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West Point was organized on the model of the École Polytechnique in France, with the mission of becoming a great scientific and technological school that would spread the benefits of its education through the population. The Corps of Engineers was stationed here in 1802, by an Act signed by President Jefferson.

THE SCIENCE THAT BUILT THE NATION

West Point and the Tradition Of the Army Corps of Engineers

by Pamela Lowry

Sylvanus Thayer, known as the Father of the Military Academy, devoted his term as Superintendent to developing the educational system at West Point, which included small classes, daily recitation at the blackboard, the study of military and civil engineering, and the famous honor system. Thayer transformed a small, isolated military academy into a first-rate scientific school, as well as the first engineering school in the nation. He is portrayed here by Robert Weir, a Hudson River School artist who painted many West Point faculty and scenes.



“We must get up early, for we have a large territory; we have to cut down the forests, dig canals, and make rail roads all over the country.”

—A West Point cadet to a foreign visitor, 1854

All the military guests at the glittering banquet in the Hotel Robert in Paris wore side arms, and many of the civilians had pistols hidden in their formal clothing. The headquarters of Lord Hill’s British Grenadier Corps loomed directly across the street, and it was possible that there would be some kind of trouble. It was Jan. 8, 1816, and a group of Americans, joined by their French, Prussian, Austrian, and Russian supporters, were about to defy the British occupation force in Paris.

Following on the heels of the final defeat of Napoleon at Waterloo, the Allied Powers of Europe had occupied Paris and reinstated the Bourbon Monarchy. The crowned heads of Europe breathed a sigh of relief that so much of the pro-American faction in Europe had been destroyed or silenced by the French Terror and the Napoleonic Wars. The British officers, flushed with victory, had been insolent in their disdain for the conquered French. The Duke of Wellington had gone so far as to commandeer the box reserved for the French King at the Paris opera, but was forced to retreat amidst a hailstorm of boos and catcalls.

British scorn was also applied to the Americans, with whom they had just finished fighting the War of 1812, Britain’s unsuccessful attempt to reconquer its lost colonies. To salve their wounded pride, the regiments that had been with the defeated Ross and Cockburn at Bladensburg, Maryland, in 1814, held a banquet in Paris on Aug. 24, 1815, to celebrate the first anniversary of the burning of Washington.

Colonel Winfield Scott, who had fought heroically on the northern frontier during the war, countered this insult by scheduling the banquet at the Hotel Robert, attended by many of Britain’s erstwhile allies in the fight against Napoleon, to commemorate the American victory at the Battle of New Orleans.

There were two young American Army officers at that banquet, both veterans of the War of 1812, who were in Paris on a mission crucial to the future of the Unit-



The École Polytechnique was founded in Paris in 1794, after the Jacobin Terror had shut down all schools that were deemed to be aristocratic and/or scientific. Lazare Carnot, trained as a military engineer, had become a member first of the Legislative Assembly and then of the Committee of Public Safety. He and Gaspard Monge established the École as an institution where French science could once again flourish after its near-destruction by the Jacobins.

Deputies, the Electoral College was informed by the victorious Allied Nations that if such an event were to occur, 20,000 additional Prussian troops would be quartered in Lafayette's district.

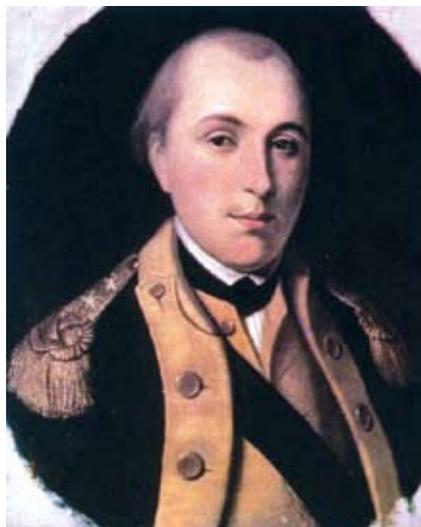
The beleaguered American Party had run an earlier rescue operation, which culminated in the founding of the École Polytechnique. When Lafayette and Franklin's circles began the French Revolution and attempted to establish a constitutional monarchy, the British reacted with desperate fury. The British Empire was determined that no American-style republic, monarchist or not, would ever exist on the continent of Europe. Therefore, British agents Danton and Marat were instructed to wreck the Revolution, and their chosen instrument, the Jacobin Terror, wiped out much of the French officer corps that had served in the American Revolution, including those who had contributed so heavily to the American victory at Yorktown. But that was not enough.

In 1793, the French Committee on Public Instruction ordered all academies suppressed, including the world-renowned Academy of Science, which had been founded in 1666 by Jean-Baptiste Colbert. Marat followed up by attacking Benjamin Franklin's theory of

electricity and the "aristocracy of knowledge" which had produced it. The "Law of the Suspects," also passed in 1793, proclaimed that the scientific aristocracy was to be prosecuted in the same manner as the aristocracy of birth. The guillotine then claimed much of Franklin's scientific circle, including Paris Mayor and Lafayette co-adjutor Jean Bailly; Franklin's former secretary, the Duke de La Rochefoucault; and chemist Antoine Lavoisier.

As soon as the 1794 Thermidorean reaction against the Reign of Terror had been accomplished, surviving American Party members Lazare Carnot and Gaspard Monge took control of the Committee of Public Safety and founded the École Polytechnique. The school was

founded to train engineers, to spread republican values throughout the popula-



The Marquis de Lafayette, a hero of the American Revolution, had been unable to stem the tide of the Jacobin Terror in France, and was forced to flee for his life. He then suffered years of imprisonment in the fortress of Olmutz, a captivity dictated by British orders to the Austrian Emperor. When he was released and returned to France, Lafayette aided Thayer and McRee with introductions to the French scientists who had survived the Terror.

tion, and to arouse talents which could advance science. Monge, who became the heart and soul of the École, based the structure and curriculum of the school on his training by the great humanist Oratorian Order, and on scientific schools which had been directly founded by Benjamin Franklin and his colleagues, while Franklin was the American representative in Paris.

The students at the École were divided into small sections, and more advanced students were able to test and widen their knowledge by teaching the younger students as assistants to the professors. The most important subject at the school was geometry. Monge taught this not as a fixed set of axioms, but as a means to educate the students' minds by showing them the coherence of the physical universe with the way their own minds worked. It gave them the capacity, therefore, to think well about any scientific or technological problem.

Monge wrote a textbook on descriptive geometry for his students, which enabled them to represent three-dimensional objects on a two-dimensional plane. It was a tool to achieve higher



Jean Sylvain Bailly was a French astronomer whose work on the satellites of Jupiter brought him membership in the French Academy of Sciences. During the early phases of the French Revolution, he worked closely with Lafayette as a member of the States-General and then as President of the National Assembly. As Mayor of Paris, Bailly attempted to curtail the excesses of the Jacobins, and for this he was guillotined in 1793.

technological levels of development, and Monge wrote in his treatise on the subject that

it was a language necessary to the man of genius who conceives a project, to those who must direct its realization, and finally, to the craftsmen who must themselves complete its specific aspects.

By the 1820s, the Americans were applying this principle to the problem of producing interchangeable parts for armaments and machines.

A Treasure-Trove for West Point

Despite the fact that the *École* had been shut down by the time they reached Paris, Thayer and McRee were able to speak with many of its faculty members, using their letters of introduction to the remnants of the pro-American networks. It is possible that they were able to speak with Carnot before he was exiled to Switzerland, and to Monge, who was still in Paris. Their journals show that they consulted with an unnamed professor who taught descriptive geometry, and that he obtained architectural models for them. Thayer bought more than a thousand books for the West Point library, including many of those used at the *École*. He also obtained topographical maps and models of fortifications. Most important, *École* graduate Simon Bernard was recruited to head the construction of U.S. coastal fortifications, and *École* Professor Claudius Crozet agreed to teach engineering and descriptive geometry at West Point.

While Sylvanus Thayer was still in Paris, he was selected to become the new Superintendent of West Point. Thayer had been an early graduate of the academy, and had experienced the frustrations felt by its faculty and students alike at its lack of funding for textbooks and scientific apparatus, and its inconsistency of requirements for its students. Thayer resolved to completely reorganize West Point on the model of the *École*, and to transform it into a great scientific and technological school which would disperse the benefits of its education into the general population.

This outlook corresponded to that of the Founding Fathers, who had pressed Congress for the establishment of a mili-



Virginia Military Institute

Claudius Crozet, a graduate of the École Polytechnique who served as a Captain under Napoleon, was recruited to become a member of the West Point faculty. By 1817, he had become head of the Department of Engineering, where he introduced the study of descriptive geometry, the first time it had been taught in an American college. Crozet wrote the first American textbook on the subject, titled A Treatise of Descriptive Geometry for the Use of the Cadets of the United States Military Academy, 1821. Later in life, Crozet became the State Engineer of Virginia, and modelled the new Virginia Military Institute on West Point.

tary academy, including the study of science and technology. George Washington, Henry Knox, Alexander Hamilton, and John Adams had all envisaged such an academy, but the funding from Congress was not forthcoming. Finally, in 1802, President Jefferson signed the Military Peace Establishment Act, creating a Corps of Engineers to be “stationed at West Point,” which was ordered to “constitute a military academy.”

Jefferson had reversed his original opposition to the plan, and appointed Jonathan Williams, the grandnephew of Benjamin Franklin, as head of the Corps of Engineers and Superintendent of West Point. Williams, a scientist in his own right, had worked with Franklin’s ally, Caron de Beaumarchais, to conduit French supplies from his base in Nantes, France, to the Continental Army during

the American Revolution. Once at West Point, Williams stocked the academy’s library with the books he had inherited from Franklin.

Williams added geometry to the West Point curriculum, but his requisition for 12 inexpensive drawing instruments took months to fill. The War Department turned down his request for more and newer textbooks, on the grounds that scientific knowledge was changing so quickly that the books would be out of date before they arrived. Despite these frustrations, Williams told one of his officers to never

lose sight of our leading star, which is not a little mathematical school, but a great national establishment to turn out characters which in the course of time shall equal any in Europe.

When Thayer returned from France, he was determined to carry out this mission, whatever it might cost him personally. He set up requirements for admission to West Point, drew up an honor code of conduct, and evaluated cadets only on their merits. As one West Pointer of the time remarked:

West Point constitutes the only society of human beings that I have known in which the standing of an individual is dependent wholly upon his own merits so far as they can be ascertained without extraneous influence.

The curriculum was completely overhauled to correspond as much as possible to that of the *École Polytechnique*. French was taught from the first year, since the *École* texts had not yet been translated into English. Mathematics, including descriptive geometry, was considered to be the basis for an engineering degree. Classes were small and used cadet instructors from the older classes to supplement the faculty.

When Claudius Crozet arrived from France and attempted to teach engineering, he received a shock. One of his students wrote that “The surprise of the French engineer instructed in the



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A West Point engineering class. Under Sylvanus Thayer's reforms, West Point became a great scientific school. The cadets studied their subjects in small sections, divided by ability, and every student was required to recite in class every day. The curriculum included mathematics, French, drawing, analytical geometry, physics, chemistry, mineralogy, rhetoric, moral and political science, and then, in the final year, engineering, with an emphasis on civil engineering. Every engineering school founded in the United States in the 19th Century copied the West Point curriculum, used West Point books, and recruited graduates of the Academy to serve as their faculty.

Polytechnique may well be imagined when he commenced giving his classes certain problems and instructions, which not one of them could comprehend or perform." Many of the cadets had only a very rudimentary background in simple arithmetic, and therefore Thayer instituted a mathematics curriculum which led from algebra, geometry, and trigonometry to calculus and engineering.

In the cadets' senior year, Crozet, using a blackboard and sometimes a student translator of French terms, taught field fortification, permanent fortification, the science of artillery, grand tactics, and civil and military architecture. In the architecture section of his class, he taught the construction of buildings, the design of arches, canals, and bridges, and the machines used to build them. He also made sure that his students learned the amount of materials, labor, and time that it took to build the structures they

studied. By 1826, the engineering course included roads, tunneling, inland navigation, railroad construction, and artificial harbors.

The West Point curriculum also included chemistry, and Thayer procured enough equipment to allow the physics course to cover hydrostatics, hydrodynamics, hydraulics, pneumatics, machinery, optics, and astronomy. The four-year course also included mineralogy, rhetoric, moral and political science, and an emphasis on both topographical and classical drawing.

In addition to teaching, the professors soon began to translate the French textbooks, and to write texts of their own. These were used in many other American colleges. By 1821, Claudius Crozet had published his "Treatise on Descriptive Geometry," and exhibited for the first time, in English, Pascal's Theorem. Cadet William Frazer wrote proudly to his brother:

We have just finished our course for this year and are now reviewing; we went as far as Spherical Projections in Descriptive Geometry, it is a study which is studied no other place but here.

To inform the nation of what was going on at isolated West Point, Thayer encouraged the War Department to establish a Board of Visitors, composed of distinguished men from across the country, who would oversee the oral examinations of the cadets and report on the progress of the school. He also formed a West Point band, and during the summer the smartly uniformed cadets would march through cities and towns, demonstrating their precise maneuvers to great applause.

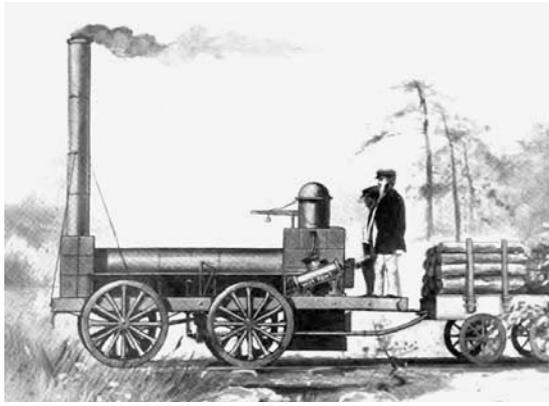
On one of these trips in 1821, they visited the aging John Adams at his home in Quincy, Massachusetts, and heard this early supporter of a military academy tell them:

I congratulate you on the great advantages you possess for attaining eminence in letters and science as well as arms. . . . These advantages are a precious deposit for which you are responsible to your country.

Building the Nation

The cadets who graduated early-on in Thayer's superintendency were generally deployed as officers in charge of the construction of coastal forts or the dredging of harbors. But Thayer and his fellow officers did not see the cadets' function as purely military. In 1823, Thayer wrote to General Alexander Macomb suggesting that if at any point some of the graduates were not needed for military service, "they might be usefully employed as Civil Engineers either in the service of the General Government or of the States." And in 1824, Congressional legislation would establish a military-civilian partnership for developing the nation.

In that year, the Supreme Court ruled in *Gibbons v. Ogden* that the Federal Government asserted authority over interstate commerce, which included river navigation. Following that decision,



The "West Point" was the third steam locomotive built in the United States, and the first featuring a horizontal locomotive-style boiler. Its name is appropriate, because the West Point graduates who entered the Corps of Engineers were involved in surveying, designing, or supervising the construction of most of America's early railroads.

A further association of locomotives with West Point began in 1818, when Gouverneur Kemble built the West Point Foundry at Cold Spring, across the Hudson from the Academy. Although manufacturing at the Foundry began with cannon, it soon progressed to designing and building railroad locomotives. Members of the West Point faculty visited the Foundry regularly.

Congress passed two pieces of legislation that enabled the Corps of Engineers to participate in planning and building civil infrastructure. The first was the General Survey Act, which authorized the President to order surveys of routes for roads and canals "of national importance, in a commercial or military point of view, or necessary for the transportation of public mail." President James Monroe assigned the survey task to the Corps of Engineers. Second, Congress appropriated \$75,000 to improve navigation on the Ohio and Mississippi Rivers by removing sandbars, snags, and other obstacles. Later, the act was amended to include other major rivers such as the Missouri. This task, too, was given to the Corps of Engineers.

In 1825, John Quincy Adams was inaugurated as President, and the American System of Political Economy came into its own. Both large and small infrastructure projects were undertaken in every area of the country, forging a system of national communication and improving the transportation of finished and unfinished products. These engineering projects for improving the gen-

eral welfare also brought the realization that the nation as a whole benefited from improvements that were made in any area of the country.

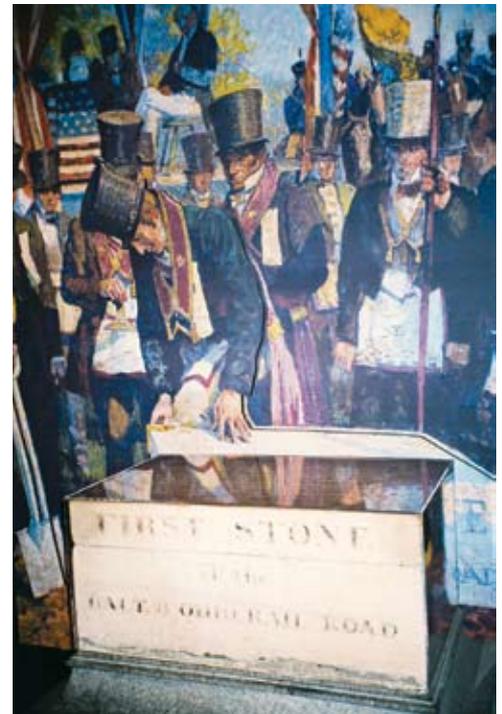
New legislation in 1826 authorized the President to have surveys made to clean out and deepen selected waterways and to make other river and harbor improvements. This led to major Corps of Engineers projects to build locks and dams along hundreds of miles of river, and to the development of floating machines to remove giant snags, or log-jams, from rivers. These were known as "Uncle Sam's tooth pullers."

Members of the Corps also built almost every canal in America, with the exception of the Erie and the Middlesex. Two

very large-scale hydraulic surveys were also mounted; one of the Great Lakes and the other of the Mississippi Delta. On land, the Corps was given responsibility for taking over construction of the National Road, which stretched from Chesapeake Bay to Illinois. As railroads began to be built in the late-1820s, members of the Corps surveyed railroad routes, and the War Department often loaned engineers to the railroad companies once construction began. Thus, Captain William McNeill supervised the survey for the Baltimore and Ohio Railroad, and Lieutenant George Whistler was in charge of laying the track.

By 1830, many engineer officers were granted furloughs to work on the railroads. This burst of internal improvements, leading to the forging of a strong national identity and a strong economy, did not go unnoticed by America's inveterate enemies, who encouraged the growth of a kind of populism known as "Jacksonian Democra-

cy," which had an eerie resemblance to the Jacobin attacks on the École Polytechnique. When Andrew Jackson was elected President in 1828, West Point began to be the target of coordinated attacks. It began with speeches and articles stating that the local militia companies were all the country really needed to defend itself, not those high-tone cadets at the military academy. Congressman Davy Crockett, who had ridden Jackson's coattails to victory, proposed in Congress that West Point be eliminated. Other attacks took the form of proposals for "local control" of internal improvements, which would eliminate



The cornerstone of the Baltimore & Ohio Railroad, one of the earliest and longest railroads, was laid on July 4, 1828 by Charles Carroll of Carrollton, the only surviving signer of the Declaration of Independence. The history of the building of the B&O is closely tied to West Point's Corps of Engineers, for members of the Corps ran the survey for the railroad. Because the early construction of the railroad coincided with the Administration of President John Quincy Adams, who supported what was then called "internal improvements," officers of the Corps of Engineers were allowed to take leave from the Army in order to supervise the building of the railroad.

This painting of the cornerstone is displayed at the B&O Railroad Museum in Baltimore.

The Minot Ledge Lighthouse, shown here in construction in August 1859, is considered a triumph of engineering and is an American Society of Civil Engineering Landmark. The Atlantic Ocean off Cohasset, Massachusetts, had seen many shipwrecks, because of rocky ledges lurking beneath the surface. In 1850, an iron structure containing a warning light was built on Minot Ledge, but the next year it was destroyed by a storm that killed its two assistant lightkeepers.

General Joseph Totten, a West Point graduate, designed the replacement lighthouse, and Barton Alexander of the Corps of Engineers supervised the construction. The large, interlocking granite blocks were cut and preassembled on the shore, and then transported to the ledge on calm days. The base of the tower could only be built when Minot Ledge was visible at low tide. Because the force of wind and waves serves to strengthen the dovetailing of the granite blocks, the lighthouse has stood for 150 years.



National Archives

sponsored public works. The rationale was that development legislation was “unequal and unjust” because money from one state was being used to benefit other states.

The populist rhetoric had gained such momentum by the mid-1830s that many states withheld the Federal treasury surplus which they normally gave to their private colleges, even though there was a tradition of state support for these institutions. The United States fell upon hard times economically in the Panic of 1837, largely because President Jackson had refused to re-charter the Bank of the United States, and had fired Treasury Secretary McLane when he refused to transfer the funds to Jackson’s “pet banks” on the state level. Jackson found a more pliant Treasury Secretary by appointing Roger Taney to do the dirty work, moving him over from the Attorney General’s slot.

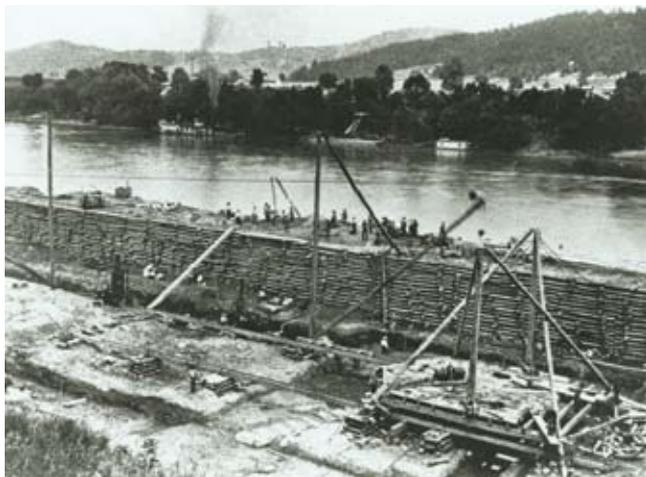
The U.S. Senate was so furious at this action that it refused to ratify Taney’s nomination as an Associate Justice of the Supreme Court in 1835. But the membership of the Senate had changed enough

the national planning focus of the Corps.

Future President Martin Van Buren fought John Quincy Adams tooth and

nail on the question of the Federal role in internal improvements, and proposed a constitutional amendment in 1825, which would have prevented Federally

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Army Corps of Engineers

Improvements to America’s waterways (shown here is work on the Mississippi River), has been a mission of the Corps of Engineers. Early steamboats energized commerce and helped tie the nation together, but travel on the major rivers was dangerous. Currents undermined the banks of the rivers, causing thousands of trees to fall into the water, where they pierced or ripped the hulls of the steamboats. Engineer officers supervised the double-hulled boats called “Uncle Sam’s Tooth-Pullers,” which pulled up the snags, cut them up in a powered sawmill on deck, and used them as fuel. By 1832, not a single boat was lost to a snag on the Ohio or Mississippi Rivers.



Department of Transportation

The U.S. Constitution gives the government the power to “establish post-offices and post-roads,” and when Ohio became a state in 1804, the need for transportation to and from the new state led to legislation authorizing construction of a National Road. By 1818, the road stretched from Cumberland, Maryland, to Wheeling, West Virginia, on the Ohio River. Gradually, the road was extended through Columbus, Indianapolis, and on to Vandalia, the early capital of Illinois. During the first phases of construction, the road was built by private contractors with Federal money, but, later, the Corps of Engineers was given the job of surveying and maintaining the National Road. Shown here is a section of the road in Eckhart, Md.

by the next year to allow Taney to be appointed as Chief Justice.

Jackson also vetoed the Maysville Road Bill, on the grounds that the road lay completely within Kentucky and therefore could not qualify as a national project. On the role of the Corps of Engineers, Jackson was more cautious, as internal improvements were popular, and Jackson himself had stated that West Point was a good school and two of his nephews graduated from it. But he defied Superintendent Thayer again and again, by reinstating cadets who had been dismissed from the academy for code infractions or academic problems.

Thayer refused to be baited, and said, "This course may in the end occasion my removal, but in the meantime I shall have done some good and performed my duty." Finally, the challenge to his authority as Superintendent became so severe that he sent Captain Ethan Allen Hitchcock, his commandant of cadets, to the White House to see what could be done. President Jackson shouted at Hitchcock: "Sylvanus Thayer is a tyrant! The autocrat of the Russians couldn't exercise more power."

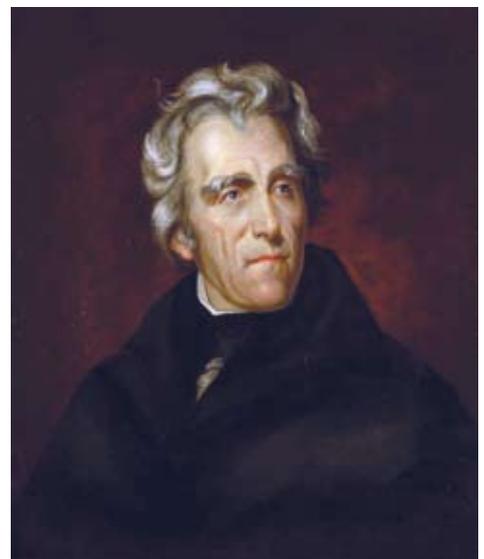
Spreading the Army Corps Tradition

On Jan. 19, 1833, Thayer resigned as the Superintendent, in order to save the institution from Jackson's further wrath. It was only a matter of time, before the Survey Act was withdrawn (it happened in 1838), and Congress passed legislation that prohibited Army officers from being granted leave to work with private companies such as railroads.

However, the foundation which Thayer had built for the Corps of Engineers endured. Many engineering officers resigned from the Army and continued to work on developing America's infrastructure, especially its railroads. Others, still members of the Corps, completed projects on America's coasts, rivers, and lakes. Still others built railroads in countries like Russia and Egypt, or in the growing republics of Central and South America. Before the Civil War, the four



Painting by J. Boze



Painting by Thomas Sully

Jean Paul Marat (left) and Andrew Jackson shared an anti-science ideology. Marat, a leader of the Jacobins, concluded that the revolution had no need of scientists. Just as the British Empire did when Benjamin Franklin became a leader of the American Revolution, Marat also attacked Franklin's scientific reputation and his experiments in electricity. These scientific findings from colonial Philadelphia supposedly sprang from an "aristocracy of knowledge," and therefore all scientists were prosecuted as if they were members of the aristocracy. The 1793 "Law of the Suspects" succeeded in wiping out a large proportion of Franklin's scientific collaborators.

President Andrew Jackson, not so openly sanguinary, destroyed the National Bank which financed America's internal improvements by putting its funds into the "pet banks" of his like-minded cronies. The clearing of snags from America's rivers came to an abrupt halt. Next, Jackson attacked Superintendent Thayer's methods at West Point, calling the cadets an "aristocracy" that the militia could easily replace, and accusing Thayer of being a "tyrant." President Jackson consistently undermined Thayer's authority at West Point by reinstating cadets that Thayer had dismissed, until finally Thayer was forced to resign to save the Academy from Jackson's wrath.

alternate routes for the Trans-Continental Railroad were surveyed by members of the Corps.

Other engineering schools were founded, including the one endowed by Thayer at Dartmouth, and many of them used West Point texts and West Point professors. Secretary of War Porter stated in 1828,

The Military Academy is scattering the fruits of its science . . . not merely to the rest of the army, but to the youth of our country generally, and the interchange of the theoretic science of this national school with the practical skill and judgment of our civilian engineers, which is now going on throughout the United States, will soon furnish every part of the country with the most accom-

plished professors in every branch of civil engineering.

As the American Civil War approached, pushed by the forces that wanted to destroy internal improvements and national sovereignty by any means possible, it was still the case that almost every infrastructural project had been planned or executed by a West Point-trained engineer. A Congressional committee declared, after enumerating some of these benefits:

These are some of the enduring memorials of the usefulness of the Military Academy, and of the returns it has made for the care, and time, and money which have been bestowed upon it.

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