

A MAN FOR ALL REASONS
John Smeaton, FRS, The First Civil Engineer

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PREMISE

John Smeaton was not a product of his time. He qualifies as a true, quiet giant in history, who was able to alter the times in which he lived, thus altering all the times that followed. This genuine, proverbial, historic hero is underrated, unheralded, and unsung. Adam Smith published his *Wealth of Nations*² also in 1776, but all that socioeconomic advocacy would have been at least another century in materializing were it not for John Smeaton's efforts that same year at delineating its enabling profession, Civil Engineering.

BROAD BACKGROUND

In 1776, perhaps the most significant historic event in the life of England, the United States, and the rest of civilization, was not the American Revolution! I believe it was the hanging of a shingle outside a London office. It proclaimed, "JOHN SMEATON, CIVIL ENGINEER."

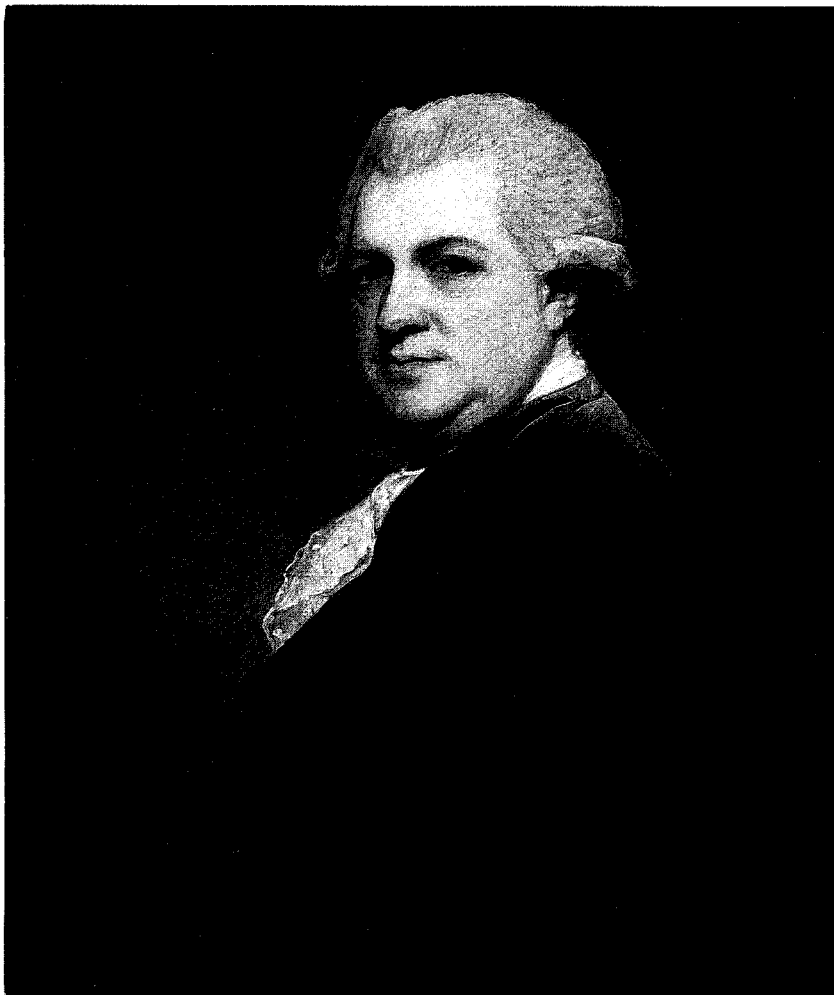
Seventeen seventy-six may not have been a good year for red wines, but it was replete with heavy historical happening: Matthew Boulton and James Watt created power from an efficient steam engine; Josiah Wedgewood produced quality china crockery for the populace; and, there was Adam Smith's *Wealth of Nations*. All that, in addition to the Jefferson-Franklin magnum opus on "truths ... self evident." Why then should the public proclamation of a professional presence by a person of particular perspicacity take precedence over all other contemporary events?

Because in the world purview, John Smeaton established and clearly defined the hitherto unrealized and unnamed profession of Civil Engineering. Those practitioners in the public good, then became the recognized people who eventually were able to provide England (and the rest of the world) with a fully designed and constructed physical plant, power base, and means of conveyance. That is what enabled the Industrial Revolution to achieve its inevitable goal, to change the world from agricultural to industrial.

Without Smeaton and his followers, that maturation might have taken another century, or even longer. Is it not true that from the Roman era until then, very little had changed? In some areas things mechanical even had regressed. During Smeaton's 1755 trip to the Low Countries he observed a windmill at Delfshaven.

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² Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, Scotland, 1776.



John Smeaton, F.R.S.
(1724-1792)

Portrait oil on canvas by George Romney, owned by the Smeatonian Society, hangs in the Institution of Civil Engineers, London. Reproduced with permission.

"Near this place I Saw a mill which turns about at the top; this Mill appears to have been built 100 Years, but is entirely the same as those of more modern date."³

What marks man's ascending civilization is:

- 1) To adjust his behavior to accommodate natural forces, (he comes in out of the rain) intellect;
- 2) To devise an adjustment to negate the effect of natural forces, (he makes an umbrella to keep himself dry while he's out in the rain) craftsmanship;
- 3) To develop an adjustment to negate a local influence of natural forces, (he builds a building complex to keep a community dry,) engineering; and hopefully,
- 4) To adjust the natural forces to accommodate his desires, (stop, or start the rain) future engineering.

As a humanist engineer functioning in the interface between science and society, Smeaton's efforts were the result of pondering problems, then attempting solutions based on both science/math, and in applying knowledge of properties of materials. This perspicacity is what enabled him to go, professionally, where no man had gone before.

The recording of history can only be done by contemporaries. But they should not interpret history, that is for the heirs and assigns of those events. It is equally unsound for later generations to attempt to revise or redirect history toward another meaning, unless some valid and compelling evidence has been unearthed. But logical interpretation is one of the delights of studying history. Another is, by knowing the real beginnings of a field you can acquire a true grasp of its value. Aristotle wrote, "He who considers things in their first growth and origin ... will obtain the clearest view of them."⁴

I spent fifty years of my lifetime as a professional civil engineer. The contributing force that enabled my non-mechanical mind to succeed in an area where it was technically unsuited was a compensating emotional suitability. That stemmed from a clear understanding of what I was doing and why I was doing it. Much of that came, at my father's urging, from reading history, and interpreting it. As such I believe today John Smeaton is perhaps the western world's least known public benefactor.

HISTORICAL BASIS

Many historians record events in terms of military, political, or socioeconomic events, strategies, and victories. Picón Salás⁵ contends (and I tend to agree) that history should be measured in terms of cultural changes. A people's culture reflects its history. This is what I perceive is the real value of Smeaton and his effort. Details

³ (N) P-28

⁴ *The Politics*, Bk. 1, Ch. 2, Trns Jowitt, Benjamin, London, 1921.

⁵ Picón Salás, Mariano, *A Cultural History of Spanish America From Conquest to Independence*, University of California Press, Berkeley, 1963.

being what they may (and the 1783 political separation of England from U.S. included) our way of life today is a direct outgrowth of the English Industrial Revolution. Socioeconomic, yes; political, yes; but mainly cultural.

The general historic tendency is to combine the three revolutions of the 18th century: the Industrial Revolution in England, the American Revolution from England, and the French Revolution. I feel that in the retrospective view, the French Revolution did not have quite the impact on 18th Century (or later) civilization that the other two did. I believe Smeaton's declaration hastened the evolution of the Industrial Revolution and thus enabled both England and America to survive separately.

"Revolutions are not made by fate but by men. Sometimes they are solitary men of genius. But the great revolutions in the 18th Century were made by many lesser men banded together. What drove them was the conviction that every man is master of his own salvation," wrote Jacob Bronowski in his poetic prose.⁶ Yet I am astounded that that particular man, who could distill such sensitive wisdom from the historical record would, by error of omission (or design) completely ignore Smeaton. That accomplished name appears nowhere in Bronowski's otherwise brilliant and flawless *Assent of Man*,⁷ while the text cites lesser men all around Smeaton: Brindley, Watt, Wedgewood, Wilkinson, etc. Why?

Though Bronowski doesn't actually call those men "cultural," the consequences of the Industrial Revolution were. Its roots were in the countryside. They grew from the people who demanded more for their efforts than a meager subsistence with Dark Ages amenities. New industry provided standard Wedgewood crockery for every table at a price a worker could afford. (Or Jasper, and bone china for a little more.)

From his Yorkshire Iron & Steel works John Wilkinson not only made swords and blades for the King's army, but he was able also to turn out flatware for the tables, and tools for farm, home, and shop. His consultant (and brother-in-law) Joseph Priestley succinctly summarized the Industrial Revolution as "the happiness of the greatest number."⁸ Priestley also had much to do with oxygen, and later taught chemistry at the University of Pennsylvania in Philadelphia.

Joseph Priestley was also scientific adviser to Wedgewood who, along with Dr. Erasmus Darwin, all belonged to a scientific and industrial society. They met monthly on the full moon at various places, and called themselves the Lunar Society. Members included Boulton and Wilkinson, among others. (Wedgewood and Darwin eventually became both grandfathers of Charles Darwin.⁹) The Lunar Society is

⁶ (C) P-259.

⁷ This blunder in historical recording is matched by (Cornell and *The New York Times*) Allison Danzig's, *The History of American Football*, (Prentice Hall, N.J., 1956). "The most detailed and accurate account of our most colorful sport," as it describes itself, completely omits mention of Rutgers's two-time (first) All American, Paul Robeson.

⁸ (C) P-272.

⁹ Charles Darwin, *The Origin of the Species*.

noteworthy here because it extrapolates and verifies the separation of the scientific/industrial group from the civil engineers who, along with Smeaton, formed their own group, described later. Prior to this point (as the top personages had done in the Royal Society) all men of a scientific or technological bent were "of imagination all compact."¹⁰

Quid pro quo is generally the way with a revolution. People get some things in exchange for other things they must give up. The Industrial Revolution brought people unlimited power in the real sense but it made the workers slaves to the place and pace of the machines. It created physical pollution of the air and the streams; and social pollution in the burgeoning squalid urban centers. All cultural changes.

Before, in the relative (though mostly impoverished) tranquility of rural "cottage industry," people did piece work at their own pace in their homes. Then they took their products to market centers. The Industrial Revolution ended that by bringing people from the countryside to the work centers, and to their inevitable ghettos. They lived in cold crowded rabbit warrens with the most meager of conveniences or social graces. But the general public gained things they never had before, at mass produced prices within their reach: dishes, flatware, stoves, tools, shoes, clothing, and more machines to make more things.

To accommodate that turning over of the socioeconomic body, ¹¹ demanded immediately, and in full scale, things from technology that until then existed only in dreamers' minds. Factory and mill buildings had to house the great new engines. Canals had to be enlarged and extended. Then roads, unchanged since the Roman *iter* had to be made all-weather and reach all places. When those two modes of transport still failed to meet the new demands, the railroads evolved. Ports, harbors, and navigation aids also had to be concocted then improved.

To keep pace with all that advancement and the rapid population shift from the soil to the cities, new water supplies, eventually waste disposal systems had to be devised and installed. Larger multiple dwellings evolved. Dams, dykes, tract drainage, bridges, and buildings came next. All that cultural change became the bailiwick of the newly emerged profession of Civil Engineering, as did the industrial plants.

James Brindley (1716-1772) built canals, improved water wheels, and consulted on such production commencing less than a decade before Smeaton. He, like Smeaton, began, as a self-taught mechanic, who went on from there. But unlike Smeaton he had not the imagination, the resourcefulness, nor the mental capacity for the top. His efforts were well built on dead reckoning and continuation of "standard practice," plus a liberal share of common sense and good fortune. Brindley's time was the transition from the artisanship before him to the engineering that followed. Also he worked well with Smeaton when they actually did, on several occasions.

¹⁰ William Shakespeare, *A Midsummer's Night's Dream*, v, i, 7.

¹¹ "Fanshen" of the Chinese People's Revolution of 1949.

ENGINEERING, CIVIL

Humanist and Civil Engineer, Solomon Cady Hollister, Dean Emeritus and father of today's College of Engineering at Cornell University lined us in, direct to what we need to know about the "Ingenious Contriver of the Instruments of Civilization."¹²

"Use of the word *engineer* has been traced back at least to the twelfth century. In Roman days the classical Latin term for military constructor was *rchitectus militarus*; but in 1196 we find the Latin term *encignesius* used in Lombardy. In 1238 the spelling is modified to *inzegnerium*. In France the designation *maistre engingnierre* was used in 1248, modified in 1276 to the spelling *engegynnyre*. In Germany *ingenieu* appeared before the middle of the fifteenth century; this word is still in use, as it is in France. The origin of our word *engineer* is connected to the German word, and is associated with the word *ingenuity*."¹³

From that etymology it appears then that the noun *engines* evolved from the devices of the "ingenious contrivers " rather than *engineers* becoming the name for those people who operated those contrivances.

The Engineers' Council for Professional Development (ECPD) in 1962 determined:

"Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind."¹⁴

Early in my college days I learned more simply, "an engineer was someone who could do for one dollar, what anyone else could do for two." It baffles me how this comparative definition has held up over the years in the light of the cost of today's constructed projects.

A succinctly more direct version of the ECPD definition came from England about thirty years after Smeaton. In 1828 Thomas Treadgold said of engineering (specifically Civil), "... the art of directing the great sources of power in nature for the use and convenience of man." ¹⁵

Inherent in all those definitions is the notion that an engineer is not just a builder, and is vastly different from an architect. He learns scientific principles (mathematics and physics) then applies them (along with an acquired knowledge of the makeup and

¹² (G) Subtitle.

¹³ (G) P-30.

¹⁴ (F) P-2.

¹⁵ (F) P-1.

behavior of materials) to design and construct devices to alter the effects and forces of nature. Smeaton's efforts harnessed wind and water to work for people.

"In the old days all engineering was military. Ever since Apius Claudius built the military roads that led from Rome, engineers have constructed impregnable fortifications—then contrived their ultimate destruction." "Since Smeaton, all the public works plus traffic patterns, tunnels, and management have become honored civil preoccupations,"¹⁶ while the military engineer continues to practice his own skills along with allied professions (chemical, aeronautic, electronic, etc.). The 'Civil's' satisfaction comes from tangible results and their usefulness."¹⁷

The ancient engineers of Sumer, Egypt, and Greece brought wealth and greatness to their lands through construction of fortifications, harbors, buildings, and war machines. The Romans added roads, bridges, and aqueducts. But, as with the major works of Leonardo daVinci, it was all for conquest or defense. Just as all the machines (catapults, etc.) were devised for warfare, little if anything was done in the public interest. Hollister allows that prior to about 1600 all the materials for construction were stone, wood, and brick. And all the labor was by hand, aided only by lever, pulley, wedge, and wheel.

The old military engineers both built the fortifications, then manned them as defense directors being majors domo, so to speak, over the activities as they developed. In the observations of his visit to the Lunette, Zealand, "works that were attacked by the french," Smeaton wrote, "Under the ravelins in many directions are chambers for the Mines, and places for the Engineers to set in, and give directions during a siege."¹⁸

Today's surviving structures show us that the only remnants of great efforts of the Renaissance are churches and castles—refinements of the temples and forts of the ancients. The number of homes, reservoirs, roads, or any public works is minuscule, if at all extant in isolated places.

Public works in the Low Countries consisted mainly in dykes, canals, and sluices. But again they were done principally to aid defensive military operations. Commerce was of raw materials for, and in, the products of cottage industry. The time had come to stop the driving effort for the military and concentrate on the needs and wants of the general public.

"The business of building is not new." As National Chairman I wrote in the introduction to the booklet commemorating the 1975 Golden Jubilee of the Construction Division, American Society of Civil Engineers: "Man has been erecting structures to overcome natural obstacles for over 10,000 years. What distinguishes our current efforts from those of the ancients is efficiency. The classic roof support columns of the Egyptian and Greek temples occupied more than 66% of the floor

¹⁶ (K) P-15.

¹⁷ (G) P-30, 31.

¹⁸ (N) P-25.

space. Now we dome-cover an 87,500-seat football stadium entirely without inside support. (NFL Superdome, New Orleans, Louisiana.) Naturally the elements of time, labor, and materials have evolved considerably but the real difference today is the engineering that goes into both the structural design and the construction method."

Smeaton started us thinking of the entire system in his thoroughly complete execution of the Eddystone Light. He examined the site, analyzed the problem, and then designed the structure from his knowledge of materials. By making a composite structure applying knowledge of the properties of the materials as criteria, he replaced uneconomical building ways that relied on the skill of the craftsmen and the mass of the structure to make it stand.

JOHN SMEATON

That John Smeaton was the maker and first standard bearer of the profession that today provides us with our tangible world, is best documented by Skempton:¹⁹

"The term 'civil engineer' appears for the first time in history on the first page²⁰ of the Minutes of our Society; the decision by Smeaton and the other founder-members to adopt this title marks the recognition of a new profession in Britain, as distinct from the much older calling of the military engineer. Obviously long before this date there had been men carrying out non-military engineering works (both civil and mechanical in the modern sense) and some of them are quite well known, at least to historians. But it was only after 1760 that the numbers of such men in England began to increase to the point that they could think of themselves as belonging to a profession."

The actual statement in the Minutes book was: "Ano 1771 Society of Civil Engineers."

Smeaton's primacy in the profession is acknowledged by Hollister,²¹ Kirby, et. al.,²² Titley,²³ Straub (indirectly),²⁴ Hartman,²⁵ Encyclopedia Britannica,²⁶ and of course Holmes, and Smiles.²⁷ Though the active practice began about 1760 and the Society was formalized in 1771, it was not until July 1776 that his own sign, "JOHN SMEATON, CIVIL ENGINEER" hung outside "Gray's Inn, his London Office."²⁸ He headquartered all summers at his family home at Austhorpe in Leeds and also

¹⁹ (M) P-5.

²⁰ *Ibid.*

²¹ (G) P-33.

²² (I) P-167.

²³ (N) P-v.

²⁴ (Q) P-134 + 170.

²⁵ (F) P-26.

²⁶ (B) Ed 1959 "Civil Engineer."

²⁷ (P) P-93.

²⁸ (E) P-xiii.

hared an office with his friend and colleague John Holmes in the joint proprietorship of the water works for Deptford and Greenwich.²⁹

Far more could have been known of this rough-hewn gentleman of knowledge, culture, pragmatism, and human empathy. Unfortunately, his closest kin (except for his daughters Mary and Ann, who helped with his writings and drawings) knew so little of his accomplishments, "... that so much 'rubbish' as it was termed, was found in that square tower at his death, that a fire was kindled in the yard, and a vast quantity of papers, letters, books, plans, tools, and scraps of al kinds, were remorselessly burnt."³⁰ Happily, all was not lost, for enough still remained to show us a clear picture of that remarkable man.

That John Smeaton had both the character and the personality to be a public personage becomes self evident on examining aspects from random samplings of his life. Smeaton tempered his forthright honest opinions³¹ with an innate wry sense of humor:

On Amsterdam's clock: "... the contrivance however of the pendulum part, with respect to measuring time is *tres miserbale*. The Bells are very good but I think inferior to those of Bruges...."³²

On Dutch machines, "this was the only attempt towards a dry dock I see in the low countrys and indeed from the awkwardness with which they had putt it into execution, one would not be surprised that they had grown weary of it."³³

On Dutch women, "...but to give the dutch their due, in this branch of Statuary they have shown great tast and Skill, which one would more wonder at, as the original living models in this country are not of the most delicate sort, especially those of the female Kind."³⁴

On Belgian machines and people, "Upon the whole this Machine is one of the worst contrived I ever say, and as badly executed: I should have thought it too despicable to have taken the least notice of it, had I not heard of it from several persons, as being cried up for a most curious piece of art, which numbers had been to see."³⁵

On Dutch Protestants, "The Sunday afternoon in Holland is rather looked upon as a Holyday for making merry than a sacred abstinence from Labour."³⁶

²⁹ (P) P-169.

³⁰ (P) P-167.

³¹ All entries are quoted exactly as they appeared in the original work, (sic), complete with errors.

³² (N) P-37.

³³ (N) P-21.

³⁴ (N) P-30.

³⁵ (N) P-10.

³⁶ (N) P-44.

On Dutch Jews, "This morning I was at the worship at the Jews Synagogue, in which there was much Shew and Ceremony. I also heard their singing, which is not performed but once in 3 weeks or 9 month, at which time it is an extraordinary favour for Strangers to be present; the performance was by 3 persons, viz. a Bass, Tenor, and trible and the musick was of much the same kind as that used in our Cathedrals and, considering it was performed by 3 persons and the trible a grown man, the Effect was Extraodinary."³⁷

On French Security, "... and finding how jealous the french are of the English, especially at this time which is looked upon as being the Eave of a War; and fearing least my curiosity at Dunkerk might have been noticed; concerning which they are very watchful, as they are constructing works there, in Breach of the treaty of Utrecht, I was resolved to depart the next morning for Ypres and get out of the french territory as fast as I could."³⁸

On Dutch Security, "This Town is in the dutch territory which being a Garrison Town I here underwent the ceremony of being Examined by the military Gentry, who handed me from one to another, was made to walk an hour in the rain and at last suffered to go to my lodging without being asked one material question."³⁹

On gambling when about to lose a sizeable sum in a card game with the Duke and Duchess of Queensberry, he beseeched her, "Your Grace will recollect that the field in which my house at Austhorpe stands may be about five acres, three roods, and seven purchases, which at thirty years' purchase, will be just my stake; and if your Grace will make a Duke of me, I presume the winner will not dislike my mortgage."⁴⁰

John Smeaton's character and disposition evinced themselves in his reaction to life's most difficult impositions, frustration, and adversity. At the end of his trip to the Low Countries 9 July Smeaton tried to sail for home. He found the ship he expected had sailed without him so he used the day for more observations. The same thing befell him on 10 July and 11 July. But on the 13th he made it aboard a vessel. Then poor winds and low tides detained it until 5 p.m. of the 15th. At the English coast, again bad winds and tides kept them out of their destined port for two more days. Finally, ten days later and a considerable land distance from his destination at Leeds, he summed that great frustration with, "I gladly took this opertunity of packing up my Bag and Baggage, and was to my great satisfaction put safely on Shoar by the pilot Boat."⁴¹

³⁷ (N) P-40.

³⁸ (N) P-6.

³⁹ (N) P-17.

⁴⁰ (P) P-175.

⁴¹ (N) P-60.