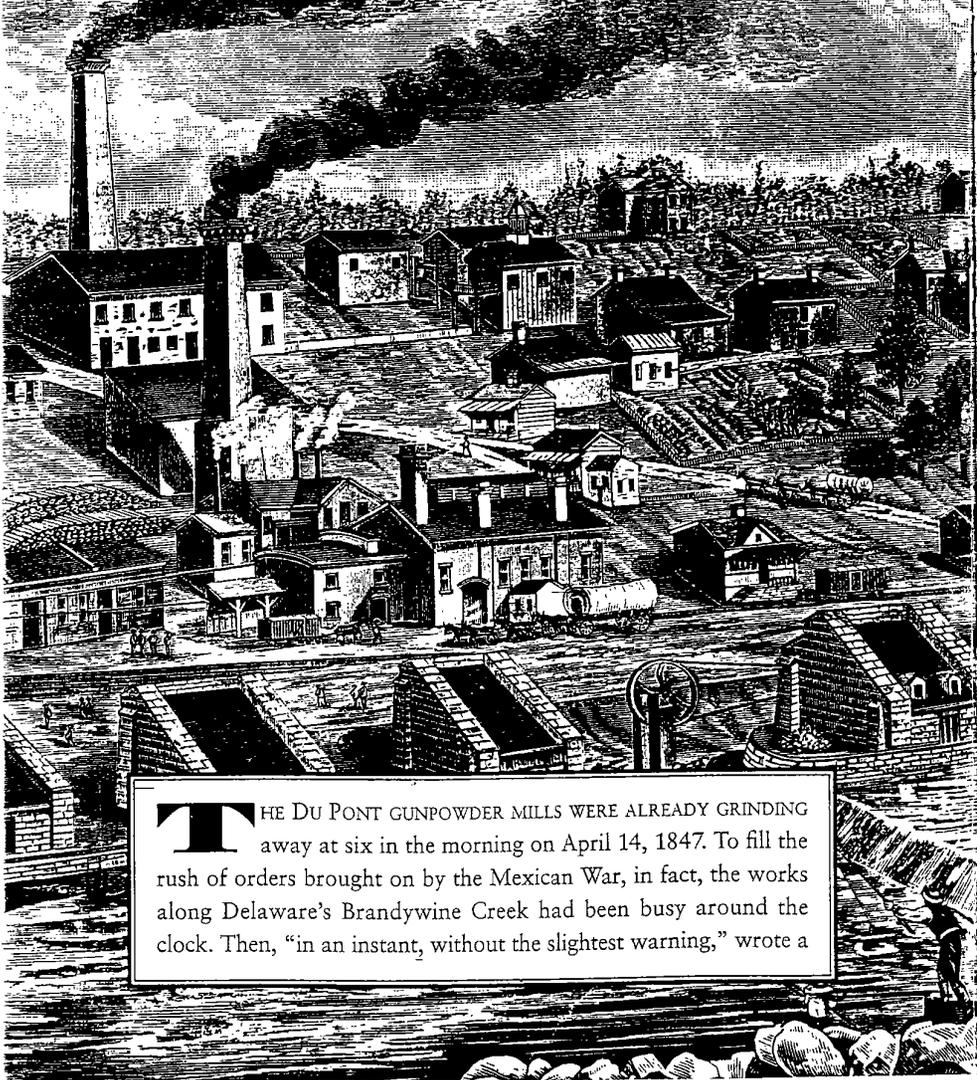


# Explosive Growth

BY JACK KELLY



**T**HE DU PONT GUNPOWDER MILLS WERE ALREADY GRINDING away at six in the morning on April 14, 1847. To fill the rush of orders brought on by the Mexican War, in fact, the works along Delaware's Brandywine Creek had been busy around the clock. Then, "in an instant, without the slightest warning," wrote a



*Left: An 1854 view of Du Pont's ever-growing Brandywine mills. Right: An American shell filled with Du Pont powder takes out a German gun during World War I.*

ALL, UNLESS OTHERWISE NOTED: HAGLEY MUSEUM AND LIBRARY, WILMINGTON, DEL.; RIGHT: UPI/CORBIS-BETTMAN

family member, "the... came a shock that seemed so terrific in its nature that I could only compare it to the meeting of heaven and earth. It appeared not to be local but a crash of the world." A row of buildings exploded in a quick chain reaction. Stones and beams were hurled in the air. Doors burst in and glass shattered in nearby houses. Windows rattled in Wilmington, six miles away. The pungent smell of burnt powder choked the air.

The explosion killed 18 men and left many others broken and bleeding. Alfred V. du Pont, the company's president, rushed to help the injured and console the widows and orphans. Besides leveling part of the plant, the explosion shattered his nerves. Some of the workers who had been blown to bits were men he had grown up with. Their fathers had worked for his father. A powderman to the core, he had carried the company's administrative responsibility as an uncomfortable burden. With his health failing, he retired in 1850, passing the mantle to his younger brother, Henry.

**H**ENRY DU PONT WOULD HOLD the reins of the family firm for the next 39 years, while the company first grew to dominate the gunpowder business and then moved into a new age of modern explosives. Like many of his relatives, Henry had been educated at West Point, and he would be known as The General after serving as major-general of Delaware forces during the Civil War. Later he was simply called The Boss. His parsimonious ways became famous. On walks he would collect willow twigs to add to batches of charcoal. In his office he worked by the light of three meager candles. Behind his old-fashioned exterior, though, lay a shrewd business sense that would take full advantage of the latest technology to build one of America's most formidable corporate dynasties.

E. I. Du Pont de Nemours & Company was already a mature firm when Henry first sat down to examine the company's books. Henry's father, Éleu-

thère Irénée du Pont, had founded the company in 1802, and it had always been a family concern. Irénée, as he was known, came to the United States from France with his own father, Pierre, and his brother Victor, a French diplomat who had served in several American postings. They arrived in Newport, Rhode Island, in the first week of 1800. Pierre had run a printing business in Paris and had taken an active role in French politics, only barely managing to keep his head during the turbulent 1790s. As he crossed the



The founder, Éleuthère Irénée du Pont, painted by Rembrandt Peale.

ocean with borrowed funds, he envisioned himself establishing a colony called Pontiana in the Ohio Valley, or perhaps fitting out a fleet of packer boats to ply the West Indies trade. In the end both Pierre and his dandyish elder son, Victor, would slide into bankruptcy, partly because Napoleon, a political enemy, refused to honor debts to the firm contracted by the French government.

The sober-minded, sometimes melancholic Irénée had studied gunpowder manufacture under the renowned French chemist Antoine Lavoisier before emigrating. Irénée's father, thinking the trade dirty and plebeian as well as dangerous, urged him to help out in the family printing shop instead. But in America Irénée was attracted to what

he believed to be a sparkling business opportunity.

Britain had not encouraged gunpowder making in its colonies, so only a handful of mills existed in America before the Revolution. In fact, part of Gen. Thomas Gage's strategy for removing the fangs from the serpent of rebellion was to withdraw powder (along with other military stores) from local arsenals. One such raid directed at the town of Concord, Massachusetts, in 1775 had backfired with momentous consequences. The scarcity of powder had even prompted Benjamin Franklin to propose that America arm its troops with pikes and bows and arrows.

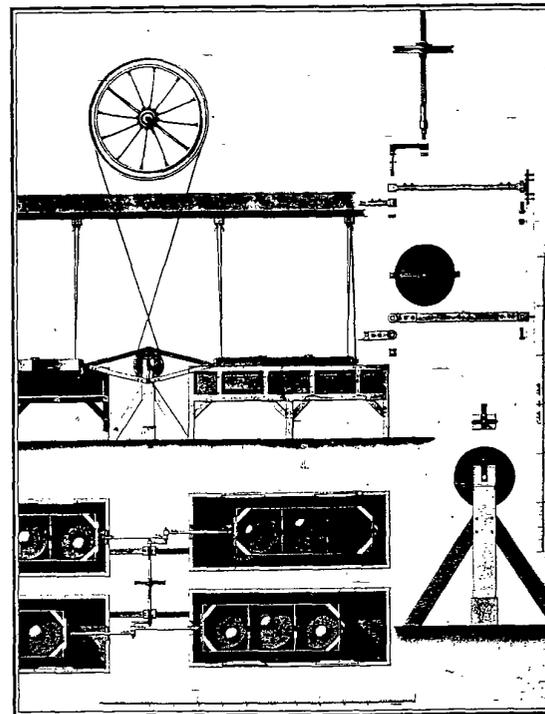
Powder mills were risky, dirty, noisy, and unpopular with their neighbors. The product, a roughly 6:1:1 mixture of saltpeter (potassium nitrate), pulverized charcoal, and sulfur, had barely changed during the previous 600 years. In 1800 British gunpowder continued to dominate the American market. The few mills in the United States produced an inferior product by antiquated methods.

In 1801 Irénée was urged to build a modern powder mill by a friend of his father—the newly elected President, Thomas Jefferson. Irénée traveled to France and brought back machinery, plans, and models. He chose a site on the Brandywine because of its reliable waterpower and its nearby colony of French émigrés. It was only natural to select a location in a rural, sparsely populated spot.

Irénée's father and brother eventually joined him on the Brandywine. All the du Ponts pitched in to help make a go of the powder business, the only one of their many New World projects that succeeded. Down through the days of Henry du Pont, all property, including homes, was owned communally by the family. For many years the company did not pay salaries to family members; they simply withdrew what money they needed from the company till.

The process of making gunpowder had evolved over the years, but by the beginning of the nineteenth century all the important steps were fixed. It

**F**OR YEARS FAMILY MEMBERS received no salaries; they simply took what they needed from the company till.



A drawing made by E. I. du Pont shows details of gunpowder manufacture.

has changed in only minor ways since. The first step is the refining of the ingredients. This must be done precisely, because small amounts of impurities can render the powder unreliable. Saltpeter was originally extracted by mixing barnyard wastes, the soil under privies, or bat guano mined from caves with potassium-rich wood ash. Water was run through the mixture to dissolve the potassium nitrate, and the resulting solution was boiled down.

Refiners then dissolved the solids in hot water, skimmed dirt from the top, and discarded the less soluble salts from the bottom. When the solution cooled, the potassium nitrate would precipitate and could be removed for further refining. In desert areas of India, soils were rich enough in saltpeter that the wood-ash step could be skipped. Sulfur could be refined by a similar method, a process often completed by importers, who obtained the

mineral from so-called Sicily.

Charcoal was originally made by constructing large stacks of logs, covering them with earth, and inducing partial combustion. The mound required constant supervision for up to two weeks. During the late eighteenth century large iron ovens became increasingly popular. While hardwoods were preferred for charcoal that would be used in iron smelting, softwood charcoal made better gunpowder. Hazel, dogwood, alder, and especially willow were used.

After refining came the key step in the process, incorporation. The charcoal was crushed and mixed with sulfur in drums containing zinc balls to pulverize the material. Up to this point the ingredients were nonexplosive, but next the sulfur-charcoal dust was mixed with the saltpeter, and then the powder could go off at any time. Originally this second mixing was accomplished in stamping mills—large mortar-and-pestle arrangements, usually driven by waterpower.

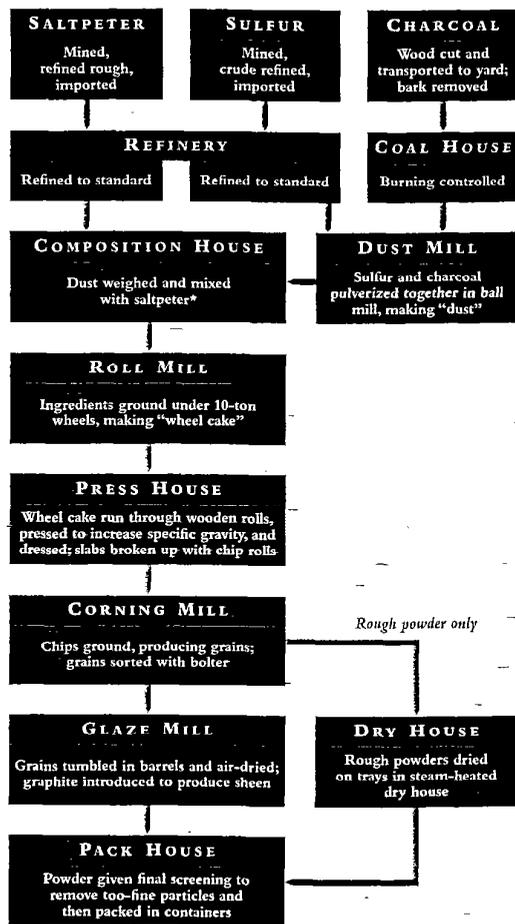
**I**N 1820 THE DU PONTS BEGAN to replace stamping mills with wheel mills, a change that was complete by the 1830s. These mills consisted of two iron wheels weighing about 10 tons each, suspended a fraction of an inch over a base of semi-circular cross-section. The wheels rotated and crushed the damp powder as attached scrapers continuously scooped the powder under them.

In medieval days the product of the mills, after drying, went straight to the cannon. This type of powder, known as serpentine, had several drawbacks. It was hygroscopic (water-absorbing), so it clumped and became useless with the least moisture. When jostled in wagons, it tended to separate into its ingredients. If packed too tightly into the breech of a gun, it became ineffective. And it burned so quickly that it often blew guns apart.

As early as the fifteenth century, gunpowder makers addressed this problem by corning their powder—forming it into grains by forcing damp powder through a sieve. The resulting gran-

## POWDER SEQUENCE

COMPLETE PROCESS PERFORMED AT HAGLEY YARD  
TO PRODUCE SPORTING POWDER, CIRCA 1870 TO 1921



\*Portions pre-weighed in refinery and dust mill can be mixed at roll mill, omitting operation at composition house

ules were then sifted through progressively finer sieves to separate powder of uniform grain size. The larger the caliber of gun, the larger the desired grains. Corned powder, by burning more slowly, avoided undue stress on the breech. At the peak of the black powder age, powder for artillery pieces consisted of pressed nuggets shaped into hexagons an inch and a half thick.

The pressing step began to be added to the manufacturing process around 1780. Compressing the incorporated powder with a screw or hydraulic press increased its density, creating more bang from an equal volume. The press produced a slate-like slab of powder that was then crushed and graded by degree of fineness as before.

One more process, glazing, became standard at the beginning of the eighteenth century. Glazing involved tumbling the corned powder in drums. The effect was to round off the grains, making them harder and more resistant to moisture. In addition, glazing caused some of the nitrate to migrate to the surface of the grain, increasing its combustibility. The heat of friction during the tumbling also removed some moisture. A dusting of graphite was then added to make the powder easier to pour.

A thorough drying was the final production step. At first the du Ponts used the old method of laying the powder out on canvas-covered trays in the sun. Heated drying houses became common in the nineteenth century. Later the glazing and drying steps were combined, with hot air or steam pipes running through the glazing barrels. After drying, the powder was packed in 25-pound kegs. The details and subtleties of the entire process were jealously guarded secrets; only du Pont family members and mill foremen were privy to them.

In spite of its superior product, the company struggled in its early years. From 1804 to 1809 E. I. Du Pont de Nemours & Company made a total profit of \$43,000. The War of 1812 brought the company some breathing room, as sales, which had averaged \$41,000 annually during the company's

first six years, soared to \$149,000 in 1812. Still, Irénée struggled with debt almost to the end of his life.

And then there were the accidents, which sometimes shook the earth as far away as Philadelphia and Baltimore. Gunpowder mills were designed with the expectation that they would blow up. Irénée built his with three massive stone walls and a comparatively thin fourth one. The layout was intended to direct the force of a blast away from other buildings and toward the far side of the creek. "Going across the creek" was the workmen's euphemism for death. Since the least spark could be fatal, all tools, even shovels, were made of wood, as were many of the wheel shafts. Employees' shoes were held together with wooden pegs instead of nails. Careless workers were not tolerated by their fellows. Yet explosions came, on the average, every 14 months. They killed powdermen, cost money, and wrecked valuable equipment.

An 1818 blast destroyed five mills and the company magazine, killing 40 men. Houses were crushed half a mile away; human remains were found in treetops. Irénée's wife, Sophie—Alfred and Henry's mother—was injured as debris flew through the windows of the family home.

MILLWORKERS, MANY OF THEM Irish immigrants, understood the peril and were loyal; only two men quit after the 1818 explosion. The du Pont family returned the loyalty. They pensioned widows, took in orphans as wards, and retained injured powdermen on the payroll, an unusually beneficent practice at the time.

E. I. du Pont died in 1834. A son-in-law ran the company for three years while Alfred learned the ropes. Then in 1837 Alfred took over and continued his father's emphasis on producing high-quality powder. He expanded the mills and converted old-fashioned waterwheels to more efficient turbines. In 1850 *Scientific American* hailed the Brandywine operation as "the most extensive powder mills in the world," turning out almost 2.5 million pounds each year.

EXPLOSIONS CAME, ON THE AVERAGE, every 14 months. They killed workers, cost money, and wrecked equipment.



Lamont du Pont, the inventor of "B" powder, who perished in an explosion.

Yet the company was failing. When the red-whiskered Henry opened the ledgers, he found that the firm was weighed down with \$500,000 in debt. He immediately began to impose financial rationality. He cut costs, collected outstanding payables, and revitalized the firm's network of sales agents. Price and service became com-

pany watchwords.

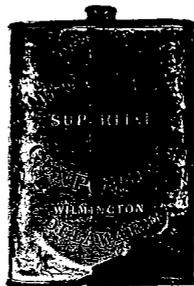
Henry's assumption of the Du Pont crown marked the beginning of a period of dynamic growth. As the country expanded westward, pioneers needed to blast stumps and clear the way for roads. Miners and builders of tunnels, quarries, and canals all needed explosives, and black powder was the

only explosive ka.

Du Pont's annual sales shot up from \$258,000 to \$694,000 between 1850 and 1855. The Crimean War in mid-decade added to the firm's profits but also highlighted a vulnerability. For at least 200 years powder makers had procured their saltpeter from deposits in India. During the war India's colonial master, Great Britain, absorbed much of its output, tripling the price of saltpeter. Gunpowder producers became acutely aware of their dependence on a single, distant source and began to look elsewhere. Peru possessed vast supplies of nitrate in the dried remains of centuries of bird droppings. However, this was sodium nitrate, not the traditional potassium nitrate. It absorbed water and left the powder unstable.

**W**HEN CRIES OF monopoly broke out, Lammot suggested a phony price war with Du Pont's main competitor.

*A nineteenth-century powder flask bears a label decorated with hunting scenes.*



Henry's nephew Lammot, who was trained as a chemist, overcame this problem by devising a usable powder based on sodium nitrate. In 1837 he patented an "improvement in gunpowder," the first major alteration of ingredients in the product's history. While the new formulation, which came to be known as "B" or "soda" powder, was too slow-burning to be used in guns, it worked well as a blasting powder and was considerably cheaper than ordinary gunpowder. These qualities answered a growing demand in northeastern Pennsylvania, where surface deposits of anthracite had been depleted and miners were driving deep shafts to get at the fuel. By the eve of the Civil War, the Pennsylvania an-

thracite fields would account for 50 percent of Du Pont's powder sales.

Transportation had always been a critical factor in the gunpowder industry, especially for Du Pont, which made all its powder in a single location. Shipment by water was the safest, but it was limited. Wrestling Conestoga wagons loaded with powder over bad roads was a treacherous business. In 1854 three of these wagons blew up in downtown Wilmington, killing 5 people, injuring 15, and causing \$100,000 in damage. Railroads often refused the product because of the danger posed by flying sparks and cinders. Mills operating near end markets thus enjoyed an advantage over distant producers. In 1858 the Du Pont company, with Lammot's encouragement, purchased a blasting-powder plant near Wilkes-

barre, Pennsylvania, its first mill away from the Brandywine.

"This expansion into the coal fields proved to be a turning point in Du Pont Company history," states the Du Pont historian Norman B. Wilkinson, "for it was the first step in the acquisition, absorption, and consolidation of a number of powder mills under its control, resulting in its near monopoly of powder production in the anthracite region within the next quarter-century." Henry and Lammot's campaign to dominate their industry would eventually take on the character of a military campaign, but before that happened, a real war intervened.

When the Confederates fired on Fort Sumter, Du Pont was producing half

the nation's powder. The family cast its allegiance with the Union, and as Du Pont powder gave Federal troops a distinct edge, government contracts gave Du Pont hefty profits. Mills ran day and night as the firm strained to supply the guns. Distracting from the effort were a total of 11 explosions during the war years that damaged 30 mills and killed 43 workers, the inevitable result of accelerated production and inexperienced help. Gen. Robert E. Lee's forays into Maryland and Pennsylvania also created some tense moments along the Brandywine since the mills presented a ripe target for cavalry raids.

**T**HE FAMILY CONTRIBUTED TO the war effort in other ways as well. Samuel Francis du Pont, Victor's son, was a Union admiral who received the thanks of Congress for capturing Port Royal, South Carolina, in November 1861. Henry Algernon du Pont, Henry's son, graduated from West Point in 1861 at the head of his class and was immediately sent into battle. He was awarded the Medal of Honor for his valor at Cedar Creek, Virginia, in October 1864. Decades later he would serve two terms in the U.S. Senate.

The Confederacy, meanwhile, struggled to provide its soldiers with powder. While Du Pont was grinding out 2,700 pounds a day at Brandywine at a top cost of 33 cents, the largest Southern mill made only 500 pounds a day, at nine times the price.

After Appomattox the government dumped tons of surplus powder onto the market at a nickel a pound. This glut depressed prices for years. What's more, many small powder mills had opened during the fighting. With peace they were forced into fierce price wars in order to survive. Henry du Pont liked order, and what he saw in the postwar powder market was chaos.

Early in the 1870s Lammot drew up a plan to confront the smaller producers in the anthracite fields. He formed an alliance with the country's number two powder maker, Laflin & Rand, whose president (from 1873), Solomon



*Workers inspect the remains of a Du Pont plant at Barksdale, Wisconsin, after an August 1918 explosion.*

Turck, was an old friend. He and du Pont would divide the anthracite business between them.

Lammot was methodical. He collected intelligence on every small powder maker in the area. Companies were invited to join a cartel or sell their interests to one of the heavyweights. If they refused, an arsenal of tactics was ready to "sicken the small men," as a Du Pont ally put it.

Du Pont would drop prices in a competing company's market, forcing it to shut. If a mill reopened after prices were restored, the market leaders were ready to undercut them again. Rights to waterpower were bought up. Used machinery was purchased and held off the market. Machinery suppliers who sold to "enemy" mills were threatened with the loss of Du Pont's business. Mine bosses were bribed to reject competitors' powder. Du Pont hired skilled workers away from small mills. When cries of monopoly broke out, Lamlot suggested that Du Pont and Laflin & Rand engage in a phony price war, "keeping up the appearance of a fight"

and thereby "throwing dust in their eyes." By 1873 Du Pont had bought out many small powder mills in the coalfields. That year a devastating financial panic swept the country, and some 23,000 businesses folded. The ensuing six-year depression made Du Pont's conquest all the easier as the company devoured failing competitors.

**W**HILE LAMMOT WAS SUBDUING Pennsylvania, Henry was leading a similar campaign of consolidation on a wider level. In 1872 Henry put on his high silk hat, traveled to New York City, and met with the two other major powder companies, New York's Laflin & Rand and the Hazard Powder Company of Connecticut. Along with four smaller firms they formed the Gunpowder Trade Association (GTA) of the United States "for the purpose of ensuring an equitable adjustment of prices and terms for sales of powder throughout the United States." The group became known as the Powder Trust. On formation, the Trust controlled 78 percent

of the industry; in less than 10 years it would control 85 percent.

GTA members who failed to abide by established prices were fined. Nonmembers who refused to knuckle under to Trust dictates were brought to their knees. The Warren Powder Company of Maine was one of the latter. First its owners were politely asked to raise their prices to GTA levels. When they refused, they were visited by a two-man delegation that relayed the same message more forcefully. Next an offer was made to buy them out. Finally Powder Trust members in New England cut prices. Warren struggled on for seven years before collapsing in 1883.

The campaign of consolidation didn't stop with small firms. In 1876 Du Pont secretly bought out Hazard, one of the big three. The move gave Henry a controlling vote on the GTA. By the early 1880s Lamlot admitted that "the G.T.A. is only another name for Du Pont & Co."

The Du Pont company and the du Pont family had always been inextric-

cable. Throughout the nineteenth century the firm was a partnership, with the leader of the family as company czar. Lammot recognized the dangers in such an arrangement when he wrote, "One family in a business is more apt to fall behind the world than to be able to keep in the advance. For while improvements are spread far and wide, the errors and mistakes remain as permanent investments." Henry's insistence on maintaining one-man rule over a complex enterprise that now spanned the continent—his office staff consisted of four men and a boy—was one of those mistakes. The very age of the Du Pont plant, with mills that went back to its founding 70 years earlier, was another; it meant that Du Pont lagged behind the industry in productivity. Perhaps the biggest mistake was Henry's failure to see that his company's sole product, a staple for centuries, was doomed to obsolescence within a generation.

**I**N 1846 ASCANIO SOBRERO, A PROFESSOR at the University of Turin, mixed nitric and sulfuric acids with glycerin to create nitroglycerin. This liquid—blasting oil, it was called—had twenty times the explosive force of gunpowder, but early experiments with it proved disastrous, for nitroglycerin was highly unstable. In 1865 a sample left in a salesman's case in the bar of New York's Wyoming Hotel began to fume. A porter quickly carried it outside, where it exploded, gouging a crater in the street. The idea that this dangerous new chemical could replace reliable Du Pont gunpowder seemed ludicrous. High explosives, Henry du Pont declared in 1871, "are vastly more dangerous than gunpowder, and no man's life is safe who uses them." Just as the Civil War was ending, though, the Swedish chemist Alfred Nobel found that nitroglycerin could be handled safely if it was first absorbed by an inert clay. It then required a powerful igniter, the blasting cap (a copper tube filled with gunpowder and connected to a fuse), which Nobel also invented. A pound of his dynamite carried three times the

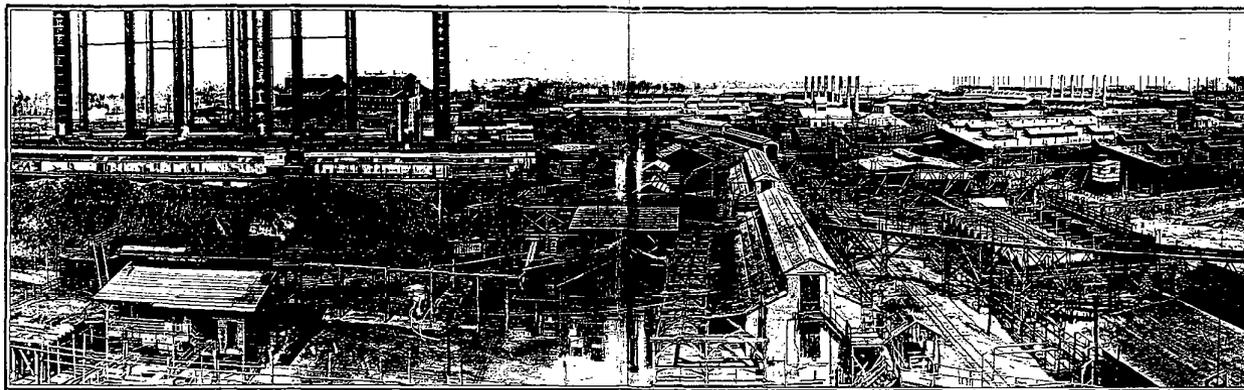
wallop of an equal amount of gunpowder. In 1867 Nobel's patent was licensed in the United States by the Giant Powder Company of California, a competitor of Du Pont.

For many centuries gunpowder had been the only explosive available. Nobel's discovery initiated the age of high explosives, whose dynamics are different from those of low explosives. Gunpowder explodes through defla-

tion so dangerous to store and transport.) Dynamite detonates at a speed between 4,000 and 23,000 feet per second. This much more rapid increase in pressure produces an explosion that shatters rock. When gunpowder is used for blasting, it tends to heave surrounding material instead of shattering it, a quality that also makes it suitable as a propellant.

In view of the nascent explosives rev-

**B**Y 1904 DU PONT MADE MORE than two-thirds of America's black powder and dynamite and all its military powder.



Above: Du Pont's huge World War I gunpowder plant at Hopewell, Virginia. Top right: A label proudly trumpets the company's military customers.

olution, Henry's conservative ways might have spelled disaster for Du Pont. Instead, because of the firm's nimble footwork, the transition to modern explosives was notable for its smoothness. As early as 1869 Du Pont began buying stock in the California Powder Works. This firm had already invested substantially in the production of its own somewhat different version of dynamite, known as Black Hercules, to counter its local rival, Giant. The forward-thinking Lammot's recognition of dynamite as the future saved Du Pont from extinction. Both California

companies were already invading Eastern markets, and Du Pont sales agents were crying for dynamite. In 1880 Lammot organized a joint venture among Du Pont, Laflin & Rand, and Hazard. (Two years later Lammot would buy out the Du Pont company's share.) This firm, the Repauno Chemical Company of New Jersey, quickly became a major dynamite producer. Lammot applied his talents as a chemist to improve on the Black Hercules product. Repauno sold its version under the name Atlas. In a sweeping coup Du Pont also bought Giant's East Coast works, gained access to the Nobel patents, and consolidated Cali-

fornia Powder's plant near Cleveland, Ohio, into Repauno. The dynamite industry was quickly brought under the protection of the Gunpowder Trade Association, with a similar allotment of prices and territories. By the mid-1880s traditional gunpowder, which came to be referred to as black powder, was already being spoken of as "the old article."

Dynamite was strictly a blasting agent and could not be used efficiently in firearms. But black powder was soon to lose its role as a propellant as well. In the 1890s smokeless gunpowder, based on nitrocellulose, began to take over the market for everything from shotguns to artillery pieces. (See

"When America Was Last in the Arms Race," *Invention & Technology*, Spring 1995.) Smokeless solved two problems that had always plagued black-powder shooters: the veil of smoke that obscured the target and revealed the shooter's position, and the residue of powder that clogged and corroded the gun barrel. With some prodding from the military, Du Pont embraced the new technology, and its researchers contributed to the improvement of smokeless powder. As usual, Du Pont



quickly came to dominate the market for it. **R**EPAUNO WAS DISTINGUISHED by more than a new product. It was a new company with a modern administration, an organized research arm, and such innovations as telephones and typewriters, all of which had been slow to arrive at Brandywine. A trained sales force of Du Pont employees replaced the system of independent agents. Lammot also looked for ways to recycle spent acids to cut costs and minimize effluent. His hands-on management style proved to have tragic results. One Saturday morning in March 1884 he was called

to examine a ton of nitroglycerin that had been drawn into a lead vat the night before as part of a recycling experiment and was bubbling and fuming strangely. He immediately drained the mixture into a tank of water and then ran. He hadn't gotten far enough away when the material exploded. The man who might have led the company into a new era was killed instantly. In spite of the growing inroads of dynamite and smokeless powder, black powder died a much slower death than Lammot. In 1888, the year before his own demise, Henry approved construction of the largest blasting-powder plant in the world in Mooar, Iowa. His judgment was not amiss; he understood his market. Many customers stayed with a product they knew well. "People in the explosives industry are conservative by nature," says Robert Howard, the engineering curator at the Hagley Museum in Wilmington, Delaware, which has preserved the original Du Pont mills. "The reason is obvious. With explosives you get only one mistake." In 1904 black powder still accounted for 30 percent of Du Pont's profits. As a blasting agent the old article held its own into the second decade of the twentieth century.

In 1902 a younger generation of the family took control of the firm. They included Pierre S. du Pont, whose hierarchy of committees would serve as a prototype for managing large corporations. That same year Du Pont swallowed Laflin & Rand, its last substantial competitor. The superfluous Gunpowder Trade Association was effectively dissolved in 1904. Now Du Pont stood virtually alone as the colossus of the industry, producing more than two-thirds of the nation's black powder and dynamite and all of its military smokeless powder. By consolidating the many companies it owned interests in, Du Pont emerged as a true mass-market, mass-production firm. In 1907 President Theodore Roose-



America's first rolling gunpowder mills, dating to the early 1820s, are preserved at the Hagley Museum.

velt and his trustbusters finally attacked Du Pont's domination of explosives. After four years of litigation Du Pont was required to divest itself of two explosives companies, which it dubbed Atlas and Hercules. For national-security reasons the company was allowed to retain its monopoly on military powder. The settlement served as a spur to the company's ongoing diversification into the wider chemical industry, a process that would accelerate with the staggering profits the company reaped during the First World War.

**D**U PONT FINALLY SHUT ITS gunpowder mills along the Brandywine in 1921, but powder manufacture continued in other locations. In 1912 the firm had built a plant in Moosic, Pennsylvania, which it operated for more than half a century, a relic of Du Pont's domination of the anthracite fields. A 1971 explosion there finally led Du Pont to abandon manufacture of the product that had been its mainstay for the entire nineteenth century.

But the U.S. military, which still had minor applications for black powder, especially in fuses, helped revive the

Moosic mill. Operated by Goex, Inc., it was the only black powder plant in the nation and one of the few left in the world until it closed in the summer of 1997, when Goex moved its production to a new facility in Louisiana. The company still makes powder for the fireworks industry and for hunters and battle re-enactors who use old-fashioned arms. Black powder also still finds use in the mining of slate and granite, which require a heaving rather than a shattering blast.

"Black powder is made pretty much the way it's always been," says Mick Fahringer, the president of Goex. "We still grind powder in a small-batch system, which has been found to produce the best product. There's an art to it, knowing how much moisture to add, when to stop the mixing." Irénée du Pont would find himself at home in the new Goex plant in spite of the nearly two centuries since he set up his mill on the Brandywine.

He would recognize, too, the company's acute attention to safety. Raw materials are carefully combed with magnets to extract bits of metal that could cause sparks. Floors receive an antistatic coating; employees wear company-issued coveralls without

pockets or zippers; matches are strictly forbidden. The manufacturing processes are carried out in buildings separated by concrete walls and thick earthen berms. These buildings, constructed with thin "blow-out" walls, are designed to let an explosion escape, just like the original Du Pont shops.

Yet accidents still happen. Touring the old Moosic plant, I could see the naked iron wheels of a rolling mill whose surrounding building had been blown away in a recent explosion. A few weeks after my visit, on the evening of April 16, 1997, two workmen were pushing a load of powder along a narrow-gauge railway to be granulated and sifted in the corning mill. For unknown reasons the powder exploded. The blast ripped into the mill, touching off a load of powder there. (The accident accelerated Goex's plan to move to Louisiana.) Glenn Hunold, 52, a mechanic at the plant for 28 years, and Edward Dominick, 28, a powderman for two and a half years, were both killed. The making of gunpowder remains a dangerous trade. ★

*Jack Kelly is a freelance writer in Red Hook, New York.*

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