SOUTH CAROLINA LAND PHOSPHATES IN THE LATE NINETEENTH AND EARLY TWENTIETH CENTURIES: TOWARD AN ARCHAEOLOGICAL CONTEXT

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What is Phosphate?

Phosphorus (P) is one of 17 nutrients required by all living plants and animals; deficiencies of this element in soils are a major cause of limited crop production. When P fertilizers are added to soils deficient in the available form of this element, increased crop yields generally follow.

Phosphorus, however, is highly reactive and is not found in its elemental form naturally. Instead it occurs as phosphate – a charged group of atoms, or an ion. Made up of a phosphorus atom and four oxygen atoms (PO_4) it has a negative charge and readily combines with other atoms and molecules within living organisms to form a variety of compounds essential to life. In inorganic chemistry, a phosphate is a salt of phosphoric acid. As a consequence, we do not mine phosphorus – we mine phosphate rock.

In 1840 Justus von Liebig, a German scientist, made the first clear, intelligent exposition of the role of minerals in plant growth and laid the ground work for modern agricultural science. He demonstrated that insoluble phosphates, readily available as bone, could be made to release their phosphorus in a form more quickly accessible to growing plants if they were first treated with sulfuric acid. Building on this, John Bennett Lawes, an Englishman, treated the readily available English fossil coprolites with sulfuric acid. By 1842 he had obtained a patent on his process and the first "superphosphate" was commercially available.

Normal superphosphate is a fertilizer containing 15 to 21% phosphorus as phosphorus pentoxide (P_2O_5). It is created by reacting ground phosphate rock with 65 to 75% sulfuric acid (virgin acid is preferred) (Mann 1992). The quality of phosphate rock is generally identified by its content of tricalcium phosphate ($Ca_3P_2O_8$), called bone phosphate of lime (BPL). Chemical analyses are usually reported as the P_2O_5 percent (phosphoric acid) or percent of BPL (1% BPL = 0.485% P_2O_5).

Within 20 years of Lawes' patent, the British were producing 150,000 tons of superphosphate a year. The coprolites, however, had a relatively low yield. With the discovery of rich deposits of rock phosphate in South Carolina after the Civil War, the American industry took the lead in both mining and fertilizer production.

South Carolina's Phosphate Beds

Synthesizing in the way that only newspapers can do, a June 4, 1868 *New York Times* article entitled, "The South Carolina Deposits of Bone Phosphate," described the phosphates:

> they frequently crop out of the surface, and are commonly found in strata from one to two or more feet in thickness, dipping from the surface to eight or more feet below it – generally the deposit is from one to two feet.

A later article, again in the *New York Times* ("South Carolina – The Phosphate Region, April 8, 1871), quoted local scientist Francis S. Holmes as observing that the rock strata were typically 15 to 18 inches in depth, with the average yield being about 600 tons per acre, although "there are many 'diggings' now returning eight hundred and a thousand tons per acre."

A decade later the *New York Times* gave a very similar account:

> while the prevailing level is not more than 10 feet above high-water mark. . . . I did not see any land mines of more than 6 feet in depth. . . . The land mines exhibit very slight differences in level, though beds are found underlying hundreds of contiguous acres. The yield of clean, dry rock varies from 300 to 1,200 tons an acre, the average yield of the land beds now worked being from 700 to 800 tons an acre. . . . nodules of egg-like, or kidney, form. The exterior of these nodules is rough and even honeycombed by irregular cavities as a generality; though they are also found of smooth and compact shapes. The nodules vary greatly in size; some are less than an inch, some are several feet, in diameter. . . . When the phosphate nodules are freshly dug they emit, under friction, a very unpleasant fetid odor, which is doubtless due to the organic matter which they contain; and before the discovery of their great value the negroes called them "stinking stones." ("Digging Phosphate Rock – Scenes at the Great South Carolina Mines, *New York Times*, October 18, 1881).

Otto A. Moses reported that the phosphate beds close enough to the surface to be profitably mined using hand labor were "about equally distributed in the counties of Beaufort, Colleton, and Charleston" (Moses was writing just before Berkeley County was carved out of Charleston County; much of his study area came to lie in Berkeley) and were called, respectively, the Coosaw, Edisto, and Ashley Deposits (Moses 1882:504). By the early twentieth century Chazal was a little more precise:

> Beginning from their Northern limit, however, the principal beds may be divided into general groups, which may be designated as follows
> Wando River beds.
> Cooper River beds.
> Northeastern Railroad and Mount Holly beds.
> Ashley River beds.
> Stono River beds.
> Edisto and Ashepoo beds.
> Coosaw River beds.
> Beaufort River beds (Chazal 1904:2; see also Rogers 1915:200-202).

He notes the Ashley River Beds had thus far provided the "greater part of the output of land rock" (Chazal 1904:3; Rogers 1915:201), although a "large and very valuable body of rock land of good quality and moderate depth" was found to the west of the Ashley, towards the Stono River, Rantowles Creek, and Bear Swamp. Chazal remarks that while this area had seen "almost continuous mining from the commencement of the industry" the beds are so large "that there has not been the same proportion of removal as on the opposite bank of the river" (Chazal 1904:4). The importance of the Rantowles Creek deposits was early reported by Rowland (1883:1008), who also noted that these deposits occurred "at a remarkably uniform depth."

Moses explained that the beds were all very physically different – it was only the peculiar odor, the chemical analyses, and the similar fossils that "unite them into one and the same group" (Moses 1882:508). He goes on to observe that the average rock contained 53-60% phosphate of lime, 5-10% carbonate of lime, and 1-10% moisture. Moreover, the rocks all contain much organic matter that is "highly nitrogenous, and is analogous to the oils of bituminous shales" which upon heating (during the drying process) "greatly assists combustion," more quickly drying the rock

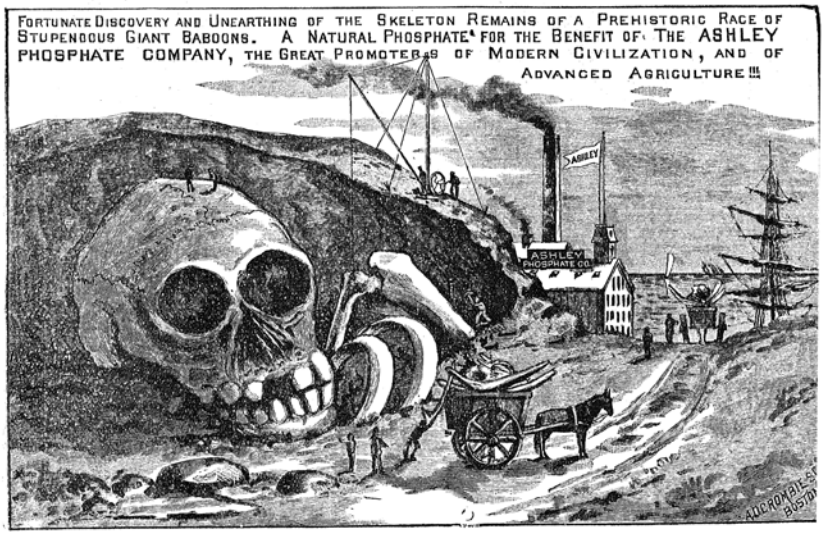


Figure 12. Ad for Ashley Phosphate based on the concept of the phosphate resulting from fossil deposits (from Holmes 1870).

(Moses 1882:510).

The phosphate rock lay in what Waggaman reports had been called the "'Fish Bed' of the Charleston Basin on account of the numerous teeth and bones of marine animals contained therein." This belt was about 20 miles in width, extending from the Wando River in Charleston County to the Broad River in Beaufort County (Waggaman 1913:2). The phosphates occur:

> embedded in a matrix of sand, clay, and calcareous mud. The beds vary from a few inches to 3 feet in thickness, with an average thickness of approximately 1 foot. The nodules average from 30 to 50 percent of the phosphate stratum, and the beds will yield from 300 to 1,500 tons of phosphate per acre, with an average of about 850 tons. The beds, as a rule, do not follow the contour of the land surface, but lie nearly horizontal. The overburden, therefore, varies considerably from place to place. . . . The South Carolina phosphates occur in nodules varying from the size of sand grains to bowlders [sic] weighing several tons. The rock varies in hardness and texture from soft porous materials to hard, lustrous, flinklike pieces. The nodules are sometimes smooth rounded or kidney shaped, closely resembling "coprolites," but more often they are irregular in shape, pitted or completely perforated, the holes usually being filled with sand and clay, which had to be removed by washing. In color the rock varies from grayish white to almost jet black, and between these two extremes there are a variety of shades of red, yellow, and brown (Waggaman 1913:4-5).

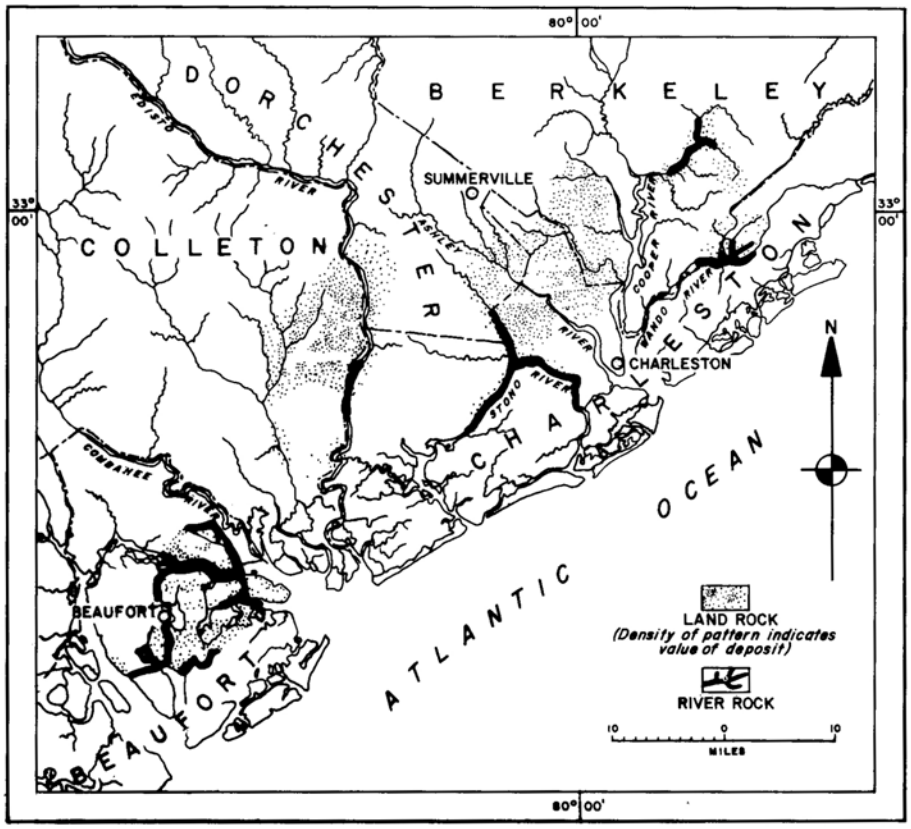


Figure 13. Distribution of phosphates in South Carolina (from Rogers 1915).

While the various descriptions of the phosphate deposits are generally similar, there remains controversy concerning the origin of these deposits. As late as the second half of the twentieth century Malde (1959:70) provided no theory of origin, focusing instead on the rocks' properties. Mappus notes that a variety of theories have been offered to explain the origin of the rock, although most were based on significant misconceptions of the geological relations of the deposits (see, for example, Holmes 1870). She notes that the most commonly accepted theory was the "residual soil theory" of Rogers (Mappus 1938:1-3; see Rogers 1915:205-209).

Rogers believed that Cooper marl formed on land surfaces during the Oligocene and early Miocene, during which time it suffered erosion with the coarser materials accumulating as re-sidual soils. By the end of the early Miocene the Cooper land surface was covered with an irregularly distributed, but highly phosphatic residual soil. At the end of the Miocene the region was depressed and fossils were added. As the ground level re-elevated a thick deposit of phosphate materials was exposed to dissolution. The phosphate then precipitated where the water stood in contact with lime carbonate. This concentrated the phosphate at the bottom of the Edisto marl. Additional fossils were added on top of the phosphate beds, but were not incorporated in the mass (see also Murphy 1995:110).

More recently Albert Sanders (2002) reported an undisturbed phosphate bed in the heart of the phosphate mining region. He reports that the upper 2.7 feet deposit was the late Pleistocene Wando Formation, with lower 0.7 foot representing lag deposits of phosphate rock and reworked bone – suggesting that the majority of the phosphate deposits are from the lower Wando Formation. Below the phosphates were the Penholoway Formation and deeper the late Oligocene Ashley Formation. This suggests that the phosphate deposits are more recent than previously thought.

Origin of the Industry

Newspaperman and local historian Chalmers Murray discusses the close-minded attitude South Carolina planters held toward

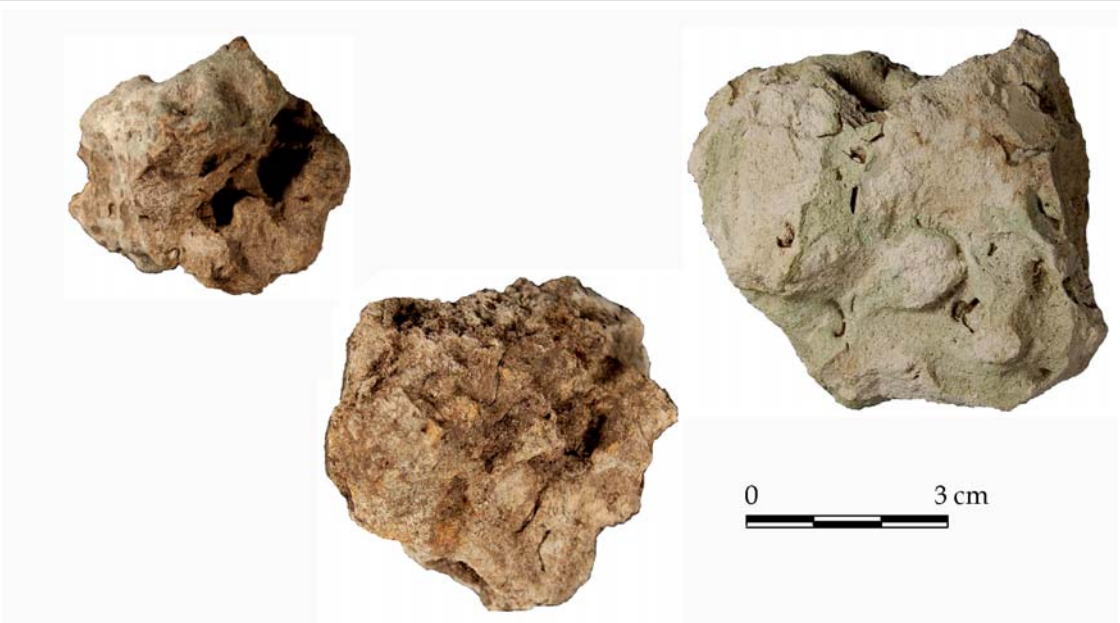


Figure 14. Examples of phosphate rock found at the Bulow Mine, showing the range in size and color from this one location.

new crops and new methods in the decade just before the Civil War. He cites an 1855 agricultural report of the U.S. Commissioners of Patents, that "according to the communications received by the patent office, the most popular fertilizers of the time were barnyard manure, guano, superphosphate, green sand and marl, and green clover plowed into the soil. None of the letters came from below the Mason and Dixon Line" (Murray 1949:120-121).

McKinley (2003) provides a rather detailed analysis of the discovery of rock phosphate, the gradual recognition of its potential, and the extraordinary need presented by the worn and often abandoned agricultural fields of the South. The American fertilizer industry was built on guano – the droppings of sea birds and bats that are high in both phosphorus and nitrogen. While never heavily used in the South, there are advertisements such as the one shown in Figure 15, appearing in 1867. Northern farmers became devoted users; with increased use, combined with political instability and nationalism abroad, the price of guano rose – making it increasing inaccessible to northern farmers (McKinley 2003:24). In its place American fertilizer factories began to focus on superphosphates, using bone as their source of raw material.

Southern farmers often "found the new commercial fertilizers too expensive, uneven in quality, and often inaccessible" (McKinley 2003:28). Nevertheless, fertilizers gradually gained acceptance, likely because superphosphates were less expensive than guano (McKinley 2003:35).

PERUVIAN GUANO.

DIRECT FROM AGENTS AT MARKET RATES.

SOLUBLE PACIFIC GAUNO, $75 Cash, $80 1st November, with interest, approved City acceptance.
SWAN ISLAND GUANO, $20 Cash, $25 1st November with interest, approved City acceptance.
BAUGH'S PHOSPHATE LIME, $60 Cash, $65 1st November, with interest, approved City acceptance.
PHŒNIX GUANO, $55 cash.
FLOUR OF BONE, unadulterated and unburnt.
FARMER'S PLASTER OR GYPSUM, warranted pure.
In offering the above Manures to Planters, I do so with every confidence, not only having testimonials from Planters who have used them the past year, but the further guarantee, that every cargo as it arrives from the Factory, is analyzed by Prof. SHEPARD of the South Carolina Medical College, and the high reputation of these manures fully kept up. J. N. ROBSON,
January 1 13mos 6 3 East Bay.

Figure 15. Advertisement for guano in the Charleston *Daily Courier*, January 1,

Figure 16. Mining guano off the Peruvian coast, ca. 1860.

McKinley (2003) and Waggaman (1913) – among others – point out that the gradual recognition of phosphate rock's importance dates prior to the Civil War. The process includes such gentlemen scientists as Edmund Ruffin and his agricultural survey of South Carolina – although he was blinded to the potential of phosphate by his single-minded focus on marl -- and Francis S. Holmes, although he, too, remained focused on marl and its fossils. It was Charles U. Shepard who first recognized the importance of phosphate rock – as well as the first to promote the mineral theory of Liebig in South Carolina (McKinley 2003:52, 58; Waggaman 1913:2).

The Civil War brought together and influenced some of the more significant phosphate scientists and fertilizer pioneers of the postbellum – Nathaniel A. Pratt, St. Julien Ravenel, David C. Ebaugh, Christopher G. Memminger, and George A. Trenholm. It was not, however, until after the Civil War that phosphates came into their own.

Hanahan (1927:84-85) remarked in 1927:

> Coming out of the Confederate war, the men of South Carolina had no industry to engage their attention but agriculture, and it was more than ever necessary that the lands be made to produce increased yields; then, too, the one crop that South Carolina could raise, cotton, was in great demand at high prices. In 1866, the attention of Shepard, Ravenel, Holmes and Pratt was centered on the utilization of the phosphate rocks, which were now known to exist in large quantities near Charleston, for the manufacture of commercial fertilizer.

Whitney (1985:1) explains that it was St. Julien Ravenel "who discovered the nature of the rock, and realized he was sitting on a gold mine." Nevertheless, McKinley notes that Ravenel did nothing with this information, at least initially, suggesting that he either doubted the claims or did not fully appreciate the possibilities until later (McKinley 2003:94). Waggaman (1913:2) spreads the credit evenly between Ravenel, Holmes, and Pratt, observing that it was Pratt who obtained the "first recorded analysis of high-grade South Carolina phosphate." Pratt also identified the core of the South Carolina phosphate region – the Ashley River region – and established the standard of 55% BPL for phosphate rock (McKinley 2003:95).

Ravenel, with David C. Ebaugh and Charleston factors C. Dukes & Company, began the Wando Fertilizer Company with $100,000 of Southern capital (McKinley, however, observes that it uncertain whether this represents actual or pledged capital; McKinley 2003:90-91). The firm set up impressive – and formidable – works

at Palmetto Wharf on the Cooper River, including an iron crusher and pulverizer (to crush and then pulverize the phosphate rock, increasing its reactivity), and a mixer (to mix the sulfuric acid with the crushed rock in order to create superphosphate). Having no source of local sulfuric acid, McKinley notes that they were importing the acid (McKinley 2003:91).

Pratt and Holmes formed a competing organization, with Holmes bringing to the table a huge acreage in the Ashley River basin. They were, however, far less successful in finding Southern investors (McKinley 2003:97-98). It remains unclear why one team was so immediately successful at raising capital, while the other was not. Certainly there was no perceivable difference in skill or expertise. Although McKinley does not tackle this issue directly, he does note that, "generally stingy in non-agricultural investments before the war, and paralyzed by war and emancipation, Charleston's planters and factors were even more conservative and cautious in what they perceived to be the socially revolutionary and financially ruinous atmosphere of Reconstruction" (McKinley 2003:98). This is certainly an adequate explanation, except that it still fails to explain one success against the other failure. Perhaps more to the point was the comment from a local businessman:

> Dr. Pratt, do you, only recently come among us from Georgia, expect us to believe you, when you say that this material is worth and will bring $20 to $25 per ton, while men like Lyell, Agazziz, Tuomey, Ruffin, Holmes, Shepard, Hume and other, have known and handled it for twenty-five years? Excuse us, we cannot believe it (quoted in McKinley 2003:98).

Reading between the lines, we see South Carolina's historic parochialism, coupled with xenophobia. Pratt, although from another Southern state and a well respected ex-Confederate, was not from South Carolina or Charleston's historically closed community.

It is then particularly ironic that after being snubbed by Charleston's business community and looking northward for capital, Pratt and Holmes were roundly criticized for enlisting "foreign capital" (McKinley 2003:103). Nevertheless, Pratt and Holmes found the needed capital in the partnership with George T. Lewis and Frederick Klett. The latter was an industry leader and president of Potts & Klett, a sulfuric acid and superphosphate manufacturer, while Lewis was a prominent chemical manufacturer (McKinley 2003:105). Together they organized the Charleston, South Carolina Mining and Manufacturing Company in September 1867.

Several decades after the fact, the Charleston *News and Courier* reported:

> The first cargo, one hundred tons, was shipped by the schooner *Renshaw*, on the 14th of April, 1868, to Baltimore, Md. By John R. Dukes, Esq., president of Wando Company, Charleston. The Charleston Mining and Manufacturing Company shipped to Philadelphia three hundred tons, per schooner *Anna Barton*, on the 18th, four days later (News and Courier 1884:54).

Although both companies shipped phosphate rock at approximately the same time, the Charleston Mining and Manufacturing Company quickly dominated the land rock field. Within a year the company owned over 10,000 acres on both sides of the Ashley River and controlled, through long-term leases, an additional 10,000 acres (Table 1).

McKinley discusses the range in prices for phosphate lands ($2.94 to $40.00 per acre – or

Table 1.
Plantations Purchased by Charleston Mining and Manufacturing
(adapted from McKinley 2003:Table 2.2)

Plantation (Owner)	Acres	Cost ($)	$/Acre	$/Acre (2002$)
Ashley Hall (Holmes)	250	10,000	40.00	482.00
Hickory Hill (Banks)	277	3,500	12.64	152.00
The Oaks (Ramsey)	750	5,000	6.66	80.00
Clear Springs (Cothers)	1,000	6,000	6.00	72.00
Marysville (Lamb)	1,000	10,000	10.00	120.00
Blacksmith (Goodrich)	3,872	45,000	11.62	140.00
Simmons Hill & Hacket Hall (Yates)	1,700	5,000	2.94	35.00
Feteressa (McPherson)	695	5,280	7.60	92.00
Pringle Farm (Pringle)	250	4,500	18.00	217.00
Turnbull (Commins)	806	7,400	9.18	111.00
O'Neill Farm (O'Neill)	149	1,500	10.07	120.00
	10,749	103,180	12.25	147.36

$35 to $482 in 2002$), noting that a variety of factors likely came to play. For example, although Joseph A. Yates received the lowest amount, he was also made superintendent of Charleston Mining and Manufacturing (McKinley 2003:111). Perhaps more interesting is the motivation behind the decision to sell family lands, regardless of the price. McKinley observes that the Radical Republican government in South Carolina created an aggressive tax policy in order to raise the funds necessary to enlarge state services. Large landowners were confronted with significant tax bills and limited agricultural potential. Moreover, lands that were – prior to phosphates – selling for $2 an acre did advance dramatically in price.

A sample phosphate lease provides some insight on the activities that took place during this early period of exploration and land accumulation. The April 24, 1868 agreement between Ottolenquin A. Moses (later Otto A. Moses who worked for the U.S. Geological Survey) of Charleston and William L. Bradley of Boston describes the lease of what is likely the Eight Mile Pump tract.

> On 4/24/1868, Horace Massot conveyed to Moses the right and privilege of by himself or his agents entering upon all or any part of the 113-acre tract in the Parish of St. James, Goose Creek [today's Berkeley County] that was conveyed to Massot by G. W. and R. G. Reynolds . . . for the purpose of searching for minerals and fossil substances, conducting mining operations to any extent deemed feasible, and for working, removing, selling, and as the property of Moses, to use and appropriate for 10 years from 4/24/1868 all organic or inorganic minerals, rocks, fossils, marl, or so-called phosphates that may be by any person or persons found on the tract, with the right at all times in order to facilitate said Moses in [these activities], to cut and remove any trees, wood, and timber – reserving the property in the trees, wood, and timer removed to Massot to dispose to his advantage. Moses shall not at any one time engage in working more than 1/3 part of the tract. Moses may select the part to be worked, and make such selection as often as he desires. Also a right-of-way to construct a railroad or other road for removing, transporting, and delivering from the quarries such minerals, rocks, marls, fossils, and so-called phosphates, and constructing and erecting any machinery used in the extraction, preparation, manufacture and

> transportation, with the right to remove the machinery at the end of the term. By this agreement, Moses assigns to Bradley his rights on the land at the west side of land owned by Northeastern Railroad Company, which runs through the plantation, for the unexpired term of the agreement between Moses and Massot. Moses covenants that the premises will yield 45,000 tons of phosphate strata, providing the same be dug out and removed from the land and weighed in a faithful and workmanlike manner. Bradley may dig where and as he please, provided it is not more than 1/3 of the tract at any one time. Bradley to pay Moses $45,000 in nine equal annual payments, the first 4/1870. Bradley will thoroughly dig over and in a faithful and workmanlike manner collect the phosphate strata in the portion of the land, to wit all 113 acres west of the railroad. He will pay Moses $1/ton (2240 lb. tons). The quantity and weight to be measured at the port where it is delivered by Bradley, a copy of the bill of lading to be provided to Moses. Moses retains the right to dig and remove for his own use, 2000 tons (2240 lb. tons) at no charge(Charleston County RMC, DB B16, p. 217).

The preceding agreement, between Moses and Massot granted Moses the right to dig and explore the same as in the agreement between Moses and Bradley, with Moses paying Massot $2,000 ($25,300 in 2002$) (Charleston County RMC, DB F15, pg. 515). At each step there was a notable increase in the profit margin – from Massot to Moses, $2,000; from Moses to Bradley $45,000 ($529,600 in 2002$); then, should Bradley succeed in mining the anticipated 113 acres with 45,000 tons of rock, he could count on a profit of perhaps $112,500 ($1,124,000 in 2002$).

Although the Charleston Mining and Manufacturing Co. dominated the land rock industry, this does not imply that Wando faltered – as implied by Chazal (1904:49). McKinley observes that the company's business plan focused not on land mining, but on fertilizer production. Wando initially depended on foreign rock for its fertilizer production, although by December 1867 began acquiring local interests and marketing itself making fertilizer affordable for local farmers (McKinley 2003:133-134).

A Brief Review of Land Rock Companies

There is yet to be produced a thorough history of the land rock companies – surprising given their significance (albeit brief) to the local economy. This review lists some of the more common companies prior to the twentieth century.

"An Augusta, Georgia Co."

This ambiguous reference (Anonymous 1870:77) adds only that the company was mining "on the line of the Northeastern Railway, about 10 miles" from Charleston.

Ashley Phosphate Mining Co.

Operating on the Middleton lands, the president was Charles C. Baker of Baltimore, with Williams Middleton as the local agent and superintendent. By 1870 "a very effective washing apparatus built by J.M. Eason & Brother" had been erected at the mines (Anonymous 1870:77). This company advertised its use of the Duc Atomizer Mill, invented by H.A. Duc, Jr. of Charleston, to create floats – very finely ground phosphate. The company explained to its consumers:

> floats will not be found in any manner or degree a substitute for Acid Phosphate . . .; and we can only recommend its use as an adjunct; . . . where one can afford to wait for tardy and remote results . . . (Anonymous 1882a:27).

McKinley (2003:223-242) provides an excellent account of these operations.

Atlantic Phosphate Co.

This company, begun in December 1870, had apparently purchased the Livingston Farm on the Ashley River and was in the process of connecting its mines "on a fine bluff" with the South Carolina Railway. The capital was $200,000 and F.J. Porcher was president (Anonymous 1870:78; Chazal 1904:85; Holmes 1870:85). The company is also cited by the Stono Board as selling their product so inexpensively as to eventually cause the Stono Phosphate Co. to dissolve (Stono Phosphate Co. Minutes, 1881-1888, South Caroliniana Library). In 1889 the Atlantic Phosphate Co., with capital of at $200,000, received a "high" credit rating (R.G. Dun & Co. 1889).

Berkeley County Phosphate Co.

This company has been identified only in the 1889 credit report of R.G. Dun & Co. (1889), where it was reported to have a high credit rating, although its capital was under $35,000. It is unclear whether this firm was engaged in mining or perhaps only fertilizer production.

Bolton Phosphate Mines

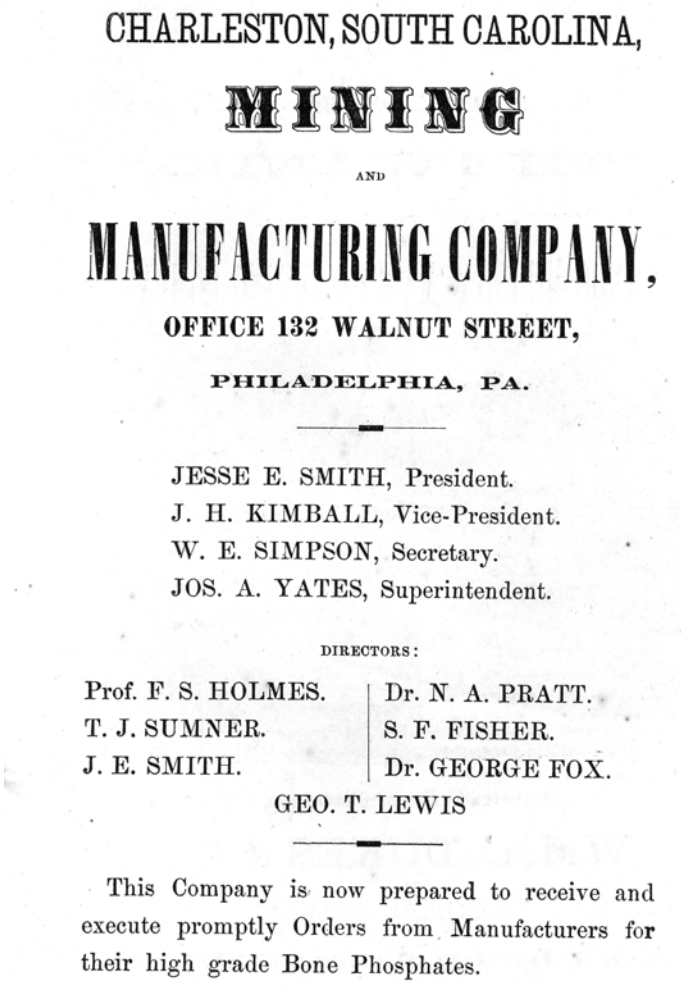
The Bolton Mines were established on a Stono River tract of nearly 3,000 acres. David K. Jackman and Milton Courtright paid $36,000 for the tract in 1867 (Charleston County RMC, DB A15, p. 150). Jackson subsequently conveyed his interest to Courtright, an industrialist and railroad engineer of Erie, Pennsylvania.

Apparently a controlling interest, at least for a time, was the London firm of Wylie & Gordon (Anonymous 1884). About this same time St. Amand reported J. C. Houston managed the Bolton Mines (Clarence W. St. Amand Journal, pp. 49, 61, South Carolina Historical Society). Wyatt (1891:55), however, notes these mines were being operated by K.S. Tupper but were poorly capitalized at only $50,000. The 1884 *News and Courier* article, "There's Millions in It," notes that the Bolton plant had a value of $25,000, employed 200 hands – both Italians and African Americans – and mined 15,000 tons of rock annually. The Edward Willis Scrapbook (South Caroliniana Library) notes that the Bolton mine was also operated by Carolina Fertilizer Company. In 1889 the Bolton Mines, with capital of under $300,000, was given a "high" credit rating (R.G. Dun & Co. 1889). By the early twentieth century Chazal (1904:65) noted that the mine, "while operated by its owners or lessees, sells its whole output to the Virginia-Carolina Chemical Company."

A long-term lease of the land to Bolton Mines Company, signed in 1909, remained in effect when Courtright's son-in-law and grandson conveyed their partial interest to Peter B. and Robert S. Bradley in 1911 (Charleston County RMC, DB U50, p. 387). The other Courtright heirs remained involved with the Bolton operation.

W.L. Bradley (Carolina Fertilizer)

Although previously associated with Carolina Fertilizer, Moses (1882:519) reports Bradley conducting business under his own name, with land mines at Rantowles Creek – what we know as Bulow Mines. Wyatt (1891:55) lists the capital at $250,000. These operations are listed under Bulow by the *News and Courier* article, "There's Millions in It," reporting that the mines produced 30,000 tons using a work force of 350. Not surprisingly, given the


CHARLESTON, SOUTH CAROLINA,

MINING

AND

MANUFACTURING COMPANY,

OFFICE 132 WALNUT STREET,

PHILADELPHIA, PA.

JESSE E. SMITH, President.
J. H. KIMBALL, Vice-President.
W. E. SIMPSON, Secretary.
JOS. A. YATES, Superintendent.

DIRECTORS:

Prof. F. S. HOLMES. | Dr. N. A. PRATT.
T. J. SUMNER. | S. F. FISHER.
J. E. SMITH. | Dr. GEORGE FOX.
GEO. T. LEWIS

This Company is now prepared to receive and execute promptly Orders from Manufacturers for their high grade Bone Phosphates.

Figure 17. Ad for Charleston Mining and Manufacturing Co.

exceptionally large company he represented, Bradley was given an A+ credit rating (R.G. Dun & Co. 1889).

Campbell and Hertz

This firm is mentioned by Wyatt (1891:55) as mining on Rantowles Creek, although it had only $50,000 in capital.

Carolina Fertilizer (W.L. Bradley)

Holmes (1870:84) mentions this firm, noting they were working at Eight Mile Pump on the Northeastern Railroad on lands owned by a Mr. Masseau (Massot), leased to a Mr. Moses, and worked by W.L. Bradley. The resulting phosphates were sold by George W. Williams & Co. The Edward Willis Scrapbook (South Caroliniana Library) notes that this company was mining at 9 Mile, Bolton, and the Bulow Place (see also Anonymous n.d. a). In contrast to many other firms, Carolina Fertilizer was given only a "good" credit rating by R.G. Dun & Co. (1889).

Charleston Mining and Manufacturing Co.

Briefly discussed above, the company began with $100,000 in capital and over 10,000 acres of phosphate lands on both sides of the Ashley River, with leases on 10,000 additional acres. Their initial operations were confined to mining the rock which was shipped in its crude state to Philadelphia (Anonymous 1870:76; see also Holmes 1870:74-77). The mine produced 60,000 tons using a labor force of upwards of 800 – 300 of whom were Italians, the rest African Americans (Anonymous 1884). The article also reported that the stock paid an unbelievable dividend of 14%. Those laboring for these profits were being paid an average of $1.00 a day. One of the early properties, the 922 acre Maryville-Soldiers Retreat Plantation on the Ashley River, became known as Lamb's for its former owner, David W. Lamb. Lambs Mill was the most convenient for the Drayton Hall mines across the river, and its railroad stop became a center of activity. About 1890 the company gave up its works at Lambs to build a new Ashley River plant at Fetteressa Plantation (today with the Evanston Estates neighborhood), only later to return to Lambs (Fick and Stockton 1995:55-56; see also Chazal 1904:61-62). The 1890 South Carolina Business Director (Anonymous 1890) locates the company at Fetteressa.

Chicora Mines

Holmes notes only that this company owned mines on Filbean Creek (Holmes 1870:84).

L.W. (or Laurens N.) Chisolm

Listed by Moses (1882:519) this individual was reported to have land mines on the Ashley. The 1884 *News and Courier* article, "There's Millions in It" reports that the Chisolm works, with $60,000 capital, produced 10,000 tons of rock using 175 laborers. The property, with 640 total acres, had about 125 acres of rock. The "Chisolm Mines" continues to be mentioned into the early twentieth century (Watson 1916:106). The 1889 credit report listed this company as in the phosphate business with less than $75,000 in capital and a "good" credit rating (R.G. Dun & Co. 1889).

Cox (William Cox)

The *News and Courier* article, "There's Millions in It," reports these works on a 318 acre tract, with only $5,000 in capital, were producing only 600 tons using 10 workers. We know that William Cox was also in charge of the field work at the Bulow mines (Anonymous 1884).

Dotterer

Although listed as the Superintendent of the Wando mines, Wyatt (1891:55) suggests the individual, with $25,000 in capital, may have struck out on his own. This is also suggested by the *News and Courier* article, "There's Millions in It," that reports a Dotterer with $50,000 in capital removing 6,000 tons of rock using 50 employees. This may also have been Dotterer & Ravenel (Mappus 1938:44). The firm, listed as Henry Doterer, was given only a "fair" credit rating, with capital listed as less than $2,000 (R.G. Dun & Co. 1889).

Drayton's Phosphate Mines

These works were mentioned by the News and Courier (1884:54; see also Wyatt 1891:55) and were located on the Ashley River. The mines annually produced about 10,000 tons using around 180 workers (Anonymous 1884). McKinley (2003:146-151) provides additional background, including the brief and under funded efforts to mine the Drayton property by Frank H. Trenholm, the son of George A. Trenholm.

Eureka Mining Co.

Wyatt (1891:55) lists this firm as having $40,000 in capital and operating on the C&S Railroad in the Jacksonboro area.

Farmers' Fertilizer Co.

In 1870 this company "contemplates digging for phosphates and manufacturing sulphuric acid" (Anonymous 1870:78). Its capital was listed at $200,000. The president was William G. Whilden and Henry T. Peake was the superintendent. They apparently had lands at Phosphateville, as well as on Shipyard Creek, "contiguous to the Etiwan works" (Etiwan was initially the Sulphuric Acid and Superphosphate Company and it appears to have only produced fertilizers). Holmes announces that they were erecting a fertilizer mill on the Ashley River and they claimed capital of $150,000. As for mining, he notes only that they "have lands under their control" (Holmes 1870:86). The firm was given a "good" credit rating in 1889 (R.G. Dun & Co. 1889).

F.C. Fishburne

Listed by Moses (1882:519) this individual was reported to have land mines on the Edisto. Wyatt (1891:55) listed the mine location as the Pon Pon River, with the company reporting only $50,000 in capital. The mine apparently opened in 1874 on about 6,000 acres of land using blacks and Italians (Anonymous

1884). The firm is reported to have had less than $10,000 in capital and a "good" credit rating in 1889 (R.G. Dun & Co. 1889).

Julian F. Fishburne

Listed by Moses (1882:519) this individual was reported to have land mines on the Ashley at Middleton Plantation (Mappus 1938:39). The 1890 South Carolina Business Director (Anonymous 1890) locates F.C. Fishburne at Jacksonboro.

Gregg's Phosphate Mines (see also Horse Shoe Mines)

Moses (1882:519; see also News and Courier 1884:54) notes that these mines were on the Ashley (at the 4,000 acre Wragg Smith place) and were operated by William Gregg. Wyatt (1891:55) reports only $50,000 capital; nevertheless, 30,000 tons of rock were mined by a force of 350 workers – 150 of whom were convicts, the remainder African Americans (Anonymous 1884).

Hannahan Mines

Wyatt (1891:55) identifies these mines as being on the Cooper River although the company had only $50,000 in capital.

Harleston & Cheves

Listed by Moses (1882:519) the company was reported to have land mines on the Ashepoo River. It ceased operation by 1884 (Mappus 1938:45).

Hertz & Warren – Archdale Mines

Wyatt (1891:55) lists this company, operating on the Ashley River (at Archdale Plantation), as having only $20,000 in capital.

Horse Shoe Mining Co.

Wyatt (1891:55) reports this was another William Gregg company, operating on the Ashepoo River (likely at Horse Shoe Plantation) with capital of $50,000.

Hume and Smalls

Mappus (1938:45) indicates that this land rock firm was defunct by 1884.

Ingleside Mining and Manufacturing Co.

Francis S. Holmes' Ingleside Mining and Manufacturing Co. was chartered in 1896, building a plant adjacent to the South Carolina Railway tracks on Ingleside, the former rice plantation Holmes had acquired in 1871. As late as 1903 when the factory was destroyed by fire, the company pledged to rebuild (Fick and Stockton 1995:55-56).

Kiawah Phosphate Co./Meadville Mines

Listed by Moses (1882:519) the Kiawah Phosphate Company was reported to have land mines on the Cooper River. Mappus (1938:45) suggests that it ceased operation by 1884 although R. G. Dun & Co. (1899) reported the Kiawah Phosphate Co., with E.J. Meade, Proprietor, as mining phosphate rock, but maintaining only a fair credit rating at least five years afterwards. Wyatt (1891:55), however, lists the Meadville company, headed by E. Meade, as operating on the Cooper River with $300,000 in capital.

Lindstedt (John G. Lindstedt)

This firm – or mine – is mentioned in the 1884 *News and Courier* article (Anonymous 1884) as having what must have been a very small plant valued at only $5,000 and producing only 1,000 tons using 75 workers. It was located on the 24 acre Palmetto Island in Rantowles Creek.

Mount Holly Mining & Manufacturing Co.

Mentioned by Wyatt (1891:55), this company is reported to have had $50,000 capital and was mining in the Mount Holly area, near the Northeast Railroad line.

Oak Point Mines

Their land mining operations were at Wimbee Creek, 18 miles from St. Helena. The company was owned by private parties, George S. Scott from New York and D.U. Jennings (Holmes 1870:81). McKinley (2003:142) reports their work focused on Kean's Neck, between North and South Wimbee creeks. In 1884 W. H. Hand was manager at Oak Point, where J. Van Eason had previously been a supervisor or manager (Clarence W. St. Amand Journal, pp. 28, 45, South Carolina Historical Society).

Pacific Guano Co.

This firm boasted $1,000,000 in capital and began operations in September 1869 (Chazal 1904:62). It operated its own mines, at least briefly, on Chisolm's Island and in Edisto region, not far from Jacksonboro on the Edisto River (Anonymous 1876:10, 44; Chazal 1904:62). Survey site 1200293 is a series of parallel ridges and pits, remnants of land mining on Chisolm Island. These appear to be both land and marsh deposits, but the description suggested they were both mined using traditional land rock techniques (Anonymous 1876:44). Chazal (1904:6) notes that the land rock proved to be unprofitable and that most of the effort was then devoted to the marsh rock. They were producing about 16,000 tons of rock using around 100 workers (Anonymous 1884). The company established its fertilizer and acid plant near Charleston, "just above the forks of the road" (Chazal 1904:77). Holmes (1870:87) doesn't mention any mining, only that the mills were located outside the city, St. Julien Ravenel was the chemist, and J.N. Robson was the business agent. By the next decade Moses reports this firm was conducting land mining on the banks of Bull River (Moses 1882:519; News and Courier 1884:54; Wyatt 1891:55).

Palmetto Mining and Manufacturing Co.

This company owned Spring Farm on the Ashley River, 16 miles north of Charleston and opposite the Middleton property. At the time of the assessment they were in the process of erecting a wharf and buildings. T.D. Easton was the president and they were distinct from other companies in that they intended to sell the ground phosphate directly to farmers, rather than to a fertilizer firm – cutting out the middleman (Anonymous 1870:78). Holmes indicates the president was T.D. Lawson and that the company, with 100 operatives, had already dug 2,500 tons (Holmes 1870:86). By 1879 South Carolina's Inspector of Phosphates mentions that they were a river mining company operating in the Ashley River. By 1882 the company was doing little or no mining, likely because the rock was either not plentiful or of particularly good quality (Anonymous 1879, 1882b).

Phosphate Mining Co., Ltd.

This company is listed by R.G. Dun as having capital between $200,000 and $300,000, with a "good" credit rating.

Pinckney's Phosphate Mines

This mining operation, operated by C.C. Pinckney, is listed by Moses (1882:519; see also News and Courier 1884:54) as being on the Ashley River. The operations were on Magnolia Plantation and the capital was listed at $100,000 (Wyatt 1891:55). The mines apparently yielded about 24,000 tons of rock using 350 hands (Anonymous 1884). With capital listed at under $125,000, R.G. Dun & Co. (1889) gave this company a high credit rating.

Pon-Pon Phosphate Mines

Mentioned by the News and Courier (1884:54), their mines were on the Edisto River. The firm, with $10,000 capital, was producing about 6,000 tons using around 50 workers (Anonymous 1884).

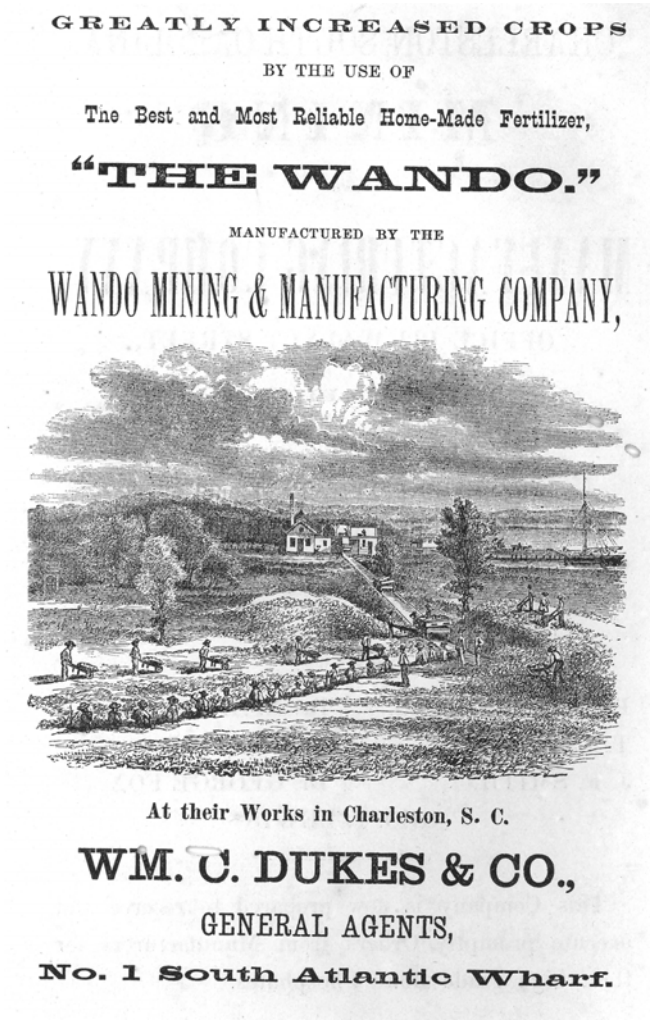


Figure 18. Ad for the Wando Fertilizer Co. showing an engraving of their land mining activities.

D. Roberts

Listed by Moses (1882:519), the company was reported to have land mines on the Stono.

Rose Phosphate Mining Co.

Listed by Moses (1882:519; see also News and Courier 1884:54) the company, owned by A.B. Rose, was reported to have land mines on the Ashley at Bee's Ferry. Wyatt (1891:55) indicates the company had $100,000 in capital. The mines produced 20,000 tons of rock using 277 workers (consisting of 180 blacks, 60 Italians, and 37 convicts) (Anonymous 1884). R.G. Dun & Co. reported capital of less than $125,000, but a high credit rating.

J.B. Sardy's Works

Holmes explains that J.B. Sardy recently purchased the Wappoo Mills and converted them from rice to phosphate. The company apparently had mines on the Ashepoo River, with offices in Savannah and New York. The business agents were George A. Trenholm & Son (Holmes 1870:87).

St. Andrew's Mining Co.

Listed by Moses (1882:519; News and Courier 1884:54) the company was reported to have land mines on the Stono. Wyatt (1891:55) reports capital of $200,000. The plant was valued at $50,000 and 300 workers yearly produced 18,000 tons of rock (Anonymous 1884). This company was reported to have less than $125,000 in capital, but a high credit rating (R.G. Dun & Co. 1889). The company was located near the Bolton Mine according to the 1890 South Carolina Business Directory (Anonymous 1890).

Stono Phosphate Co.

The president was James S. Gibbes and the company, with $500,000 capital, was mining at Happold's Farm on the Ashley River (Anonymous 1870:78). Holmes doesn't mention the mines, but explains that the company's stock was owned mainly by planters and merchants in the interior of South Carolina and documents only $350,000 in capital. A fertilizer mill was being erected on the Ashley. The chemist was Lewis R. Gibbes and the business was being managed by the firm of J.D. Aiken & Co. (Holmes 1870:85). In 1889 the company was given a high credit rating (R.G. Dun & Co. 1889). The 1890 South Carolina Business Director (Anonymous 1890) locates

Stone Mines near Bolton Mine, 16 miles from Charleston on the ACL Railroad.

George A. Trenholm & Son

Listed by Moses (1882:519) the firm was reported to have land mines on the Ashley.

Wando Mining and Manufacturing Co.

Also briefly discussed above, this company also began with $100,000 in capital. John R. Dukes was the initial president, with Thomas D. Dotterer listed as Superintendent (Anonymous 1870:76; see also Holmes 1870:78-79). In 1889 the company was reported to less than $125,000 in capital, but a high credit rating (R.G. Dun & Co. 1889).

Wayne and Von Kolnitz

Wyatt (1891:55) reports their mines were located on the Ashley River and that the firm had capital of $50,000.

Williman Island Co.

Wyatt (1891:55) reports that this land mining company was located on the Bull River and began with capital of $200,000.

Mining and the Miner's Life

There is general agreement concerning the activities involved in early hand mining of land rock, although there are relatively few detailed accounts dating from the first decade of the efforts. An 1871 tour of the Ashley River described the phosphate mines as "settlements," in the midst of what was otherwise a jungle of growth ("a land of ruins," "a wilderness," "luxuriant semi-tropical forest") that had overtaken once fine plantations (Jacques 1871). McKinley suggests that the first years of mining was "haphazard," with pits following deposits – the "random method pioneered by Homes and Nathaniel A. Pratt in 1867." In addition, clearing was minimal, with minors focused on open areas, emphasizing speed over thoroughness (McKinley 2003:172-173). This, however, conflicts with Haskell's later description of mined areas appearing as though "a whirlwind had passed over it" with trees "scattered her and there," resulting in a "sunny expanse of desolation; a desert with not a green oasis nor a sheltering palm" (Haskell 1882:411).

Wyatt explained the method of prospecting, in use at least by 1891 although likely used much earlier:

> A careful topographic survey is first made of the country, and when this has been done there commences a systematic series of bore-holes from any point that may be arranged, by means of a long steel borer or rod, specially designed for the purpose . . . . These bore-holes are practiced at distances of 100 feet apart over the total surface to be examined. The results obtained with the rod are verified and confirmed by a series of exploratory pits – 10 feet long by 5 feet wide – which are dug over the course of the bore-holes at intervals of 500 feet. The bore-holes are driven to a maximum depth of 15 feet, and no pits are at present sunk on those portions of the land where at that distance no phosphate has been encountered. Immediately after removing the overlying strata the phosphate is carefully taken out, its depth and thickness measured, and an average sample of the rock and nodules secured and laid aside for analysis (Wyatt 1891:49).

McKinley (2003:175) also reports the use of octagonal rods or probes, with depths estimated based on resistance, as well as 4½-inch pipes

rather than an auger (see Rogers 1915:210). Regardless, the effort at prospecting seems far more sophisticated than the initial mining efforts.

McKinley (2003:223-242) provides a compelling account of early mining operations by Williams Middleton. Middleton complained of the blacks' destitution and his need to provide food, tools, and "shanties." He complained about the "uncertainty of negro labor" – a theme that would be repeated over and over. The workers "go & come at their own pleasure regardless often of the sacrifice of wages" (quoted in McKinley 2003:230). Even those that did report for work (Middleton sought to operate his mines "a full week" – sunup to sundown six days a week) were unsatisfactory according to Middleton:

> We are subject to an infinity of trouble about our labour. So much depends upon negro caprice it is difficult to feel sure about anything. The hands break off upon every imaginable pretext. They do little or nothing before 12 o'clock on Monday, and never do anything after 12 o'clock on Saturday. [They are] all crazy upon the subject of "going to farming." Poor wretches! (quoted in McKinley 2003:231).

It seems that the African American laborers resisted Middleton's efforts to create gang work instead of their preferred task system (discussed below). As a result, those on a task system might mine about a ton a day, while those in gangs did only half as much work (McKinley 2003:232). McKinley also outlines Middleton's various pay schemes – including wages by the hour, day ($.75/day [$9 in 2002$]), ton, and barrowful (from $.10 to .12 [$1.27 to $1.45 in 2002$] per barrowful, which McKinley equates to approximately $2.04 to $2.76 per ton [$25 to $35]).

When wage increases failed to improve the situation, Middleton turned to housing as a means of attracting and retaining workers – a tactic that was used by many companies. He had the mine laborers build "pineland houses" close to the mines. Six double "coarse houses," each costing $86 ($1,088 in 2002$), were also built – and may have been typical of more permanent company housing. Middleton also thought that "ordinary negro houses," would not suffice and that "something better was required." How these "coarse houses" were better is unclear. It may be that the "ordinary houses," perhaps also the "shanties," were old slave houses, while the "coarse houses" were simply new and without the stigma of having been used in slavery.

Williams Middleton also felt the commissary store was a necessity, hoping it would tie the laborers to the mine. McKinley suggests that Middleton also anticipated charging inflated prices and thus improving his financial condition. This, however, apparently did not work out, as there were constant complaints of the store being robbed and goods being stolen (McKinley 2003:238-239).

We are also indebted to McKinley for his work with the 1870 and 1880 census records that provide a tentative view of the phosphate workers. Although his account should be examined, especially for all the caveats and warning that come with use of these data, we can provide a brief synopsis.

In 1870 the vast majority of the workers were living in group housing (of the 262 black phosphate workers, 252 were recorded in St. James Goose Creek and 242 of these lived in

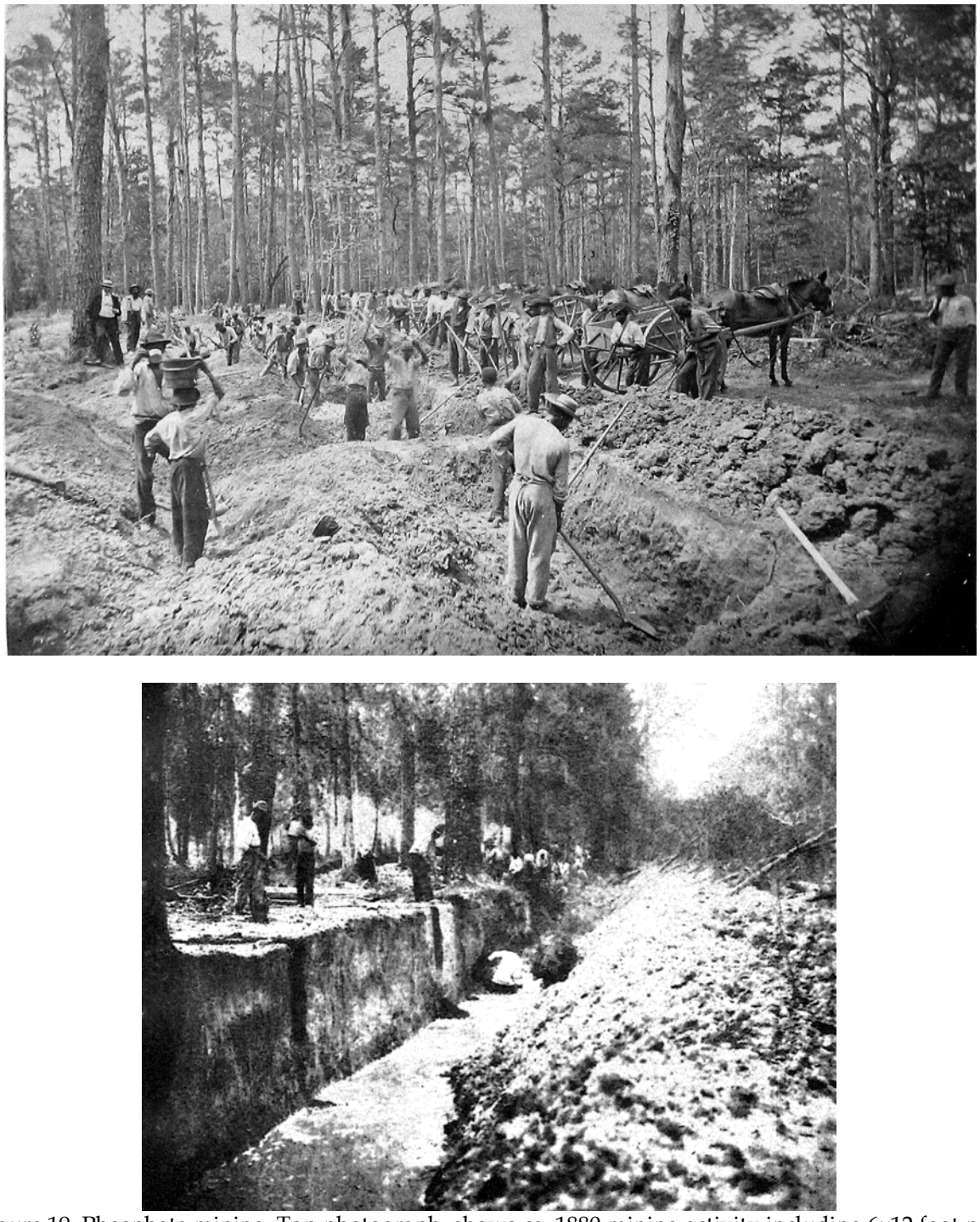


Figure 19. Phosphate mining. Top photograph shows ca. 1880 mining activity including 6x12 foot pits with phosphate rock thrown up in piles waiting to be moved to a tram by mule carts (courtesy of the South Caroliniana Library). Bottom photograph shows hand excavation of phosphate (from Waggaman 1913).

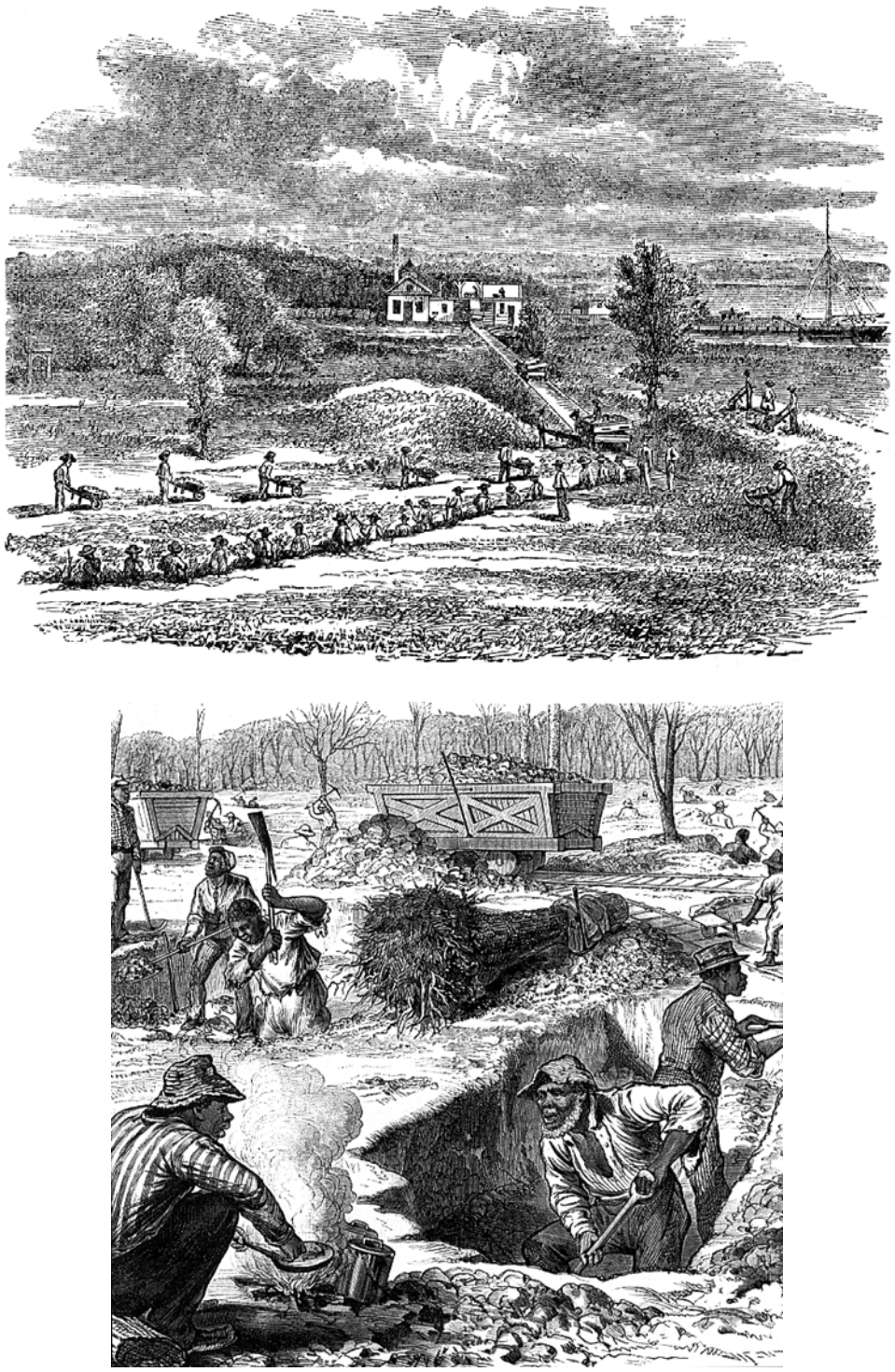


Figure 20. Phosphate mining. Top engraving is a view of hand excavation (from Wando Mining and Manufacturing Co. ad in Holmes 1870). Bottom is from Frank Leslie's Illustrated Newspaper (courtesy of The Charleston Museum, Charleston, South Carolina).

group housing). Very few could read or write and ages ranged from 12 to 61, with an average age of 31 years and most being in their 20s.

Looking at the 1870 census data McKinley reports three broad groups of workers: (1) rootless men – single miners without family who mined year-round, (2) seasonal miners – those who migrated to the camps as agricultural activities allowed and earned additional income, and (3) miners who lived their nearby families, working their farms and occasionally mining (McKinley 2003: 207-208).

Table 2.
Summery of Occupations and Average Pay Rates, 1891-1892 (from Wright 1893)

Occupation	# Employed	Day's Rate
Miners & Laborers	4090	$1.00
Dumper	41	$1.02
Fire Man	39	$1.18
Engineer	27	$2.27
Track Man	26	$0.98
RR Laborers	24	$1.00
Locomotive Engineer	21	$1.82
Foreman	15	$2.73
Carpenter	13	$1.63
Blacksmith	11	$1.45
Machinist	2	$2.55
Sorters	2	$1.00
Dipper Tender	1	$2.00
Chief Engineer	1	$4.17
Excavator Engineer	1	$2.40

McKinley also provides insight into the importance of phosphate mining. Although the census records (including the industrial census) are flawed and their counts of miners cannot be trusted, he was able to extrapolate the annual yield per hand for the listed companies to unlisted companies mining in 1870 – yielding an approximate total of at least 968 employees (McKinley 2003:213). This made phosphates the state's second largest industry, trailing only cotton manufacturing by less than 200 employees (McKinley 2003:222).

The 1880 census, while still flawed, is appreciably better. Most miners were still black or mulatto males, although four females are reported. Dubose Heyward, in *Mamba's Daughters*, included women in his mines, but admitted that it was unusual: "the mines were for men." Group housing, however, was no longer reported. Of the 63% who were married, most lived with their wives and children in single-family units. Most of the wives earned wages. Single men comprised the remaining 34% of the land mining workers and these lived alone or with families (McKinley 2003:244-245). The average age was 32 years, although the largest group continued to be in their 20s.

McKinley suggests that the change from group housing in 1870 to family housing in 1880 was at least partially the result of the mines moving west into the rural countryside where small hamlets of workers already existed (McKinley 2003:246).

The industry had at least 1,685 workers and likely many more given the vagaries of the census definitions and reporting. It still ranked second, far behind the tar and turpentine industry (4,512), but noticeably larger than lumber (1,431) (McKinley 2003:257).

Wright, based primarily on 1892 data, identified an average of 4090 "miners and laborers" at 23 South Carolina land mines, although the numbers may reflect the same miner being counted by more than one company. Regardless, this account provides an interesting view of the occupations present at the mines and the pay rate for that period. The data is presented in Table 2. The occupants include some, such as the excavator engineer and dipper tender, that were almost certainly associated with steam shovels or land dredges. Others, such as the fire man, might be found on either railroad locomotives or steam shovels. In spite of these problems, the list provides a good

view of the occupations one would expect at land mines. The average number of employees at the 23 mines ranged from a low of 47 to a high of 615.

An 1881 account of South Carolina's land rock miners elaborates:

> The land mines cover many hundred acres of ground; they are worked with picks and shovels. The whole tract has to be well and deeply trenched, and this is always done with reference to its natural drainage. Sometimes, however, all ordinary ditching proves inadequate, and the steam pump has to be continually used. The miners work in the trenches, a few feet apart, throwing the superincumbent earth behind them, and the phosphate rock in front. . . . It is then carried to the works . . . .
>
> The mining is done by negroes, although lately some companies have found it both necessary and profitable to import laborers. These imported laborers are mostly Italians. For negroes are agriculturalists, and taking far more naturally to the hoe and the plow than to the pickaxe and the shovel. Indeed, the labor it is so distasteful to them that just as soon as they earn enough to buy a peck of grits, some bacon and tobacco, they knock off work until the following week. They receive a dollar and a half a day in money, or a dollar a day and their rations; but they complain universally that this sum is far too little, and, considering the hard, the unhealthy, and unpleasant nature of the toil, I think the complaint not unjust. On the other hand, superintendents of mines claim that it is all the uncertainty of their labor deserves. I asked one man why he did not work regularly, and he answered with a yawn, "It too much tiring to work ebery day, Misses." I have seen negro laborers under all circumstances, but not even among the convict gangs of Georgia did I meet with such sullen faces. They were not only sullen and silent in the trenches, but sullen and silent when loafing on their own cabin steps with money in their pockets; and I note this circumstance as quite exceptional, for I have never before seen Southern negroes with nothing to do and a dollar to spend, who were not talkative and polite at least, or, more likely still, as merry as a lot of children on a holiday. The cabins of the miners consist of two rooms, equally dirty and comfortless. The women had nearly all a pipe between their lips, and their general squalor and untidiness seemed in keeping with their sullen, brutal tempers and ungracious silence ("Digging Phosphate Rock – Scenes at the Great South Carolina Mines," *New York Times*, October 18, 1881).

McKinley (2003:248) suggests that the reporter's paternalistic attitude "may have influenced the demeanor of her subjects," although discussions of miner housing are extraordinarily rare. Haskell (1882:412) also recounts the difference between most of the workers and "some few 'old-time' darkies, who retain the polished manners of their ancient training."

During a May 1881 meeting of Stono Phosphate Company's board, Col. C.H. Simonton proposed erecting houses for the workers on the company's property, suggesting "we could thus secure a more permanent and reliable class of laborers." While the board "thought favorably of this proposition" no action was taken – so while many companies attempted to retain workers by providing houses, not all were willing to make this commitment (Stono Phosphate Company, South Caroliniana Library).

An account of the mining at the Wando works provides another view of hand excavation:

> Making our way over ground already worked, we came to the open trench, where some one hundred and fifty hands were engaged with picks, spades, and forks, laying bare the deposit and throwing out the precious nuggets, destined to prove of more real value to the State than all the precious metals within our borders. . . . The nodules are thrown into large heaps, as they are taken from the mines, whence, after drying awhile, they are conveyed in small cars, running on a tram-way, to the mill (Anonymous n.d. b).

Moses offered an account of mining as done by well-funded companies such as the Charleston Mining and Manufacturing Company:

> A main trunk line leading from the washers (which may be a mile away) is laid, dividing the rock field into equal parts on both sides of it. Alternate laterals curve out and run at right angles to the main track as far as the boundaries of the designated field, but conforming to the intermediate ground. The laterals are 600 feet apart, and the space between any two of them is subdivided by a line ditch parallel to and midway between them. At this ditch two sets of workmen start their lines in opposite directions and at right angles to the laterals. This gives each man a space of 300 feet long and 12 feet wide to excavate. Over this path he wheels his "stratum" in barrows to his portion of a platform running at the side of the road. Here his work is sharply scrutinized by a foreman before it is loaded on the cars for a washer. This material furnishes about one-third in weight of the clean washed rock. When mining is carried on in wooded land it is difficult to keep the lines straight. Trees are undercut with mattaks [sic] and thrown behind upon the high ground, the rock being picked out from between the roots. Dynamite might here be used with advantage. The only tools employed are spades, shovels, and picks. In undrained territory or old rice fields where the alluvial character of the soil makes deep ditching impossible, steam pumps are employed.
>
> Recently Italians have been brought from New York during the winter, notably at Leland Yates's works . . . the negro, however, furnishes most of the labor. He digs about three days in the week, and is not to be depended on for regular work;

> but, when he fancies, can accomplish a great deal more than a white man in the same time. He is docile, and not given to strikes. The hand can earn from $1 to $2 a day. Irregular habits and distrust prevent his co-operating in working gangs under contract, which would tend to improve his condition (Moses 1882:513-514; Haskell 1882:412 also reports pay of $2 a day).

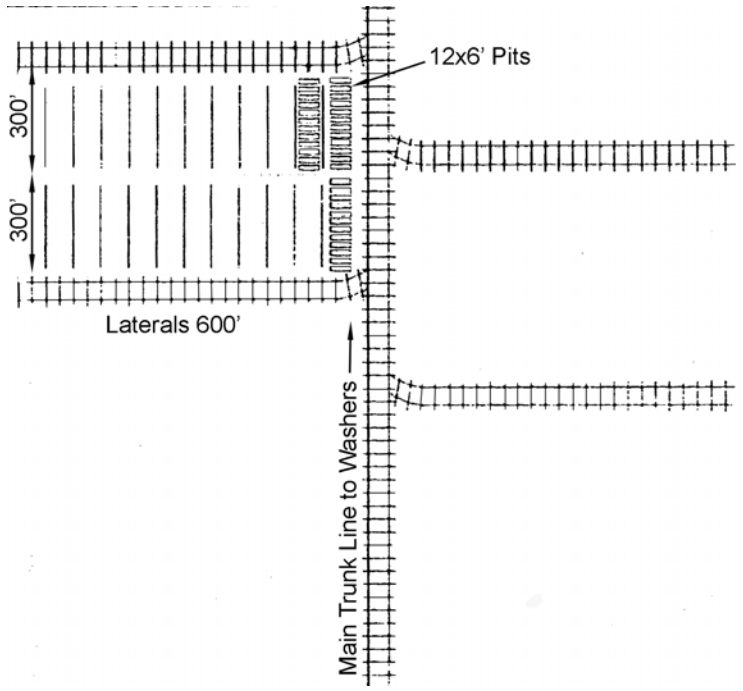


Figure 21. Mining operations based on Moses' account (adapted from McKinley 2003:Figure 3.9).

This account is particularly important since it documents the efforts by mining companies to find "consistent" industrial workers. Their efforts, however, were not without problems. Most fundamentally, white immigrant labor could only work the cooler season, limiting their usefulness. In addition, there were repeated accusations of abusive labor conditions. In May 1891 there were reports of problems with Italian workers in St. Andrew's Parish, although an investigation found that "what troubles they have arises from contracting debts among them." The article explained that the Italians brought to the mines were, "the very lowest dregs" and that, "they even eat turkey buzzards, thus exciting the disgust and contempt of the commonest negro labor" ("An Outrage Story Spoiled – Italian Phosphate Miners in South Carolina Eat Turkey Buzzards," *New York Times*, May 28, 1891).

These views are echoed in at least one oral history of a low country African American:

> Hit was the roughest kind of men come to work there – Irishmen, Italians, Polacks and all – some kind of furriners hit was. Couldn't hardly understand em when they'd talk. They had what they'd call kittle. A big pail or somp'n, and they just cooked out in the woods. Camping out. They even eat buzzard. They catch and eat a buzzard just as soon as you er me'd eat a turkey. That's just the way they was. Knock down a buzzard with a shovel er a rock, set up three sticks into the ground to hang up their kittle, build a fire and cook him right there. Hit was rough and mean crowd – most too bad for these Edisto colored to work with (Lindsay 1977:23).

In 1892 new accusations surfaced concerning the treatment of German workers at Pon-Pon Phosphate Mines. The claim was that the Germans were induced to work in the mines by the promise of earning $1.50 a day. Once they arrived they were reportedly detailed by armed guards and "herded into quarters with some seventy others, mostly Italians and Greeks." They were paid $.25 for each cubic foot of

Figure 22. Loading phosphate rock for transport to the washers. Top photograph shows loading into a hopper with the tram adjacent to pits (http://www.angelfire.com/sc2/tokenofthemonth002). Bottom photograph shows loading from wheelbarrows onto a flat car (Waggaman 1913).

phosphate mined, making at most $.75 a day. Out of this they were required to "provide their own food, purchasing all supplies at a store kept by the contractor, who charged high prices" ("Worked Under Armed Guards – Abuse of German Laborers in Phosphate Mines," *New York Times*, May 28, 1892).

In 1893 the abuse of Italian workers was in the news, with the report that a New York Italian, Antonio Galasso, hired other Italians to go to the phosphate mines "under the false pretenses of favorable climate, steady work, and high wages." The men reported "great cruelty while at work, and forcibly detained when they wished to get away, on the ground that they were in debt to the company's storekeeper" ("Galasso Will Have to Explain – Charged with Cruelly Deceiving His Countrymen," *New York Times*, January 26, 1893).

Abuse was again in the news in November 1897, when the *New York Herald* alleged that Philadelphia men were forced to work at Bulow by armed guards. They also alleged inflated prices, poor housing, and inadequate food ("Workmen Suffer on John's Island," *New York Herald*, November 26, 1897). While there may have been a thread of truth in the allegations, the *New York Herald* was the most sensationalist of the New York tabloids. And the article was not picked up by the *New York Times*.

In addition to the use of Italian, German, Polish, and Greek laborers, the mine operators also resorted to the use of convict labor (McKinley 2003:248-250). The phosphate mines accounted for 10% of the state's leased convict labor in 1880, but 84% the following year. The state received between $10 and $12.50 a year for each convict, with the mine responsible for feeding and housing.

One article explained that since the mines were located in "malarious" regions, "the few native white men who superintend the work seldom venture to spend a night in the deadly locality, but come into Charleston or the neighboring towns by the afternoon trains and go out to their work again in the early morning." Only the "negroes and hardy Italians" were able to survive the swampy lands that the rock mines were found in ("Mining Phosphate Rock, *New York Times*, January 29, 1891; Haskel 1882:412 comments on workers digging pits with "water up to the ankles").

Clearly executives, officers, and white supervisors did not live near the phosphate mines (or the fertilizer plants). The Charleston and Savannah's daily service connected city businessmen to depots in St. Andrews Parish. Other mainline railroad companies running up Charleston Neck allowed a comfortable daily commute to phosphate and fertilizer plants on both the Ashley and Cooper rivers. In 1899, streetcars finally made public transportation widely available when the Charleston Consolidated Railway, Gas and Electric Company extended the electric trolley line up Charleston Neck to Chicora Park (which soon became part of the Charleston Naval Shipyard) (Fick and Stockton 1995:31). Workers in Neck-area plants could now travel easily to their homes near or within the peninsular city. Beginning in 1912, white executives found that the new Charleston neighborhood of Hampton Park Terrace was convenient to their businesses on Charleston Neck. There is no indication that any of them ever lived close to their factories.

A decade after Moses' account of mining, a similarly detailed account is offered by Wyatt:

> it is customary to establish a main trunk railroad, starting at the river front or on the bank of some convenient stream, and passing right through the centre of the property to be exploited. Alternative laterals can be run off at right angles from any portion of this main line, at distances of, say, 500 feet, in

> conformity with the nature of the ground. Between and parallel to these laterals a ditch or drain is dug to a depth extending 4 to 5 feet below the phosphate strata. From this main drain the excavators start their lines at right angles to the laterals, commencing at one end of the field and cutting trenches 15 feet wide and 500 feet long, the work being so arranged that the men are stationed at intervals of 6 feet. Every man is supposed to dig out, daily, a "pit" 6 feet long, 15 feet wide, and down to the phosphate rock. The overlying material is thrown out to the left-hand side of the trench. The phosphate itself is thrown out to the right and taken in wheelbarrows to the railroad cars which pass at either end of the trench. The water drains from the trenches into the underlying ditch, and is thence pumped out by means of a steam pump worked by a locomotive engine. The pump and the engine are secured to connected railway platforms, and run along the railroad tract from one ditch to another as occasion requires (Wyatt 1891:53).

This view is substantially the same as offered by Haskell, who commented that, "the rock is generally conveyed to the cars in wheelbarrows, but often platforms are located along the line of the rail on which the rock is thrown, and immediately emptied into the care, thus saving considerable expense in the handling" (Haskell 1882:413).

By the early twentieth century Waggaman (1913:1) remarked that the "conditions in these fields have changed so materially" it was important to update the record. His description of the labor involved in hand mining is not materially different, although there may have been a changing relationship between the mines and the processors of the rock:

> Hand mining is usually performed on contract, a certain price being paid for the rock delivered at the washer. The contractor in turn pays the laborers by the task, assigning each man a section of the phosphate property, from which he removes the overburden and digs out the phosphate and loads it on the cars (Waggaman 1913:7)

The most significant change is found in his description of deep mining with steam shovels:

> Where the overburden is 8 feet or more in thickness steam shovels are employed to remove it. This machine digs a canal about 20 feet wide, depositing the overburden on one bank, while a hoist equipped with a single grab bucket, or a series of buckets to be loaded by hand, runs on a track on the opposite band of the canal. As fast of the steam shovel removes the overburden from the deposit the hoist is used to place the phosphate thus exposed on the cars. When the limit of the deposit is reached the steam shovel returns, dredging out a canal adjacent to that already dug and depositing the overburden in the old ditch. Many deposits which could not be economically worked by hand are now rendered valuable by the advent of

> machine mining. . . . Unfortunately for the South Carolina phosphate industry, the cost of production has increased with a corresponding advance in the price of phosphate rock. Indeed, the price of this material is now so low that the smaller operators in these fields have entirely ceased mining. The price of labor has also advanced from 30 to 50 per cent, and frequently it is so difficult to obtain hands that the output of rock is seriously curtailed (Waggaman 1913:7-8).

Thus we see the gradual movement from relatively shallow hand trenching to much more aggressive soil movement using steam shovels – each leaving a distinctive scar on the landscape (see also Shick and Doyle 1985:19) With the introduction of steam shovels overburden as deep as 22 feet was being removed (Rogers 1915:210, 213).

The equipment was often very complex. For example, the Osgood Excavator, used at least by the Pacific Guano Co. in Beaufort on Chisolm Island, combined a water tank, boiler and engine, an A-frame, boom, dipper-handle, and dipper. The excavator required an excavator engineer, fireman, a dipper-tender, and between five and 10 laborers. The dipper held 1¾ cubic yards of soil and was capable of excavating a trench from 25 to 35 feet in width to a depth of at least 15 feet. The equipment replaced upwards of 100 men, being able to excavate 800 to 1,000 cubic yards of soil every day.

One of the more interesting themes running through these accounts is the difficulty in securing laborers. Almost every account, newspaper article, or company report at least mentions the difficulty in finding and retaining labor. Over a decade ago historian Bernard E. Powers, Jr. understood that, "for some blacks the conditions under which they worked were as important as their wages" – and the rural freedmen "only desired to work in the phosphate industry to supplement their farm income" (Powers 1994:126). Consequently, at peak planting or harvesting times blacks would desert the mines and return to the farms. In slack times, when the crops could be maintained by children and wives, the men would supplement their income with mine work (Anonymous 1885).

This division of labor is still remembered by rural African Americans. One oral history recalls men working in mines during the week and returning home on the weekend, although there seems to be some question concerning exactly how much money returned home with them:

> But after that storm [1893 hurricane], can't make no crop no how, and he leave out. A whole army of the young men left out from here [Edisto]. He gone to work at the rock mine, the phosphate mine over at Red Top, call it Rock Field. He work there a while, make <u>good</u> money. Then the next year he come home again, help his old man. They make a good crop that year and the next. . . . Then he do just I done later on, he plant that year's crop with his daddy, and as soon as that crop is up, he gone off to try to get some kind of wages for us. . . . My daddy and my wife's daddy worked at the Rock Mines, the Bulow mines is where they worked. Daddy worked through the week, and came home on the weekends. The wages were very high, though only a little of the money paid to the men got home to Edisto (Lindsay 1977:19,22).

Figure 23. Land mining with steam shovels. The top photograph shows the shovel removing overburden and depositing it on either side of the pit. The lower photograph shows the subsequent phase of removing the phosphate rock and loading it in buckets that were then lifted out of the pit and dumped in rail cars (Waggaman 1913).

McKinley suggests that, "to many of those who mined, it was a seasonal and part-time job, good for extra income during slow times on the plantation, but hardly a career. Independent farming was their goal" (McKinley 2003:216). This view was earlier stated by Morgan, discussing the importance of the task system. He seems to suggest that while integrating farming with mining might have been a goal, perhaps even more significant was the freedman's desire "for autonomy not only from the impersonal marketplace but also from individual whites" (Morgan 1982:596).

Both Morgan and McKinley also note that low country blacks had a diversified subsistence base, successfully integrating farming, hunting, fishing and – at times – mining. The mines were, most fundamentally, a welcome supplement to agricultural pursuits.

We see in the historic accounts, including the census records, a movement from very early group housing and shanties to more substantive housing resulting in more stable mining populations. Yet in spite of the general theme, there are regrettably few descriptions of the housing at different periods. Of far greater interest, it appears, were technological descriptions of the process of mining.

Shick and Doyle (1985:17) suggest that not only housing, but also medical services and general stores were provided to induce year-round settlements. They cite a short article, "Colored Mining Labor" for support:

> The system of payment in checks or scrip . . . is common. This enables the miner to get provisions every evening at the store. At the end of the month, rent, doctor's bills, and the amount of scrip drawn, or money advanced, are deducted from the balance due for wages, and the balance is paid in cash. Many of the miners live on from $3.50 to $7.50 per month. Most companies employ their own physicians, and the employees are taxed to pay the doctor's salaries and the cost of medicines used. A few of the colored miners lay up a certain amount every month from their earnings. Most of them keep in debt to the storekeeper, or simply draw enough to support themselves as they go along, and on pay day receive the remainder and spend it within a short time (Brainerd 1885-1886:79).

Although Shick and Doyle don't mention that this article concerns hard-rock mining of iron ore and the author was writing from Birmingham, Alabama, we know that that the Bulow mines did have both a commissary and a hospital, proving additional credence to Brainerd's observations.

C.W. St. Amand was very interested in the business of storekeeping at low country phosphate mines, both in his capacity of bookkeeper for Wylie & Gordon, and as a family man hoping to increase his income. His "Merchandise Account at Oak Point Mine" for March through August, 1884, shows weekly figures for cash sales, which vary from $208 to $453, usually around $300 (Clarence W. St. Amand Journal, pp. 29-30, South Carolina Historical Society).

At least by February 1886 he was trying to acquire his own business. He wrote to William Guess at Latham's Mines, Johns Island (the depot on the mainland side of Stono River). Guess had told Mr. Jaudon that he [St. Amand] would like to rent the store now occupied by Jaudon, and St. Amand was "anticipating negotiating for his stock." Before committing himself, he wrote to "Tom": "I visited the place in question yesterday . . . . Arriving at the depot proper, take the main road north about ½ mile,

turn left or west, proceed about the same distance, which brings you to a store. It is situated about a mile from either Bulow or Latham's, and about ½ mile from Linsted's and 1½ from Bolton. It is the same place held by these parties for the last three years . . . . I think it an excellent stand, and if I can get the party you spoke about to stay up here, why I think it almost a surety, my success. I must have a settled person to stay up there as the place is very important, and trade commences just about the time the train leaves the depot (6:30 PM). I presume we can get Jenkins there by March 1st prepared to remain there . . . . "

A few days later he wrote Tom, "Jaudon tells me – in fact he guarantees me – that I will have no trouble about the checks, as Bulow (Stortell) [probably the Z. E. Sawtelle cited in 1888 *News and Courier* article as the superintendent of the Bulow mines] takes them at par, while Linsted and Latham's both 10% off. Bolton he cannot use, though he has taken some of them and sent them through the hands . . . ."

But St. Amand soon pulled out of the negotiations, writing to Jaudon later that February, "I find that the store at Red Top would not pay a sufficient return on the investment without the liquor business in connection with the groceries and dry goods, and I do not want to keep the former." With this, St. Amand turns away from the Red Top Store and opens negotiations for the business being kept by William O'Shaughnessy at Drayton Station. That fell through, and in January 1887 he is writing to Julius Fishburne, in Summerville: "Some time ago Mr. Jenkins endeavored to get the store at your works for me, without success . . . . He tells me I could rent if for $65 or $75 and that at present it's occupied by parties to whom you were not very favorably disposed . . . ." The letterbook ends soon after this entry, with St. Amand still not having found a store.

Although the account is ambiguous concerning the "checks" accepted by Bulow at par, while accepted by other nearby mines at 10% below par, it does reveal a complex interaction of local mines and merchants, suggesting that not all mines forced workers to use only their facilities. Moreover, it provides us with a general accounting of at least one merchant and points out that of all the items offered for sale, alcohol might have been most sought by the miners.

State business directories for 1890 (Anonymous 1890) list several general stores along the Charleston and Savannah Railway through St. Andrews Parish. There were three general merchants at Red Top, J.G. Lindstedt (previously discussed as a mine owner), R.D. Stelling, and H. Struhs. The Stono Station stop 16 miles from Charleston was known also as the Johns Island Ferry. A post office "for the convenience of the large phosphate interests centered here" was kept by J.C. Houston (manager of the Bolton mine). The W.L. Bradley Company kept a general store, as did independent merchant D.G. Utsey and Company. At Rantowles "just a small station," there were three general merchants. In 1889 R.G. Dun & Co. (1889) listed two general stores in Red Top: Lindstedt and Stelling. At Stono two others: W.L. Bradley and St. Andrew's Phosphate Co. At Johns Island, however, R.G. Dun listed 13 general stores and one dealer in groceries and liquor, H. Stubbs. At the Rantowles station there were two other general stores: J.T. Clark and P. Fox.

By 1905 (Anonymous 1905), the Charleston and Savannah Railway had become part of the Atlantic Coast Line system, but its depots remained centers of local commerce. At Red Top, a "small town nine miles from Charleston," were two general stores, John G. Lindstedt's and W.J. Wolfe's. Farther along was the Johns Island Depot, with a population reported as 1,000. This station stop remained the center of the phosphate world: there were three general stores (Bolton Mines, Joseph S. Hart, and John Johnson) and a clothing store. At

Rantowles, 19 miles from Charleston, were two general stores.

In 1912 the Johns Island station, with a population down to only 100, still had nine general stores: E. Ferri, Cyrus Gadsen, J.E. Glover, Joseph S. Hart, J.F. Limehouse, J.G. Lindstedt (listed as "near" the station), I.H. Lowry, Frank W. Rivers (listed as being "near" the Johns Island station), and Henry Struhs. Also at Johns Island was A. Banov, who sold shoes and clothing, and two mines, Bolton and Bradley. At Stono were two general stores, S.H. Jones and J.E. Sterling, and one druggist, J.L. Strohecker.

Processing and Industrial Activities

The level of phosphate rock processing varied tremendously. Some firms, such as Bradley, only washed their rock before shipping it either to northeastern fertilizer factories or overseas. Other firms also dried their rock, reducing its weight.

Looking back on the development of the industry, Waggaman (1913:6-7) observed that the earliest washing was perfunctory at best, consisting of washing the material by hand in a nearby creek. This was inefficient and resulted in a dirty product that degraded the value of South Carolina phosphates. Chazal (1904:49) remarked that the "rough scrubbing with hand brushes in a convenient creek" removed so little soil that initial cargoes of the rock "were so dirty that they had practically to be mined out of the vessels" in which they were shipped.

Waggaman (1913:7) reports that after hand washing was abandoned the South Carolina miners adopted log washers, such were being used in Florida.

Log washers are still used in mining today. What appears to be the first patent – although probably not the first use – dates to 1891. The device was invented by Samuel C. McLanahan, who used it to wash clay from the rock of his Florida deposits. These log washers consisted of long, gently sloping boxes or troughs in which were mounted logs with cast iron paddles attached. Earlier it appears that railroad spikes (which would have been plentiful) were attached instead. The logs – today shafts – were paired and counter-rotated, with the paddles or railroad spikes intermeshing to provide the maximum scrubbing. The paddles also subjected the material being cleaned to constant abrading, scouring, and grinding – all intended to clean the heavy plastic clays and even break down soft stone. The paddles slowly moved the material toward the discharge opening at the upper end of the tub, while the debris were caught up with overflowing water and passed through a grated opening at the lower end (Anonymous 2002).

Because the South Carolina rock was often found in a sandy matrix and the "elaborate cleaning process" typical of this type of washer was found to be unnecessary and log washers were also abandoned.

In the place of log washers Waggaman describes a simpler washer where the rock:

> is scraped in a hopper, which discharges into a mechanical conveyor composed of units holding one-half ton each. It is carried to the top of the washer, where each unit of the conveyor is automatically discharged, and a stream of water washes its contents down to a crusher. From the crusher it is discharged through troughs into the lower end of several cylinder washers, which vary in number from two to eight, depending upon the size of the plant. Each cylinder is 27 feet long and 5 feet in diameter, the discharge end being 14 inches higher than the end where the phosphate material enters. The

> first part of the lower end and the last 2 feet of the upper end are composed of heavy wire screen, having perforations of a dimension three-sixteenths by three-fourths inch.
>
> The interior of the cylinders is fitted with plates arranged in the form of a spiral [or screw] so that they throw the phosphate forward and toward the upper end as the cylinder revolves. A 2-inch stream of water under pressure of 60 pounds to the square inch is played upon the phosphate materials from the upper end of the cylinder. The washes the sand, clay, and finely divided phosphate down to the lower end of the cylinder where it escapes through the screen and then flows out through a trough to the wash head, which is usually located at some distance from the plant. The washed rock falls from the upper end of the cylinder upon a rubber-coated belt 26 to 30 inches in width, along which it is carried to the wet bins. Pickers are stationed along this belt for the purpose of removing clay balls, marl, and any other foreign material which may be mixed with phosphate (Waggaman 1913:7-8).

Waggaman reported that such washers could clean from 150 to 600 tons of rock every day. It appears that these new washers were little more than modified log washers – a single screw assembly was used in place of double logs, but the device was still elevated, it still pushed the material along its pathway, and it still used water to remove the sands and clays.

Wyatt generally confirms this account, explaining that from the mine the rock is shipped by tram to the washer:

> constructed at an elevation of some 30 feet from the ground, and generally consisting of a series of semi-circular troughs 20 to 30 feet long, set in an iron framework at an incline of some 30 inches rise in the length. Through every trough passes an octagonal iron-cased shaft provided with blades so arranged and distributed as to form a screw with a twist of one foot in six, which forces the washed material upwards and

Figure 24. Photograph of the washer at Lambs. This twentieth century view represents a more refined washery than would have been used at late nineteenth century mines.

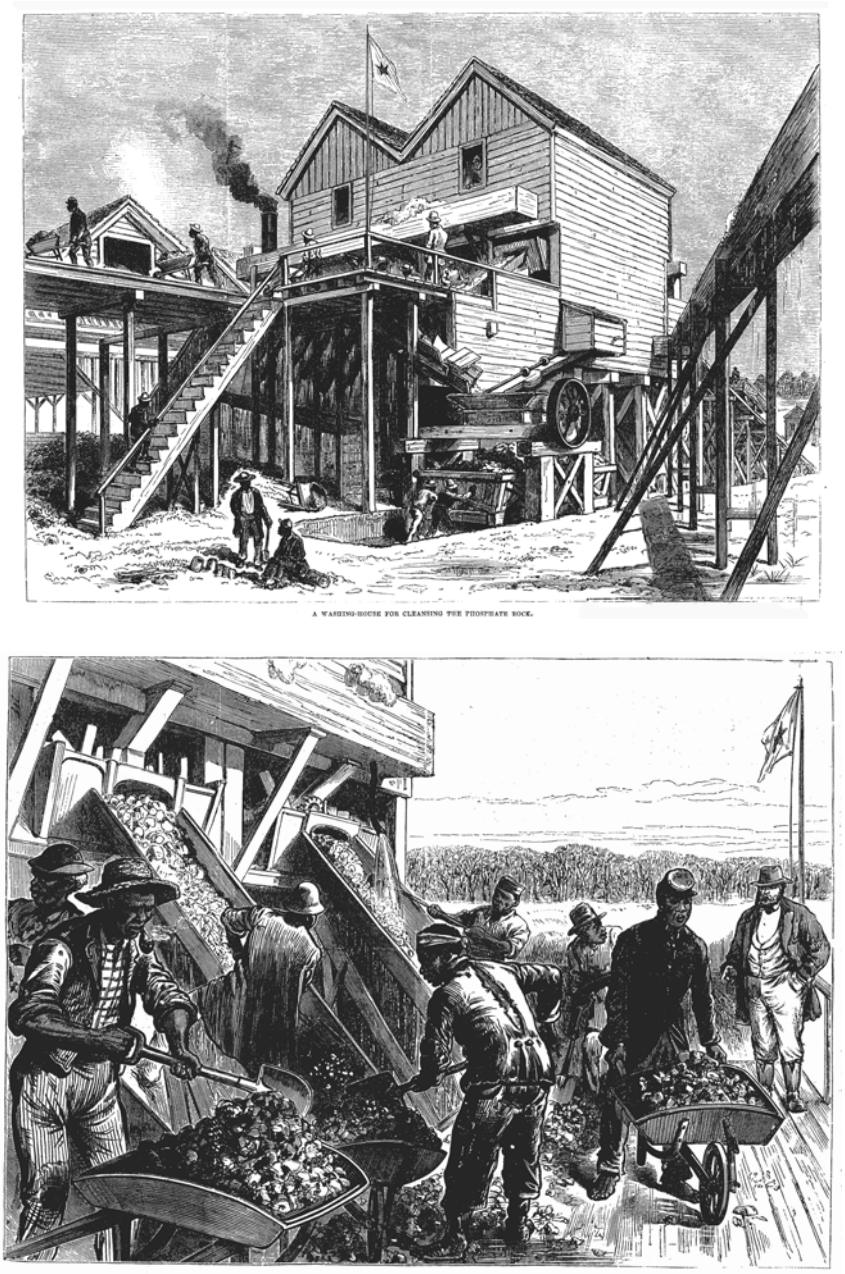
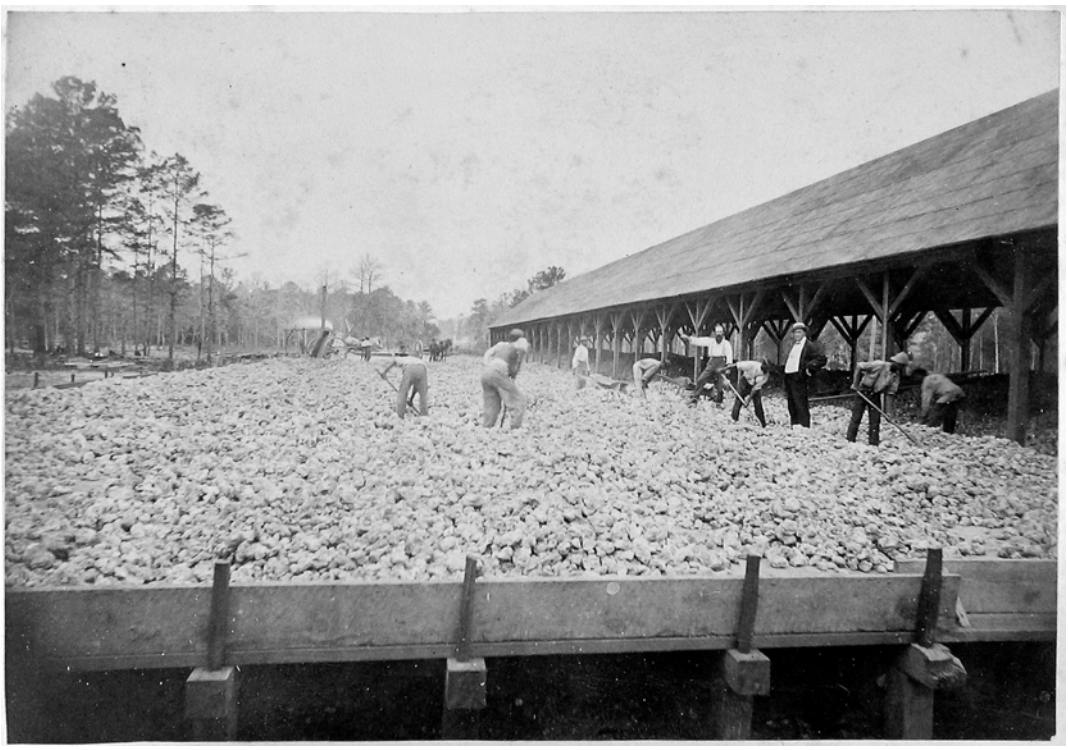


Figure 25. Washers as illustrated in *Frank Leslie's Popular Monthly Mazagine*, 1882 (courtesy The Charleston Museum). In the upper illustration the rock is being drawn up to the washer in the rear, screw washers are seen at the front, and a sluice is shown transporting the debris to the right side of the illustration. Workers are shown carting the cleaned rock off to the left. On the side of the building there is a grinding mill, but its relationship to the other operations is unclear, as is the car being pushed under the mill to catch the ground rock. The lower illustration shows the "semi-circular troughs" into which the phosphate rock is being removed after cleaning (although technically the rock was forced upward, not downward as shown here). The illustration shows only one trough using water and there is no indication of its overflowing.



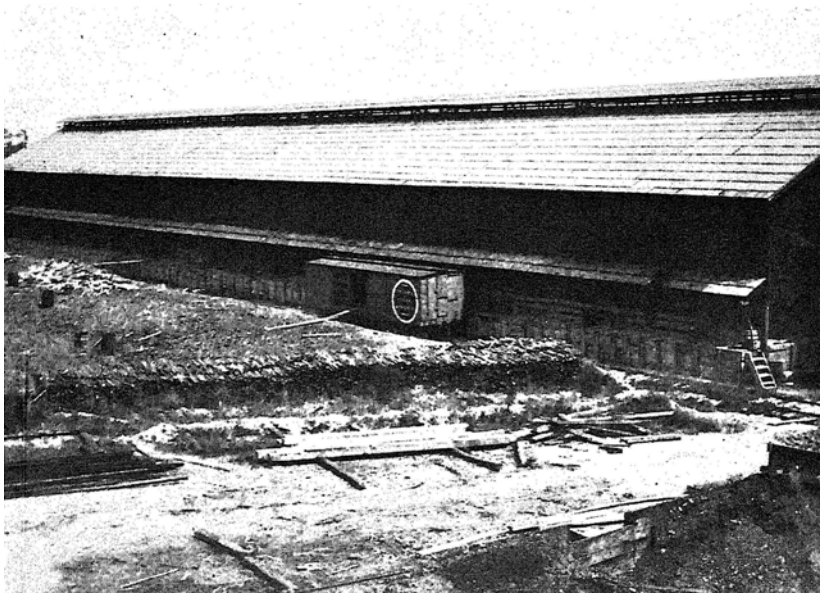


Figure 26. Drying of phosphate rock. The upper photograph (courtesy of the South Caroliniana Library) shows what appears to be open air drying using workers to constantly turn the material – similar to the situation reported for Bulow. This activity, while documented early, was supposedly replaced by kiln drying. The lower photograph (from Waggaman 1913) shows the drying and storage shed. We have found no photographs of phosphate being dried using a kiln.

> projects the fragments against each other. The phosphate-laden cars are hauled up an incline and their contents dumped into the bottom trough, where the phosphate encounters . . . heavy streams of water, pumped by a steam-pump. This water does not run off at the bottom, but overflows at the higher end near where it enters. When sufficiently washed, the material is pushed out upon a half-inch mesh screen; the small debris being received on oscillating wire tables below (Wyatt 1891:53-54).

The differences in the two accounts (and the nearly identical description of Rogers 1915:212) are minimal and likely are the result of describing slightly different versions of the same equipment. Lindsay's oral informant, Bubberson Brown, reported that a characteristic of the washer was the sound it made as the rock hit the metal tubes and screw blades (Lindsay 1977:22). Haskell (1882:414) also describes (and illustrates) a washer. The only substantial difference is that she explains the rock "gradually works it way down toward spouts," while all other accounts are uniform in describing the screws as forcing the rock upwards.

Chazal tells us that the first washer built by the Charleston Mining and Manufacturing Company (known as Washer No. 1) :

> was given practically no elevation above the ground, and all the material had to be rolled up on the rock piles in barrows. The costliness of this handling was soon realized, and the No. 2 Washer, erected in 1869, was considerably elevated (Chazal 1904: 50).

This suggests that the elevation (which Washer No. 1 lacked) was intended to allow the debris to collect under it and without an elevation (and presumably a tram road leading to the washer), the material to be processed would need to be unloaded and carried through the debris field and loaded onto the washer by hand – clearly a very labor intensive undertaking.

Moses (1882:515) tells us that many companies allowed the "solid portion of the dump [to be] flowed upon adjoining marshes" or dumped directly into the river that provided the water for the washer. That same year the Inspector of Phosphates complained to the legislature:

> [the] practice too frequently prevailing among the Land Companies of emptying their debris into the navigable streams and rivers of the State, these companies usually erect their machinery, washers, &c., on the shores of such streams, not only for the purpose of obtaining a fully supply of water for such washers, but also for more ready means of shipping their rock, the deposit as dug from the soil is brought from the mines in tramways to the rivers or streams, where it is washed and crushed. The rock is shipped, while the sand and mud, constituting fully one-half of the stuff removed from the mines, is emptied from a shoot into the river (Anonymous 1882:186).

This, the Inspector reported, was causing navigational problems. We have not learned whether the legislature took steps to stop the action.

Rogers (1915:212) observes that "much" phosphate was lost during the washing.

Upwards of 60% of the material taken to the washers is sand, clay, and finely divided phosphate that is screened out. One estimate indicates that nearly 8% of the material mines, or as much as 20% of the phosphate present, is lost to the waste piles. The problem was far worse in some areas, such as around Tenmile Hill, where the rock was reported to be so friable that a very large amount was lost in handling and washing.

From the washers (and perhaps the pickers, although this action is not consistently reported; see Haskell 1882:414), the rock might be transported by either tram or conveyor to some facility for drying. As previously mentioned, however, not all firms dried their rock.

Chazal explains the earliest method, with the rock placed in covered bins, open at the front. Hot air was then distributed through perforated pipes laid near the bottom of the piles. He remarked:

> The drying action was necessarily very uneven. The rock next to the pipes was thoroughly burnt and frequently calcined, particularly near the point of entrance of the hit air, where the heat was, of course, greater. Toward the opposite end of the shed, and as the distance of the rock from the pipes increase, the heat and drying action diminished very materially, so that the bulk of the mass received little more than a fairly thorough drying. . . . In addition to this the cost of the pipes was great and their durability small (Chazal 1904:16).

Haskell (1882:414) describes the rock being piled "over perforated flues, through which heated air is blown into a strong blast from the furnace, and passes through these masses of rock, drying it." It appears that this approach was abandoned by many companies about this time (for example, the Charleston Mining and Manufacturing Company, see Chazal 1904:50) and replaced with:

Figure 27. Lambs Mine (Charleston Mining and Manufacturing Co.) drying shed (courtesy South Caroliniana Library).

> burning the rock in sheds, open on all sides, on wood carefully piled to permit a proper draft. The heat evolved is intense, that furnished by the wood being materially increased by the combustion of the organic

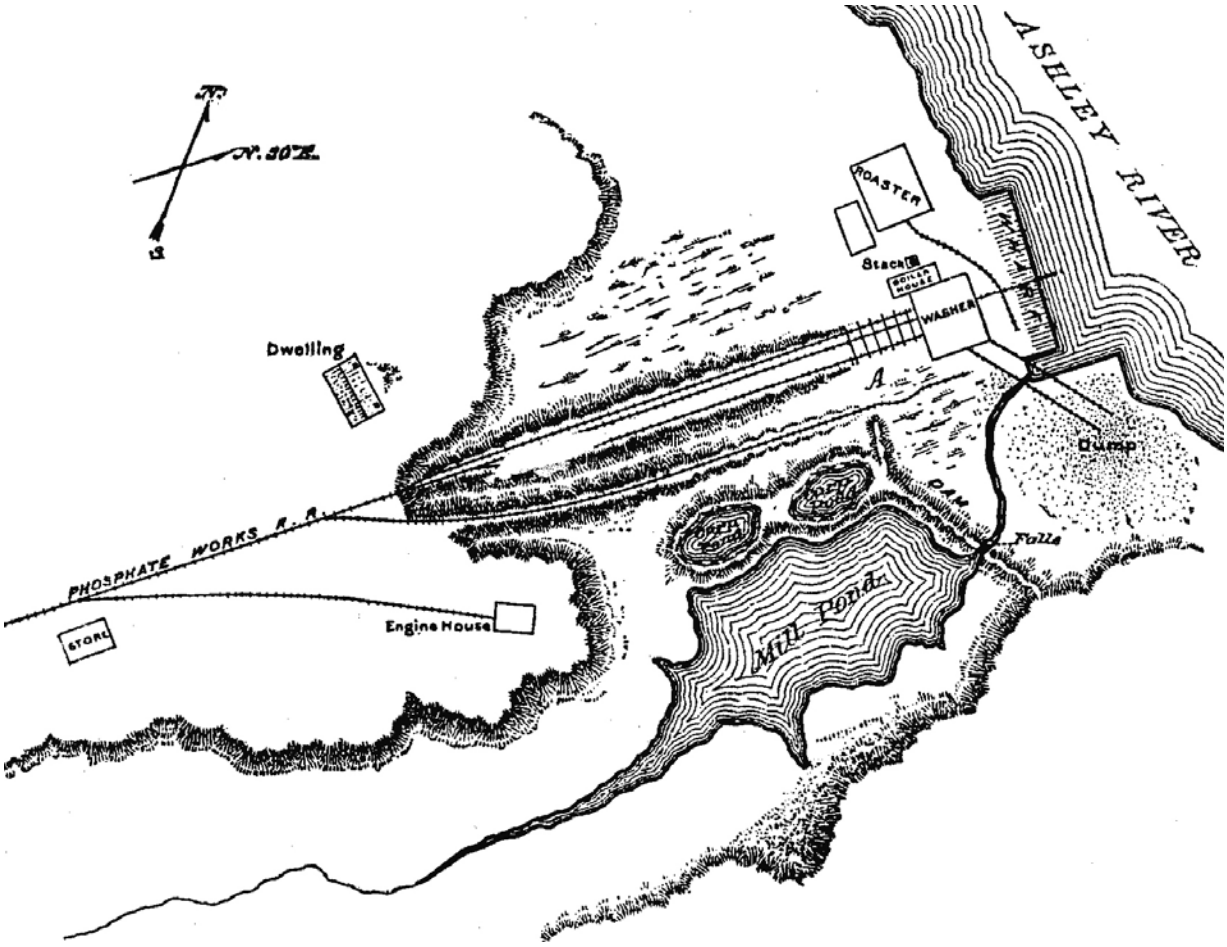


Figure 28. Gregg's phosphate works on the Ashley River showing the washer, boiler house and stack, and roaster. The dump for the waste material is southeast of the washer, adjacent to the river (McGee 1986:300).

> material of the rock, and also by the formation and combustion of water gas (Chazal 1904:16).

Waggaman (1913:8) describes substantially the same process, explaining that from the washers the rock was placed back in cars and transported to a drying shed, where it was "burned on ricks of wood" with about 8 cords of wood required for every 100 tons of rock. Wyatt, in 1891, described the drying process in the same way:

> that of simple roasting in an ordinary kiln, such as is generally used in the manufacture of bricks, is said to have been found at once the most rapid, effective and economical. . . . The rock is built on layers of pine wood, and owing to its containing a considerable quantity of organic matter, is readily lends itself to combustion and requires but a short time to become quite red-hot (Wyatt 1891:54).

Wyatt further explained that the kilns were constructed to "allow free passage to a train of cars, which, running on the main line of railroad, can be loaded in the kiln, run down to the landing place and discharged directly into the barges or boats on the river (Wyatt 1891:54).

Moses had reported that the earlier technique of drying using heated air was still being used, at least by some companies, in 1882, when he reported the use of high powered Sturtevant blowers drawing air through a wood burning furnace and down a 100 foot long brick flue to the rock. These drying sheds were 100 by 400 feet in size (Moses 1882:515). He also reported that at least some rock was only air dried (as opposed to mechanically dried).

While hot air drying reduced the moisture content of the rock (as high as 15% after washing) to perhaps 2%, several authorities remark that kiln drying would reduce moisture content down to about 0.5% (Chazal 1904:17; Waggaman 1913:8).

There are few detailed plans of phosphate processing facilities. One is the plan of the track and washers at Gregg's Phosphate Works, produced after the 1886 earthquake, during the height of the phosphate industry. We see the phosphates being delivered directly to the "Washer." Although the source of the water is not identified, it was probably the nearby Ashley River. Adjacent to the washer was the boiler house – necessary to pump the water, and operate the conveyors and screws. The dump area for the washers is clearly shown to the northeast.

To the north of the washer, and probably connected by conveyor, was the "Roaster," or drying shed. This sketch does not indicate the type of dryers being used, but the implication is that blowers, powered by the nearby boiler, were being used, with the furnace perhaps in the unlabeled building to the southwest.

From the drying shed the rock would have been transported by rail back to the wharf, where it would then have been loaded for shipment. This particular drawing does not show any grinders or acid chambers, suggesting that fertilizer processing was not taking place on the site (see the discussion of fertilizers below).

The Fertilizer Industry

From the washers (and perhaps the dryer) phosphate rock might being be loaded in ships for transport to a northeastern or foreign fertilizer factory – or it might be processed into fertilizer at any one of a number of Charleston plants, typically being transported by rail.

The development of phosphate mining can only with great difficulty be separated from the simultaneous development of South Carolina fertilizer industry. In fact, the Sulphuric Acid and Superphosphate Company (subsequently the Etiwan Works) – the first company to manufacture this critical acid for fertilizer production in the South – applied for its charter in May 1869, but actually began operation the previous August, producing its first acid in December 1868. While this earliest effort used sources of phosphates other than South Carolina rock, as the industry stabilized, local factories used local materials.

Some factories simply ground the phosphate rock to a fine powder, known as "floats." The Ashley Phosphate Company explained:

> Floats is phosphate rock reduced to an impalpable powder, so fine that it will float in the air. All the floats that is offered by the Ashley Phosphate Co. is ground by the Duc Atomizer out of high grade Phosphate Rock, and it will be found of superior quality in every respect. This extreme reduction is accomplished by the use of the Duc Atomizer Mill, invented by Mr. H.A. Duc, Jr. of Charleston, S.C. By the attrition of Rock against Rock, in a revolving hollow disc the grinding is effected, and the product is removed by suction.
> (Anonymous 1882:27).

Other companies, as well, offered this product. In 1881 the Annual Report of the Stono Phosphate Company announced that , "the finer grinding of Rock has become more than ever an imperative necessity . . . . [resulting in] the introduction into our works of the Duc Atomizer Mill" (May 3, 1881 Annual Report, Stono Phosphate Co. Minutes, South Caroliniana Library). By 1886, however, the company found "almost no demand" for floats and the use of the Duc Mill was discontinued.

Many mills processed the rock to produce what was called superphosphate (sometimes called acid phosphate). Superphosphate was the chief material supplying phosphoric acid in fertilizers and is considered the basis of the modern fertilizer industry. The insoluble phosphate rock was converted to soluble superphosphate and gypsum, with the superphosphate generally containing 14 to 16% available phosphoric acid. Memminger (1883) explains the process involved four basic steps: the manufacture of sulfuric acid, the drying and grinding of the rock, the mixing of the acid and ground rock, and finally, the "disintegrating and screening" and bagging of the fertilizer.

Although the fertilizer companies initially purchased their sulfuric acid from northeastern manufacturers, this was costly. Memminger explains that the local companies (like the Sulphuric Acid and Superphosphate Company) began building their own "sulphuric acid chambers" – lead lined rooms with piping to introduce steam. Connected to them were furnaces where sulfur was burned in the presence of air to create sulfur dioxide. The sulfur dioxide gas was then mixed with air, steam, and oxides of nitrogen (created using nitrate of soda to produce nitric acid). These react in the lead vessel to yield sulfuric acid as fine droplets that fall to the bottom of the chamber. The resulting acid is not particularly pure and is only about 62 to 70% sulfuric acid, with the rest being water.

Another account explains that superphosphate was made by mixing equal weights of finely ground phosphate rock (the grinding would promote a faster chemical reaction by exposing more surface area) and sulfuric acid. The material was:

> mixed in cast iron pans, equipped with stirring apparatus, which rapidly mixes the rock and acid. From these pans the mixture, while still fluid, is dropped into a "hot den," where it soon solidifies. After remaining in the den from 15 to 30 minutes the reaction has usually proceeded to the point where the material can be removed with a pick and shovel or some special mechanical device. However, frequently the material is left in the den 24 hours (Anonymous 1929:124; see also Anonymous n.d. b, McKinley 2003:387-388).

It was also possible to create double superphosphate in a two-stage operation. A weak sulfuric acid was mixed with the rock to create phosphoric acid and gypsum. The latter was filtered out and discarded, while the phosphoric acid was collected and used to treat additional rock. Techniques were similar to the creation of superphosphate, except that the final product was dried in a direct-heat dryer. The resulting double superphosphate typically contained 2½ to 3 times as much available phosphoric acid as regular superphosphate (Anonymous 1929:125).

The available accounts do not clearly distinguish between the drying conducted at the mines and that which took place at the fertilizer factories, although clearly a variety of methods were being used. Memminger (1883:203) describes a process not dissimilar to kiln drying using wood, while McKinley (2003:388) reports Wando used "two large furnaces and ovens." In

addition, there was variation resulting from technological improvements and the financial abilities of the companies. For example, some fertilizer, after the acid reaction, was ground and redried, and sometimes a "disintegrater" was used instead of men with picks (McKinley 2003:393). It's likely that at least some of the technological capability of individual mills can be deduced from the number and size of steam engines and boilers that were present.

The Sanborn maps of the Ashepoo, Pacific Guano, and Stono companies show some significant similarities, and a few variations. For example, while Ashepoo and Pacific Guano relied exclusively on rail lines for both delivery of rock and shipment of fertilizer, Stono also had access to the Ashley River. All three plants hadlead acid chambers and in each case they were separated, more or less, from the rest of the processing facilities. The greatest separation was at the Ashepoo facility, where one furnace was nearly 500 feet distant – providing relief from the resulting fumes. At the other facilities the separation was not nearly so great and the extent of the technology varied, with the Stono plant having two furnaces within about 300 feet of the processing facilities.

The firms evidence from three to five boilers. While Stono apparently processed a cotton seed fertilizer, only Pacific Guano was also using fish and "scrap" in their mixes. The plans also show varying reliance on artesian and surface wells, as well as water reservoirs. Each facility had an office, as well as other support structures, such as blacksmith and carpentry buildings. In addition, all show one or more dwellings in proximity to the works.

The Sanborn maps, then, provide a glimpse of the plants, frozen in time, and offer an opportunity to compare and contrast the production features, arrangements, and housing at the individual facilities. Since at least some plants are also shown on maps for several years, it is possible to evaluate diachronic changes.

The 1874 prospectus for the Ashepoo Fertilizer Co. offers another view of what those involved in the industry found important:

> situated near the river, convenient for mining and transporting . . . . much of it has been cultivated, upon which suitable houses have been erected for tenements of laborers . . . .land in St. Andrew's Parish, S.C., at the Wapoo Cut, opposite the city of Charleston, near and convenient to the Charleston and Savannah R.R. Depot, upon which land there is a an extensive and substantial factory building, the erection of which cost $50,000, of sufficient capacity to stow at least two (2) tons of materials, besides sufficient room for working the extensive machinery, consisting of one eighty-horse-power steam engine, and three (3) large boilers in boiler house, all in good working order, four sets of French burr stone mills, . . . complete with belting, gear, &c., one new Poole & Hunt mixing machine and Poole & Hunt "smithering," with which the fertilizers are ground, mixed, screened and bagged by steam power in the most approved manner, at the rate of seventy-five tons per diem, and from eight to ten thousand tons of the best commercial fertilizers could be turned out for each selling season when required.
>
> There is excellent wharf property attached . . . having an office building and laborers' dwelling house and the premises (Anonymous 1874:5).

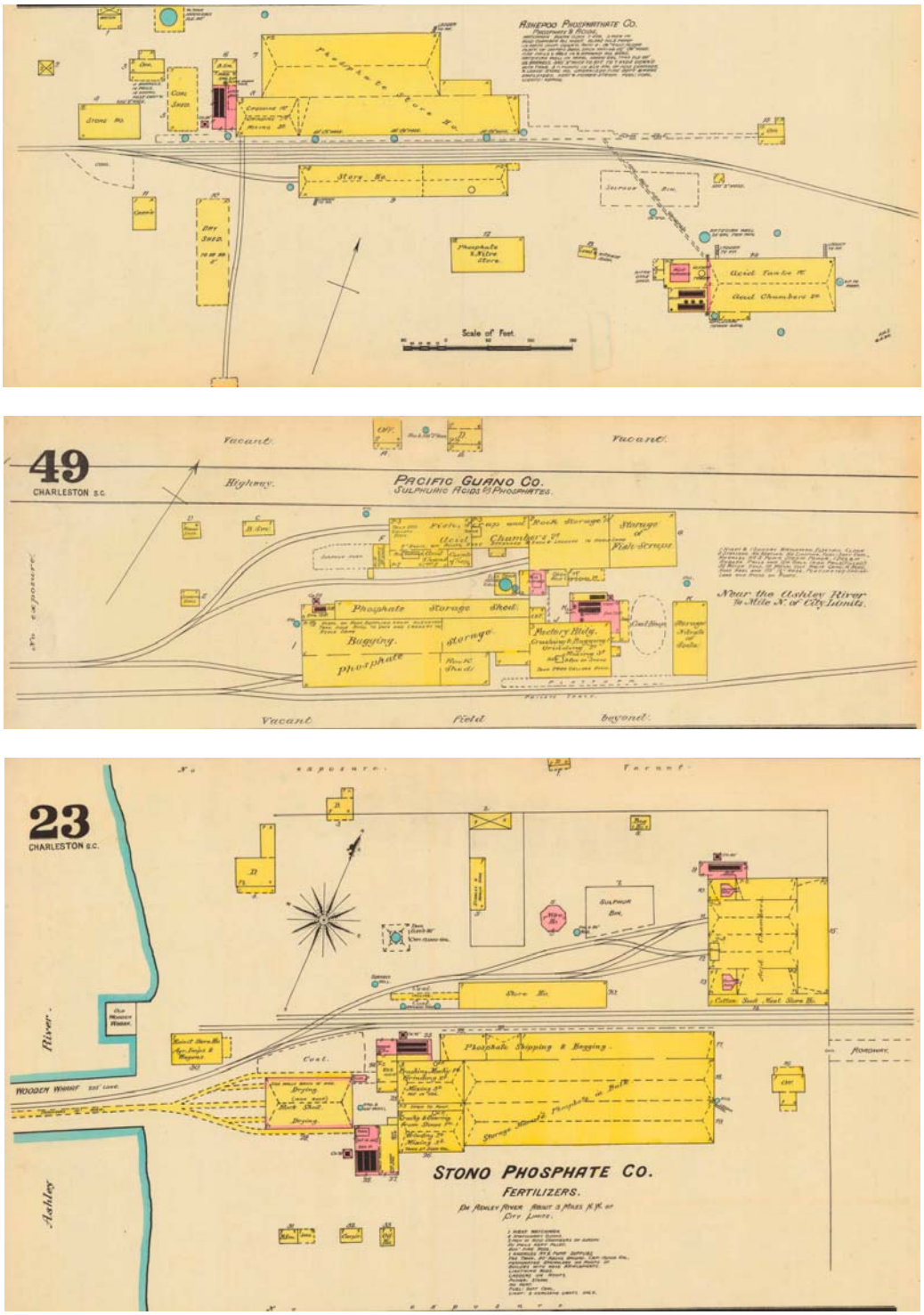


Figure 29. Sanborn Fire Insurance Maps showing the Ashepoo Phosphate Co., Pacific Guano Co., and Stono Phosphate Co. from 1888.

Obviously the setting was important in respect to the phosphate fields and transportation. Likewise, the nature of the equipment was a critical component. But the prospectus twice mentions the availability of housing for laborers – a factor already discussed in relation to the phosphate mines, and apparently also being considered important to the factories (places like the Read Fertilizer Co, later Read Phosphate, did establish a laborers' village, see Fick and Stockton 1995:60).

Memminger's description remarks that at the Sulphuric Acid and Superphosphate Company (later Etiwan) plant there were dwellings for the white supervisory workers:

> To the east of the Works, on a point commanding a most beautiful view of the harbor and sea, are four dwelling houses, in which live the families of seven of the white employees of the Company, including the Superintendent, Engineer and sulphur burners, so that at all times the property of the Company is protected by the presence of a large number of intelligent and efficient men; the roofing of the different buildings covers an acre and a half of ground, and the total horse-power of all the engines is 320 (Memminger 1873:205).

Were these dwellings necessary? Given that there were seven families occupying four houses, it is clear that the staff members in residence were expected to function as night watchmen. The beautiful view of the harbor and sea might have compensated for the industrial landscape seen from other vantage points, and sea breezes might have cleared the air. Certainly there were constant complaints regarding both the hazards of the fertilizer plants and their odors (see, for example, McKinley 2003:390, 422-425). Another account gives a compelling vision:

> All the rotten fish was brought up to Charleston until there was a big mountain of it. . . . Well, you never experienced such a terrible smell as what came from that mill. Naturally, the smell got on the people who worked there, and that made a special type of segregation. The majority of the workers in the mill were Negroes. Since the company made no provision for them to take showers or change clothes, they had to come to Charleston on the streetcar just as they were. Oh, my! The smell on those workers was so bad until the transit had to do something. They decided to put on a special car, segregating the Negroes from the mill from their own people. I wonder what they did with the whites (and including the whites who were supervisors, too), because not just the blacks working there took on the stench of that rotten fish cooking up with the chemicals. Anything nearby would stink. In fact, all Charleston stank. Although you were way down in town, sometimes you could pass out from the fumes, without knowing what was wrong. We had a joke that you could smell Charleston. Every time you came back from somewhere on the train, the fertilizer mill told you what station you were in (Fields and Fields 1983:24).

McKinley also recounts the importance of housing to the black workers (as well as the whites) involved in the fertilizer plants. He points out that as factories moved to the Neck, they were occupying a region almost as rural as the mines themselves (McKinley 2003:413).

Table 3.
Fertilizer Companies in 1882 and 1891

Company	Location	1882	1891
Ashepoo	Ashley	X	X
Ashley	Ashley	X	X
Atlantic	Ashley	X	X
Baldwin	Port Royal		X
Berkeley	Charleston		X
Bulwinkle, H.	Ashley	X	
Charleston Phosphate	Ashley	X	
Chicora	Charleston		X
Columbia	Columbia		X
Ebaugh's Marl Works		X	
Edisto	Charleston		X
Etiwan	Cooper	X	X
Globe	Columbia		X
Greenville Fertilizer Co.	Greenville		X
Hume's (or Hume Bros.) Works	Beaufort	X	
Imperial	Charleston		X
Mead	Charleston		X
Medway	Ashley	X	
Pacific	Ashley	X	
Pinckney, C.C.	Ashley	X	
Port Royal	Beaufort (Port Royal)	X	X
Royal	Charleston		X
Sea Island Chemical	Beaufort	X	
Stoney Landing Co.	Stoney's Landing	X	
Stono	Ashley	X	
Walton, Whann & Co.	Beaufort	X	
Wando	Ashley	X	X
Wilcox, Gibbes & Co.	Charleston	X	X
Woodstock Lime Co.	Woodstock, SSRR	X	

Using the 1880 census and acknowledging the same flaws for the fertilizer workers as for miners, McKinley suggests that small villages of company sponsored housing were growing up around the mills. Workers were the same average age as the miners and appear demographically stable, with nearly two-thirds of them having children and three-quarters married to wives keeping house (McKinley 2003:421). Wages were $2.50 ($44 in 2002$) a day for skilled workers and $1.00 ($17.50 in 2002$) a day for unskilled – far above what was being offered in the textile industry. McKinley also observes that as factories began to offer company housing, strikes (such as the 1873 strike among fertilizer workers in Charleston) ceased and he suggests that the workers, "surrendered working safety and independence for good wages and a roof overhead" (McKinley 2003:421).

Chazal (1904:63) notes that by 1873 there were at least six companies in the Charleston area: Atlantic, Pacific Guano, Stono, Sulphuric Acid and Superphosphate, Wappoo Mills (J.B. Sardy's) and Wando. Moses (1882:519) indicates the number had grown to at least 20, by 1888 there were 21 (Fick and Stockton 1995:55), while Watson (1907:398) reports 25 in 1907. The Inspector of Fertilizers in 1878 and 1879 list 54 and 58 companies for South Carolina respectively. While not all were manufactured in South Carolina these are likely fairly comprehensive lists and suggest the growing popularity of fertilizers. Cotton farmers used fertilizer heavily: 248,000 tons in 1899, over a million tons in 1919. Demand for fertilizer then plummeted, as the boll weevil killed the cotton industry (Fick and Stockton 1995:56).

A variety of factors affected fertilizers. At least some sense of these events can be gathered in the Stono Phosphate Co. Minutes (South Caroliniana Library). In 1882 the company's annual report explained that the drought of 1881 was a "serious impediment" to business. Collections were tardy and cash flow was restricted. Added to this several northern fertilizer factors failed and, Stono's Board complained, "their affairs placed in the hands of Assignees, who seemed anxious to realize at any price and on any terms, the stocks of their Companies; where were distributed throughout the entire cotton planting region, thus creating a

Table 4.
Fertilizer Companies list in 1907

Company	Actual Value	2002$
Ashepoo Fertilizer Co.	$149,173	$2,983,460
Combahee Fertilizer Co.	75,000	1,500,000
Etiwan Fertilizer Co.	113,400	2,268,000
Germofert Manufacturing Co.	24,000	480,000
Virginia-Carolina Chemical Co.	1,320,106	26,402,120
Atlantic Works	140,747	2,814,940
Chicora Works	290,656	5,813,120
Imperial Works	317,882	6,357,640
Standard Works	466,184	9,323,680
Stono Works	72,560	1,451,200
Wando Works	32,077	641,540

severe competition and consequent decline in prices" (1882 Annual Report, Stono Phosphate Co. Minutes, 1881-1888, South Caroliniana Library). Finally, the Board complained that the success of Charleston firms had "caused capital North, South; and West to embark in the business." The 1883 Annual Report repeated the concern with "active competition." By 1887 the Board complained that because of the "depressed condition of the trade" they discovered other companies, such as Atlantic Phosphate Co., were to begin selling their fertilizer at $10 per ton. This was the proverbial "final straw" and the company liquidated that June.

A decade later Wyatt (1891:60) lists 17 fertilizer companies and by 1907 there were five, with the Virginia-Carolina Chemical Company having absorbed a number of the earlier companies. The R.G. Dun and Co. provided a slightly different list of fertilizer factories for that same year, listing eight firms: Combahee Fertilizer Co., Etiwan Fertilizer Co., The Florida Phosphate Co., Germofert Mfg. Co., Ingleside Mining & Mfg. Co., Planters' Fertilizer & Phosphate Co., Read Phosphate Co. (a Tennessee firm), and the Virginia-Carolina Chemical Co. All of the firms had at least a good credit rating and some, such as the Virginia-Carolina Chemical Co., were given superior ratings (R. G. Dun and Company 1907).

In 1910 the *News and Courier* reported six fertilizer companies in the area: Etiwan (established in 1868, chartered in 1900, operated into the 1930s), Read Phosphate (organized in Virginia in 1874 as the Read Fertilizer Co. and reorganized as the Read Phosphate Co. in 1898, and absorbed into the Davidson Chemical Corp. of Maryland in the mid-1930s), the MacMurphy Co. (1906), Planters' Fertilizer and Phosphate Co. (1906), and the Virginia-Carolina Chemical Co. There were, in addition, five importers. With plants scattered from the Charleston Neck to St. Andrews Parish, altogether these firms were reported to employ nearly 1,400, with about 1,100 being African American (Fick and Stockton 1995:56).

Ten companies were listed by 1916: American Agricultural Chemical Co., Combahee Fertilizer Co., Etiwan Fertilizer Co., Inter-state Chemical Corp., Lambs and Chisolm Island

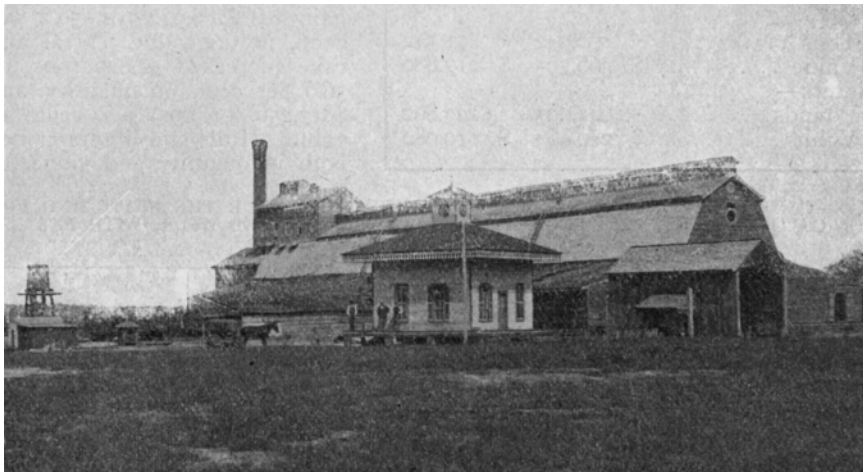


Figure 30. View of a 1907 fertilizer factory on the Charleston Neck. In the foreground is the office. In the background are the main operations, including the storage, crushing, grinding, and milling building. The smoke stack is associated with the boilers and engine house. On the far left is a water tower.

Figure 31. 1949 aerial view of Naco Fertilizer (a division of W.R. Grace).

Mines, Molony and Carter, Planters Fertilizer and Phosphate Co., The MacMurphy Co., Va.-Carolina Chemical Co., and Wulbern Fertilizer Co. These companies represented nearly 50% of the capital invested in South Carolina and produced products nearly three times the value of their nearest rival, the state's textile industry (Watson 1916: 96, 106).

The early 1900s were a time of extensive mergers and it was probably difficult to keep tract of the different companies. For example, Read Fertilizer – then Read Phosphate – sold a portion of its 70 acre property to the Coe-Mortimer Co. of New York. In 1913 Coe-Mortimer conveyed the property to American Agricultural Chemical Co., which operated the Ashepoo Fertilizer Works (Fick and Stockton 1995:60).

By 1927 some of the glory of the fertilizer industry was beginning to wear off. Although Charleston still boasted of twelve manufacturing plants and eight mixing facilities (where composite fertilizers were mixed), Charleston was usurped by Baltimore as the largest manufacturing point for commercial fertilizers in the world (Hanahan 1927:87). But two decades latter Sass (1949) still proclaimed the importance of the fertilizer industry to South Carolina and Charleston in particular. Explaining that fertilizers were a $16,000,000 a year business employing 1,200 persons, Sass listed the major firms, including American Agricultural Chemical Co., Virginia-Carolina Chemical Co., Molony Fertilizer Co., Maybank Fertilizer Corp., Naco Fertilizer Co., and the Planters Fertilizer & Phosphate Co.

It was also in 1949 that Matthews (1950:1000) announced that the Virginia-Carolina Chemical Corp. began the erection of a state-of-the-art electric furnace for producing elemental phosphorus. This new plant was being built on the site of the first phosphoric acid plant, built by Virginia-Carolina in 1907. The phosphate rock for the facility was not to be from South Carolina, but would be hauled by train from the company's Florida fields.

Left unsaid was the continuing environmental deterioration caused by these firms. Beyond the foul smelling guano and fish scraps, or the acrid smell of burning sulfur or even sulfuric acid, was the gradual contamination of the soil with arsenic and lead, as well as the leaching of phosphorus into the waterways – resulting in the exploding shrimp reported by the *Charleston Post and Courier* ("Legacy of Contamination Still Haunts Rivers, Creeks, *Charleston Post and Courier*, February 24, 1998, pg. A7). McKinley (2003:452) summarizes at least some of the damage. It lingers on today, with at least seven fertilizer plants recognized by the EPA as significant sources of pollution, including Ashepoo Phosphate (discharging to

the Ashley River), Atlantic Phosphate Works (plume discharging to the Ashley River), Carolina Eastern-Malony Fertilizer (being monitored), W.R. Grace & Co. (plume being discharged to a tributary of Shipyard Creek at one of two locations), Stono Phosphate (plume discharging to the Ashley River), and Swift Agri-Chem (plume discharging to the Ashley River).

The Economic Impact and the Industry's Demise

There is no question that phosphates brought great wealth to the state. For those who sold their land, the prices of $6 to $20 an acre were well above to the pre-phosphate values of $2 an acre (see McKinley 2003:110, 116). The News and Courier (1884:54) reported a uniform six-fold increase in land values. The sale price was probably even more attractive in light of the aggressive tax program of the Radical Republican legislature. For many who invested in phosphate companies the returns were good. Even the ill-fated Stono Phosphate Co. was paying dividends of $15 a share. The *New York Times* reported that phosphates were bringing a 25% profit ("South Carolina's Prosperity – What White Labor Has Accomplished in Recent Years," *New York Times*, February 4, 1884). And for those who worked at the mines the wages, while pitiful, were still far above what could be earned as a farm laborer. Although not a topic of this study, if the royalties paid by the river mining companies were considered, then the value of phosphates to the state treasury would also be clear (accounting for 20% of the state's income according to the News and Courier 1884:54).

Rowland, as early as 1883, explained that the profitability of land mining was based on six critical features: the location of the deposit with reference to the transportation network, the difficulty of extracting the rock (i.e., its depth, drainage, presence of trees, and so forth), the quality of the rock, the extent and yield of the deposit, the supply of necessary raw materials (labor, water, and wood, for example), and the facilities for removing the rock (probably the ability to capitalize the equipment necessary) (Rowland 1883:1007). While he did not attempt to develop costs, we are fortunate that several other individuals did.

In 1886, as part of their internal discussions surrounding their financial future, Stono Phosphate calculated production costs per ton of fertilizer (Stono Phosphate Co. Minutes, 1881-1888, South Caroliniana Library). Although not strictly mining costs, these are still useful for evaluating the profit margin of the industry at the time. They found that each ton of superphosphate cost them $11.69 ($225 in 2002$). Of this total, the ingredients were $6.61 ($127 in 2002$), the bags were $1.08 ($21 in 2002$), with the rest ($4 or $77 in 2002$) being labor and salaries. They compared their costs of $4 per ton to those of Edisto Phosphate, where the costs were only $2.50 per ton (it appears they assumed that ingredient costs would be about equal). While interesting, this fails to provide information on the actual cost of phosphate mining – except to suggest that in the mid-1880s production costs were between $6 and $7 per ton.

Table 5.
Phosphate mining costs per ton in 1886 and 1891

1891		1913	
Mining, max 15'	$1.00	Mining, labor	$1.50
Draining	.50	Washing, labor	.10
Loading, carrying to washer	.60	Drying, labor	.05
Washing	.30	Haulage	.30
Drying	.50	Fuel for power plant	.04
Shipping via water	.25	Fuel for drying	.12
Interest and repairs	.15	Interest	.40
Supervision and management	.20	Insurance	.05
Towage to Charleston	.25	Taxes	.05
		Overhead	.10
		Depreciation	.75
Total	$3.50	Total	$3.46

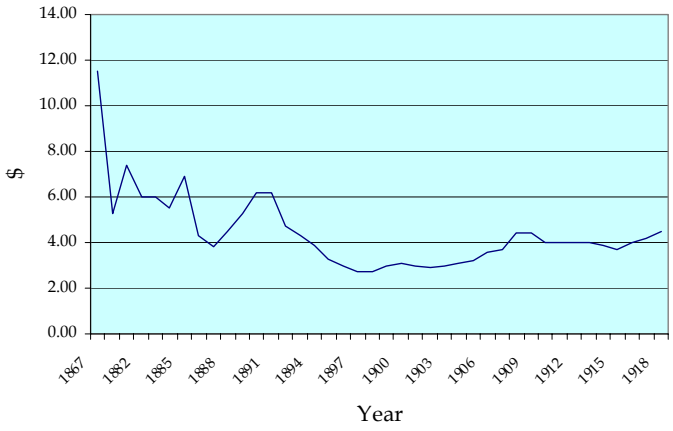


Figure 32. Prices for South Carolina phosphate rock (from Shick and Doyle 1985:19).

Wyatt (1891:60) provides a more detailed account from 1891. He found that each ton cost about $3.50 ($69 in 2002$). A very similar figure of $3.46 ($63 in 20024) is reported by Waggaman (1913) about a decade later.

These have little meaning, however, without comparing them to the price of phosphates. Fortunately Shick and Doyle (1985:19) provide these prices, which are shown in Figures 32 and 33 (as period prices and with the prices converted to 2002$). In 1886 rock was selling for about $4.30, while production costs were at least $6.00 – reflecting a loss of $1.70 per ton or a loss of around 40%. By 1891 phosphate was selling for $6.20 and production costs had declined to $3.50 – netting a profit of about 77%. In 1913, with phosphates selling for $4.00 a ton, the production costs were $3.46 – allowing a return of only .54¢ or 16%.

When prices were good, phosphates appear to have been profitable. When prices dropped, however, phosphates – like rice and cotton before them – were a significant economic drain. Using $3.50 as a standard cost of production, it is clear that from 1895 to 1905 phosphates were selling at below the production cost and that both before and after this period there were occasional years when the profit margin would have been very slim – perhaps only a few cents per ton. Given the investment, the return would likely not have been worth the risk. The "heyday" of phosphates, then, was relatively brief, from 1867 to about 1891 – a little over two decades.

With the 1890 discovery of phosphates in Florida, South Carolina reacted with amazing speed, sending E.L. Roche, the special phosphate assistant, to investigate conditions in Florida. He reported that "while with our deep water facilities for placing the product in the markets of the world and prestige of an already established trade, there need be no fear of immediate detriment to our phosphate interest, yet the Florida rock is bound in the near future to become an important factor in the market and the sooner this is recognized, the better will we be able to prepare for the competition when it comes" (Mappus 1938:52-53). One wonders whether South Carolina learned from his guarded advice. The *New York Times* reported that while the previous year's discoveries in Florida, "temporarily injured the

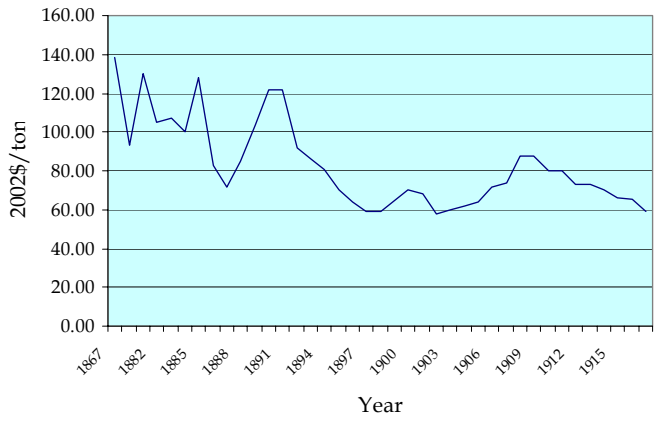


Figure 33. Prices in 2002$for South Carolina phosphate rock (from Shick and Doyle 1985:19).

industry" in South Carolina, the final result was to stimulate yet additional development in 1890 – with an additional $1,000,000 of capital pumped into the South Carolina mines. The justification was apparently that the "demand for commercial fertilizers is constantly growing" ("Mining Phosphate Rock," *New York Times*, January 29, 1891). In retrospect Chazal criticized at least some of this additional investment by the Charleston Mining and Manufacturing Co.:

> new management was . . . composed of men ignorant of the phosphate business, and who . . . were equally unfamiliar with its lessons and results. Carried away by wild opinions as to the dangers threatened to the value of their property – through of its real value, indeed, they could have had but a hazy idea – by the recent Florida development and disregarding the advice of the experienced and skillful management which had been in successful conduct of the business of the company for so many years, they thought they had found a panacea for their anticipated troubles in a cheapening of the cost of production by the abandonment of their old plant at Lamb's, and the erection of a new, larger and more costly one on the Fetteressa plantation at Bee's Ferry (Chazal 1904:61-62).

On the heels of the Florida discovery South Carolina's new government, Ben Tillman, took a careful look at the phosphate industry (or at least that part regulated by the state – the river rock mining permits). This was not his first expression of interest – in the late 1880s, he had leveled charges of corruption at the state-chartered monopoly on phosphate mining. As governor he proclaimed, "if we are to permit capital to shirk taxation and corporations to dictate to the State in order to have money come here for investment, we don't want it" (quoted in Kantrowitz 2000:186). Although this demagoguery may have supported his populist appeal, the years that the river rock was tied up in court dramatically hurt the industry.

While it might be expected that Tillman's Coosaw litigation would have driven river rock interests into land rock mines, it did not, because Florida rock was being found vastly superior. It contained 70% bone phosphate of lime, yielding a superphosphate containing 18% soluble phosphoric acid. In contrast, South Carolina, with 58% bone phosphate of lime, produced a superphosphate with only 14% soluble phosphoric acid (Mappus 1938:63). The Florida rock was also significantly lower in contaminants such as iron and alumina than even South Carolina's land rock (Rogers 1915:215).

The Florida rock was also of a pebble variety – allowing it to be mined hydraulically and allowing easier processing. The cost of mining Florida rock was, at the high end, about $2.50 per ton, compared to costs of $3.50 to as much as $4.70 per ton for South Carolina rock. In addition, Florida's royalty was more than 50% lower than South Carolina's (Mappus 1938:57).

So, while only 10,000 tons of Florida rock was shipped between 1888 and 1890, up to June 1891, 110,000 tons were shipped to Europe alone – more than all the South Carolina rock shipped in any one year. Although mining had only just begun in Florida, 18 companies began almost immediately and were operating with a capacity of 867,000 tons per year.

Rogers (1915:215) observes that despite the advantages of Florida rock, South Carolina phosphate tended to grind better, react more thoroughly with sulfuric acid, and produce a finer fertilizer than the phosphate from Florida.

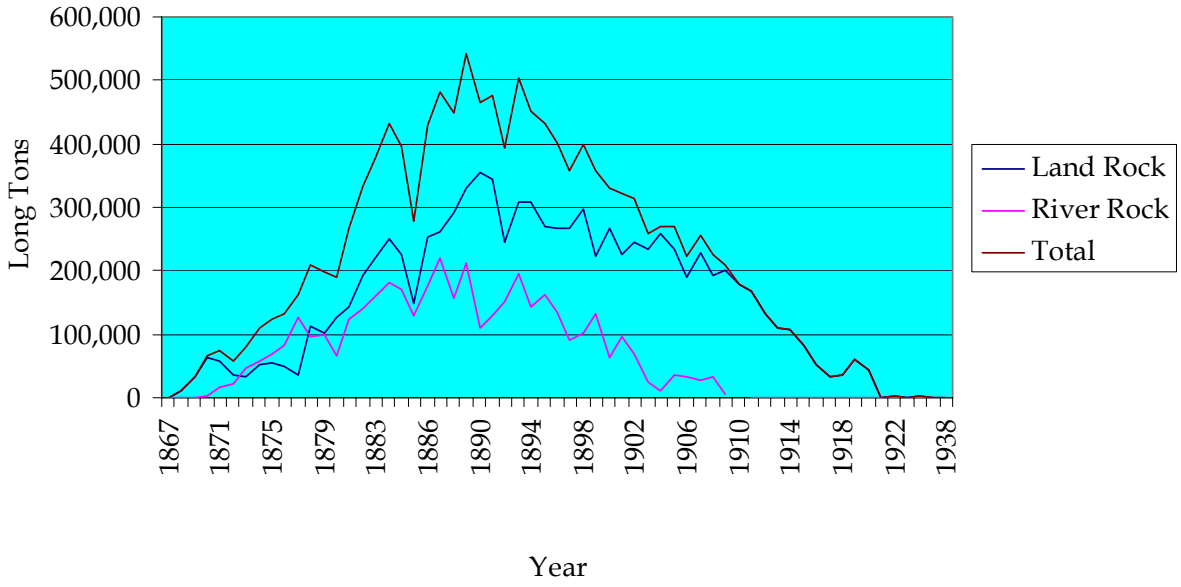


Figure 34. Production of South Carolina phosphate rock.

Although Rogers notes that these characteristics "have aided the South Carolina product in competition with the higher-grade Florida rock" they were not adequate to save the South Carolina industry.

Prior to the fields in Florida opening, Mappus (1938:58) reported that the demand for phosphates was just equal to supply. With Florida flooding the market, the price fell dramatically, to levels where South Carolina was unable to produce its lower grade rock and see any profit.

Many authors consider that the 1893 hurricane dealt a death blow to South Carolina's phosphate kingdom (see, for example, Fraser 1989:327, who observes, "the machinery and facilities of the phosphate mining operations were damaged so extensively by the hurricane that some companies never fully recovered"). It seems reasonable to counter that the region suffered extreme hurricanes in August 1885 and August 1893, followed by a major hurricane later in October 1893 (Mathews et al. 1980:55). The 1893 hurricanes, however, coincided with the onset of a general economic depression, which worsened the financial turbulence experienced by South Carolina's railroads, most of which were being absorbed by out-of-state trusts indifferent to the possibilities of Charleston as a rail or port terminus (Doyle 1990:172-173). More reasonable assessments come from authors such as Waggaman (1913:1) who attribute the decline in South Carolina phosphates, very simply, "to the marketing of higher-grade phosphate from other sources."

By 1910 there were only four land mining companies still operating: Charleston Mining and Manufacturing Co., C.C. Pinckney, Bolton Mines, and Bulow Mines. Together they employed less than 1,200 men (Fick and Stockton 1995:56).

With some regret Hanahan (1927:85-86) announced in 1927 that South Carolina was

producing no phosphate (production for all intents and purposes ceased in 1920) and that the 200,000 tons being used was all shipped from Florida. A decade earlier Rogers had commented that the higher-grade Florida rock could be delivered to the Charleston harbor "at a price only slightly above that of the local product" (Rogers 1915:220).

Although certainly requiring more capital, phosphates might be placed in the classification of what Coclanis described as "rudimentary extraction and plunder – the stuff of Marxian primitive accumulation" (Coclanis 1989:58). The parallels to rice (and indigo, cotton, and lumbering) cannot be overlooked. Among historians the big issue seems to be whether phosphates brought any significant, long-term change. Shick and Doyle argue that phosphates represent a "stillbirth of the New South," a "harmless flurry that left the area, its economy, and its hierarchy of class and race, still within the mold of the Old South" (Shick and Doyle 1985:4). Charleston, they claim, reached the twentieth century "untouched" by new ideas and still clinging to old, conservative ideas and economic stagnation. They even claim that the failure of the phosphate industry can at least partially be laid at the feet of the African American community, which resisted the "wage labor market."

The issue of wage labor and the African American response was convincingly dealt with by Philip Morgan (1982) several years prior to Shick and Doyle's (1985) article. African Americans were focused on their needs and issues – not those of a largely white industry looking for cheap labor. African Americans, after years of slavery, sought to establish independence from whites and white society. They chose not to accept the Protestant work ethic and adopt to the expectations of white society, but to diversity their own means of subsistence and survival, ensuring economic and social autonomy.

In spite of this obvious flaw in Shick and Doyle's thesis, many researchers continue to support their "stillbirth" theory. Fletcher and his colleagues (Fletcher et al 2003:58), for example, find the thesis "aptly" describing the "tragic ending to a promising beginning."

More recently McKinley (2003:466-470) has reviewed Shick and Doyle's conclusions, finding several of them to be flawed. He points out, for example, that far from being apathetic and inactive, Charleston's leaders such as Memminger, Trenholm, and Adger were all aggressively pursuing phosphates. He suggests that comparing Charleston to Atlanta distorts the reality of a less successful, but still energetic city. Most importantly, McKinley disputes that the phosphate industry left no lasting economic impression, pointing to the sustained fertilizer development that continued to dominate Charleston for the next 60 years. Certainly there can be no dispute that a lasting legacy of phosphates are the sites in Charleston so badly polluted that they deserve superfund status. Nor can the extraordinary destruction of the landscape caused by what was essentially strip mining be ignored. For the two to three decades of profitable production, South Carolina has paid a terrible toll.

It is still to be decided if the demise of South Carolina's phosphate industry really can be ascribed – as McKinley suggests – to a "combination of bad politics, bad luck, and bad weather" (McKinley 2003:468). Why did river rock interests not turn to land mining? Was it "just" bad luck that South Carolina business community was overwhelmed by over production, cheaper rock, and higher grade phosphates in Florida? Can a natural event that occurred several times during the history of phosphates really have caused its collapse? Should we place greater importance on the general depression of the 1890s? Might historians be able to examine indigo, rice, cotton, lumber, phosphate – and come to some more substantive conclusion concerning the roads that

South Carolina has taken and the choices that have been made?

Research Questions

Historic contexts are intended to link properties – such as archaeological sites – to important historic trends. The National Register observes that a context refers "to all of those historic circumstances and factors from which the property emerged." By understanding the context we can better understand the importance of the resources being evaluated and we are more likely to accurately understand the property's role in history (Sherfy and Luce 1998).

One way – perhaps the most important way – for a context to achieve these goals is for it to clearly focus on the important questions that a particular type of site might address. That is the goal of this final section. Having provided a broad overview of land rock phosphate mining in South Carolina, it is appropriate to now look at the research questions the archaeological remains of phosphate mining (including the fertilizer factories) may address.

At least one historic context (Fletcher et al. 2003) for evaluating phosphates is available to the researcher. Within the examination of the Ashley Phosphate Co. and Bulwinkle Works, Fletcher and his colleagues suggest several research topics, all largely historical. Their conclusions are indefinite: "archaeologically, the value of phosphate and fertilizer production facility sites is not yet known" (Fletcher et al. 2003:114). However, some of their archival findings, particularly the graphics and maps, do suggest potentially fruitful areas for field work as well as further research. For example, the image (Fletcher et al. 2003:48; also shown here as Figure 20) shows a laborer cooking over a wood fire, apparently using metal vessels. This reminds us of the historical accounts suggesting that the laborers often prepared their meals in the mines. The plan of a "typical fertilizer operation" and the 1902 Sanborn map of the Ashley Phosphate Company plant (Fletcher et al. 2003: 33, 65; as well as similar figures in this study) clearly depict dwellings – begging for additional research and archaeological study.

An earlier report, examining a portion of the Bradley processing facilities at Rantowles Creek (Sipes and Hendrix 2002), identifies the barge landing associated with the property being studied here (although it does not identify the washer or other structures known to exist based on historic accounts and at least one twentieth century map). A nearby domestic site is mentioned as "possibly associated with a logging company that leased the property" (Sipes and Hendrix 2002:60). Little investigation of the site was conducted, and it was not determined whether it was associated with the McLeod Lumber Company's post-1943 activities on the site, with the phosphate operations, or perhaps some other use of the land.

The Bradley holdings, historically many thousands of acres, are now in several ownerships. Sipes and Hendrix studied approximately 125 acres, most or all of which was formerly part of Long Savannah Plantation, a 3300-acre tract that was incorporated into the Bradley holdings. The 3,053 acre "Campbell Tract" included in fieldwork for this study is a separate portion of Long Savannah Plantation.

It is important to counter the common argument that historical research can more quickly, conveniently, and forcefully address the majority of phosphate-related topics. For example, given the level of detail provided by the 1880 and 1890 census records, could we not reconstruct the lifeways of African American phosphate workers using these published materials? As McKinley – an historian himself – observes, "due to the inadequacies of the census and the nature of the work and businesses, the phosphate and fertilizer industries were virtually invisible in the historical record, but extremely important to South Carolina's economy" (McKinley 2003:4). He notes that this "invisibility" is identical to that attributed to the

lumber industry by historian Gavin Wright (1986:156-165). Both were extractive industries with temporary bases, dominated by black workers who chose to maintain a low profile to the ruling white class. As a result, many of the topics in this context will be difficult – perhaps impossible – to examine using primary historical documents, but may be approached using archaeological investigations.

African American Laborers

Who were the African Americans that labored in South Carolina's phosphate mines? McKinley provides us with the suggestion that contrary to the common perception they were "not trapped in the exploitative postwar agricultural labor system," but were actually forging their own place under their own terms. While not discounting the social and legal limitations that African Americans faced, he is also unwilling to classify them as either powerless or victims. He notes that historic evidence exists of a:

> quiet economy – including fishing, hunting, an internal economy, and temporary jobs – that enabled black families and workers to survive alongside – and only occasionally within – the inhospitable white economy. Phosphate miners, and to a lesser extent fertilizer workers, passed like shadows across the historical scene, partly because they did not want to be detected (McKinley 2003:10-11).

He goes on to observe that oppression breeds what he terms a "world of hidden lives, not just isolated acts" and he urges historians to "pry open that concealed world."

Can archaeology document this "quiet economy?" Does this lifeway leave behind a recognizable archaeological pattern – distinct from that of slavery or those African Americans more strongly devoted to agrarian pursuits? And most fundamentally, shouldn't archaeologists also be attempting to "pry open" the "concealed world" of the phosphate miners and fertilizer factory workers? Consequently, the most fundamental category of research is a focus on the lifeways of the phosphate workers – especially the African Americans. Issues of the "quiet economy," so intimately associated with subsistence, should be suitable for archaeological inquiry, especially if the research designs are not preoccupied with block stripping, but are willing to emphasize careful hand excavation. It may also be necessary to examine non-traditional areas, such as the immediately adjacent swamps or mine pits, looking for refuse from the structures.

Research questions might profitably include:

1. identification of assemblages and patterns thought to be associated with mine or factory workers for comparison and contrast to those from slavery and agricultural tenancy;
2. efforts to identify evidence of ethic differences, realizing that the phosphate mines employed not only African Americans, but also Germans, Italians, and Polish workers;
3. study of those areas where convicts were known to be housed to compare and contrast the lifeways of independent workers with those contracted out by the state;
4. documentation of worker's cabins as part of an effort to determine the nature of construction and distinguish between the "shanties" and more substantial housing – as well as to compare and contrast phosphate or fertilizer housing with that found in slavery;
5. efforts to identify and distinguish "group" housing – known from the 1870 census from individual or family housing (an interesting comparison might be the Union efforts to establish

barrack housing for contraband during the Civil War); and
6. research to document activities specific to the mines, including such divergent topics as ownership/possession of tools, use of a commissary, and heavy drinking or gambling that might support the "rowdiness" said to be typical of the camps.

The Complexity of the Mines

Although it is tempting to look at mines only from the perspective of either industrial processing or domestic settlements, such a view oversimplifies at least some operations. These sites also had offices, hospitals, commissaries, and other structures. Research questions might:

1. consider the full range of structures likely present on mine or factory sites, and attempt to both identify and collect adequate assemblages to begin formulating artifact patterns for the various structures;
2. explore the specific structures while taking into consideration the domestic structures (for example, where a hospital is present do the domestic sites exhibit a lower than anticipated quantity of patent medicines?);
3. examine the spatial layout or patterning of the mines and fertilizer plants to determine what level of functional or administrative clustering might be present; and
4. look for the economic, technological, or social stability of the 1870s and 1880s, being replaced by evidence of instability during the 1890s as the industry became more depressed and efforts were made to control costs.

Industrial Archaeology

While industrial archaeology is a vibrant and exciting field in some states, the discipline seems never to have matured in South Carolina (perhaps because of the state's preoccupation with agrarian pursuits, rural sites, and especially plantation archaeology). As a result, there seems to have been little attention on the variety of worthwhile research topics that phosphate mining and fertilizer production opens.

Admittedly, many industrial sites offer challenges to conventional archaeological research. They are often of a relatively transient nature – phosphate production, for example, lasted only about 50 years. Some have seen continuous activity that has changed the site – but the change may be no greater than is often seen at urban sites, where archaeologists have learned that "disturbance" is part of the archaeological record. The sites may also have left toxic deposits – these should not dissuade research or be used as excuses for not fully investigating sites. Finally, some authors have excused inadequate research on the pollution and danger of these sites. Yet in other areas of the United States archaeologists have had no problem complying with health and safety mandates and still investigating industrial sites (see, for example, Hamilton and Stratton 2001 and Hamilton et al. 2000).

There are significant research issues that might be addressed at phosphate mines and processing centers, including:

1. variability and change in mining technology and how these issues may be seen in the archaeological record;
2. the impact of mining technology – and its change – on the workplace and the workers;
3. the spatial organization of the mines and fertilizer factories;
4. the relative uncertainty of technological activities at the mines (in contrast to the far better documented activities at fertilizer factories);
5. creation of adequate inventories of mine processing facilities and fertilizer

factories, including documentation at the level of HABS/HAER;
6. how the extant vestiges of the mining or fertilization facilities relate to the broader technological development of the locality and region;
7. a broader understanding of the individuals associated with the particular facilities and their impact on the state; and
8. how the mining or fertilizer production activities are reflected in the archaeological record.

Certainly additional research topics will be devised as work progresses, but we should begin to focus more attention on this component of South Carolina's history. The mines, processing plants, and fertilizer facilities represent very finite resources and the mines and their processing plants have already been significantly impacted as development spreads west toward Red Top, southwest toward Johns Island and northward into Berkeley County from Charleston. Similarly, as superfund cleanup continues preceding development on the Charleston Neck it is likely that the fertilizer plants themselves will be dramatically transformed, with the resulting loss of critical archaeological data.

Archaeologists and historians should renew interest and focus on this overlooked aspect of South Carolina's transition from the "old" to the "new" South.