The river-tamers

In Part 2 of a series, Richard Freeman presents a brief history of the U.S. Army Corps of Engineers, which made America a technological giant.

Part 1 of this two-part series, "Lessons of the Flood," appeared in our Aug. 13 issue.

The U.S. Army Corps of Engineers is one of a handful of the most important institutions ever in the history of America's development for the last 200 years. Its name is synonymous with dirigistic economics, infrastructure development, and the spawning and transmission of science and engineering. For that reason, it is the model for the kind of institutions which must be established if the territory of the United States is not to soon resemble the rubble of ancient imperial Rome.

There is scarcely an infrastructure project in America in the nineteenth century that the Army Corps of Engineers did not either plan, survey, engineer, or construct, or as with most projects, all of the above. It participated in a huge number of such infrastructure projects in the twentieth century. It has worked on over 2,500 projects. It built nearly every lock and canal system in America, including the groundbreaking Chesapeake and Ohio and Erie and Pennsylvania canals, and the St. Lawrence Seaway, and it operates every major lock and canal today; it deepened, dredged, or built all the nation's 250 deep-draft and shallower ports, and the same for all of its harbors, and it manages all of them today; it supervised nearly every major river improvement project, including for the Mississippi, Missouri, and Ohio river systems, which constitutes the third longest, integrated river and tributary system in the world, at 1.2 million miles, and it performed similar operations for numerous other river systems, such as the Tennessee and the Sacramento rivers. In the 1930s, it built all the nation's major dams, including the Grand Coulee, the Bonneville, and the Hoover dams, and built and operates over 400 dams; it supervised and built the Tennessee Valley Authority flood control/reclamation/hydro-electrification program, one of the wonders of the world; it engineered, graded, and built scores and scores of the country's railroads, including the Baltimore and Ohio, and the Western Railroad of Massachusetts; it conducted almost every major geographical survey in America; and it built the nation's network of highways, starting with the original Cumberland Road, and so forth.

The military's role in infrastructure

In 1802, the Army Corps of Engineers was established by the same Act of Congress that established the U.S. Military Academy at West Point, part of a project of the nation-builder Alexander Hamilton, and others. The Corps of Engineers and the Military Academy were in fact the same institution: The Military Academy was the nation's first engineering school, and remained under the direction of the Corps of Engineers until 1866. Up until 1875, nearly every engineering college founded in America attempted to obtain members of its faculty from, and base its curriculum upon, that of the Army Corps of Engineers and West Point.

The prehistory of the Corps goes back to the Army Engineers of the American Revolution, established in 1775. Richard Gridley, the ranking engineer at the Battle of Bunker Hill, in April 1775 became the Continental Army's first chief engineer. The Corps of Engineers was formally formed in May 1779, and the first head of the Corps was Louis DuPortail, a Frenchman. The French scientific tradition is prominent throughout the history of America's Corps of Engineers. Duportail had been recruited in France, and sent to America in 1777 with other engineers, by France's minister of war, the Comte de St. Germain, and France's Foreign Minister Vergennes. The arrangement was secretly organized under the direction of the American ambassador to France, and the intellectual author of the Revolution, Benjamin Franklin.

A key person in the American Army's Revolutionary War engineer corps was the Polish republican freedom-fighter Thaddeus Kosciusko (1747-1816), who was the favorite of Commander-in-Chief George Washington, and later, during the southern campaign, of Gen. Nathanael Greene. Kosciusko built the fortifications at West Point, and also the huge chain across the Hudson River there, which prevented the British from linking up their forces and supplies in New York City with those in Northeastern Canada. After the Revolutionary War, Kosciusko went back to fight for his native Poland's freedom from Russia. Kosciusko had studied, along with every French engineer, and many other foreign engineers in America, at the Ecole Militaire in Mézières, France. The Ecole had been founded in 1749 upon the teachings of the formidable engineer and master of siegecraft, Sebastien

de Vauban (1633-1707). The Ecole Militaire was transmuted, at a later date, into the celebrated Ecole Polytechnique of the great geniuses of constructive geometry and warfare, Gaspard Monge and Lazare Carnot. Carnot saved the nation of France through his scientific projects. His science had a still greater influence on the Corps of Engineers.

The Ecole Polytechnique curriculum

Under the influence of President Thomas Jefferson's treacherous Treasury Secretary Albert Gallatin, the American military was dismantled, and a good part of the earlier French engineering tradition was lost. During the War of 1812 against the British, American officers had little or no training, maintained few standards, and knew little about continental European methods. These weaknesses showed during the war.

In 1815, the outstanding American engineer Sylvanus Thayer (1785-1872) was dispatched to France, arriving after Napoleon's defeat at Waterloo, with a mission to bring back science and restore the American military. Thayer was provided with a $5,000 credit, a huge sum in those days, by U.S. President James Madison, with which to buy every important map, book, or piece of equipment in France that had to do with French science. Early in 1816, after the Ecole Polytechnique was reopened following a temporary closure, Thayer went there to study. Returning to America in May 1816, he proceeded with the treasure trove of goods he was authorized to buy, to West Point, where the next month, Madison and the Congress appointed him superintendent.

Thayer's version of the Ecole Polytechnique's curriculum presents only an outline of what was taught at West Point. The first-year engineer-cadet studied French, algebra, geometry, trigonometry, and mensuration. The next year he studied the same subjects, adding drawing (the drawing department was headed by important American artists) and calculus, with the introductory geometry changed to analytical geometry. In his third year, the engineer-cadet studied physics, topological drawing, and chemistry. The major course in the fourth year, and the crowning embellishment of the curriculum, was engineering. Students also studied mineralogy, and took one course in moral science and rhetoric, taught by the Military Academy's chaplain.

The curriculum as taught under Thayer had its drawbacks. It emphasized far too much rote learning, theory was deliberately deemphasized, and the classics were altogether omitted. But on the whole, this curriculum had a profound and positive effect. It guided the Corps of Engineers into an outpouring of infrastructure building and engineering feats rarely matched in the history of man.

George Washington Whistler and rail building

Since it is difficult to survey here the vast expanse of what they accomplished, we focus here on the work of one graduate of this curriculum and a member of the Corps of Engineers, George Washington Whistler, who became the world's foremost railroad engineer of the nineteenth century. He graduated West Point July 1, 1819. After doing topographical duty for eight months, he became assistant professor of descriptive geometry and drawing at the Military Academy (his son James was a famous artist). In 1828, as an officer in the Corps of Engineers, Whistler supervised the construction of the Baltimore and Ohio Railroad, America's first commercial railroad. After a few years, he moved over to supervise another railroad project, the Baltimore and Susquehanna Railroad. He then moved to New Jersey to help the construction of the Paterson and Hudson River Railroad. In 1833, Whistler shifted to Connecticut, where the railroad from Providence to Stonington became his next project.

At the end of 1833, Whistler resigned his commission so that he could become engineer to the Proprietor of Locks and Canals in Lowell, Massachusetts. There his position included the supervision of the machine shops, which operated principally for the construction of the most advanced locomotive engines. In 1837, Whistler began the crowning achievement of his American engineering career, the Western Railroad of Massachusetts. The degree of the project's difficulty was amazing. It ran from Worcester, Massachusetts through Springfield and Pittsfield to Albany, New York, overcoming the highlands between Connecticut and the Hudson River and connecting Boston to that part of the country, which in America's early history was called the "Great West."

In the 1840s, the government of Russia decided to build a crucial rail line from St. Petersburg to Moscow. Russia's engineering corps was first rate, but it needed railroad engineers. After several tours of the major European countries and America to examine rails, the Russians determined that George W. Whistler was simply the best railroad engineer in the world, and should head the project. In a remarkable scientific paper, Whistler convinced the Russians to adopt the standard gauge of four feet eight inches instead of the six-foot gauge they favored. Whistler oversaw virtually the entirety of the St. Petersburg-to-Moscow project. A mechanical workshop was set up at Alexandoffsky, where the rolling stock was made. For his work, Whistler was rewarded by Emperor Nicholas with the Order of St. Anne. (See "America's Railroads: Success Story for Dirigist Nation-Building," *New Federalist,* Jan. 27, 1992.)

Transforming the Mississippi River

It is fitting to present flood control as a final example of the work of the Army Corps of Engineers. The current flooding of the Mississippi is far from the only major flood in this country's history. In 1692, a flood occurred on the Delaware River in Trenton, New Jersey, which, if repeated today in the same unprotected circumstances, would be disastrous. In 1763, the "Point" at Pittsburgh, Pennsylvania was sub-

merged by a flood. In 1861, some 700 people died in a deluge on the Sacramento River in California. In 1869, at Johnstown, Pennsylvania, uncontrolled waters killed 2,209 persons and destroyed over $10 million in property. Floods on the unruly Colorado River in 1905 broke into the Imperial Valley in California, and for over a year, the uncontrolled flow into the valley created the Salton Sea. The nation's previous most devastating flood occurred on the Mississippi in 1927; and in 1937, the Ohio River Valley suffered its worst flood in history, in which 500,000 people were driven from their homes, with damage estimated at $400 million.

The first works for control of floodwaters developed largely on the Mississippi in 1712, at the lower end of the river. The young engineer Blond de la Tour was given the task of planning a levee (from the French word, *elevée*) system so that the town that was to become New Orleans could be built. By 1727, the French had built a levee over one mile long and three to four feet high, along with a system of drainage ditches. This was part of a series of piecemeal efforts, that were not very effective, for the next 120 years.

In 1824, provisions of the Constitution were interpreted to permit and affirm improvements for navigation of America's river systems. But the federal government remained hamstrung in assisting localities and states in reducing flood damage. According to the "free enterprise users' fee" argument used against federal intervention, since the people who lived near or on the riparian plain were the ones who needed flood control, they alone should pay for it. Starting in 1819, the state of Mississippi authorized construction of levees and provided for collection of taxes from riparian plain settlers. In 1846, the state began to tax the backlands, to help the landowners on the river. Louisiana essentially did the same thing. The problem with this system was that it often bankrupted farmers and those living on the plains, but had little serious effect in preventing floods. The flooding of the Mississippi in 1849 and again in 1850 was devastating.

In 1866, the Senate directed the chief engineers in the Corps of Engineers to investigate repairs necessary to prevent extensive damage to agriculture along the river. The resulting report recommended federal intervention to build flood protection. Though the report was favorably received, the "free enterprisers" blocked action. Finally, in 1879, Congress created the Mississippi River Commission, and after a giant Mississippi flood wrecked a levee line along the Mississippi in 1882, nearly wrecking the financial credit of the impoverished districts, Congress enacted the Rivers and Harbors Act of that year, which put responsibility for building levees and maintaining them into the hands of the Army Corps of Engineers. This authority was not given in the name of flood protection directly, but only in the name of providing ease and safety of river navigation.

The bankruptcy of halfway measures was again demonstrated in 1927, when the most disastrous flood in American history struck, as the Mississippi surged and swelled. Just to give one example of its dimensions: On the night of April 15, New Orleans had a deluge of almost biblical dimensions—14.01 inches of rain in one night. By the end of the flood, 200 people were dead, and 700,000 had been driven from their homes, while property losses alone totalled $200 million.

In 1928, Congress finally passed a new plan, which is sometimes called the "Flood Emancipation Act." It authorized the Corps of Engineers to develop a unified flood control system in its own name in the entire alluvial valley. The "free enterprisers" had at last been temporarily beaten back. The act set up the Mississippi River and Tributaries Project to shackle the mighty Mississippi. The Army Corps of Engineers and Mississippi River Commission, along with, eventually, the parallel commissions for the Missouri, Ohio, etc., were instructed to use the following methods for flood control, which are usually used in combination: 1) levees; 2) floodways, diversion channels, and other outlets; 3) dams and reservoirs, bank and channel stabilization; 5) cutoffs; and 6) contour plowing and reforestation. As a result, the Mississippi has been continuously shaped, dredged, embanked, shortened, and fortified for the last 70 years, as flood control acts for the Mississippi have been updated and refined.

Over the years, on all the major rivers of the United States, the Army Corps of Engineers was put in charge of flood control, along with navigation, port and harbor development, dam construction, etc. Since the 1928 act, the Corps of Engineers has completed about 3,400 projects that have flood control benefits. This includes over 400 dams and reservoirs located in 42 states. The reservoirs created by the Corps of Engineers store hundreds of millions of acre-feet of water throughout the country. The man-made lakes created by Corps of Engineers' flood control dams have become such popular recreational spots that twice as many visitor-days are registered by vacationers at them every year as at the national parks. The Corps today operates 460 hydroelectric installations, most of which it built, which produce one-third of the nation's hydro-generated electric energy.

The Corps of Engineers Waterways Experiment Station also has a six-laboratory complex that specializes in hydraulics, structures, and geotechnical and coastal engineering.

But over the last decade, in particular, the Congress has put a straitjacket on the Corps because of Adam Smith-ite budget-balancing. Many upgrades and improvements on the Mississippi River and other river systems, as well as other infrastructure projects were not made, with the now-obvious catastrophic results. But let the Corps' glorious history of nation-building be a sharp rebuff to anyone who says we can't turn a continent from a wilderness into a flourishing garden of agriculture and industry.