landscape. It is, rather, to show that the survey's lasting legacy was far more subtle than such direct metrics of achievement can demonstrate.

The conceptual and philosophical legacies of surveying were far-reaching. I would suggest too that, despite the difficulty in gauging the direct and practical legacy in the sense explained above, the conceptual legacy was in fact "practical" also, in the sense of contributing a legitimate form of land "practice" to the landscape. The survey left a record of cataloging "the native resources of our common country," in Rogers' words, of producing a summary of the state's natural wealth.⁶⁵ It provided this catalog through rhetorical representations in annual

⁶⁵ Rogers, *Geology of the Virginias*, 546.

reports, with analytical results of hundreds of specimen evaluations, by the visual representation of rock strata and other geological features in diagrams, composite sketches, and other illustrations accompanying the report—actual maps of the direction, depth, variability, and prominence of different types of rock formations under the visible surface of the land—and in the cabinet of specimens accrued over the course of the project. The Rogers Survey mapped the territory, providing an account of the state’s native and natural resources. It incorporated the active participation of everyday farmers across the state whose interests were not only for obvious personal gain; their interests were also enfolded within the greater mission of cultural improvement. This was, perhaps, the culmination of the antebellum georgic project.

In strictly philosophical terms, the survey’s execution and results also indicate the prominence of particularistic, materialistic concepts of nature. One major point of the survey work, Rogers said, was that the “researches” contained therein were directed at “the determination of the *composition* and consequent *value* of numerous specimens.”⁶⁶ Establishing the “value” of soil and fertilizer by directly tying it to its chemically determined composition was a significant achievement of the Survey and one that relied on a detailed process of a mechanistic reduction while translating from field to lab and from lab to report. Furthermore, by arbitrating the relationship between local citizen and water sample—no longer a jug of water, but now a “specimen” of chemical substances, no longer a piece of clayey marl but 21.5% carbonate of lime—Rogers further circulated the authority of scientific mediation for producing practical knowledge of the environment. With its quantified and individualized analyses, Rogers’ reports both assumed an existing degree of comfort with mechanical views of nature, as opposed to the vitalist perceptions of a John Lorain and Humphry Davy, and promoted those views. In Chapter 3, Ruffin stood as a transitional figure between the vitalist doctrines of Davy and the reductionist

⁶⁶ Rogers, “Report on the Geological Survey for the Year 1837,” in *Geology of the Virginias*, 192. Emphasis in the original.

doctrines of Liebig into the 1840s. There is more to say about Rogers' own philosophy of nature than I can address here, but in the context of his Survey, at least, we can see in his work evidence of that same pivot from vital to material. In fact, the success and economic viability of the survey, the composition and consequent value, relied on that transition. For the state, the survey's system of politically acceptable analysis was one that proved to the public that the environment could be known, and thus controlled. These factors not only reveal the more deep-seated legacy of the survey but also place that survey into the trajectory of my own project.



The case of the state survey allows me to re-address and expand the issues brought out with the case of the county surveys. These include (1) the means by which citizens understood and worked their land, (2) the tension between local experience-based notions of land knowledge and general, universal definitions of that nature, and (3) the ways in which the surveys laid down conditions of possibility for the later scientific authority that provided practical and relevant knowledge of the environment.

“Knowing” the environment for antebellum citizens was based most directly on working the land, since agriculture was the primary mode of production and occupation. Eight out of ten Virginians worked on farms in 1840. Wheat, corn, oats, and potatoes grew all over the Commonwealth, in addition to the more famed tobacco grown only in a fourth of the state's counties. The labor required to plow fields, sow seeds, manure soil, cut and bail hay, harvest crops, and prepare the farm for the next season left little time for disengaged observation or sublime appreciation.

Virginians knew their land by expending their energy in the dirt and through the slow pattern of the harvest. This kind of knowledge developed in much the same way humans knew,

in Richard White's example, the Columbia River by reacting to the force of water determined to resist navigation or to patterns of eddies and rapids that disrupt fishing. Even if they did transcend the rigors of labor, or, as plantation masters, oversee the labors of slaves and tenants, their notions of nature were either particularized within local regions, or defined by religious doctrine. The kinship networks that defined most farming communities helped promote a sense of locality and identity, so that extant practices of improvement, like manuring, crop rotation, and experimental planting systems, generally shared common popularity within close-knit religious communities or extended-family towns. In each case, the Virginians were expressing an economic sensibility of land, cultivating it to generate income, to convert crops into money. True, wealthy planters enjoyed more time for literate pursuits such as reading the rural press and local newspaper, but even then they were concerned with increasing agricultural output and tied to local notions of nature. This centuries-long mode of interaction was slowly being augmented in post-Enlightenment modernity with more precise and predictable ways to work the land. In all, the first decades of the nineteenth century left Virginia farmers and planters to contemplate their land within a framework of local values, relationships, and property worth assessments, contrary to the universalizing generalizations that were associated with the scientific idiom.⁶⁷ By virtue of those new scientifically guided means, American agrarians were changing the ways they interacted with their lands with means not defined by local knowledge.

In tension with these local views were the codified, universalized definitions of the land. On this point, the breadth and depth of the geological and agricultural analyses encompassed by the state survey stand as an example of a new lens with which to see the land. Having state support, broad geographical aims, and a common method and purpose meant that the

⁶⁷ For statistics on Virginia's workforce, see Shade, *Democratizing the Old Dominion*, 30-46. For an assessment of the sources of knowledge about nature see Merchant, *Ecological Revolutions*, 133. Claudia Bushman, *In Old Virginia: Slavery, Farming, and Society in the Journal of John Walker* (Baltimore, MD: Johns Hopkins University Press, 2002), an account of a Methodist farmer of eastern Virginia, provides an excellent example of the local context of agricultural knowledge and farming practice.

environment could be described and acted upon in a more totalizing manner. The belief that surveyors could provide a “unified, clear picture of Nature,” according to historian Michele Aldrich, was a guiding assumption of the entire state survey era. This assumption seems to have been borne out in the continuing promise and conceptual legacy of those surveys. By introducing the scientific element, notions of land and nature were interpretable in a standardized way. When Robert Mills, for example, an engineer, architect, hopeful mineral prospector, and land-holder in northwestern Virginia, wrote to Rogers asking for a copy of the reports he had heard advance notice of, he was tapping into a new method for improving his lands. He assumed that whatever Rogers had collected in the report would have a direct effect on his property, the need for translation to local conditions being unnecessary. George Perkins Marsh, as I quoted in Chapter 4, observed much the same a few decades later when he claimed that “in proportion to man’s advance in natural knowledge, and his consequent superiority over outward physical forces, is his emancipation from...local causes.”⁶⁸ The goal for Rogers, Mills, and Marsh was to make local places scientifically known and, thus, erase the restrictions of unique and uncodifiable land.

There is, finally, the place of these surveys in the larger environmental history of America. Donald Worster, writing in reference to the federal surveys of the second half of the nineteenth century, explains that “the survey demands scientific expertise; it is a project characteristic of a modern nation-state steeped in the perspective of science.”⁶⁹ This is true. Yet those broader federally aimed surveys relied on the prior work of state-based surveying in the antebellum era, examples where we can see the specific ways in which the environment first became the surveyable and quantifiable entity that is taken for granted thereafter. State surveys

⁶⁸ Aldrich, *New York State Natural History Survey*, 54; Robert Mills to W.B. Rogers, 25 April 1840, Geological Survey Papers, LVA, Box 1; G.P. Marsh, “The Study of Nature,” *The Christian Examiner* (January 1860), as reprinted in D. Worster, ed., *American Environmentalism: The Formative Period, 1860-1915* (New York: John Wiley and Sons, 1973), on 16.

⁶⁹ Donald Worster, *A River Running West*, 203.

bear a relationship to federal surveys of the later nineteenth-century that combined cartographic grids with geological analysis to help settle the West, projects generally set against the backdrop of westward exploration, settlement, and control in environmental history literature. That is, the federal surveys were not born of nothing. The viability of those surveys relied on the antebellum work of the relatively localized state surveys, where reliable methods for systematically analyzing the environment were first established.

Only in retrospect do the local agricultural surveys conducted by county societies and planters appear as small-scale precedents for the larger surveys. They of course were not designed as test grounds for the state surveys any more than the state surveys were formulated as test grounds for the later federal surveys. Yet, they are connected by their conceptual aims and through their practical executions. Hugh Slotten has written about the role of the U.S. Coastal Survey in creating a site of training and development for nascent American scientists in the antebellum era. Historians of the American Association for the Advancement of Science, such as Sally Kohlstedt, trace the context for the basis of that organization and its role in stabilizing a young American scientific community.⁷⁰ The AAAS, in fact, grew out of the American Association of Geologists founded in part by Henry and William Rogers, whose involvement in the story of American science was not limited to state surveying. In much the same way, I see the agrarian improvement schemes of non-specialized citizens—sometimes partnered with authorized scientific agents, other times not—as important sites for deploying scientific means for agricultural, and thus environmental, ends. What is usually left out of these stories though, is just that, the concomitant increase in attention to definitions and concepts of the land. The county surveys helped produce the conditions of possibility—politically, organizationally,

⁷⁰ Hugh Slotten, *Patronage, Practice, and the Culture of American Science: Alexander Dallas Bache and the US Coast Survey* (New York: Cambridge University Press, 1994) and Sally Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1846-1860* (Urbana: University of Illinois Press, 1976).

conceptually, practically—for states surveys, just as the state surveys helped produce the conditions of possibility for later federal surveys. In no single case did one directly cause the other, but in all cases the earlier examples show us how the circulation of science prepared the means for its later political relevance and ecological significance.

Conclusion

“No society sets itself tasks for whose accomplishment the necessary and sufficient conditions do not either already exist or are not at least beginning to emerge and develop.” Antonio Gramsci, *The Prison Notebooks*, 1932¹

By putting the circulation of agricultural science in the context of early Republic improvement-minded agents, we can better locate agrarian American culture into a post-Enlightenment setting, we are better equipped to recognize how everyday citizens came to treat scientific practice as a legitimate means of interacting with their lands, and we have a more developed picture of how morality, materiality, and theory were wedded in the much-revered principles of practice and practicality. The sum of those points highlights how traditional means of managing the land—such as religious doctrine, almanac strictures, the lessons inherited familiarly from generations of daily practice, or uncodified folk knowledge in general—were being complemented with or displaced by organized, methodical, and systematic—eventually, scientific—practices on the land. The consequences of introducing the sciences of agriculture to improvement-era America thus go beyond the mere temporal scope of those early nineteenth-century decades, as they stand for some of the necessary conditions that Gramsci observed always exist before the emergence of a new task, in this case the scientization of nature. The lesson from this dissertation is not that the entirety of our modern scientific worldview can be traced to the activities of a disgruntled antebellum American farming class, but that this example of rural science and agricultural improvement provides a fruitful example of what it takes to make a scientific worldview.

¹ Antonio Gramsci, *An Antonio Gramsci Reader*, ed. David Forgacs (New York: Schocken Books, 1988), 200.

To understand the place of science in antebellum land and agrarian practices, I have focused on the interaction of ideas and materialist practices in the two halves of this project. What we *think* about something, such as the environment, dictates the way we treat it; *how* we think about it thus plays a large part in determining what happens. The material and the ideal are forever interrelated. This connection is hardly a novel insight, though its full explication rarely crosses the fields of science and environmental studies. Richard White has lamented this lack of connection, while Gregg Mitman has made efforts to bridge that gap between the connection of practice and ideas in science studies and the payout for environmental historiography. He quotes the sociologists of science Adele Clarke and Joan Fujimara, for example, as arguing that the basic social processes of scientific practice are “embedded in practice *and* in ideas.” Almost all of Carolyn Merchant’s work, *Ecological Revolutions* in particular, has likewise been concerned with the combination of people and places. *Ecological Revolutions*, in fact, might be the work most closely aligned with my own in terms of identifying changing ways to see the world, the cultural values that attach to those changes, and the political, social, and environmental consequences that follow from them.² In my project, I offer the case of science, land, and the early American Republic as an example of this continuous relation between people, places, and ideas.

In the early nineteenth century, farmers, politicians, and philosophers alike were pursuing strategies for improving their culture by seeking better means for knowing and working farmland. Inside this very broad improvement ethic, the modes of interaction between human and nature—the different ways we know about the land—were being complemented by scientific

² See Gregg Mitman, “When Nature *Is* the Zoo: Vision and Power in the Art and Science of Natural History,” in Henrika Kuklick and Robert Kohler, eds., “Science in the Field,” *Osiris*, 2nd Series 11 (1996): 117-143, on 121; Richard White, “Environmental History, Ecology, and Meaning,” *Journal of American History* 76 (1990): 1111-1116; Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press, 1989).

inquiry and systematically organized analysis. It has been my goal to show how Americans of the early Republic did so and toward what ends. In the first half, Part I, I focused on the cultural and practical place science held in the era of agricultural improvement. In Part II, I addressed the measures by which science was offering a new and different way to define place. The general trend of the research has been to look at how people interpreted science (Part I) and at how science, when used as a tool of improvement by those people, interpreted the land (Part II).



I worked from several premises as I constructed this project. The first is that people know their environment by their modes of interaction with it: how we know our world depends on how we live in it. The second is that agriculture is an important form of interaction with the land and, as such, an important facet of environmental history. The third is that science too is a practice, an activity that practitioners carry out in specific settings; it too is a mode of interaction. Therefore, when the sciences of agriculture were developed and practiced for reasons beyond simply the development of a professional sphere of scientists, they provided a new form of interaction with the land.

Along with these premises, I used several theoretical reference points that followed the course of my work. These included the notion of a georgic ethic, the exegesis of science not just as an activity, but as a lens through which people see their world, and the philosophical and cultural precept of the conditions of possibility. These theoretical reference points overlapped in several chapters, while remaining implied or avoiding overt reference in several others. Each carried with it some sense of active engagement and direct connection to the world. The georgic ethic, defined at its core by the virtue of agricultural labor, along with conceptualizing science as a tool with which (and, when considered a lens, *through* which) we view the world, were

themselves important conditions of possibility for the later expansion of scientific means for environmental ends. By discussing “conditions of possibility” I do not argue for a simple causal relationship between antebellum arguments in favor of agricultural science and the later dominance of an entire scientific worldview—that the one led solely and directly to the other. The world is too full of contingent and unused elements to allow such simple connections to remain valid. I refer to them, instead, as a way to understand how the context around a given issue offers the process by which that issue can have meaning and significance.

I have argued that the introduction of science into the landscape did not occur passively or without resistance. Instead, it arrived in the middle of an ethic of work and practice. To review, in Chapter 1 I demonstrated the evolving cultural and epistemological importance of the georgic ethic, in the process offering an alternative to the pastoral ethic so celebrated by analysts of nineteenth-century America. I summarized the georgic ethic’s contrast with the pastoral as the difference between understanding life as labor and life as leisure. At the start, then, the georgic makes my work a different kind of environmental history since I write about the nature that early Americans knew through their work and not by way of the more studied examples of sublime appreciation, wilderness dynamics, or wildlife observation. My focus has been on the cultivated or cultivatable land in America, not the strictly wild or distant environment.³ By calling attention to the value that agricultural work held during the early national period, I maintain that the georgic ethic best expresses the relationship Americans had to their environments during that period when agriculture was central to political economy, cultural identity, and national exceptionalism. With labor as the center point, the georgic ethic usefully

³ I do not mean that agricultural studies are lacking in environmental history. Rather, I mean that my work uses agrarian nature as a site of knowledge about the land, not just as a place that exemplifies how humans have changed the land. Worster’s call for more agro-ecology was a call to utilize agrarian nature for the latter purpose. See Worster, “Transformations of the Earth: Toward an Agroecological Perspective in History,” *Journal of American History* 76 (1990): 1087-1106.

forces the connection between work in the environment and the moral dictates to strengthen the social fabric and augment political identity. Connection, interaction, and work thus stand as the basis for georgic environmental sensibilities just as, again, I intend them to stand as the basis for my understanding of science in this American agrarian world.

In an effort to introduce science into this guiding national framework, I developed the idea of a georgic science. I used the term to refer not to scientific principles in general, or as definitive of all “science,” but as it addressed the dual discourse of improvement and moral order within an agrarian political economy, bridging agriculture and science with the values of rural virtue. Furthermore, by reference to georgic science, I highlighted the importance of place (location) in the construction of the authority of science, because georgic virtues relied upon a direct connection to the land.

In Chapter 2, I used georgic science as the means for examining the debate about “book farming” in the antebellum rural press. Book farming was also a question of connection and engagement. It was not just print media, but a form of what we might call ecological media, offering the means by which farmers could learn about their environments. By studying it as a debate about georgic science, I took that basis of engagement and forced the issue of experiential knowledge—knowledge from physical activity rather than removed contemplation—to the fore. Arguing for the place of science in rural culture, those debating the book farming issue wanted to ensure that the science associated with it was based on the experience of farming. The *place* of scientific practice thus took center stage in evaluating its acceptability; in this example it was understood as referring irreducibly to both its geographical location and its cultural status. By understanding science as a beneficial tool of agrarian improvement, the farmers, editors, and philosophers involved in the issue were proposing that geographical and cultural places were

integrally tied together. When they argued that it should be practical and useful, they were demanding the cultural relevance of the sciences of agriculture. Put simply, the order of debate was first about *who*, not *what*—first, which people were promoting science, then what was that science.

The examples of Edmund Ruffin, John Lorain, and Daniel Adams and their judgment of Humphry Davy's chemistry comprised my third chapter. There, the *who* and the *what* became harder to disentangle. These authors, from New England to Virginia, sought to align their own views of agricultural science with place-specific notions of improvement. Writing in the 1820s and 1830s, they contributed to a nation not yet divided by firm sectional contrasts. The entire country remained comfortably agrarian and, though of course each state promoted its own unique identity and sought to pursue policies most advantageous to itself, the conceptualization of agricultural improvement as both moral and material was still common to all. In my analysis of the author's works, I treated science as a lens through which people see their land more explicitly than in other chapters. The three men made this a straightforward explication, because their own ideas of science were defined quite clearly through its application to their lands and utility as a tool. They promoted it in their works as a mediator for achieving cultural and material goals of improvement. By appropriating, tempering, or refuting Davy and his chemistry the authors were forwarding their own philosophies of nature and their own perceptions of how chemistry could be fit between them and their land. They began with a sense of nature and sought to complement that sense with chemistry. For that combination to work, they explicated chemistry in a way that was consistent with their pre-existing philosophies of nature, be they vital, material, or, more likely, a complex combination of both.

These chapters consistently skirted close to a direct study of Davy, the often scrutinized professional chemist, and his peer in the annals of agricultural chemistry, Justus von Liebig.⁴ But, as is evident from the tenor and flow of Part I, I referenced Liebig's work only obliquely and allowed Davy's work to be discussed mostly as referenced through the authors I discussed. This was intentional, since the context into which Davy and Liebig entered was more important in the framework of georgic improvement than the singular entrance of these famous chemists onto the world stage, at least for the sake of us understanding non-centralized views of that chemistry. It is true that we still lack, on the one hand, a thorough study of the reception of Davy in rural America, while, on the other, Rossiter's work on Liebig provides a still-unmatched review of his reception after the 1840s. My work hints at the former, and all but avoids the latter. In each of the first three chapters, my interest was in understanding how and for what reasons the sciences of agriculture were being promoted, resisted, and authorized without resorting to a historiographically anachronistic explanation based on assumptions of inevitable and obvious scientific progress. To be sure, theoretical scientific ideas about soil fertility, plant physiology, and climatic dimensions were frequently presented in rural press treatments of agricultural improvement, but the planters involved in those discussions were not wholly dependent upon, nor blindly obedient to, the theories proposed by natural philosophers and men of science.

By looking to the agrarian classes, I was identifying the questions that were already being asked about the science of agriculture, the practices that were already being disseminated and debated, the techniques that were already being tested, and, basically, the conditions that already existed in the early Republic. Those elements help explain why Davy or, later, Liebig, even had

⁴ I would note that the opportunity to add to biographical or theoretical studies of their works will always be available. Before the 1840s, references to Humphry Davy are nearly uncountable in the rural press; after 1840, references to Justus von Liebig are similarly nearly uncountable.

a part to play in agricultural improvement. To a large extent, those elements made the contributions of Davy, Liebig, and other scientists possible. It was in this way, by conceptualizing a georgic science and treating it as a lens through which we see the world, that I sought to introduce the conditions of possibility that were already present in American culture when someone like Edmund Ruffin, for example, tempered Davy's import, or when Liebig was considered no more clever than a horse that ploughs the field. We cannot claim that Liebig's theories came like a bolt of lightning from the sky.

In Part II, I took the questions and analysis of Part I as given and, on top of those concerns, asked (1) how science interpreted the land and (2) how people used that science to do the interpreting. The reciprocal effects between those two queries demonstrate how scientific and technological networks have been created to effect environmental change. In the cases I considered, ideas about soil identity and practices of fertilization (in Chapter 4) or land quantification and increasing technical analysis (in Chapter 5) served as my examples. Both of those chapters were designed in parallel, beginning with the use of science by general groups (the county society/the state polity), then to intermediaries (the planters/William Barton Rogers), and then to implementers (slaves/field assistants).

I brought the approach of county agricultural improvement societies to the center in Chapter 4. Those organizations introduced a range of factors that would serve as necessary conditions for the production of further scientific knowledge of the land, including the motivation for using science for local gain, the creation of mechanisms for studying the land, forums for communicating and evaluating those studies, and the power and social credibility to launch such programs of coordinated analysis. William Fanning Wickham and John Hartwell Cocke farmed and experimented in the georgic spirit of John Taylor before them, but with

increased focus and more developed means for pursuing their activities. They leveraged the conditions offered by the georgic authors I discussed in the first half of the dissertation.

Rogers and his Geological Survey provided the grounding for the last chapter. The state survey retained many similarities with the county agricultural surveys, even though it was structured on such a larger scale as to hold a legacy in historical scholarship wholly distinct from the local agricultural surveys. This is to say that in keeping with the context of agricultural improvement, I saw the state geological survey as informative for many of the same issues already introduced in my work. I discussed the coordination of the survey between political, agricultural, and scientific actors to show that in terms of organizing studies of the land, the survey was in fact much like previous lower-level ones. For example, many organizational and epistemological aspects of soil and fertilizer analysis that had concerned the Albemarle Society of Agriculture also concerned Rogers. I also considered the very basis for Rogers' survey as being embedded within the same ethos of improvement that marked the other instances of attention to augmenting cultivation practices. This stepping-up process, for me, was a way to register how the tensions between local and global concepts of nature—the land—were being developed and approached. Those tensions are just the thing that become erased with the successful abstraction and generalization offered by scientific and technological definitions of nature in later generations.



In this dissertation, I have presented a conceptual history of non-centralized science in America, a social analysis of agricultural improvement's alignment with systematic land practice, a contribution to environmental ethics and policy, and a study of how various contributors produced a network of science and technology to effect change on the land. That is

ambitious. Some chapters have emphasized one aspect over another while several chapters took on a few of those themes at once. Nevertheless, several conclusions can be drawn from my work and I will summarize five that overlap to some degree and reinforce one another.

The first conclusion is that the use of agricultural science fit into a pre-existing and dominant practical, practice-oriented ethos of American culture that was part of a much broader era of post-Enlightenment “improvement.” This shows too that the idea of practice and the practical is more deeply rooted than mere economic benefit, having social, cultural, philosophical, and political facets as well. The driving force for introducing the sciences of agriculture had as much to do with strengthening social identity as with establishing a professional class of scientists. The second conclusion, connected to the first, is that the practice of science in the early Republic was disparate yet widely circulating, involving a range of actors in part professional, amateur, non-centralized, and largely tenuous. Liebig, in 1841, did not come from nowhere like a bolt of lightning from the sky; Davy was not immediately a completely authorized chemist making the farming class better; the farmers who resisted book farming were not acting only from a position of irrational ignorance and dogma. There were many rational, experience-based, and internally logical reasons to question the association of science with progress.

Those points speak more to an audience of science studiers than environmental historians. The next points connect the two fields. My third main conclusion is that land management on already cultivated, but improvable, and uncultivated, but developable, land was increasingly directed by the tenets of sciences of agriculture over the first four decades of the nineteenth-century because those tenets were considered useful and advantageous to non-scientists. This mode of acceptance is consistent with the idea that science was considered valid

when it fit into a pre-existing and dominant ethos, a georgic ethos, as I have understood it. Following this point, and my fourth conclusion, is the view that the above work is not just a story about how farmers and interested citizens accepted the validity of agricultural science but about how Americans more broadly came to treat and employ scientific means for environmental knowledge, about how the roots of the connection of science to the land were neither created from an inevitable movement of progress, from an uncontested change in how we manage nature, nor from the introduction of an obvious and respected theory of fertilization or plant growth—all of those things were the result of long, tenuous, and value-based arguments. It is not true, as the Scottish chemist J.F.W. Johnston wrote, that before 1848 agriculturalists had “undervalued the worth of natural science to the farmer, and ridiculed the pretended value of chemistry.” Johnston might be afforded the apology of living too close to the era, but scholars today, such as the historian William Scarborough, can no longer maintain that “Quite simply, American farmers failed to adopt progressive agricultural methods....”⁵ The idea of progress was not so clear, the reasons for resisting new methods were not always foolhardy, and the perception that science was good for the land was a difficult one to create.

My final point melds into the realm of implication, leading me to my interest in informing current environmental ethics and policy with deep historical context. To wit, by drawing out a georgic ethic I am not just situating the early days of agricultural science in a deeper social setting, but also showing that values based on interaction dominate how people view their surroundings and dictate what they do with and in those surroundings. Even though

⁵ J.W.F. Johnston, “The present state of agriculture in its relation to chemistry and geology,” *Yorkshire Gazette Supplement* (14 July 1848), 2, as quoted by Vance Hall, *A History of the Yorkshire Agricultural Society 1837-1987: In Celebration of the 150th Anniversary of the Society* (London: Chrysalis Books, 1987), 82. The article also appeared as “The present state of agriculture in its relation to chemistry and geology,” *Journal of the Royal Agricultural Society of England* 9 (1848): 200-236; William Scarborough, “Science on the Plantation,” in Ronald Numbers and Todd Savitt, eds. *Science and Medicine in the Old South*, (Baton Rouge: Louisiana State University, 1989), 79-106, on 80.

we no longer live in the same kind of agrarian world, this view of connection (or disconnection, as it may be) is as valid today as it was in the antebellum period. We still have knowledge (or lack knowledge) of our natural world by our forms of interaction with it. By showing that pre-existing systems of belief and values guide how we understand new developments and come to accept, refute, or debate them, my points about the early days of connecting science to the land are also points about how we assess any form of interaction with our world and, by looking in reverse, how we can change our world through new forms of interaction. Therefore, even though the dissertation is embedded in the early American Republic, my goals have been to lay out groundwork for understanding events which occurred entirely after the temporal scope of this work. I emphasize action, process, and engagement because those categories are timeless; they are just as relevant to our views of nature and science today as two hundred years ago. I highlight human labor in the earth because it shows us that a human-nature dichotomy is not valid, that we are connected to nature. In our industrialized world today this is harder to see, but it is no less true.



All told, the legacy of the introduction of the sciences of agriculture to America has been the production of the necessary conditions for the task of making nature a scientific place. As Gramsci points out, “No society sets itself tasks for whose accomplishment the necessary and sufficient conditions do not either already exist or are not at least beginning to emerge and develop.”⁶ My own philosophy of history is that of a continuist, and I take seriously the idea, expressed in great but obtuse detail by the French philosophers Gilles Deleuze and Felix Guattari, that we are always in the middle. That is, at any given moment in history we are always

⁶ Gramsci, *An Antonio Gramsci Reader*, 200.

at a transition point between what came before and what will come next; there is no finality, there are no endpoints, only a series of continuous overlaps and shifts. Things change over time, of course, but they do not change singularly or without relevant precedents. The conditions for those changes are always around, even if undetected or simply ignored. When Dostoevsky bemoaned the loss of a less rationalized, scientized world, where perhaps two twos making five was a fine thing, he was observing the instantiation of a world produced by decades, if not centuries, of conditions that allowed the preeminence of the rational, scientific worldview.

This entire project, I believe, is in the middle. One difficulty for me has indeed been acknowledging the transitional nature of almost every element I studied: the very term “scientist” was not yet widespread in the 1830s; the opacity of chemistry as a lens was sometimes hazy, sometimes clear, and sometimes still dark; the professional classes were indistinct; the rising storm of American politics and sectional distinctions that led to the Civil War only looks so obvious in hindsight; the Jacksonian Age was either a market revolution, transportation revolution, industrial revolution, or all of these. Nothing was clear; everything I have chosen to focus on was in flux. Instead of explaining those contingencies away, I accept them as the definition of a middle.

This study situates the credibility of environmental science in a different light, suggesting that the way we have used science to understand nature has been tied quite strongly to our larger cultural mores and social settings. We see also that the rise of a world defined scientifically has more to do with the everyday workings and goals of non-scientists than has been generally acknowledged. One of the most pressing implications of my study, too, is to resituate how we assess that historical combination of science and the environment. James Scott’s influential *Seeing Like a State* made the point that political states wrote legible patterns of control and

identification into nature by the dawn of the twentieth-century, that, as seen through examples such as city planning, rational forestry, scientific agriculture, and Le Corbusier's architecture, this codification and scientization of nature marked the desire to make order out of chaos that defines modernity. Scott also emphasizes *mētis*, the practical, non-codified knowledge that has striking resonance with the georgic ethic and which becomes the victim of the abstraction, generalization, and decontextualization of this constructed legibility. My argument rides along with Scott's, for the most part, but shows the complicity and cooperation of *mētis*-based local knowledge in the production of the state-based universal knowledge. By the 1850s, when mechanistic philosophies of nature guided Liebig's mineral theory and structured a new view of agriculture and land, the credibility of science for defining the landscape was becoming firmed up. With rhetorical, political, social, moral, and practical conditions already demonstrated, the scientization of nature was possible.

The basic timing of the accomplishment of a scientized nature has been corroborated in other scholarship dealing with the rise of the modern nation-state. Gilles Deleuze and Felix Guattari, in their massive *A Thousand Plateaus*, make many of the same points as Scott, though within a considerably denser philosophical narrative. In particular, they contrast "royal" with "nomadic" ways to know the world—the former consistent with Scott's state-controlled programs of writing order into nature, the latter consistent with *mētis* and the practical, everyday practices of the non-centralized actors I discussed.⁷ Charles Rosenberg has argued about the origins of a stable American scientific class arriving by the mid-to-late nineteenth century. More germane to rural science itself, Alan Marcus marks the rise of professional agricultural science in

⁷ Ted Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1995), adds the numerical and statistical dimension to the argument, showing how and why numbers came to the aid of public policy projects. Porter's story complements well the way by which increasing quantification of environmental analysis was beginning to gain legitimacy in rural America.

the later nineteenth century as well. Carolyn Merchant observes that “By the 1860s, [and] through scientific management of agricultural production, human control over nature was increased.”⁸ The lesson of Margaret Rossiter’s work on Liebig was that agricultural chemistry had gained a valid foothold in state policy (through agricultural experiment stations) by the 1870s. Donald Worster’s study of John Wesley Powell took the fact of the scientific federal survey as given by the later decades of the nineteenth century. Fertilizer crazes struck up and down the eastern seaboard into the 1850s, each underpinned conceptually by codified mechanistic principles. Natural fertilizers like guano made their mark in the same style as marl had in the previous decades; soon the era of artificial fertilizers, such as phosphates and superphosphates produced in factories as Liebig had predicted, would trump the natural agents.

My story introduced the production of an important set of conditions that allowed later scientific developments across the land to have meaning and to be significant: forms of communication, precedents of organization, field-tested modes of analysis, a tradition of improvement and experimentation, the long-standing search for solutions to soil exhaustion, increasingly mechanistic philosophies of soil composition, a market force to drive all of these, and a unique American political and agricultural environment into which the above could take shape. Federal land surveys were not caused by state ones, but took advantage of groundwork already done by them; the political justifications for using science to benefit the state were already tested in local contexts for decades by the time the full scientific class argued much the same by the later nineteenth-century; the arguments about philosophical and conceptual bases for scientizing the land can gain strength and plausibility by reference to the workings of antebellum agents who first sought to use science to define their land.

⁸ Merchant, *Ecological Revolutions*, 220.

Bibliography

PRIMARY SOURCES

Archival Material

- William Barton Rogers Papers: Accession MC-1, at the MIT Institute Archives and Special Collections, Cambridge, MA
- Virginia Geological Survey Records: 1834-1903, Accession 24815, State Government Records Collection, The Library of Virginia, Richmond, VA
- William Fanning Wickham Papers: Mss1 W6326 c FA2, Virginia Historical Society, Richmond, VA
- Baylor Family Papers, Mss1 B3445 e FA2, Virginia Historical Society, Richmond, VA
- Eppes Family Papers, Mss1 Ep734 d353, Virginia Historical Society, Richmond, VA
- Robert Wormeley Carter Papers, Mss 1959-a, Virginia Historical Society, Richmond, VA
- Papers of John Stuart Skinner, Mss2 Sk352b, Virginia Historical Society, Richmond, VA
- John Pollard's Account Book, 1830-1843, Mss5:3 P7624:2, Virginia Historical Society, Richmond, VA
- Bagby Family Papers, Accession Number Mss1 B1463, Virginia Historical Society, Richmond, VA
- John Lewis Commonplace Book: Mss3 L7702 a 5, 1806-1823, Virginia Historical Society, Richmond, VA
- John Hartwell Cocke Papers: Accession 640, the University of Virginia Special Collections Library, Charlottesville, VA
- Joseph Cabell, Agricultural Diary, Mss 38-111, the University of Virginia Special Collections Library, Charlottesville, VA

The Rural Press

- Farmer's Register* (Shellbanks and Petersburg, VA)
- Southern Planter* (Richmond)
- New England Farmer* (Boston)
- The Argus* (Albany)
- The Cultivator* (Albany)
- Genesee Farmer*
- Plough Boy* (Albany)
- American Farmer* (Baltimore)
- Southern Agriculturalist, Horticulturalist, and Register of Rural Affairs* (Charleston, SC)
- Southern Cultivator* (Columbus, GA)
- Southern Quarterly Review* (Charleston, SC)

Other periodicals and journals

- American Journal of Science*
- The Literary Magazine and American Register*
- Memoirs of the Philadelphia Society for Promotion of Agriculture*
- Memoirs of the Society of Virginia for Promoting Agriculture*
- Minute Book of the Agricultural Society of Albemarle County*

Proceedings of the Agricultural Society of Virginia
Transactions of the American Philosophical Society
Transactions of the Society for the Promotion of Agriculture, Arts, and Manufactures of New York

- Adams, Daniel (1824) *The Agricultural Reader, Designed for the Use of Schools* (Boston: Richardson and Lord)
- Adams, Daniel (1825) "An Address Delivered before the Hillsborough Agricultural Society at their Cattle Shown and Fair, at new Boston, Sept. 22, 1825," *The New England Farmer* 4 (December 2): 148-150
- Allibone, Samuel Austin (1859-1871) *Critical Dictionary of English Literature, and British and American Authors, Living and Deceased, from the Earliest Accounts to the Middle of the Nineteenth Century* (Philadelphia: J. B. Lippincott & Co.)
- Binns, John (1803) *A Treatise on Practical Farming; Embracing Particularly the Following Subjects, Viz. the Use of Plaister of Paris, with Directions for Using It: And General Observations on the Use of Other Manures.* (Fredericktown, MD: Printed by John B. Colvin)
- Boulware, William (1851) "Edwin Ruffin, of Virginia, Agriculturist, Embracing a View of Agricultural Progress In Virginia for the Last Thirty Years, With a Portrait," *DeBow's Review* 11: 431-436
- Boussingault, Jean Baptiste (1850) *Rural Economy, in its Relation with Chemistry, Physics, and Meteorology, or, Chemistry Applied to Agriculture* (New York: D. Appleton & Co.; Philadelphia: G. S. Appleton)
- Buel, Jesse (1840) *The Farmer's Companion; or, Essays on the Principles and Practice of American Husbandry* (Boston: Marsh, Capen, Lyon and Webb)
- Butler, Frederick (1819) *The Farmer's Manual: Being a Plain Practical treatise on the Art of Husbandry Designed to promote an Acquaintance with the Modern Improvements in Agriculture* (Hartford, CT: Samuel Goodrich)
- Chevalier, Michel ([1839] 1967) *Society, Manners, and Politics in the United States: Letters on North America* (Gloucester, MA: P. Smith)
- Cobbett, William ([1819] 1969) *A Year's Residence in the United States of America: Treating of the Face of the Country, the Climate, the Soil, the Products, the Mode of Cultivating the Land, the Prices of Land, of Labour, of Food, of Raiment* (New York: A. M. Kelley)
- Cochrane, Archibald, Earl of Dundonald (1795) *A Treatise Shewing the Intimate Connection that Subsists between Agriculture and Chemistry* (London: For the Author)
- Comstock, John Lee (1839) *Elements of Chemistry* (New York: Robinson, Pratt & Co)
- Dana, Samuel ([1842] 1851) *A Muck Manual for Farmers* (Lowell, MA: James P. Walker, 3rd edition)
- Davy, Humphry ([1813] 1840) *Elements of Agricultural Chemistry* in *The Collected Works of Sir Humphry Davy*, edited by John Davy, (London: Smith, Elder, and Co. Cornhill), Volume VII
- Deane, Samuel (1797) *The New England Farmer; or Georgical Dictionary: Containing a Compendious Account of the Ways and Methods which the Important Art of Husbandry* (Worcester, MA: Isaiah Thomas)
- Dickens, Charles ([1842] 1957) *American Notes* (New York: St. Martin's Press)
- Dostoevsky, Fyodor ([1864] 1975) *Notes from Underground*, in Walter Kauffman, ed., *Existentialism from Dostoevsky to Sartre* (New York: Penguin Books, 1975), 52-82
- Drown, William (1824) *Compendium of Agriculture: or, The Farmer's Guide, in the Most*

- Essential Parts of Husbandry and Gardening, Compiled from the Best American and European Publications, and the Unwritten Opinions of Experienced Cultivators* (Providence: Printed by Field & Maxcy)
- Dwight, Timothy (1794) *Greenfield Hills: A Poem* (New York)
- Eliot, Jared (1762/1934) *Essays Upon Field Husbandry in New England, and Other Papers, 1748-1762*, ed. Harry Carman and Rexford Tugwell (New York: Columbia University Press)
- Ewell, Thomas (1806) *Plain Discourses on the laws or properties of matter* (New York: Printed by Brisban and Brannan)
- Christopher Caustick [Thomas Greene Fessenden] (1806) *The Modern Philosopher or Terrible Tractoration!* (Philadelphia: E. Bronson)
- Fessenden, Thomas (1834) *The Complete Farmer and Rural Economist; Containing a Compendious Epitome of the Most Important Branches of Agriculture and Rural Economy* (Boston: Lilly, Wait, and Company, and G.C. Barrett)
- Forbes, Stephen (1887) "The Lake as a Microcosm," *Bulletin of the Peoria Scientific Association*, 77-87
- Fothergill, A. (1791) "On the application of chemistry to agriculture," *Letters and Papers of the Bath Society* 3: 54-62
- Hunter, Alexander (1770-1774) *Georgical Essays*, 8 volumes (London)
- Irving, Washington and James Kirke Paulding (1806-1808) *Salmagundi; Or, The Whim-Whams and Opinions of Launcelot Langstaff, Esq & Others*, edited by Bruce I. Granger and Martha Hartzog (Boston, MA: Twayne Publishers)
- Jefferson, Thomas ([1787] 1999) *Notes on the State of Virginia* (New York: Penguin)
- Jefferson, Thomas (1931) *The Correspondence of Jefferson and Du Pont de Nemours* (Baltimore, MD: The Johns Hopkins Press)
- Jefferson, Thomas (1944) *Thomas Jefferson's Garden Book, 1766-1824*, edited by Edwin Morris Betts (Philadelphia, The American Philosophical Society)
- Jefferson, Thomas (1976) *Thomas Jefferson's Farm Book*, edited by Edwin Morris Betts (Charlottesville: University Press of Virginia)
- Johnston, J.F.W. (1848) "The Present State of Agriculture in its Relation to Chemistry and Geology," *Journal of the Royal Agricultural Society of England* 9: 200-236
- Johnston, J.F.W. (1851) *Notes on North America, Agricultural, Economical, and Social* (Boston: C. C. Little and J. Brown)
- Kames, Lord (Henry Home) (1776) *The Gentleman Farmer, Being an Attempt to Improve Agriculture by Subjecting it to the Test of Rational Principles* (Edinburgh: W. Creech)
- Liebig, Justus ([1840] 1842) *Chemistry in its Application to Agriculture and Physiology*, ed. Lyon Playfair (London : Printed for Taylor & Walton, 2nd edition)
- Lorain, John (1825) *Nature and Reason Harmonized in the Practice of Husbandry* (Philadelphia, PA: H.C. Carey & I. Lea)
- Marcet, Jane ([1807] 1818) *Conversations on Chemistry, Intended More Especially for the Female Sex* (Greenfield, MA: Denio and Phelps, 4th edition)
- Marsh, George (1860) "The Study of Nature," *The Christian Examiner* [n.p.]
- Marsh, George (1864 [2003]) *Man and Nature*, edited by David Lowenthal (Seattle: University of Washington Press)
- Nichols, James R. (1867/1970) *Chemistry of the Farm and Sea* (Boston: A. Williams & Co.; reprinted as New York: Arno Press)
- Peters, Richard (1797) *Agricultural Enquiries on Plaister of Paris* (Philadelphia: PSPA)

- Petzholdt, Alexander (1846) *Lectures to Farmers on Agricultural Chemistry*, introduced by John Skinner (New York: Greeley and McElrath, Tribune Buildings)
- Pritts, Joseph (1845) *The Farmer's Book and Family Instructor* (Chambersburg, PA: Printed for Purchasers)
- Rogers, William Barton (1884) *A Reprint of Annual Reports and Other Papers, on the Geology of the Virginias* (New York: D. Appleton and Co.)
- Rogers, William Barton (1896) *Life and Letters of William Barton Rogers*, 2 vols., edited by Emma Rogers (New York: Houghton Mifflin)
- Ruffin, Edmund ([1832] 1961) *An Essay on Calcareous Manures*, edited by J. Carlyle Stitterson (Cambridge, MA: Harvard University Press)
- Ruffin, Edmund ([1843] 1992) *Agriculture, Geology, and Society in Antebellum South Carolina: The Private Diary of Edmund Ruffin, 1843*, edited by William Mathew (Athens, GA: University of Georgia Press)
- Ruffin, Edmund (1957) "Writers of Anonymous Articles in *The Farmer's Register*," *Journal of Southern History* 23(1): 9-102
- Ruffin, Edmund (2000) *Nature's Management: Writings on Landscape and Reform, 1822-1859*, edited by Jack Temple Kirby (Athens: University of Georgia Press)
- Smith, Joseph (1843) *Productive Farming: Or, a Familiar Digest of the Recent Discoveries of Liebig, Johnston, Davy, and other Celebrated Writers on Vegetable Chemistry* (New York: Wiley and Putnam)
- Spurrier, John (1793) *The Practical Farmer* (Wilmington, DE: Brynberg and Andrews Printers)
- Squarey, Charles (1842) *A Popular Treatise on Agricultural Chemistry: Intended for the Use of the Practical Farmer* (Philadelphia, PA: Lea & Blanchard)
- Stephens, Henry (1847) *Book of the Farm* (New York: Greeley and McElrath, Tribune Buildings)
- Strickland, William (1801) *Observations on the Agriculture of the United States of America* (London: W. Bulmer and Co.)
- Taylor, John ([1813] 1977) *Arator: Being a Series of Agricultural Essays, Practical and Political, in Sixty-Four Numbers*, edited and introduced by M.E. Bradford (Indianapolis, IN: Liberty Fund)
- Tocqueville, Alexis de ([1835-1840] 1964) *Democracy in America*, Vol. II, edited by Andrew Hacker (New York: Washington Square Press)
- Tull, Jethro (1733) *The Horse-hoeing Husbandry; or, An Essay on the Principles of Tillage and Vegetation* (London)
- Washington, George (1803) *Letters from His Excellency George Washington, to Arthur Young...and Sir John Sinclair... Containing an Account of His Husbandry, with His Opinions on Various Questions in Agriculture; and Many Particulars of the Rural Economy of the United States* (Alexandria: Cottom and Stewart)
- Washington, George (1998) *The Papers of George Washington, Retirement Series*, edited by Dorothy Twohig (Charlottesville: University Press of Virginia)
- Worster, Donald, ed. (1973) *American Environmentalism: The Formative Period, 1860-1915* (New York: John Wiley and Sons)
- Young, Arthur (1771) *A Six Months Tour through the North of England, Containing, an Account of the Present State of Agriculture, Manufactures and Population, in Several Counties of this Kingdom* (London: Printed for W. Strahan)
- Young, Arthur (1794) *Travels During the Years 1787, 1788, & 1789* (London: W. Richardson)

Young, John (1822) *The Letters of Agricola on the Principles of Vegetation and Tillage* (Halifax, N.S. : Printed by Holland & Co.)

REFERENCE WORKS

Dictionary of American Biography (1946-1958) edited by Dumas Malone (New York: Scribner)

Appleton's Cyclopaedia of American Biography, (1887-1889) edited by James Grant Wilson and John Fiske, six volumes (New York: D. Appleton and Company)

SECONDARY SOURCES

Adams, Sean Patrick (1998) "Partners in Geology, Brothers in Frustration: The Antebellum Geological Surveys of Virginia and Pennsylvania," *The Virginia Magazine of History and Biography* 106: 5-33

Adams, Sean Patrick (1999) "Old Dominions and Industrial Commonwealths: The Political Economy of Coal in Virginia and Pennsylvania, 1810-1875" (Ph.D. Diss., University of Wisconsin-Madison)

Adams, Stephen (2001) *The Best and Worst Country in the World: Perspectives on the Early Virginia Landscape* (Charlottesville: University of Virginia Press)

Aldrich, Michele (1979) "American State Geological Surveys, 1820-1845," in Cecil Schneer, ed. *Two Hundred Years of Geology in America* (Hanover: University Press of New England), 133-144

Aldrich, Michele and Alan Leviton (1982) "William Barton Rogers and the Virginia Geological Survey, 1835-1842," in James Corgan, ed., *The Geological Sciences in the Antebellum South* (Tuscaloosa, AL: University of Alabama Press), 83-89

Aldrich, Michele (2000) *The New York State Natural History Survey, 1836-1842* (Ithaca, NY: Paleontological Research Institute)

Allmendinger, David (1990) *Ruffin: Family and Reform in the Old South* (New York: Oxford University Press)

Alpers, Paul (1996) *What is Pastoral?* (Chicago: University of Chicago Press)

Amber, Charles Henry (1913) *Thomas Ritchie; A Study in Virginia Politics* (Richmond, VA: Bell Book & Stationery Co.)

Aulie, Richard (1970) "Bousssingault and the Nitrogen Cycle," *Proceedings of the American Philosophical Society* 114: 433-479

Baatz, Simon (1985) "*Venerate the Plough*": *A History of the Philadelphia Society for the Promotion of Agriculture, 1785-1985* (Philadelphia: Philadelphia Society for the Promotion of Agriculture)

Bedell, Rebecca (2001) *The Anatomy of Nature: Geology and American Landscape Painting, 1825-1875* (Princeton, NJ: Princeton University Press)

Bedini, Silvio (1990) *Thomas Jefferson: Statesman of Science* (New York, Macmillan)

Bensaude-Vincent, Bernadette and Isabelle Stengers (1995) *The History of Chemistry* (Cambridge, MA: Harvard University Press)

Bensaude-Vincent, Bernadette and Anders Lundgrens, eds. (2000) *Communicating Chemistry: Textbooks and Their Audiences, 1789-1939* (Canton, MA : Science History Publications)

Benton, E. (1974) "Vitalism in 19th-century scientific thought: A typology and reassessment,"

- Studies in History and Philosophy of Science* 5: 17-48
- Bercovitch, Sacvan and Myra Jehlen, eds. (1986) *Ideology and Classic American Literature* (New York: Cambridge University Press)
- Berlin, Ira and Philip Morgan, eds. (1993) *Cultivation and Culture: Labor and the Shaping of Slave Life in the Americas* (Charlottesville: University Press of Virginia)
- Berry, Wendell (1977) *The Unsettling of America: Culture and Agriculture* (San Francisco, CA: Sierra Club Books)
- Bierck, Harold A. (1954) "Spoils, Soils, and Skinner," *Maryland Historical Magazine* 49: 21-40, 143-155
- Black, Charles (1993) *Soil Fertility Evaluation and Control* (Boca Raton, FL: Lewis Publishers)
- Boscoe, Francis (2003) "'The Insanities of an Exalted Imagination': The Troubled First Geological Survey of Pennsylvania," *The Pennsylvania Magazine of History and Biography* 127: 291-308
- Bowler, Peter (1992) *The Norton History of the Environmental Sciences* (New York: Norton)
- Bowler, Peter ([1984] 2003) *Evolution The History of an Idea* (Berkeley: University of California Press, 3rd edition)
- Bressler, R.G. (1958) "The Impact of Science on Agriculture," *Journal of Farm Economics* 40:1005-1015
- Brock, William (1992) *The Norton History of Chemistry* (New York: Norton)
- Brock, William (1997) *Justus von Liebig: The Chemical Gatekeeper* (New York: Cambridge University Press)
- Brown, Chandos Michael (1989) *Benjamin Silliman: A Life in the Young Republic* (Princeton, NJ: Princeton University Press)
- Brown, Ralph (1939) "Agricultural Science and Education in Virginia Before 1860," *William and Mary Quarterly* 19: 197-213
- Bruce, Robert (1987) *The Launching of Modern American Science, 1846-1876* (New York: Knopf)
- Brunt, Liam (2003) "Rehabilitating Arthur Young," *Economic History Review* 56(2): 265
- Bryson, Michael (2002) *Visions of the Land: Science, Literature, and the American Environment from the Era of Exploration to the Age of Ecology* (Charlottesville: University of Virginia Press)
- Buell, Lawrence (1995) *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture* (Cambridge, MA: Belknap Press of Harvard University Press)
- Bullion, Brenda (1988) "The Agricultural Press: To Improve the Soil and the Mind," in Peter Benes, ed., *The Farm* (Dublin Seminar for New England Folklife, Annual Proceedings 1986, Boston University), 74-94
- Bushman, Claudia (2002) *In Old Virginia: Slavery, Farming, and Society in the Journal of John Walker* (Baltimore, MD: Johns Hopkins University Press)
- Callon, Michel (1986) "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay," in John Law, ed., *Power, Action and Belief. A New Sociology of Knowledge?* (London: Routledge & Kegan)
- Carney, Judith (2001) *Black Rice: The African Origins of Rice Cultivation in the Americas* (Cambridge, MA: Harvard University Press)
- Carter, Edward, ed. (1999) *Surveying the Record: North American scientific exploration to 1930* (Philadelphia: American Philosophical Society)

- Cashin, Joan (1994) "Landscape and Memory in Antebellum Virginia," *The Virginia Magazine of History and Biography* 102(4): 477-500
- Cohen, I.B., ed. (1980) *Jefferson and the Sciences* (New York: Arno Press)
- Cohen, I.B. (1995) *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams, and Madison* (New York: Norton and Co.)
- Collins, Harry ([1985] 1992) *Changing Order: Replication and Induction in Scientific Practice* (Chicago: University of Chicago Press)
- Collins, Harry and Trevor Pinch (1998) *The Golem: What You Should Know About Science* (Cambridge : Cambridge University Press)
- Conlogue, William (2001) *Working the Garden: American Writers and the Industrialization of Agriculture* (Chapel Hill: University of North Carolina Press)
- Cooter, Roger (1994) "Separate Spheres and Public Places: Reflections of the History of Science Popularization and Science in Popular Culture," *History of Science* 32: 237-267
- Corgan, James X., ed. (1982) *The Geological Sciences in the Antebellum South* (Univ. Alabama Press)
- Cowdrey, Albert ([1983] 1996) *This Land, This South: An Environmental History* (Lexington: University Press of Kentucky)
- Craven, Avery (1926) *Soil Exhaustion as a Factor in the Agricultural History of Virginia and Maryland, 1606-1860* (Urbana, IL: University of Illinois Press)
- Cronon, William (1983) *Changes in the Land* (New York: Hill and Wang)
- Cronon (1990), "Modes of Prophecy and Production: Placing Nature in History," *Journal of American History*, 76: 1122-1131
- Cronon, William (1994) "Cutting Loose or Running Aground?" *Journal of Historical Geography* 20(1): 38-43
- Cronon, William, ed. (1995) *Uncommon Ground: Toward Reinventing Nature* (New York: W.W. Norton & Co.)
- Crosby, Alfred (1990) "An Enthusiastic Second," *Journal of American History* 76: 1107-1110
- Cunningham, Andrew and Nicholas Jardine, eds. (1990) *Romanticism and the Sciences* (Cambridge: Cambridge University Press)
- Cunningham, Andrew and Perry Williams (1993) "De-Centring the 'Big Picture': *The Origins of Science* and the Modern Origins of Science," *British Journal for the History of Science* 26: 407-432
- Daniels, George (1968) *American Science in the Age of Jackson* (New York: Columbia University Press)
- Daniels, George, ed. (1972) *Nineteenth-Century American Science: A Reappraisal* (Evanston, IL: Northwestern University Press)
- Daston, Lorraine (1991) "The Ideal and Reality of the Republic of Letters in the Enlightenment," *Science in Context* 4: 367-386
- Davidson, Arnold (2001) *The Emergence of Sexuality: Historical Epistemology and the Formation of Concepts* (Cambridge, MA: Harvard University Press, 2001)
- Davis, Donald (2000) *Where There Are Mountains: An Environmental History of the Southern Appalachians* (Athens: University of Georgia Press)
- De Certeau, Michel ([1974] 1984) *The Practice of Everyday Life* (Berkeley, CA: University of California Press)
- Deleuze, Gilles and Felix Guattari (1980/1987) *A Thousand Plateaus* (Minneapolis: University of Minnesota Press)

- Demaree, Albert (1941/1974) *The American Agricultural Press, 1819-1860* (Philadelphia, PA: Porcupine Press; first edition New York: Columbia University press, *Columbia University Studies in the History of American Agriculture No. 8*)
- Demaree, Albert (1941) "The Farm Journals, Their Editors, and Their Public, 1830-1860," *Agricultural History* 15(4): 182-188
- Demeritt, David (1994) "Ecology, Objectivity, and Critique in Writings on Nature and Human Societies," *Journal of Historical Geography* 20(1): 22-37
- Dew, Charles (1994) *Bond of Iron: Master and Slave at Buffalo Forge* (New York: W.W. Norton)
- Dupree, A. Hunter (1957) *Science in the Federal Government: A History of Politics and Activities* (Cambridge, MA: Harvard University Press)
- Epstein, Steven (1995) *Impure Science: AIDS, Activism, and the Politics of Knowledge* (Berkeley: University of California Press)
- Ernst, William (1974) "William Barton Rogers: Antebellum Virginia Geologist," *Virginia Cavalcade* 24: 13-21
- Evernden, Neil (1992) *The Social Creation of Nature* (Baltimore: Johns Hopkins University Press)
- Fea, John (2003) "The Way of Improvement Leads Home: Philip Vickers Fithian's Rural Enlightenment," *Journal of American History* 90: 462-90.
- Ferguson, Robert (1997) *The American Enlightenment, 1750-1820* (Cambridge, MA: Harvard University Press)
- Findlay, Mark (1991) "The Rehabilitation of an Agricultural Chemist: Justus von Liebig and the Seventh Edition," *Ambix* 38: 155-167
- Fischer, David Hackett and James C. Kelly (2000) *Bound Away: Virginia and the Westward Movement* (Charlottesville: University Press of Virginia)
- Fitzgerald, Deborah (1993) "Farmer's Deskilled: Hybrid Corn and Farmers Work," *Technology and Culture* 33: 324-343
- Fitzgerald, Deborah (2003) *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven, CT: Yale University Press)
- Forgan, Sophie, ed. (1980) *Science and the Sons of Genius: Studies on Humphry Davy* (London: Science Reviews Ltd.)
- Foster, George (1973) *Traditional Societies and Technological Change* (New York: Harper and Row)
- Foucault, Michel (1980) *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*. Colin Gordon, ed. New York: Pantheon Books.
- Fox-Genovese, Elizabeth (1976) *The Origins Of Physiocracy: Economic Revolution And Social Order In Eighteenth-Century France* (Ithaca : Cornell University Press)
- Gates, Paul W. (1960) *The Farmer's Age: Agriculture, 1815-1860* (New York: Harper Torchbook)
- Gee, Brian (1989) "Amusement Chests and Portable Laboratories: Practical Alternatives to the Regular Laboratory," in Frank A.J.L. James, ed , *The Development of the Laboratory* (Basingstoke, Hampshire: Macmillan Press Scientific & Medical), 37-59
- Gerstner, Patsy (1994) *Henry Darwin Rogers, 1808-1866: American Geologist* (Tuscaloosa: University of Alabama Press)
- Goetzmann, William ([1966] 1993) *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Knopf)

- Golinski, Jan (1992) *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* (Cambridge: Cambridge University Press)
- Goodman, Dena (1994) *The Republic of Letters: A Cultural History of the French Enlightenment* (Ithaca, NY: Cornell University Press)
- Grammer, John (1996) *Pastoral and Politics in the Old South* (Baton Rouge: Louisiana State University Press)
- Gramsci, Antonio (1988) *An Antonio Gramsci Reader*, ed. David Forgacs (New York: Schocken Books)
- Gray, Lewis (1933/1941) *History of Agriculture in the Southern United States to 1860*, two volumes (New York: Peter Smith)
- Greene, John (1984) *American Science in the Age of Jefferson* (Ames: Iowa State University Press)
- Hall, Vance (1987) *A History of the Yorkshire Agricultural Society 1837-1987: In Celebration of the 150th Anniversary of the Society* (London: Chrysalis Books)
- Hayes, Elizabeth (2003) "Science, Politics, and Satire: Reconsidering the American Philosophical Society in its Political Contexts, 1771-1806," Paper delivered at the History of Science Society Annual Meeting, Cambridge, MA
- Headlee, Sue (1991) *The Political Economy of the Family Farm: Agrarian Roots of American Capitalism* (New York: Praeger)
- Holton, Gerald (1986) "On the Jeffersonian Research Program," *Archives internationales d'histoire des sciences* 36: 325-336
- Ihde, Aaron (1952) "Edmund Ruffin, Soil Chemist of the Old South," *Journal of Chemical Education* 29: 407-414
- Ihde, Aaron (1964) *The Development of Modern Chemistry* (New York: Harper and Row)
- Isaac, Rhys (1982) *The Transformation of Virginia 1740-1790* (Chapel Hill, NC: University of North Carolina Press)
- Isaac, Rhys (2004) *Landon Carter's Uneasy Kingdom: Revolution & Rebellion on a Virginia Plantation* (New York: Oxford University Press)
- Jacobson, David (2002) *Place and Belonging in America* (Baltimore, MD: Johns Hopkins University Press)
- James, Frank, ed. (1989) *The Development of the Laboratory* (London: Basingstoke)
- Jehlen, Myra (1986) *American Incarnations: The Individual, the Nation, and the Continent* (Cambridge, MA: Harvard University Press)
- Johnson, Hildegard (1976) *Order Upon the Land: The U.S. Rectangular Survey and the Upper Mississippi Country* (New York: Oxford University Press)
- Judd, Richard (1997) *Common Lands, Common People: The Origins of Conservation in New England* (Cambridge, MA: Harvard University Press)
- Keeney, Elizabeth (1992) *The Botanizers: Amateur Scientists in Nineteenth-Century America* (Chapel Hill: University of North Carolina Press)
- Kennedy, Roger (2003) *Mr. Jefferson's Lost Cause: Land, Farmers, Slavery, and the Louisiana Purchase* (New York, NY: Oxford University Press)
- Kirby, Jack Temple (1995) *Poquosin: A Study of Rural Landscape* (Chapel Hill: University of North Carolina Press)
- Kirby, Jack Temple (1990) "Virginia's Environmental History: A Prospectus," *Virginia Magazine of History and Biography* 99: 449-488
- Kirsch, Scott (2002) "John Wesley Powell and the Mapping of the Colorado Plateau, 1869-1879:"

- Survey Science, Geographical Solutions, and the Economy of Environmental Values," *Annals of the Association of American Geographers* 92(3): 548-572
- Kirschke, Martin (2003) "Liebig, his University Professor Karl Wilhelm Gottlob Kastner (1783-1857), and his Problematic Relation with Romantic Natural Philosophy," *Ambix* 50: 3-24
- Klein, Ursula (2003) *Experiments, Models, Paper Tools: Cultures of Organic Chemistry in the Nineteenth Century* (Palo Alto, CA: Stanford University Press)
- Kline, Ronald (2002) *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore, MD: Johns Hopkins University Press)
- Klonk, Charlotte (1996) *Science and the perception of Nature: British Landscape Art in the Late Eighteenth and Early Nineteenth Centuries* (New Haven, CT: Yale University Press)
- Kloppenbergh, James (1987) "The Virtues of Liberalism: Christianity, Republicanism, and Ethics in Early American Political Discourse," *Journal of American History*, 74: 9-33
- Knight, David (1976) "Agriculture and Chemistry in Britain around 1800," *Annals of Science* 33: 187-196
- Knight, David (1986) "Accomplishment or Dogma: Chemistry in the Introductory Works of Jane Marcet and Samuel Parkes," *Ambix* 33: 88-98
- Knight, David (1992) *Humphry Davy: Science and Power* (Cambridge: Cambridge University Press)
- Kohler, Robert (2002) *Labsapes and Landscapes: Exploring the Lab-Field Border in Biology* (Chicago, IL: University of Chicago Press)
- Kohlstedt, Sally (1976) *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1846-1860* (Urbana: University of Illinois Press)
- Kohlstedt, Sally (1976) "The Nineteenth Century Amateur Tradition: The Case of the Boston Society of Natural History," in G. Holton and W. Blanpied, eds., *Science and Its Publics: The Changing Relationship; Boston Studies in the Philosophy of Science*, vol. 33 (Boston: D. Reidel Publishing)
- Kohlstedt, Sally (1988) "Curiosities and Cabinets: Natural History Museums and Education on the Antebellum Campuses," *Isis* 79: 405-426.
- Kohlstedt, Sally (1990) "Parlors, Primers, and Public Schooling: Education for Science in Nineteenth Century America," *Isis* 81: 424-445.
- Kohlstedt, Sally and Margaret Rossiter, eds. (1985) "Historical Writing on American Science," *Osiris* (second series), vol. 1
- Kuklick, Henrika and Robert Kohler, eds. (1996) "Science in the Field," *Osiris*, second series, volume 11
- Kulikoff, Allan (1992) *The Agrarian Origins of American Capitalism* (Charlottesville: University Press of Virginia)
- Kurzer, Frederick (1997) "Samuel Parkes - Chemist, Author, Reformer; A Biography," *Annals of Science* 54(5): 431-462
- Larson, John Lauritz (2001) *Internal Improvement: National Public Works and the Promise of Popular Government in the Early United States* (Chapel Hill: University of North Carolina Press)
- Latour, Bruno and Steve Woolgar (1979/1986) *Laboratory Life: The Construction of Scientific Facts* (Princeton, NJ: Princeton University Press)
- Latour, Bruno (1987) *Science in Action* (Cambridge, MA: Harvard University Press)
- Latour, Bruno (1999) *Pandora's Hope* (Cambridge, MA: Harvard University Press)
- Laudan, Rachel (1987) *From Mineralogy to Geology: The Foundations of a Science, 1650-1830*

- (Chicago : University of Chicago Press)
- Lawrence, Christopher (1990) "The Power and the Glory: Humphry Davy and Romanticism," in Andrew Cunningham and Nicholas Jardine, eds., *Romanticism and the Sciences* (Cambridge: Cambridge University Press), 213-227
- Levere, Trevor (1977) "Coleridge, Chemistry, and the Philosophy of Nature," *Studies in Romanticism* 16: 349-379
- Levere, Trevor (2001) *Transforming Matter: A History of Chemistry from Alchemy to the Buckyball* (Baltimore, MD: Johns Hopkins University Press)
- Lewenstein, Bruce (1989) "'To Improve Our Knowledge in Nature and Arts': A History of Chemical Education in the United States," *J. Chem. Educ.* 66: 37-44
- Lewis, Charlene M. Boyer (2001) *Ladies and Gentlemen on Display: Planter Society at the Virginia Springs, 1790-1860* (Charlottesville, VA: University Press of Virginia)
- Lewis, Ronald (1998) *Transforming the Appalachian Countryside: Railroads, Deforestation, and Social Change in West Virginia, 1880-1920* (Chapel Hill: University of North Carolina Press)
- Lindee, Susan (1991) "The American Career of Jane Marcet's *Conversations on Chemistry*," *Isis* 82: 8-23
- Livingstone, David and Charles Withers, eds. (1999) *Geography and Enlightenment* (Chicago: University of Chicago Press)
- Livingston, David (2003) *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press)
- Loehr, Rodney (1969) "Arthur Young and American Agriculture," *Agricultural History* 43: 43-67
- Lowery, Charles (1973) "James Barbour, a Progressive Farmer of Antebellum Virginia," in John Boles, ed., *America, The Middle Period: Essays in Honor of Bernard Mayo* (Charlottesville, VA: University of Virginia Press), 168-187
- Lucier, Paul (1995) "Commercial Interests and Scientific Disinterestedness: Consulting Geologists in Antebellum America," *Isis* 86: 245-267
- Lundgrens, Anders and Bernadette Bensaude-Vincent, eds. (2000) *Communicating Chemistry: Textbooks and Their Audiences, 1789-1939* (Canton, MA : Science History Publications)
- Majewski, John (2002) *A House Dividing: Economic Development in Pennsylvania and Virginia before the Civil War* (Cambridge: Cambridge University Press)
- Mårand, Erland (2002) "Everything Circulates: Agricultural Chemistry and Recycling Theories in the Second Half of the Nineteenth century," *Environment and History* 8: 65-84
- Marcus, Alan (1985) *Agricultural Science and its Quest for Legitimacy: Farmers, Agricultural Colleges, and Experiment Stations, 1870-1890* (Ames: Iowa University Press)
- Marcus, Alan (1988) "The Wisdom of the Body Politic: The Changing Nature of Publicly Sponsored American Agricultural research Since the 1830s," *Agricultural History* 62 (2): 4-26
- Marti, Donald (1980) "Agricultural journalism and the Diffusion of Knowledge: The First Half Century in America," *Agricultural History* 54 (1): 37
- Martindale, Charles, ed. (1997) *The Cambridge Companion to Virgil* (New York: Cambridge University Press)
- Martindale, Charles (1997) "Green Politics: the *Eclogues*," in *The Cambridge Companion to Virgil* (Cambridge University Press 1997), 107-124
- Marx, Leo (1986) "Pastoralism in America," in Sacvan Bercovitch and Myra Jehlen, eds.,

- Ideology and Classic American Literature* (Cambridge: CUP), 36-69
- Marx, Leo (1987) "Does Improved Technology Mean Progress?" in *Technology Review* 90: 32-41
- Marx, Leo (1964/2000) *The Machine in the Garden: Technology and the Pastoral Idea in America* (Oxford: Oxford University Press)
- Marx, Leo and Bruce Mazlish, eds. (1996) *Progress: Fact or Illusion?* (Ann Arbor, MI: University of Michigan Press)
- Mathew, William (1988) *Edmund Ruffin and the Crisis of Slavery in the Old South: The Failure of Agricultural Reform* (Athens, GA: University of Georgia Press)
- McCall, A. (1931) "The Development of Soil Science," *Agricultural History* 5: [n.p.]
- McClelland, Peter (1997) *Sowing modernity: America's first agricultural revolution* (Ithaca, NY: Cornell University Press)
- McCook, Stuart (2002) *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940* (Austin: University of Texas Press)
- McCorrison, Marcus (1995) "Thomas Green Fessenden, 1771-1837: Not in BAL," *Proceedings the Bibliographic Society of America* 89 (1): 5-59
- McGehee, Minnie Lee (1967) "The Rivanna Navigation Company," *Bulletin of the Fluvanna Historical Society* 5: 1-201
- McMurry, Sally (1989) "Who Read the Agricultural Journals? Evidence from Chenango County, New York, 1839-1865" *Agricultural History* 63 (4): 1-18
- Meikle, Jeffrey (2003) "Leo Marx's *The Machine in the Garden*," *Technology and Culture* 44 (1): 147-159
- Meisel, Max (1924, 1926, 1929) *A Bibliography of American Natural History: The Pioneer Century, 1769-1865*, 3 Volumes (New York: The Premier Publishing Co.)
- Melhado, Evan (1990) "Mineralogy and the Autonomy of Chemistry Around 1800," *Lychnos* 55: 229-262
- Melhado, Evan and Tore Frangmyr, eds. (1992) *Enlightenment Science in the Romantic Era: The Chemistry of Berzelius and its Cultural Setting* (Cambridge: Cambridge University Press)
- Merchant, Carolyn (1980) *The Death of Nature: Women, Ecology, and the Scientific Revolution* (New York: Harper & Row Publishers)
- Merchant, Carolyn (1989) *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill: University of North Carolina Press)
- Merchant, Carolyn, ed. (1993) *Major Problems in American Environmental History* (Lexington, MA: D. C. Heath)
- Merchant, Carolyn (2002) *The Columbia Guide to American Environmental History* (New York: Columbia University Press)
- Merrill, George (1924) *The First Hundred Years of American Geology* (New Haven, Yale University Press)
- Merrill, George, ed. (1920) *Contributions to a history of American state geological and natural history surveys* (Washington: Govt. Printing Office)
- Michel, Gregg (1991) "From Slavery to Freedom: Hickory Hill, 1850-80," in Edward Ayers and John C. Willis, eds., *The Edge of the South: Life in Nineteenth-Century Virginia*, (Charlottesville: University Press of Virginia)
- Milici, Robert and C.R. Bruce Hobbs, Jr. (1987) "William Barton Rogers and the First Geological Survey of Virginia, 1835-1841," *Earth Science History* 6: 3-13

- Millbrooke, Anne (1981) *State Surveys of Nineteenth Century* (Ph.D. Diss., University of Pennsylvania)
- Miller, Angela (1993) *The Empire of the Eye: Landscape Representation and American Cultural Politics, 1825-1875* (Ithaca, NY: Cornell University Press)
- Miller, Charles (1988) *Jefferson and Nature* (Baltimore, MD: Johns Hopkins University Press)
- Miller, Randall, ed. ([1978] 1990) *"Dear Master": Letters of a Slave Family* (Athens: University of Georgia Press)
- Miller, Randall and William Pencak, eds. (2000) *Pennsylvania: A History of the Commonwealth* (State College: Pennsylvania State University Press)
- Mills, William J. (1982) "Metaphorical Vision: Changes on Western Attitudes to the Environment," *Annals of the Association of American Geographers* 72: 237-253.
- Mitman, Gregg (1992) *The State of Nature: Ecology, Community, and American Social Thought, 1900-1950* (Chicago: University of Chicago Press)
- Mitman, Gregg (1996) "When Nature *Is* the Zoo: Vision and Power in the Art and Science of Natural History," in Henrika Kuklick and Robert Kohler, eds., "Science in the Field," *Osiris*, 2nd Series 11: 117-143
- Munday, Pat (1991) "Liebig's Metamorphosis: From Organic Chemistry to the Chemistry of Agriculture," *Ambix* 38 : 135-154
- Myers, Greg (1997) "Fictionality, Demonstration, and a Forum for Popular Science: Jane Marcet's 'Conversations on Chemistry,'" in Barbara T. Gates and Ann B. Shteir, eds., *Natural Eloquence: Women Reinscribe Science* (Madison: University of Wisconsin Press), 43-60
- Nye, David (2003) *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge, MA: MIT Press)
- Novak, Barbara (1980) *Nature and Culture: American Landscape and Painting, 1825-1875* (New York: Oxford University Press)
- Numbers, Ronald and Todd Savitt, eds. (1989) *Science and Medicine in the Old South* (Baton Rouge: Louisiana State University)
- O'Connell, Joseph (1993) "Metrology: The Creation of Universality by the Circulation of Particulars," *Social Studies of Science* 23: 129-173
- Oleson, Alexandra and Sanborn Brown, eds. (1976) *The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War* (Baltimore: Johns Hopkins University Press)
- Ophir, A. and Steve Shapin (1991) "The Place of Knowledge: A Methodological Survey," *Science in Context* 4: 3-21
- Orwin, Christabel and Edith Whetham (1971) *History of British Agriculture, 1846-1914* (London: Newton Abbot, David and Charles)
- Ostrander, Gilman (1999) *Republic of Letters: The American Intellectual Community, 1776-1865* (Madison, WI: Madison House)
- Outland, Robert (1996) "Slavery, Work, and the Geography of North Carolina Naval Stores Industry, 1835-1860," *Journal of Southern History* 62: 27-56
- Pauly, Philip (2002) "Fighting the Hessian Fly: American and British Responses to Insect Invasion, 1776-1789," *Environmental History* 7: 485-507
- Peskin, Lawrence (2002) "How the Republicans Learned to Love Manufacturing: The First Parties and the 'New Economy,'" *Journal of the Early Republic* 22: 235-262
- Peskin, Lawrence (2003) *Manufacturing Revolution: The Intellectual Origins of Early American*

- Industry* (Baltimore: Johns Hopkins University Press)
- Phillips, Dana (2003) *The Truth of Ecology: Nature, Culture, and Literature in America* (New York: Oxford University Press)
- Philips, Sarah (2000) "Antebellum Agricultural Reform, Republican Ideology, and Sectional Tension," *Agricultural History* 74(4): 799-822
- Ploeg, R.R. van der, W. Bohm, and M.B. Kirkham (1999) "History of Soil Science: On the origin of the Theory of Mineral Nutrition of Plants and the Law of the Minimum," *Soil Science Society of America Journal* 63: 1055-1062
- Porter, Theodore (1981) "The Promotion of Mining and the Advancement of Science: the Chemical Revolution of Mineralogy," *Annals of Science* 38: 543-570
- Porter, Theodore (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press)
- Poovey, Mary (1998) *A History of the Modern Fact: Problems and Knowledge in the Science of Wealth and Society* (Chicago: University of Chicago Press)
- Rabbitt, Mary (1979) *History of the U.S. Geological Survey* [Publisher?]
- Ragsdale, Bruce (1996) *A Planter's Republic: The Search for Economic Independence in Revolutionary Virginia* (Madison, WI: Madison House)
- Ramberg, Peter (2000) "The Death of Vitalism and the Birth of Organic Chemistry: Wöhler's Urea Synthesis and the Disciplinary Identity of Organic Chemistry," *Ambix* 47: 170-195
- Rasmussen, Wayne and Robert Tilton (2003) *Old Virginia: The Pursuit of a Pastoral Ideal* (Charlottesville, VA: Howell Press)
- Regis, Pamela (1992) *Describing Early America: Bartram, Jefferson, Crèvecoeur, and the Rhetoric of Natural History* (DeKalb, IL: Northern Illinois University Press)
- Reingold, Nathan, ed. (1979) *The Sciences in the American Context: New Perspectives* (Washington: Smithsonian Institution Press)
- Reingold, Nathan (1991) *Science, American Style* (New Brunswick, NJ: Rutgers University Press)
- Richards, Robert (2002) *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago, IL: University of Chicago Press)
- Rigal, Laura (1998) *The American Manufactory: Art, Labor, and the World of Things in the Early Republic* (Princeton, NJ: Princeton University Press)
- Rogers, Everett (1995) *Diffusion of Innovations*, 4th ed. (New York: Free Press)
- Rogers, Muriel (2003) "John Hartwell Cocke (1780-1866): From Jeffersonian Palladianism to Romantic Colonial Revivalism in Antebellum Virginia" (Ph.D. Diss., Virginia Commonwealth University)
- Rosenberg, Charles (1976) *No Other Gods: On Science and American Social Thought* (Baltimore: Johns Hopkins University Press)
- Rosenberg, Charles (1988) "Woods or Trees? Ideas and Actors in the History of Science," *Isis* 79: 565-570
- Rossiter, Margaret (1974) "The Organization of Agricultural Improvement in the United States, 1785-1865," in Alexandra Oleson and Sanborn Brown, eds., *The Pursuit of Knowledge in the Early American Republic* (Baltimore: Johns Hopkins University Press), 279-298
- Rossiter, Margaret (1975) *The Emergence of Agricultural Science: Justus Liebig and the Americans, 1840-1880* (New Haven, CT: Yale University Press)
- Rouse, Joseph (1996) *Engaging Science: How to Understand its Practices Philosophically*. (Ithaca, NY: Cornell University Press)

- Russell, Ed (2001) *War and Nature: Fighting Insects with Chemicals, from World War I to Silent Spring* (New York: Cambridge University Press)
- Ryden, Kent (2001) *Landscape with Figures: Nature & Culture in New England* (Iowa City: University of Iowa Press)
- Sayre, Laura (2002) "Farming by the Book: British Georgic in Prose and Practice, 1697-1820" (Ph.D. Diss., Princeton University)
- Scarborough, William (1989) "Science on the Plantation," in Ronald Numbers and Todd Savvitt, eds. *Science and Medicine in the Old South*, 79-106
- Scheese, Don (1996) *Nature Writing: The Pastoral Impulse in America* (New York: Twayne Publishes)
- Schlotterbeck, John (1980) "Plantation and Farm: Social and Economic Change in Orange and Greene Counties, Virginia, 1716-1860" (Ph.D. Diss., Johns Hopkins University)
- Schlebecker, John and Andrew W. Hopkins (1957) *A History of Diary Journalism in the United States 1810-1950*
- Schling-Broderson, Uschi (1992) "Liebig's Role in the Establishment of Agricultural Chemistry," *Ambix* 39: 21-31
- Schneer, Cecil J., ed. (1979) *Two Hundred Years of Geology in America* (Hanover, NH: University Press of New England)
- Schneider, Daniel (2000) "Local Knowledge, Environmental Politics, and the Founding of Ecology in the United States: Stephen Forbes and 'The Lake as a Microcosm' (1887)," *Isis* 91: 681-705
- Scott, James (1998) *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press)
- Secord, Ann (1994) "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," *History of Science* 32: 269-315
- Sellers, Charles (1991) *The Market Revolution: Jacksonian America, 1815-1846* (New York: Oxford University press)
- Shade, William (1993) *Democratizing the Old Dominion: Virginia and the Second Party System* (Charlottesville: University Press of Virginia)
- Shalhope, Robert (1980) *John Taylor of Caroline: Pastoral Republican* (Columbia: University of South Carolina Press)
- Shapin, Steven (1983) "'Nibbling at the Teats of Science': Edinburgh and the Diffusion of Science in the 1830s," in Ian Inkster and Jack Morrell, eds., *Metropolis and Province: Science in British culture, 1780-1850*, ed. (Philadelphia: University of Pennsylvania Press), 151-178
- Shapin, Steven and Simon Schaffer (1985) *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press)
- Shapin, Steven (1989) "The Invisible Technician," *American Scientist* 77: 554-563
- Shapin, Steven (1995) "Cordelia's Love: Credibility and the Social Studies of Science," *Perspectives on Science* 3: 255-275
- Shapin, Steven (1995) *The Social History of Truth* (Chicago: University of Chicago Press)
- Sharrer, G. Terry (2000) *A Kind of Fate: Agricultural Change in Virginia, 1861-1920* (Ames: Iowa University Press)
- Siegel, Frederick (1987) *The Roots of Southern Distinctiveness: Tobacco and Society in Danville, VA, 1780-1865* (Chapel Hill, NC: University of North Carolina Press)
- Silver, Timothy (1990) *A New Face on the Countryside: Indians, Colonists, and Slaves in South*

- Atlantic Forests, 1500-1800* (New York: Cambridge University Press)
- Slotten, Hugh (1994) *Patronage, Practice, and the Culture of American Science: Alexander Dallas Bache and the US Coast Survey*. New York: Cambridge University Press.
- Smith, Merritt Roe and George Clancey, eds. (1998) *Major Problems in the History of American Technology* (New York: Houghton Mifflin)
- Smith, Michael (1999) "The Conflict between 'Practical Utility' and Geology: Denison Olmstead, Elisha Mitchell, and the 1823 to 1828 Geological Surveys of North Carolina," *Southeastern Geology* 38: 145-154
- Socolow, Arthur, ed. (1988) *The State Geological Surveys: A History* (Association of American State Geologists)
- Spanagel, David (1996) "Chronicles of a Land Etched by God, Water, Fire, Time, and Ice" (Ph.D. Diss., Harvard University)
- Spanagel, David (2001) "Review of Edmund Ruffin, *Nature's Management: Writings on Landscape and Reform 1822-1859*," H-SHEAR, H-Net Reviews, October, 2001 <<http://www.h-net.msu.edu/reviews/showrev.cgi?path=274641002733673>> accessed 10 October 2004
- Stafford, Barbara (1994) *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education* (Cambridge, MA: MIT Press)
- Star, Susan Leigh and James Greisemer (1989) "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39," *Social Studies of Science* 19: 387-420
- Steinberg, Ted (1991) *Nature Incorporated: Industrialization and the Waters of New England*. (New York: Cambridge University Press)
- Steinberg, Ted (2002) "Down to Earth: Nature, Agency, and Power in History," *American Historical Review* 107: 798-820
- Steinberg, Ted (2002) *Down to Earth: Nature's Role in American History* (Oxford: Oxford University Press)
- Stephens, Lester (2000) *Science, Race, and Religion in The American South: John Bachman and the Charleston Circle of Naturalists, 1815-1895* (Chapel Hill : University of North Carolina Press)
- Stewart, Mart ([1996] 2002) "What Nature Suffers to Groe": *Life, Labor, and Landscape on the Georgia Coast, 1680-1920* (Athens: University of Georgia Press)
- Stewart, Mart (2002) "Southern Environmental History," in John Boles, ed., *A Companion to the American South* (Malden, MA: Blackwell), pp. 411-423
- Stilgoe, John R. (1982) *Common Landscape of America, 1580-1845* (New Haven: Yale University Press)
- Stokes, Melvyn and Stephen Conway, eds. (1996) *The Market Revolution in America: Social, Political, and Religious Expressions, 1800-1880* (Charlottesville: University Press of Virginia)
- Stoll, Steven (2002) *Larding the Lean Earth: Soil and Society in Nineteenth-Century America* (New York: Hill and Wang)
- Stowell, Robert (1970) *A Thoreau Gazetteer*, ed. William Howarth (Princeton: Princeton University Press)
- Sweet, Timothy (2002) *American Georgics: Economy and Environment in Early American Literature* (Philadelphia: University of Pennsylvania Press)
- Taylor, George (1968) *The Transportation Revolution, 1815-1860* (New York: Harper

- Torchbooks)
- Taylor, Joseph (1999) *Making Salmon: An Environmental History of the Northwest Fisheries Crisis* (Seattle: University of Washington Press)
- Throne, Mildred (1951) "'Book farming' in Iowa, 1840-1870," *Iowa Journal of History* 49: 117-142
- Tolley, Kim (2003) *The Science Education of American Girls: A Historical Perspective* (New York: Routledge)
- Tuan, Yi-Fu (1997) *Space and Place: The Perspective of Experience* (Minneapolis: University of Minnesota Press)
- Turner, Charles (1986) *Virginia's Green Revolution: Essays on the Nineteenth Century Virginia Agricultural Reform and Fairs* (Waynesboro, VA: Humphries Press)
- Turner, Stephen (1987) "The Survey in Nineteenth Century American Geology: The Evolution of a Form of Patronage," *Minerva* 25: 282-330.
- Upton, Dell (1988) "New Views of the Virginia Landscape," *The Virginia Magazine of History and Biography* 96: 403-470
- Valençius, Conevery Bolton (2002) *The Health of the Country: How American Settlers Understood Themselves and Their Land* (New York: Basic Books)
- Van Leer, David (1990) "Nature's Book: The Language of Science in the American Renaissance," in Andrew Cunningham and Nicholas Jardine, eds., *Romanticism and the Sciences* (Cambridge: Cambridge University Press), 307-321
- Van Noy, Rick (2002) "Surveying the Sublime: Literary Cartographers and the Spirit of Place," in ed. Steven Rosendale, *The Greening of Literary Scholarship, Theory, and the Environment* (Iowa City: University of Iowa Press), pp. 181-206
- Walls, Laura D. (1995) *Seeing New Worlds: Henry David Thoreau and Nineteenth-Century Natural Science* (Madison, WI: University of Wisconsin Press)
- Warner, Michael (1990) *The Letters of the Republic: Publication and the Public Sphere in Eighteenth-Century America* (Cambridge, MA: Harvard University Press)
- Wellman, Kathleen (2003) "Materialism and Vitalism," in J.L. Heilbron, ed., *The Oxford Companion to the History of Modern Science* (Oxford: Oxford University Press) 490-491
- White, Richard (1990) "Environmental History, Ecology, and Meaning," *Journal of American History* 76: 1111-1116
- White, Richard (1995) "Are You an Environmentalist or Do You Work for a Living?" in William Cronon, ed., *Uncommon Ground* (New York: W.W. Norton & Co.), 171-185
- White, Richard (1995) *The Organic Machine* (New York: Hill and Wang)
- Wilson, Leonard, ed. (1979) *Benjamin Silliman and His Circle: Studies on the Influence of Benjamin Silliman on Science in America* (New York : Science History Publications)
- Wines, Richard A. (1985) *Fertilizer in America: From Waste Recycling to Resource Exploitation* (Philadelphia: Temple University Press)
- Withers, Charles (1985) "A Neglected Scottish Agriculturist: the 'Georgical Lectures' and Agricultural Writings of the Rev Dr John Walker (1731-1803)," *The Agricultural History Review*
- Withers, Charles (1989) "William Cullen's Agricultural Lectures and Writings and the Development of Agricultural Science in Eighteenth-Century Scotland," *The Agricultural History Review* 37: 144-156
- Withers, Charles (1989) "Improvement and Enlightenment: Agriculture and Natural History in the Work of the Rev. Dr. John Walker (1731-1803)," in Peter Jones, ed., *Philosophy and*

- Science in the Enlightenment* (Edinburgh), 102-116
- Withers, Charles (1994) "On Georgics and Geology: James Hutton's 'Elements of Agriculture' and Agricultural Science in Eighteenth-Century Scotland," *The Agricultural History Review* 42: 38-48
- Worster, Donald ([1977] 1994) *Nature's Economy: A History of Ecological Ideas*, 2nd Edition (Cambridge: Cambridge University Press)
- Worster, Donald, ed. (1988) *The Ends of the Earth: Perspectives on Modern Environmental History* (New York: Cambridge University Press)
- Worster, Donald (1990) "Transformations of the Earth: Toward an Agroecological Perspective in History," *Journal of American History* 76: 1087-1106
- Worster, Donald (1993) *The Wealth of Nature: Environmental History and the Ecological Imagination* (New York: Oxford University Press)
- Worster, Donald (2001) *A River Running West: The Life of John Wesley Powell* (New York: Oxford University Press)
- Zakim, Michael (2001) "Sartorial Ideologies: From Homespun to Ready-Made," *The American Historical Review* 106: 1553-1586

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