

WASC 2281 ●

A Grand Assemblage

- Col. Raines & Augusta

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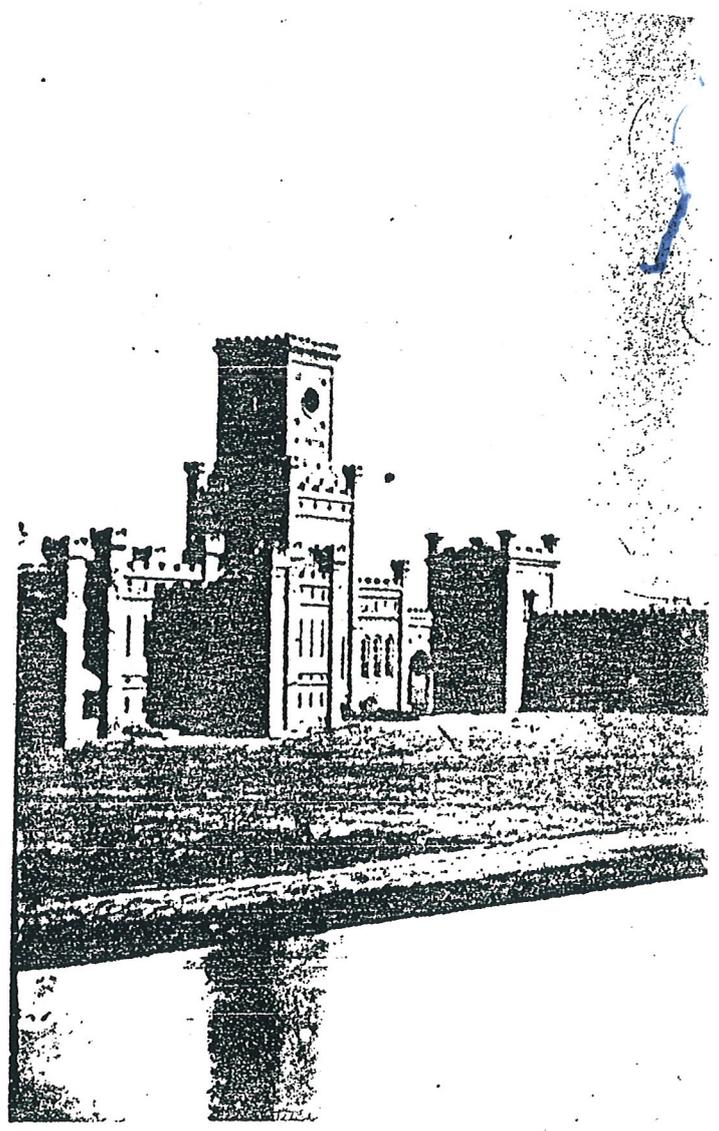
George W. Rains and the

In the opening weeks of the Civil War Colonel Josiah Gorgas, the Confederacy's Chief of Ordnance, wrote to Colonel Edward Manigault, his counterpart in the state of South Carolina's war bureaucracy, asking for an estimate of the gunpowder on hand in that state. "You may well imagine," said Gorgas, "that I feel anxious to ascertain how long we can *hold out* before being thrown on our own resources. . . ."

The colonel had reason to worry. By the week after the firing on Fort Sumter the War Department had gathered together at various points within the Confederacy 491,111 pounds of powder for cannon, rifles and muskets, or about enough to give a theoretical supply of thirty rounds per man in the armies then forming. In light of the prewar ordnance manuals' specification of 200 rounds per man, members of the War Department wondered if the new nation had enough powder for one good battle per army. An additional 292,316 pounds of powder for cannon and muskets recovered on the occupation of Norfolk helped, but no one imagined that a war of any consequence could be prosecuted by relying on random gifts from unexpected sources.

The need for a strong, home-based gunpowder industry capable of supplying all the wants of the nation was obvious; so vital was it to the war effort that the government gave no consideration to reliance on private industry for its principal source. In early July George Washington Rains tendered his services to the Confederacy and was assigned the double duty of providing an immediate supply of gunpowder for the army of Albert Sidney Johnston, and choosing a site for and constructing a gunpowder factory capable of supplying all the future wants of the Confederate armies.

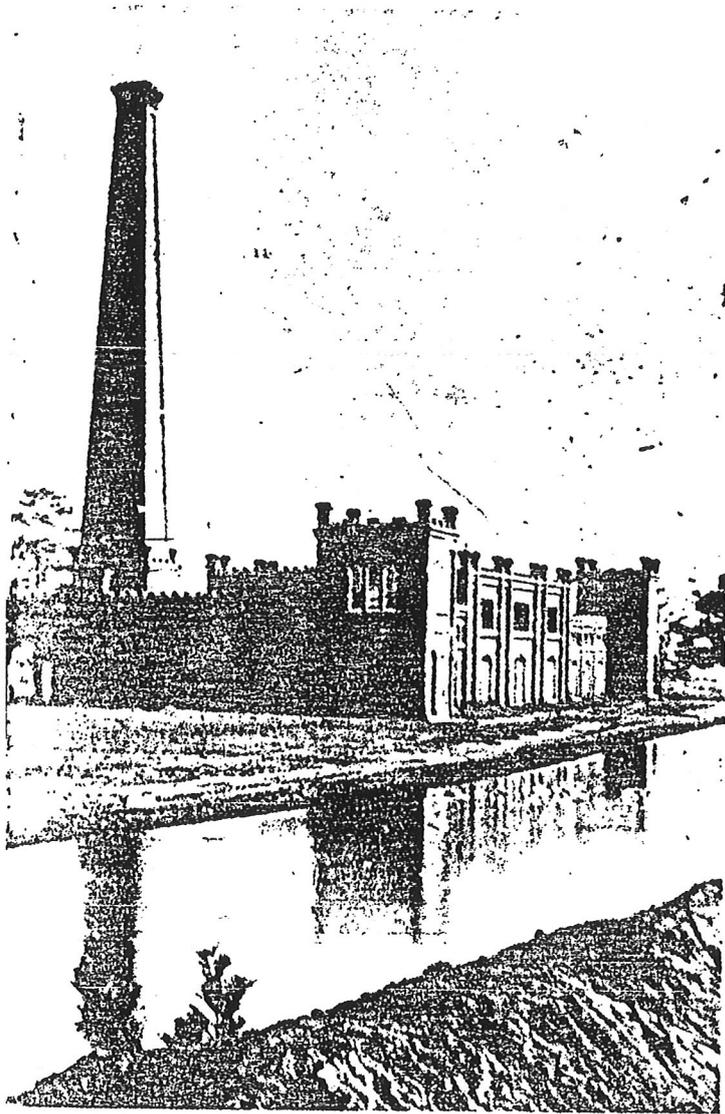
Rains, the younger brother of Brigadier General Gabriel J. Rains of land mine fame, possessed a background that fitted him well for wartime industry. Educated at West Point, he was graduated third in his class with a commission in the prestigious Engineers, and assigned to assist in the construction of Fort Warren in Boston Harbor. He then made the unprecedented request for transfer out of the engineers to a less elite arm, the artillery, for what he considered a more military life, and served honorably and notably in the Mexican War. He had also held an assistant professorship at the Military



Academy, and made himself known in scientific circles through work in the area of steam engine design. In 1856 he had resigned from the Army to take on the presidency of, and part interest in, the Washington Iron Works in Newburg, New York, the home of his wife's family. President Davis and Colonel Gorgas apparently knew their man, for they assigned him perhaps the most vital task in the young nation, and left him to his own devices to accomplish it.

„semblage”

Augusta Powder Works



The Augusta Powder Works, circa 1865.

Library of Congress

Rains left Richmond on July 10, not even waiting to receive his official commission, on a rapid railroad tour of the South, working to expand and improve existing powder-making facilities and preparing for construction of the major work charged to his care. “I almost lived on railroad cars,” he said, “devising plans, examining the country for a location, hunting up materials, engaging workmen, making contracts, and employing more or less every available machine shop and foundry from Virginia to Louisiana.”

Small gunpowder-making facilities had already been erected in New Orleans by Major General David E. Twiggs, and in Nashville and Raleigh by private enterprise with state government support. Rains gave these such aid as he could (the works in Nashville, together with similar factories soon to be built in Manchester, Tennessee were later taken over by the central government), and pressed on, searching for a suitable location for the major gunpowder factory.

On July 20 he found his site, beginning at the grounds of the old United States Arsenal (abandoned after an epidemic in 1820 for a site on higher ground) between the Savannah River and the canal just west of Augusta, Georgia. Railroad connections linked Augusta to Atlanta and other major shipping points, the city was far enough south and inland to be relatively safe from attack, workmen and building materials were available, the river and canal provided easy water transportation within the area of the proposed factory complex, and planters in the area could supply the willow and cottonwood needed for charcoal. Alone in the clear July morning, Rains stood “on the silent and deserted bank” of the canal, “revolving in my thoughts the erection of the extended works to which I had committed my reputation. . . .” Augusta it would be.

By MAURICE MELTON

*Rains showed a genius for getting things done, and to him--
almost alone--is due credit for keeping the guns firing.*



Colonel George Washington Rains. His appointment as brigadier general was never confirmed.

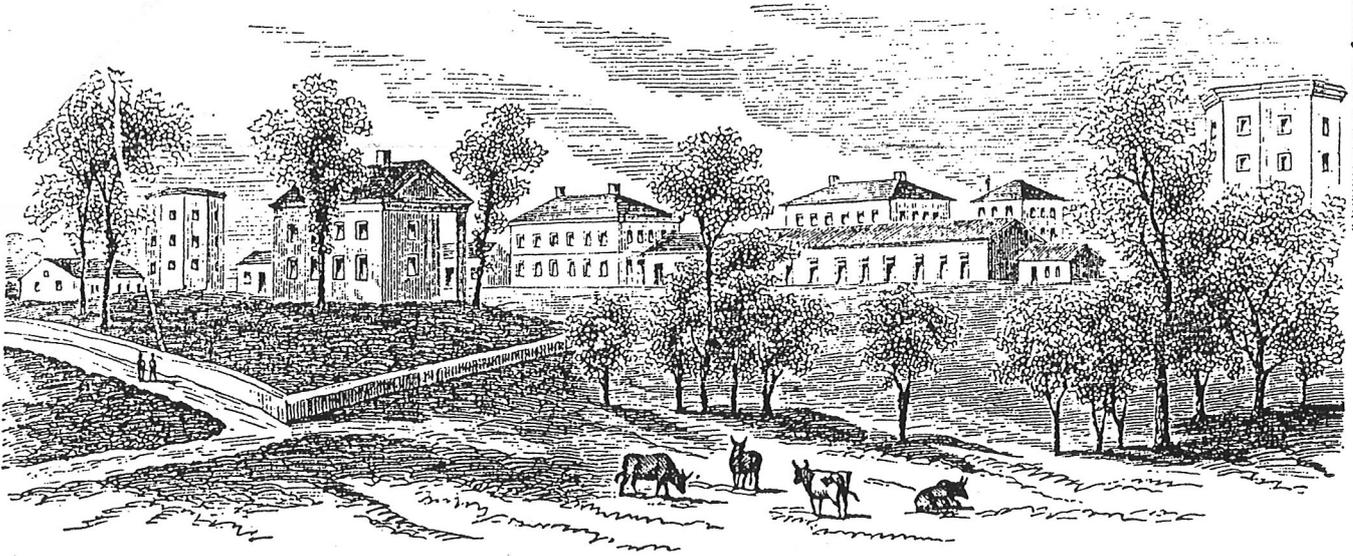
Rains had spent his hours in the railroad cars sketching the factory's layout, basic architecture, and machinery. The various buildings in the plant would cover a stretch of two miles along the canal. Rains placed them in a logical flow sequence, the raw materials coming from Augusta to the warehouses, then traveling up the canal through refining, mixing, incorporating, and granulating processes, until the finished product was stored in a magazine at the end of the line, far from town. The principal building in point of size and architectural care would be the first one, a combination warehouse, refinery, charcoal works, and office complex. Rains designed it after the English House of Parliament, and centered in it the main chimney, surrounded by a tall, battlemented obelisk. He intended the entire work, and

all its attendant buildings up the line, to stand as a perpetual monument to the industrial accomplishments of the new nation.

As a guide to the actual process of gunpowder manufacture, Rains had only a pamphlet describing the operation, written by Major J. Fraser Bradley of England's Waltham Abbey works. He found, too, a man named Wright who had been employed by the British powder factory, and put him to work in the new plant at Manchester, Tennessee, which he was using as a school to train workmen who would later be transferred to Augusta.

The principal ingredient of black powder is potassium nitrate, or saltpeter or niter as it was called, which comprises three-fourths of each grain of powder. Wood for the charcoal that served as the basis of each grain was readily available, and the sulphur comprising about 10 percent of each grain could be imported, but a large and steady supply of saltpeter was so vital that Rains sought to build up a nationwide saltpeter industry to give his works a reliable source for the material throughout the war. He placed his building and machinery plans in the hands of Captain C. Shaler Smith of the Engineers, recommended by the Tredegar Iron Works of Richmond for the position of chief architect and superintendent of construction. Rains then devoted his energies for several months to a crusade to build within the Confederacy a fervor for saltpeter production. He wrote a pamphlet describing his method of converting the calcium nitrate found in earth mined from limestone caves to usable potassium nitrate, had it published in New Orleans, Nashville, and Richmond, and distributed by Colonel Gorgas through the War Department. Rains and his assistants visited limestone caves in Georgia, Alabama, Tennessee, and Arkansas to find those that would produce earth from which saltpeter could be made, and let contracts with individuals or groups to supply the material for the government.

By October 9 Rains had a saltpeter refinery in operation in Nashville, turning out 1,500 pounds of purified saltpeter every day for use in the gunpowder plant in that city. In late November he visited New Orleans, where Major General Mansfield Lovell suggested sending the steamer *Tennessee* overseas to bring in a cargo of the material. Rains endorsed the idea, and it was approved by the War Department. But before the ship could sail the blockade off New Orleans had become too tight for her to get out. Still, it would be Lovell's plan of importation that kept the Confederate gunpowder industry supplied with its most vital component throughout the war. Despite Rains's efforts, saltpeter in the quantities needed could not be obtained within the Confederacy. During the war only about 300,000 pounds came in from the limestone caves and niter beds worked throughout the nation, while 2,700,000 pounds were imported from Europe.



The government arsenal at Fayetteville, North Carolina, seized by the Confederates. Its workers were later transferred to Rains's powder works at Augusta, Georgia.

By the end of November Rains's principal duties, overseeing gunpowder plants in Tennessee and North Carolina and constructing the major facility at Augusta, had become so demanding that Colonel Gorgas sent F. H. Smith to take charge of the procurement of saltpeter, working out of Nashville under Rains's direction. In April 1862 the Ordnance Bureau would relieve Rains of this responsibility completely by the creation of the Nitre Bureau (later the Nitre and Mining Bureau) under Colonel I.M. St. John.

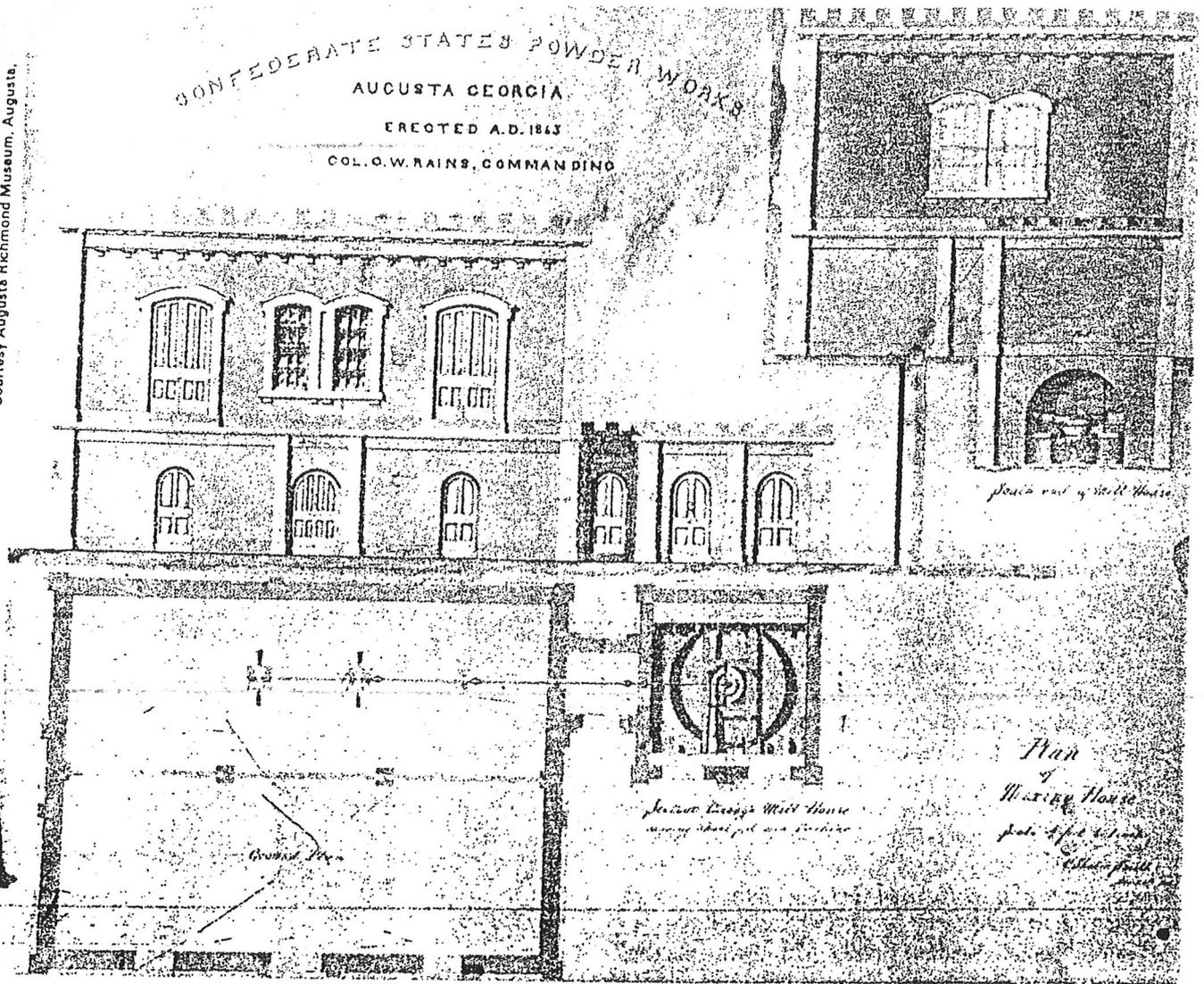
Meanwhile, C. Shaler Smith had been making progress on the long line of factory buildings outside Augusta, taking directions from Rains by mail. Raw materials were gathered from throughout the Confederacy. Tin and zinc for roofing came from Mobile; brick from Augusta and Hamburg, South Carolina; boilers (large copper chambers from turpentine stills) from Wilmington, North Carolina; cut stone to bed heavy machinery from Chattanooga, and granite for sills, lintels and copings from Stone Mountain outside Atlanta; drying and evaporating pans from Nashville; machinery from foundries in Augusta, Richmond, Macon, and Chattanooga; steam pipe and valves from Atlanta; cement from Richmond.

Construction started on September 13, 1861. In accordance with Rains's plans, Smith laid the foundation for the principal building, the refinery-office-warehouse complex known simply as the Refinery, closest to town. It was a square structure, open in the back, its east wing a sulphur and saltpeter warehouse, the west wing a laboratory for testing the powder made by the factory. The central area, behind the Parliament facade and the great chimney, housed the refinery proper. Square towers containing offices stood at each corner, and in the open area behind were furnaces and large iron retorts for the

production of charcoal, and equipment for reclaiming saltpeter from damaged powder and factory refuse. Next to the Refinery was the Laboratory, where the time would be struck on the half hour, its seventy five-foot tower to be forever vacant of the four large round clock faces that were supposed to grace it. The building itself was never to be put to use, as the work to be done there was taken over by the Augusta Arsenal. Up the canal from the Laboratory was the Mixing House, a long, rectangular building divided into a dozen sections, each holding a circular iron bed and a pair of five-ton rollers that ground together the three chemical components into gunpowder. Each of these incorporating mills was surrounded on three sides by thick brick walls while the fourth side, facing either to the front toward the canal or to the back toward the Savannah River (the mills facing in alternate directions to cut down the possibility of chain-reaction explosions), was built of light wood and glass, intended to blow out easily and release the force of any chance explosion without creating major damage in any other direction. Beneath the building ran a trench housing a 300-foot drive shaft, with a dozen power take-offs to operate the mills. Power was supplied by a 130-horsepower steam engine, brought to Augusta before the war for use in a flour mill.

Beyond the Mixing House, 1,500 feet up the canal, was the Cooling Magazine, where the warm, moistened lumps of crude powder were taken for cooling before being boated across the canal to the Press House, where two hydraulic presses brought from Richmond would stamp it into solid cake. Back across the canal was the Granulating Building, where the powder cake would be broken apart under bronze-toothed rollers and separated by size for use in cannon, rifles, or muskets, then carried to the Drying House and spread on trays over a network of large steam pipes for drying, dusting, and glazing. The furnace and boiler providing the steam heat and power for these operations were housed in a small brick structure 200 yards from this department, and the chimney for

Courtesy Augusta Richmond Museum, Augusta.



Plan of Mixing House at the Augusta Powder Works.

the furnace was another hundred yards away, connected by a subterranean flue, so that sparks flying from the chimney would have to be blown a full 300 yards before reaching the fireproof zinc roof under which the powder was being dried to the peak of its explosive potential. Three quarters of a mile past the Drying House was the Magazine, where the gunpowder, packed in boxes, would be stored until transfer to the Augusta Arsenal, or shipment out via the railroad.

Smith had little trouble finding workers. The war excitement had brought local construction to a halt, and the army had yet to swallow all the area's skilled artisans and laborers. He had some trouble securing building materials, however, particularly brick. Brick yards as far away as Savannah and Charleston promised an adequate supply, but the railroads refused to ship at a satisfactory price. So the entire load had to be borne by brickyards in Augusta and Hamburg. With supplies of brick going also to Lieutenant Colonel W. G. Gill for the expansion of the

Augusta Arsenal, construction at the Powder Works was considerably retarded. Once, in mid-November, it ceased altogether, masons and hod carriers sitting idle until the flow of brick started again. But materials and laborers were still relatively plentiful, and the railroads had not yet come to their later state of near-collapse, so work did progress, and the structures going up were quite substantial. By the end of September work was well advanced on the Refinery and the Cooling Magazine, and the trench for the Mixing House drive shaft was nearing completion. Temporary buildings were erected as carriage houses, stables and blacksmith shops, and a road was laid along the canal. Construction continued through late winter, while Colonel Rains contracted with the Tredegar Works for twenty of the five-ton rollers for the incorporating mills (two were made in Macon and two more in Chattanooga), the dozen circular iron beds for them to roll on, and the transfer gears and power take-offs to operate them. He contracted, too, with the Cumberland Iron Works and another firm in Nashville for large copper and iron pans to be used in the refining process.

January 1862 the powder works and saltpeter works in Nashville and Manchester were closed, and personnel and some machinery brought to Augusta. April 10, 1862 the Augusta Powder Works began operation. The work was "a grand assemblage," boasted Rains, "imposing from the magnitude of the separate parts, and beautiful from their architectural style and perfection of workmanship." That perfection probably went unnoticed by the Powder Works' employees, at least at the time. For the works as a whole were merely a group of shells housing the machinery.

To carry out the theme of his architectural and industrial masterpiece, Rains had insisted on a great number of windows. All of these, as well as the doors (including the ten-foot-wide double sliding doors in the warehouses) were to have uniform glass arches. None were in yet, either arches, windows or doors, nor were the two thirteen-foot bull's-eye windows planned for the front of the building. Workmen carried sulphur and saltpeter through a Refinery with drafts sweeping through dozens of openings, and the stiff spring breezes blew through open fronts in the incorporating mills while the big rollers ground away. The sulphur warehouse lacked a roof, and in the offices the water closets were unfinished. Not until mid-May of 1863 would the work be completed.

Whether from a sense of duty or from a need to satisfy his own ego, Colonel Rains was determined to make the highest-quality, most powerful gunpowder possible. The charcoal was made at the factory by Rains's workmen instead of by an outside agent, burned in retorts in the Refinery courtyard. The sticks were then sorted, the imperfect pieces rejected, and the remainder placed in a revolving drum where bronze balls crushed them into powder. The commercial sulphur stock was purified through a two-fold process. First it was melted and poured into high, narrow wooden boxes, where the impurities settled to the bottom. When the sulphur solidified, the "pure" chemical (about the top three feet from each five-foot box) was broken off and distilled. The remaining impurities boiled first, and the beginning of each run was drawn off and discarded. "The remainder," said Rains, "was of a beautiful citron yellow when cold, and entirely pure." The solidified and purified sulphur went under two 600-pound grinding wheels to be crushed to powder, and then was bolted. When the silk bolting cloth wore out and could not be replaced, Rains devised a substitute process. He had fabricated a revolving drum, with ledges or vanes inside to lift and throw the powder, and hollow stub axles through which passed a current of warm air that carried the fine sulphur dust out of the barrel and into a collection room. Rains claimed this to be a considerable improvement, the gentle agitation giving much finer grains than those from the bolting process.

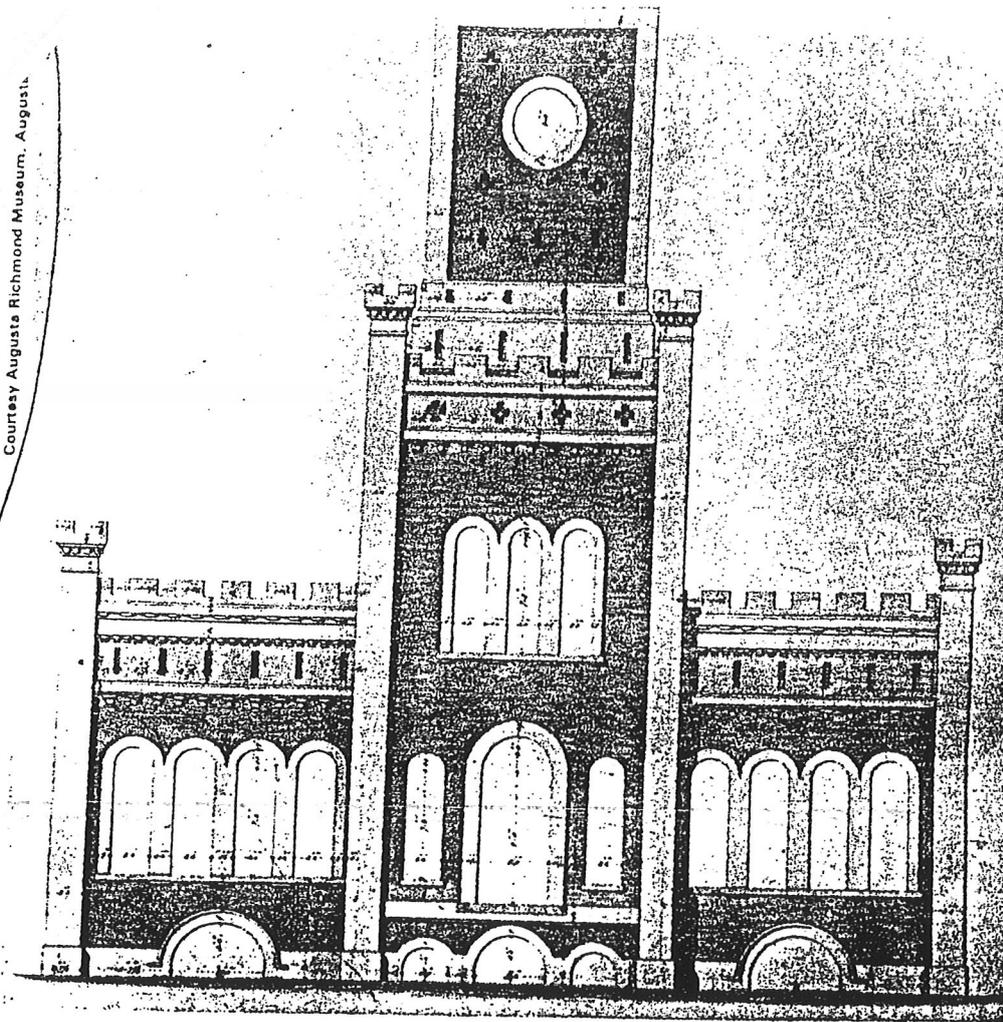
Since the bulk of each grain of powder consisted of saltpeter, and since it was the salts present as impurities

that absorbed moisture and allowed a deterioration of gunpowder in damp conditions, Rains devoted considerable care to the purification of this material. At first, the process was simply that of repeated washings; the salts dissolved in the water, which was poured off. But as production expanded and thousands of pounds of pure saltpeter were required each day, purification by the old method became too slow. Rains developed the process of boiling the saltpeter and water solution, then dipping out the purified saltpeter as it began to cool and crystalize. This process was so fast that each day's requirement could be boiled two or three times, leaving the material purified "beyond that of the most celebrated powder factories."

Two general methods of incorporating or mixing the three ingredients were in general use—stamping or rolling. Rains had favored putting up stampers, possibly because stamping machines were less complicated to construct than the massive rollers and their attendant motive machinery. But Colonel Gorgas had directed that the roller process be used instead. Sixty pounds of material—forty-five pounds of saltpeter, nine pounds of charcoal and six pounds of sulphur—were placed on each of the dozen seven-foot iron beds, dampened to prevent an explosion, and pressed under the giant rollers for four hours.

Rains soon devised an improvement. Before going into the mills, each charge was placed in copper cylinders revolving on hollow, perforated brass tubes. Steam was jetted through the tubes, heating and damping the mixture, bringing the sulphur and saltpeter to the boiling point and allowing the combination to penetrate the pores of each grain of charcoal. After eight minutes of this process, only an hour was required under the rollers for complete incorporation. Additionally, it was found that the immense weight of the rollers pressed the damp powder into such a solid cake that there was no need to send it across the canal to the hydraulic presses. Instead, the cakes were cooled, then taken immediately to the Granulating Building, where bronze-toothed rollers broke it into grains. Vibrating wire screens then separated the finer grains into powder for rifle or musket. The smoothbores, firing a lighter ball, took powder grains of less than 1/25 of an inch in diameter, while those for the rifles, firing the heavier conical ball, averaged a little less than 1/20 of an inch.

The larger grains were used for cannon, separated by size, the larger the caliber the larger the grain. In the fall of 1863 Colonel Rains began paying more attention to the size and density of the grains of his cannon powder, however, when Commander Catesby ap R. Jones of the Navy's ordnance works at Selma informed him that



Plan of front elevation of Laboratory, Augusta Powder Works. The clock never received its works. Note the crenellated battlements and arched windows.

some of the grains in his powder charges remained unburned. Larger and less dense grains meant less strain on a gun tube (a problem not encountered with the rifle and musket grains, since those weapons were capable of withstanding the strain of almost as much powder as their barrels would hold), but in tests in the Refinery the colonel found that, as Jones's tests had indicated, larger grains might burn too slowly, or not be consumed at all. Hence, in an effort to save stress on the gun tube, velocity was being lost through oversize grains. Large inch-square cubes weighing about an ounce could be used in the 10- and 11-inch seacoast guns. Rains found, but the grain used in the 6.4- and 7-inch naval guns and even smaller field pieces had to be adjusted accordingly. To compensate for the stress inherent in smaller, denser grains, he suggested a small pasteboard tube in the center of each artillery cartridge to allow the relief of pressure, accomplishing the same end as the air chamber in the breech of the Blakely gun.

After quality, Colonel Rains's greatest concern was for safety. One explosion could, conceivably, touch off a chain of blasts violent enough to wipe out the entire gun-

powder factory. For the Confederacy, such an event could be a death blow. Thus, Rains required a distance of at least 1,000 yards between buildings. Thick stands of pine trees and brush shielded one building from another to defend against flying fragments. A 30-gallon container of water was balanced over each of the dozen incorporating mills, so that should an explosion occur in one, all would be flooded. Workers wore rubber-soled shoes with no exposed nail heads, and foremen were expected to act the martinet on the subject of safety. Fire doors to all furnaces were outside the buildings, and in the areas up the line where the powder was taking on its explosive character, chimneys were set at a considerable distance from the buildings in which the gunpowder was being processed.

Four explosions did occur at the works in the course of three years, three of these in the incorporating mills. The first was the most severe, as the workers had neglected to remove a finished charge from the mill before beginning the incorporation of a new one, so that a total of 120 pounds of gunpowder took fire at once. The light front and roof were blown off the mill, and several of the workers were injured, none seriously. The interruption was slight: the other eleven mills were back in operation as soon as they were drained. The most destructive blast occurred during the first year of the works' existence, in a temporary granulating building across the canal. The foreman, a man named Gibson who was known for his strictness on safety regulations, was away at the time; it was theorized that the cause of the explosion was a match, as the workers were known to smoke when the foreman was absent. Whatever the cause, a large amount of gunpowder was destroyed, and all in the building were killed. The explosion was heavy, "shaking the earth for some distance, and throwing up a convolving column of flame and white smoke five hundred feet in height." Seven men were in the building at the time of the blast, a sentry was outside, and a boy and a mule were in an adjoining shed. Rains described their fate with clinical detachment.

The bodies of the seven men and the boy, with the debris, were carried up with the ascending column, and by its

ing action, reduced mainly to small fragments and
rersed [dispersed]; the sentinel was killed by the shock,
his body was not otherwise disturbed.

No mention was made of the fate of the mule.

None of the explosions crippled the plant's ability to produce; at no time was the factory unable to meet demands made on it. In fact, it never went to what Rains referred to as full production—a 24-hour workday. Extremely heavy demands were met with little strain. Considerable powder was required to replace that consumed in beating back the Federal ironclad attack against Fort Sumter in April of 1863. Losses were heavy at Port Hudson, Vicksburg, and Gettysburg that summer, and in the fall Charleston called for 200,000 pounds to replace that consumed in defensive operations from the first of July to the end of September. A year later the Army of Tennessee called for a replenishment of its entire reserve ammunition train, destroyed during the retreat from Atlanta. To the arsenals at Augusta and Macon, where the cartridges were made up, it was "a shock of such magnitude as to beggar imagination." But the powder factory supplied the arsenals with enough gunpowder to fill this order in two days' work, without going into nighttime production. There were times, true, when the Augusta Arsenal, also under Rains's control, could not immediately supply demands. But the problem lay in the manufacture of cartridges at the arsenal, not in the production of powder at the works on the canal.

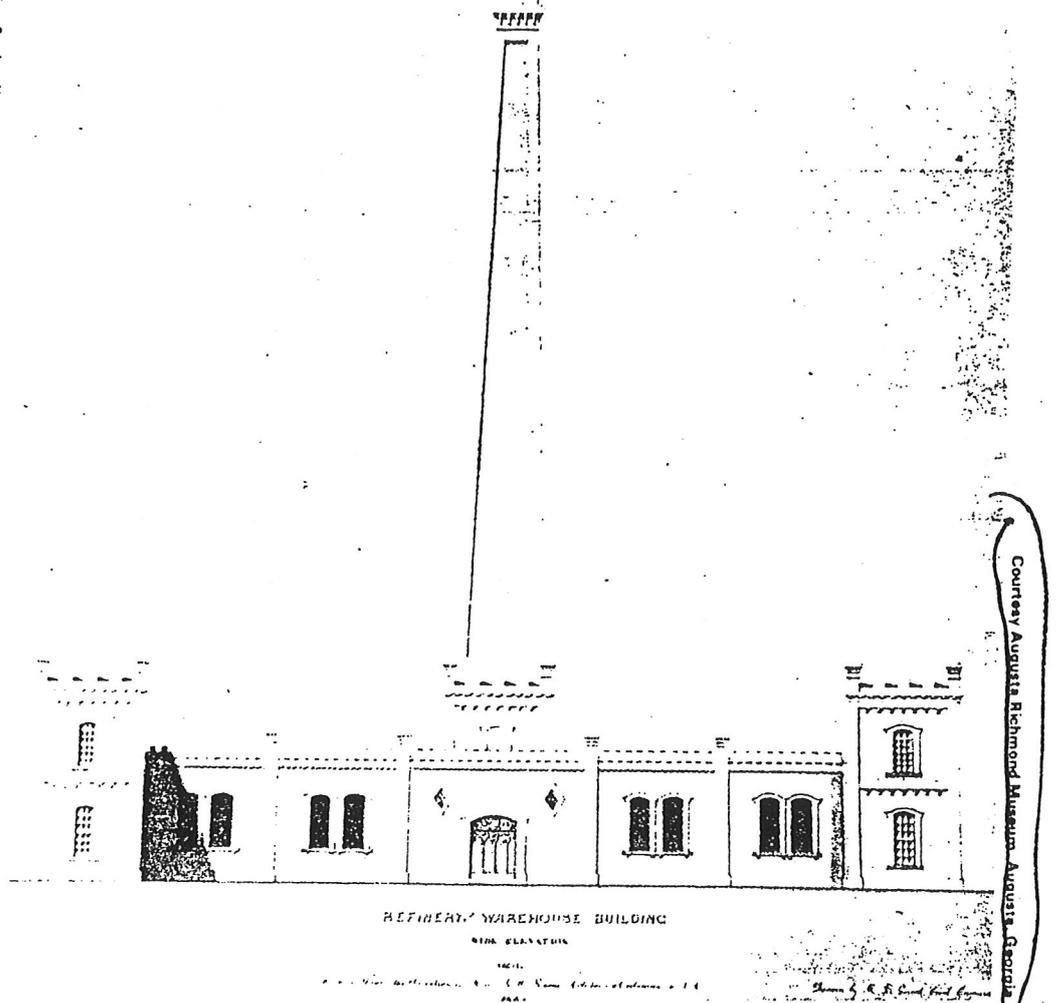
Colonel Rains had chosen Augusta as his site in part "for its security from attack." He began erecting a ring of earth forts around the city and organizing home defense forces under his command as early as the late spring of 1862. The area remained unthreatened until midsummer of 1863, however, when Rains began to fear a cavalry raid from Pocotaligo, South Carolina, just ninety miles from Augusta. "There are public interests involved in the city of Augusta to the extent of not less than \$25,000,000 besides some \$15,000,000 or \$20,000,000 worth of cotton in private hands," he told

Gorgas, and asked for a garrison for the city. No raid materialized from Pocotaligo, however, and not until Sherman's march would the city be seriously threatened. In late February 1865 Rains decided to remove the powder works to Athens, Georgia, farther out of reach of the Federal army moving through South Carolina. But by the middle of March the threat to the area had subsided, and Gorgas informed his powder-maker that the plant was in what once again was the safest part of the confederacy.

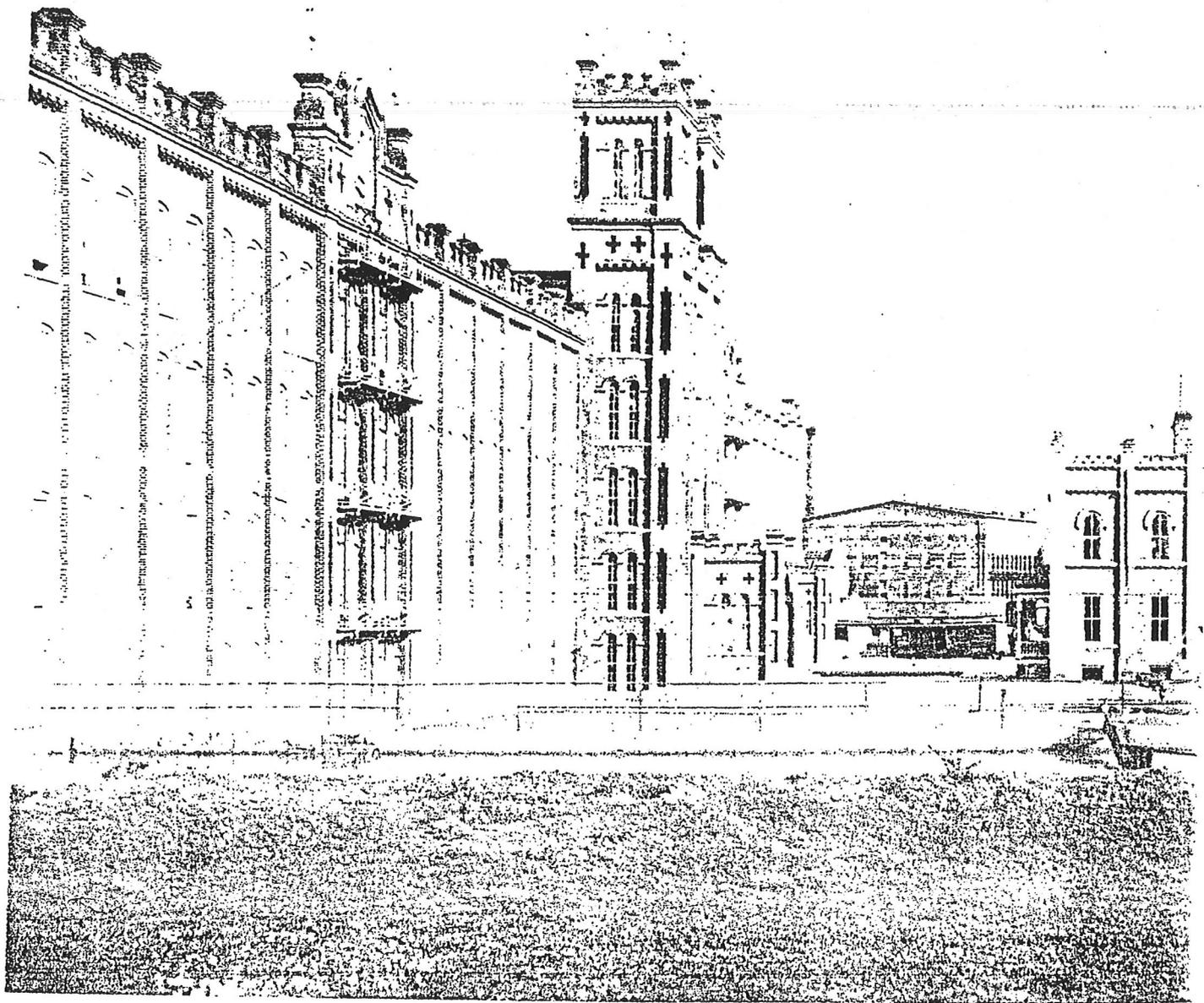
More constant than the threat of an occasional explosion or enemy action was the instability of the labor force, a situation created mainly by the Army's need for men. Rains was almost a chronic complainer on the subject of his workers being inducted into the Army or called away from the plant for drill with a home guard unit. In 1864 he wrote Gorgas:

My principal agent attending to the transportation of wood for the Steam Engine &c for the powder works, has been taken from the works to do duty with a local company here, so that these works are liable to be stopped for want of wood

Side elevation of Refinery and Warehouse Building at Augusta.



The Sibley Cotton Mills, built on the site of the Augusta Powder Works. The chimney of Rains' powder works stands at the right. Compare with the wartime photograph on pages 28-29.



on any day, and as the supply for all the Arsenals depends on the powder daily made at the works, such interruptions are likely to be disastrous.

But neither explosions nor raids nor the unavailability of labor ever shut down the Augusta Powder Works. Operating for three years and eight days, the plant manufactured 2,750,000 pounds of gunpowder. In the course of the war there were other works in operation: In the first year Rains had sent men to begin a powder works in the Trans-Mississippi to supply the armies in that area, and it carried on throughout the war with no more help from the East. The Navy relied on its own gunpowder factory, located at Columbia, South Carolina. And as the war progressed other government and private factories were erected in Selma, Raleigh, Charlotte, and Richmond. But these four mills together were capable of turning out less than 3,000 pounds of powder per day by the time they were all in operation at the beginning of 1865, while the Augusta Powder Works had been turning out as much as 5,000 pounds per day since mid-1862.

The factory continued in operation until April 18, 1865 when, together with the Augusta Arsenal, the foundry and machine shops, and all the other government works that Rains—now a brigadier general—operated in the city, it shut down. Decades later, addressing the city's Confederate Survivors' Association, Rains recalled for the old veterans the end in Augusta.

Sadly I took down the last beloved flag and folded it away; the fires went out in the furnaces; the noise of the mills ceased; one by one the workmen slowly went away, and once more I stood on the banks of the canal alone—

In the big-business bustle of postwar Augusta the buildings of the Confederate Powder Works, those solidly constructed architectural beauties that Rains had envisioned as a practical, perpetual monument to Confederate industry, came tumbling down. Their brick went into culverts and drains in the expanding city, and a cotton mill sprang up on the site. But the obelisk remained, standing thick and tall beside the railroad tracks—extensions of those General Rains had run to the Magazine—that now ran to the Sibley Manufacturing Company. And in 1878 the Confederate Survivors' Association received from the city council a deed to the obelisk and a 10-foot square reservation around it for a Confederate memorial. Rains, then professor of chemistry at Augusta's Medical College of Georgia, spoke at the monument's dedication. And he must have felt a mixture of pride and bitterness, for the obelisk was so little compared to the live and functioning factory he had hoped would remain at work under his flag forever.

In 1898 Rains died in Newburg, New York. His will gave instructions as to the Confederate garrison flag he had hauled down at Augusta in 1865. He asked that it be buried at the obelisk.

