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Antecedents, Precedents, and Continuities, 1800–1865

The rocks seemed to be everywhere, but no one knew their value. Francis S. Holmes was a nineteenth-century planter, slave owner, and gentleman-scientist living next to the Ashley River, northwest of Charleston, who followed local tradition and directed slaves to remove the "useless nodules" from his fields. Before the discovery that phosphate-based fertilizer could reinvigorate worn-out fields, planters considered the phosphate rocks physical obstacles to agricultural production.[1] Industry chronicler Edward Willis testified that most local plantations contained piles of the seemingly worthless rocks and that specimens weighing up to several hundred pounds had been found on or near the surface. Travelers on the Dorchester Road labeled the rocks "stinking stones," because the rocks emitted a "fetid" odor when broken. Colonial and antebellum South Carolinians found phosphate rocks on both sides of the Ashley but rarely east of the Cooper River. More rocks lay just below the surface. Later, entrepreneurs and scientists discovered the rocks in rivers near Charleston and Beaufort. Three important lowcountry industries—land mining, river mining, and fertilizer manufacture—emerged within a few years. Industry insiders Holmes, Willis, and Nathaniel Pratt marveled that the rocks had appeared as if by holy design to offer "their" state and section "redemption" during their most dire hour of need, Reconstruction.[2] In reality, the revelation had begun decades before.

The gestational period for the three industries began about 1800 and ended in 1865. Developments within the American fertilizer industry and lowcountry scientific community during the antebellum era established the foundation for commercial exploitation of lowcountry land and river rock

after the Civil War. With fertilizer, farmers realized the needs, scientists refined the formulas, and entrepreneurs marketed the new products. The lowcountry, and especially Charleston, was home to a strong tradition of agricultural science before the war, but slavery slowed the adoption of fertilizer and the development of a local fertilizer industry. The slaves themselves formed the most significant feature of the area's society and economy but only tangentially contributed to the discovery of phosphate rock as a fertilizing material. Involving local entrepreneurial and scientific talents, the Civil War was both a catalyst and an obstacle to the development of the industries. Emancipation became the major event in unleashing lowcountry entrepreneurs, scientists, and free laborers to exploit the land and river rock and to develop the region's fertilizer industry.

The American Fertilizer Industry

South Carolina's land-mining companies had their roots in the development of the American fertilizer industry. The national industry began as crude domestic soil enrichment and waste disposal, and evolved, by midcentury, into the mass marketing and production of commercial fertilizers—sophisticated chemical mixtures often made from imported materials and specifically designed to improve soil and yield. Due to increasing soil exhaustion, land scarcity, and market demand, northeastern farmers began to use homemade fertilizers in the first decades of the nineteenth century. Mid-Atlantic farmers, especially those in eastern Maryland and Virginia, experimented with fertilizers in the 1830s. Farmers and planters in the Southeast began to use some fertilizers in the 1850s, while midwesterners, especially residents of the Ohio Valley, began late in the century. Price differences (based on transportation costs and accessibility), density of cultivation, and social structure were important factors in the timing of each region's adoption of commercial fertilizers.[3]

Northern farmers were quick to realize that agriculture drained soils of crucial nutrients and that their soil needed active maintenance. Initially, farmers collected manure and other waste materials from their own farms and spread them on fields. To meet the demands of the growing population, especially in the Northeast, farmers needed greater waste supplies to increase agricultural production. Historian Richard Wines argues that

northeastern farmers, by mixing into their fields various materials from the nearby and burgeoning cities and then selling their produce back to the urban markets, fully embraced a "recycling" mentality by the 1840s. In a significant step in the evolution of commercial fertilizer, the farmers abandoned self-sufficiency for dependency on added nutrients from outside sources.[4]

Wines contends that with the substitution of Peruvian guano for locally obtained urban waste in the 1840s, the commercial fertilizer industry in the United States was born. The industry switched from bulky, locally derived, recycled material to modern commercial fertilizer manufactured from imported and nonrenewable resources. The relatively casual collection of waste materials became a large, highly organized business of importing, manufacturing, developing, marketing, and distributing. Entrepreneurs in Baltimore and other cities imported large amounts of guano from Peruvian islands, the South Pacific, and the Caribbean. Fertilizer was now a manufactured and marketed commodity to be purchased rather than collected.[5]

The American fertilizer industry created demand by training farmers to become Peruvian guano consumers. Northeastern farmers easily adopted guano, because it fit into the existing recycling system as well as their established fertilizing mentality. Guano came from city merchants, improved the soil, and helped increase production for expanding urban markets. In addition, the major guano importers were located in New York and Baltimore, making the substance both accessible and relatively affordable. In the North, the transition from farmers' intuition to "book farming" was not difficult. The result of scientific experiment and commercial marketing, complicated mixtures including guano represented merely differences of degree, rather than substantial changes in a farmer's agricultural routine. Indeed, most American farmers referred to guano as "manure" and to the later commercial fertilizers as "manures" or "guanos."[6]

Guano importation and distribution were major milestones for the development of the modern commercial fertilizer industry. Although "book farming" involved scientists, manufacturers energetically marketed fertilizer, selling brand names for the first time to increasingly demanding consumers. Farmers continually viewed the new and improving fertilizers as a necessity, not a luxury.

Guano was not the ideal raw material for the fertilizer industry. It was

costly to transport. Foreign governments began by the 1850s to demand more control over their raw materials, and guano costs rose. Northern farmers had become dependent on commercial fertilizer by this time, and rising guano prices gouged their incomes. Most significantly for price and accessibility, guano became increasingly scarce. As Peruvian sources dried up, high-grade alternative supplies of guano proved difficult to find, control, or transport. Guano imports into the United States peaked in 1856 and steadily declined thereafter. Guano had helped to change northern agriculture, but the end of the guano boom was in sight before the Civil War.[7]

Even at the height of Peruvian guano mania, merchants searched for cheaper and more abundant raw materials. "Superphosphates" were substitutes for Peruvian guano made from bones and from phosphatic guanos that helped pave the way for later adoption of South Carolina's phosphate rock. Recognizing in the 1850s the agricultural value of what came to be called bone phosphate of lime (BPL), American manufacturers burned, pulverized, and dissolved (in sulfuric acid) bones to make a fertilizer material labeled "superphosphate." Manufacturers utilized a similar process on phosphatic guanos from Caribbean and Pacific islands, also calling the result "superphosphate." Although both superphosphates were attempts to supplant Peruvian guano as the favorite fertilizer, they managed to gain only a small share of the fertilizer market. And as was Peruvian guano, bones and phosphatic guanos were expensive, scarce, and of inconsistent quality. In order to keep the retail price competitive with Peruvian guano, producers often added fillers, such as sand, which only intensified farmers' and agriculturists' suspicions.[8]

With an expanding fertilizer industry came better chemistry, or at least more scientific research. Although early superphosphates failed to overtake Peruvian guano, they did help to introduce a change of perception in soil chemistry. Aware that urban waste materials contained low amounts of important nutrients, scientists experimented to find the correct balance of nitrogen, potassium, and phosphorus to reverse soil exhaustion. Adding to the soil potassium from ashes, nitrogen from Peruvian guano, and phosphorus from superphosphates, commercial and academic scientists hoped to improve crop yields and extend soil life. Until the introduction of superphosphates, most scientists followed the "ammoniacal," or "organic," theory in claiming that nitrogen was by far the most important factor in restoring

worn-out soils. Phosphatic guano merchants, in aggressively promoting their new product, helped to change scientific orthodoxy by promoting Justus Liebig's "mineral theory." In 1843, the German agricultural chemist argued that phosphates and other minerals were more important to the soil than ammonia content. Adding sulfuric acid to make crushed bones more soluble, Liebig proved that phosphate of lime, not gelatin, was the fertilizing element in bones. By eliminating grease and gelatin from bones, he also proved that phosphate of lime from bones was identical to phosphate rock. While exaggerating nitrogen's faults and mineral phosphates' benefits, the merchants helped popularize the need for phosphate in fertilizer. Although English and American manufacturers had added small amounts of phosphate rock to commercial fertilizers since 1845, the material did not immediately assume major importance. In 1855, John Ketterwell added Mexican guano, which contained no ammonia but high BPL (50–60 percent), to Peruvian guano to produce Ketterwell's Manipulated Guano. In the decade after the Civil War, "complete" fertilizers—those that included high concentrations of potassium, nitrogen, and phosphorus—gradually became the industry standard. Most importantly for the South Carolina fertilizer industry, with the dissemination and acceptance of Liebig's theory, a large and increasing demand for phosphate rock began.[9]

Fertilizer in the South

Although fertilizer consumption increased throughout antebellum America, it took a significantly different path in the South. While northern farmers identified and acted on soil problems, and substantially increased their fertilizer use over the first half of the century, southern planters began talking about soil exhaustion in the 1830s but used comparatively little fertilizer before the Civil War. Scientists and agricultural reformers published papers and gave speeches for agricultural societies, and letters to the editor after 1850 reflected a growing sense of panic about southern soil conditions. This sense of alarm only increased as war and the consequent need for self-sufficiency approached. However, few southern fields received adequate amounts of any fertilizer, and many farmers and planters generally avoided commercial varieties. Use of manure was scattered and ineffective. Peruvian guano and its substitutes made some headway in the upper South

and near coastal cities in the 1840s, but dealers' hype obscured the reality that only a small minority did more than experiment with the materials before the late 1850s.[10]

Economically based on plantations and slaves, the antebellum South held fast to soil-depleting agricultural methods and remained a poor candidate for increased commercial fertilizer use. The result was an agricultural system that exacerbated the national fertilizer industry's major weaknesses—price, quality, and supply. While successful northern farmers intensively cultivated smaller fields near cities using family labor, southern planters farmed huge tracts of rural land with slave labor. Planters and yeomen farmers in the South found the new commercial fertilizers too expensive, uneven in quality, and often inaccessible.

Rural southerners did not become enthusiastic fertilizer consumers before the war. Inadequate transportation networks increased fertilizer prices and decreased availability. Poor communication networks left rural farmers ignorant of proper fertilizing methods. Immature channels of capital flow left most without a way to purchase fertilizer on credit. The South had comparatively few urban centers, and consequently, the vast majority of farmers and planters lived far from city waste, the keystone of the North's recycling system. No farm could supply enough manure for adequate fertilization. Without a homegrown fertilizing mentality, southern farmers developed and maintained a severe skepticism toward "book farming" and the industry's Yankee promoters. Most fundamentally, the limitations of slavery and the plantation system made the extensive farming of large tracts a logical option but intensive farming a virtual impossibility. Only the most ardent reformers were willing to undertake a major commitment to manure collection, storage, and distribution. Fertilization, crop rotation, and deep plowing made little sense to planters who controlled an indifferent labor supply. Centuries of this type of farming left southern soils nutritionally deficient. While planter-led southern state governments defended their peculiar institution as the ideal social and agricultural system, the reality was declining crop yields and poor soil conditions. Commercial fertilizers made little headway in this environment.[11]

Historians Eugene Genovese and Gavin Wright suggest several specific obstacles to greater fertilizer use within the slave South. Genovese argues that agricultural reform in the Southeast, including the adoption

of fertilizer, proceeded "slowly and painfully" and that the region's failure to fight soil exhaustion became "one of the most serious economic features of its general crisis." The slave labor system contributed to poor agricultural practices, low capital accumulation, and the inability to buy adequate amounts of commercial fertilizers. In a society whose wealth was tied up in human capital, little liquid capital was available for fertilizer purchases. Wealthy planters in the Deep South owned slaves and land but not cash. Only in Maryland and Virginia were planters, through sales of surplus slaves to the Lower South, able to afford improved agricultural methods, including the use of fertilizer. Genovese contends that in passively resisting their condition, slaves were careless with tools and in cultivating fields, and consequently, planters felt that any program of fertilization would be "of doubtful outcome" with slave labor. The vast increase of slave supervision, as more slave labor would be needed to gather, store, and apply manure, discouraged most planters. Even had planters been willing to increase supervision, inadequate manure supplies were another roadblock. Antebellum planters generally kept a small number of livestock, and consequently, manure for cotton fields was in short supply.[12]

The peculiar institution helped to undermine planters' need to practice intensive farming. As Wright suggests, the mobile "laborlords" had two-thirds of their wealth tied up in slaves and were primarily interested in maximizing labor output, not land values. Planters were "land killers" and considered land productivity, town building, internal improvements, and a modern financial system low priorities. Many considered moving to the Southwest a better alternative than improving their "old" soils. Those who stayed in the Southeast kept alive a tradition of indifferent soil husbandry that left only the most successful planters able to afford expensive fertilizers. Not surprisingly, the exhortations of southern agricultural reformers made little headway with laborlord elites. While Wright argues that planter priorities rather than the quality of slave labor limited agricultural reform in the South, both Genovese and Wright think that soil exhaustion was a fundamental weakness in the slave South. And soil exhaustion was an important part of the cycle involving poor yields, lack of capital, expensive slaves, and abundant land that helped discourage planters from purchasing fertilizer.[13] Neither manure nor commercial fertilizer made much of an impact across the South before the Civil War.