Cement and Concrete, Creativity and Community, and Charles E. Peterson

DAVID GREGORY CORNELIUS

Charles E. Peterson's research into the "lost history" of cement and concrete reveals as much about the researcher as it does about his subject.

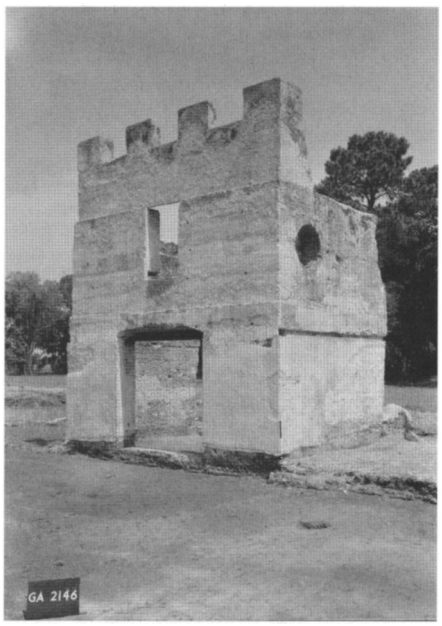

Fig. 1. Tower of barracks from southeast, Fort Frederica National Monument (1741-42), St. Simons Island, Georgia, May 1958. Photograph by Jack E. Boucher. Library of Congress, Prints and Photographs Division, Historic American Buildings Survey, Reproduction Number HABS GA, 64-FRED, 1-5.

A Simple Question

In 1948 Charles E. Peterson, then a 41-year-old architect with the National Park Service in St. Louis, received a letter from A. J. Boase of the Portland Cement Association that contained this information: "As far as we have been able to learn the first monolithic concrete building built in the United States was erected in the year 1849 in Wisconsin. It is still in service. However the cement used in that job was not a portland cement but a natural cement and I believe it was hauled by wagon from New York State."[1]

As he would continue to do throughout his career, Peterson had formulated a fundamental and deceptively simple question: in this instance, what was the first concrete building in America? Having addressed this query to the recognized expert authority (the Portland Cement Association) and received its reply, Peterson spent the next five decades challenging the answer, reformulating the question, pursuing the precedents, questioning the terminology, torturing the received wisdom.

Peterson's drive for knowledge could never be contained within a single job description. After founding the Historic American Buildings Survey from his relatively insignificant post in the National Park Service in 1933, his attentions were temporarily diverted to winning the Second World War in the Pacific, with the acknowledged assistance of Chester W. Nimitz. But back with the Park Service, from 1946 to 1948 in St. Louis and 1948 to 1962 in Philadelphia, Peterson's wars to preserve nineteenth-century architecture from mall-building politicians were harder to win, and the frustrations many.[2] In those years Peterson had a scholarly bully pulpit in the American Notes section of the *Journal of the Society of Architectural Historians*, which he edited from its inception in 1950 until the feature's discontinuation in 1967.

Peterson and McKee: "A Deep, Involved and Confusing Topic"

Peterson's most important mentor and colleague in the study of cement and concrete was Harley J. McKee (1905–1976), professor of architecture at Syracuse University, who became a valuable contact during Peterson's years of editing American Notes and remained so until McKee's death.

In the day-long Historic Structures Training Conference conducted for the Eastern Office of Design and Construction of the Park Service on July 28, 1961, toward the end of Peterson's tenure there as supervising architect for historic structures, McKee spoke and contributed the supplementary notes entitled "Cement and Mortar, 1800-1850."[3] In 1962, at Peterson's urging, McKee contributed an American Note on the early use of natural hydraulic cement on the Erie Canal, in which the important engineer Canvass White (1790–1834) figured prominently.[4] The same year Peterson left the Park Service and established a private architectural practice in Philadelphia, supplemented by adjunct teaching in the historic preservation program, led by James Marston Fitch, within Columbia University's School of Architecture.

In the 1960s Peterson deferred to McKee as a leading authority on the subjects of early cement and concrete, while not selling his own growing interest short.[5] He exercised this balance in writing to an editor in 1966: "At the moment I am busy trying to persuade Professor McKee to do a résumé of American concrete which (in my

opinion) comes to us from the Mediterranean and the Caribbean with lime concrete in the very earliest days, through tapia, the gravel wall and other things."[6] In November 1966 Peterson, as he was occasionally disposed to do, composed a circular letter, copied to anyone and everyone who might have useful information of value to him, announcing that

> For our graduate seminar on Preservation and Restoration in the School of Architecture we have had for two years a lecture on 'The walls of Buildings in America to 1860.'...During this coming Spring Term it is hoped to explore this tremendous subject in greater depth and a lecture on early concrete by Professor Emeritus Harley McKee of Syracuse University is hoped for. Eventually we may have a handbook and finally, perhaps, an encyclopedia on Early American materials and construction techniques.[7]

With his lecture in March 1967 to the students in Peterson's seminar, Early American Building Materials and Construction Methods (up to 1860), McKee provided seven pages of supplementary notes that summarized British technology up to Aspdin and Vicat's 1818 treatise, as well as the American natural cement industry beginning with Canvass White in the same year.[8]

Much of the material in the research and course notes would find its way into McKee's still invaluable book *Early American Masonry*, which constituted a partial fulfillment of Peterson's hoped-for handbook.[9] As he stated in his preface to that book, however, McKee had explicitly excluded the subjects of concrete and cast stone. Perhaps both he and Peterson deemed the subject of primitive American concrete as too vast and undeveloped, rather like the early nation, for inclusion. Apparently, both men came to view concrete as the appropriate subject of a separate monograph, which increasingly loomed as Peterson's responsibility, inevitably so after McKee's death.

Peterson's junior colleagues — which, of course, in his later days comprised virtually all of them — tended to grant him a somewhat godlike authority that could be challenged only with ample documentation and greater fortitude. But Peterson, as seen in his association with McKee, always kept an open mind to those he credited with having the better data or superior reasoning. In 1961 McKee, having warned that the early history of cement was a "deep, involved and confusing topic which cannot be taken lightly," figuratively read Peterson the riot act:

> In my judgement, you are incorrect in referring to the material used on the Erie Canal as portland cement. I have found it referred to by contemporaries as hydraulic cement, water-lime, water-proof lime, water-proof cement. Benjamin Wright, Chief Engineer for all of the New York State Canals, in 1818, suggested to the canal commissioners that they import Tarras or Roman cement, but they did not follow his recommendation. The material discovered and experimented with by Canvass White was thus used in mortar as a substitute for Roman-type natural cement. It appears to me that White was following the same general lines as James Parker in England (1796) — Parker called his material Roman cement.[10]

For Peterson, under McKee's tutelage, the clear definition of the terminology, for any given subject, became increasingly an essential obligation of the historian. In his 1966 circular letter in anticipation of the spring term at Columbia, Peterson wrote on the subject of cement and concrete history: "One of the great difficulties in discussing this subject is semantic in nature. On this Marion Elizabeth Blake, [in] *Ancient Roman Construction*...showed that the use of words has been troublesome for nearly two thousand years."[11] Among the excerpts from Blake selected by Peterson was the following: "The English word cement, though obviously derived from the Latin word *caementum*, has come down to have another material entirely. Consequently, we are forced to adopt the English commercial name for the material that is to say, concrete."[12]

McKee and Peterson were afforded one more concerted assault on the mysterious origins of early American cement and concrete when both presented at the Symposium on Restoration of Historic Concrete Structures, held as part of the 1975 annual convention of the American Concrete Institute in Boston.[13] Although the focus of the agenda was preservation, three historical studies were presented: "Concrete Crosses the Atlantic, 1498-1818" by Peterson; "Historical Development of Hydraulic Cements" by McKee; and "The First Half Century of Reinforced Concrete, 1855-1905" by Carl Condit. McKee spoke on the development — between 1790 and 1880 in Britain, France and America — of hydraulic limes, natural cements (emphasizing Canvass White), and early portland cements, but left "the Dutch developments and the use of Trass to Charles Peterson, who has found a great deal of valuable information on that branch of the subject."[14]

In his presentation McKee was still battling for rigorous terminology. "For historical purposes, the term 'cement', which has a precise connotation to a modern engineer, is too restrictive," McKee wrote. "At times, other substances in the composition of concrete or mortar were responsible for its ability to set and harden under water."[15] McKee's definitions, as much as his corrections, assisted Peterson in advancing his own researches.[16]

Tabby, Tabia, Tabas . . .

For a 1952 piece in American Notes Peterson "induced" (his choice of word) a Park Service colleague, Albert C. Manucy, to contribute a brief but detailed article related to the ongoing stabilization of the tabby concrete ruins of the eighteenth-century British fortress town of Fort Frederica in Georgia (Fig. 1).[17] Manucy ventured into the amorphous and semantically treacherous topics of tapia and tabby: tapia, Manucy wrote, derives from Spanish and "refers to mud or adobe wall construction," with or without lime. Manucy then made clear that he was referring not to adobe unit masonry but instead to rammed-earth monolithic construction, placed in horizontal lifts using wood formwork, which could also be employed for floors and roofs.[18] Where oyster-shell lime was employed, Manucy noted that the Spanish term was *tabique de hostión*, to which the English *tabby* was the exact equivalent. He also noted that shell lime was obtainable both from Indian shell middens, which were particularly abundant in Georgia, and from coquina, the shell-rich limestone local to Florida.[19]

Two terms which appeared neither in Manucy's text nor in Peterson's introduction were *cement* and *concrete*: the identification of *tabby* with *cement* (in the sense of a material with hydraulic properties) and with *concrete*, liberally defined as monolithic construction,

Fig. 2. Rear view, Capilla del Cristo (1753), Cristo and Tetuan streets, San Juan, Puerto Rico, undated photograph. Library of Congress, Prints and Photographs Division, Historic American Buildings Survey, Reproduction Number HABS PR, 7-SAJU, 2-4.

would have to await the disentanglement of the word's various meanings and senses.[20]

Peterson's exposure to vernacular building traditions would be expanded two years later with his appointment as the chief historic architect of the National Park Service's newly created Eastern Office, with oversight for the region that included the Carolinas, Georgia, Florida, and Puerto Rico. "Since 1952," wrote Peterson, "I have many times walked the streets of the ancient city of San Juan, Puerto Rico where fallen stucco reveals that a large part of the old walls are built of a low grade — but generally adequate — type of lime-earth concrete [Fig. 2]. In that city the term *mamposteria* is often used today though its exact derivation and meaning are still unclear."[21]

One term that is not unclear in the preceding passage is *concrete*, which Peterson by then unabashedly identified with any form of monolithic construction employing lime or cement, including most construction in the ancient and global tradition of rammed earth or pisé.[22] The origins of the Hispanic tapia tradition therefore became, in Peterson's eyes, the true story of concrete in the New World:

> Going back in time to the very beginnings of European construction in the New World, we can note Columbus' new town — Nueva Isabella (begun in January, 1494) where the houses were built of wood, the public buildings of stone and the fort of tapia. In Spain I have had no luck discussing the origin of tapia with architects and archeologists. But in examining old structures along the coast of Andalusia I was much impressed by the defensive towers of the ancient port city of Almería which was held by the Arabs over seven centuries until the year 1487…Because tapia is generally held to be a word of Arabic origin it seems logical to trace the Moors back across the Straits of Gibralter.[23]

In November 1975, on the convenient pretext of advising on the restoration of the old American chancery residence in Tangier, Peterson realized a long-deferred dream of visiting Morocco (Fig. 3).[24] Peterson wrote to his friend, the noted anthropologist Carleton Coon, as follows:

> In 1969 I stood at Tarifa and looked across the Straits of Gibralter wondering what was coming and going with the Moors a thousand years ago. I am still wondering but last month I got closer to an answer…I found that the Almohad walls of Rabat were made of the stuff [tapia] and in talking (with an interpreter) to men who are repairing them found that the old mix was 50% *hamri* (the local reddish clay) and 50% *jir* (lime burned on the beach at Sale across the river). Nowadays they add a little Portland cement for obvious reasons, use steel scaffolding (lumber is too expensive) and a mechanical lifter. But otherwise the material is generally mixed by hand and tamped in layers as revealed in many Moroccan constructions of great age still to be seen…It looks as if the answer lies with the archeologists.[25]

A decade later Peterson came closer to a resolution in correspondence with Thomas F. Glick, a Boston University historian of cultural continuity and diffusion in Islamic and post-Islamic Spain. To him Peterson posed: "I have cruised a bit with camera and sample jars on both sides of the Straits of Gibralter. The structures are there but I haven't found any literary sources that explain how the technique migrated…It is possible that the technique was never forgotten in Spain. But it seems more likely that it was re-introduced by the Moors."[26] In a 1976 article Glick had written, as if anticipating Peterson's inquiry, that "the unity of Spain and North Africa in a network of continuous cultural interchange throughout antiquity and the middle ages seems undeniable. Indeed, the historical sequence in the transmission of tamped earth construction is all but lost, masked over by the universality and homogeneity of the technique."[27]

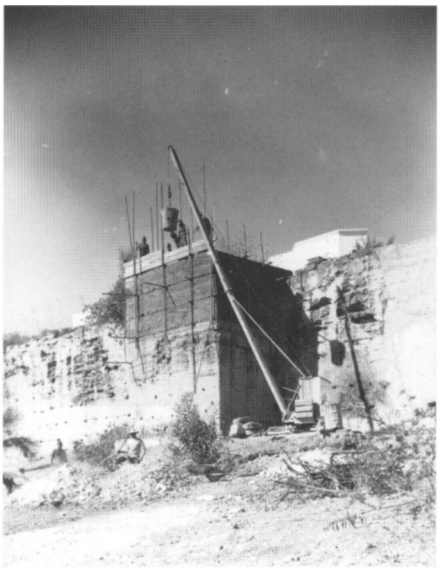

Fig. 3. Repairs to the Almohad Era (1130–1269 CE) city walls, Rabat, Morocco, November 1975. Photograph by Charles E. Peterson. Charles E. Peterson Concrete Research Notes, Box 6, Folder 62, The Athenæum of Philadelphia.

Trass, Tarras, Terrace . . .

One of the most characteristic themes in the work of Charles E. Peterson was tracing the temporal development and geographic movement of technologies. Beginning in the 1950s, as described above, Peterson had sought to trace a tabia tradition of monolithic construction linking North American vernacular construction back through the West Indies to Spain and, ultimately, Islamic Africa. Soon thereafter, he was to discern a parallel, more northerly vector, involving the transmission of natural hydraulic cements from Germany through Holland and Britain, and their respective empires, thereby enabling construction of some of the first public works in the new American republic. The invaluable natural cement was known variously as *trass*, *tras*, *tarras*, and *terrace*.[28]

Trass was one of the stepchildren of the history of construction that Peterson sought to rehabilitate. Like rammed earth, trass cement was one of the traditional materials that nineteenth-century technology sought to replace. Both materials tended to be ignored or trivialized by some historians as the detritus of

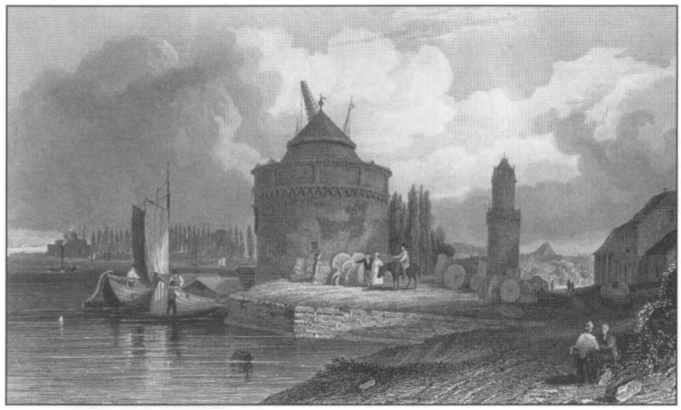

Fig. 4. *Tower near Andernach,* William Tombleson, delineator, J. Watts, engraver (London: Black and Co., n.d.). Note the millwheels staged by the Crane Tower, from which they will be loaded onto barges and sent down the Rhine to Dordrecht. Collection of D. G. Cornelius.

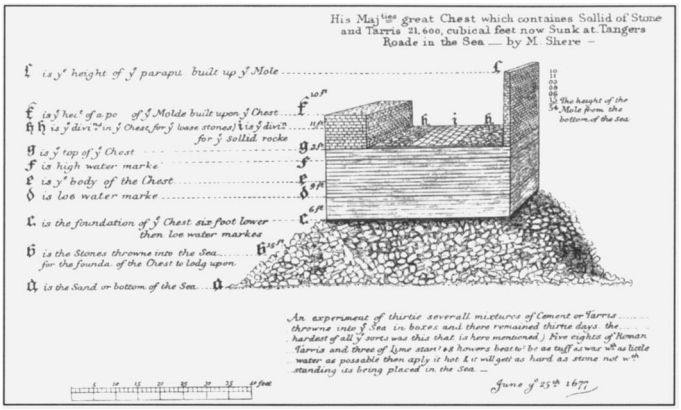

Fig. 5. Henry Sheere, engineer, "The Great Chest constructed . . . June 1677." Filled with stone mortared with trass, it was sunk as part of the construction of the Great Mole at Tangier. E. M. G. Routh, *Tangier* (London: John Murray, 1913), facing p. 356.

darker times, without any serious attempt to understand the rich vernacular building cultures in which they performed admirably for centuries.

Exchanging information on early cements in 1967, Peterson wrote McKee: "The wonderful stuff on the Middlesex Canal, trass, etc., just came in. What a find!"[29] The "wonderful stuff" was proof of the application of natural hydraulic cements in American civil engineering prior to its previously known discovery by Canvass White in 1818. Specifically, McKee and Peterson were galvanized by finding shipping papers for the 1795 importation of trass from St. Eustatius in the Netherlands Antilles for use in the Middlesex Canal (also known variously as the Massachusetts Canal and the Merrimac Canal), as specified by William Weston, the English hydraulic engineer brought in to supervise the construction, and Laommi Baldwin, his American assistant. The next winter found Peterson visiting St. Eustatius and seeking source materials on the history and architecture of the Dutch West Indies.[30]

Seeking to trace the European roots of trass, Peterson fell back on one of his large-caliber research weapons, the circular letter. "Throwing myself on the kindness of Dutch and German friends," he wrote:

> The Romans invented "hydraulic cement" which hardened under water for masonry in wet places. The Dutch somehow inherited the technique and must have found it indispensable for "hydraulic construction" such as sluices, dams and bridge footings. Trass, tras or terras (an important ingredient used in many places) was mined at Andernach on the Rhine [Fig. 4] from Roman times. It was later ground at — and exported from — Dordrecht and Amsterdam…My problem is to close the time gap between the Romans and the seventeenth century Dutch…Archeological excavations have revealed massive concrete constructions of classical times at modern Cologne, Trier, etc. But I understand that written records for the Netherlands do not begin before about the year 1100.[31]

Peterson and his correspondents were actually unable to do much to fill this historical lacuna. Instead, their investigations revealed the development of a strong sellers' market in construction materials by the Dutch over two centuries, including the creation of a cartel to fix prices when Louis XIV's construction projects accelerated demand, and the successful domination of British — and by cultural influence North American — hydraulic construction by Dutch vendors and, occasionally, Dutch engineers as well.[32] Trass would therefore play a major role in the Great Mole of Tangier (1662-1680), the most important British hydraulic construction project to that date, and one of Peterson's favorite topics (Fig. 5).[33] As with Joseph Totten's fortification designs in the nineteenth-century United States, the Mole of Tangier — begun by the British admiralty and then demolished while still unfinished, at great expense, when it abandoned the brief-lived North African naval station — was no secret to military historians, but its great technological significance had largely eluded historians of architecture and engineering.

As the most sophisticated hydraulic constructors of their time, the Dutch first realized the value of waste material left over from grinding millstones made of Bavarian volcanic stone shipped down the Rhine and then repeated their discovery in their West Indian possession, St. Eustatius, which possessed very similar geological resources. German and St. Eustatian trass therefore enjoyed a near-monopoly in hydraulic-engineering specifications, until engineers in Britain, France, and America began seeking domestically occurring natural cements with similar properties. Among the first to do so in Britain were John Smeaton, who in the mid-eighteenth century discovered not only the specific utility of "Welsh" cements (actually from Cornwall) but also the underlying necessity of expansive clays in hydraulic cements, and Joseph Parker, whose patented "Roman" cement (1796), using Thames Valley clay stones, was extensively used in America.[34]

Cementing the New Republic

By the early 1970s Peterson was voraciously collecting anything and everything relating to cement and concrete history. In 1973 he wrote: "There is a fantastic amount of material coming to hand. My most recent push is on the canal builders and the U.S. Army engineers."[35] The construction of canals, rather than buildings, indeed proved to be one early cutting edge of the native cement industry and the rationalization

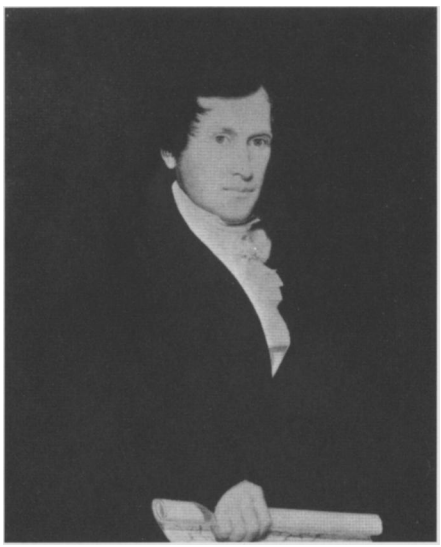

Fig. 6. *Canvass White.* Courtesy of Munson-Williams-Proctor Institute, Utica, New York.

of American concrete practice; military architecture was the other.

The defining event in the history of American cement and concrete had been identified by McKee as the discovery and immediate exploitation of native natural hydraulic materials by Canvass White in 1818 during the construction of the Delaware and Hudson Canal.[36] In seizing on this information, however, Peterson was not merely content to honor a canonical event; he also wanted to know the context in which it occurred. Writing to Richard N. Wright of the Canal Society of the State of New York in 1972, Peterson stated: "One of the things I'd like very much to know is whether or not the Erie Canal builders learned about the value of hydraulic cements for underwater masonry from the Merrimac [or Middlesex] Canal. Laommi Baldwin got trass from St. Eustatius and the story goes back to Andernach on the Rhine. The question could be asked: Was Canvass White (or his associates) in touch with Baldwin? Did any of them go over to see the Massachusetts [another name for the Middlesex] Canal?"[37] The question could be asked, but perhaps not answered; it is easier to ascertain that White visited Britain in 1817 than to track his movements closer to home.[38]

The relatively precocious interest of such individuals as George Washington and Thomas Jefferson in the incipient cement technology of their time was another finding gleaned by Peterson from evidence hidden in plain sight. For example, Peterson wrote, at the 1779-1780 Morristown encampment "Washington had three or four of his principal French engineers trying to 'make some mortar into a consolidated mass' according to the directions of Loriot, whose *Practical Essay* on a *Cement and Artificial Stone* had been translated and published in London only a year before the war broke out. The experiments at Morristown were not a success for 'the result' as the General wrote 'was infinitely distant from what we had been led to expect.'"[39] Peterson found Jefferson sending $40 to New York for Roman cement, presumably made under Parker's patent, in 1815.[40] Amongst Peterson's last correspondence, from 2004, was with Travis McDonald, of Poplar Forest, regarding Jefferson's use of "brick dust" in the stucco rendering of his columns.[41]

Peterson brought to his independent scholarship a mastery of delegation learned during his Navy and Park Service days. Where there were documents in languages obscure to Peterson, translators would "volunteer" to help, often gratis.[42] Correspondents would be persuaded to drop into distant archives. But sometimes the "if you want it done right" adage would prevail. Writing to Darwin H. Stapleton, of the Papers of Benjamin Henry Latrobe, about other matters in 1975, Peterson demanded to know: "Who is going to look up Latrobe's experience with John Smeaton?"[43] Peterson in this instance ended up delegating the work to Peterson, who wrote an amusing passage on how Latrobe — justly deified for most aspects of his architecture and engineering — really should have known better when specifying cements.[44] "Actually," Peterson wrote, "Latrobe was quite wrong on certain phases of the concrete story — but so were most professionals at the time…Doing it as the Romans did frustrated many Englishmen over a long period. On the Continent, the story was somewhat different."[45]

Knowing the French dominance in civil and military engineering into the early nineteenth century, Peterson went in search of French engineers in America during the unsettled years of the American and French revolutions and

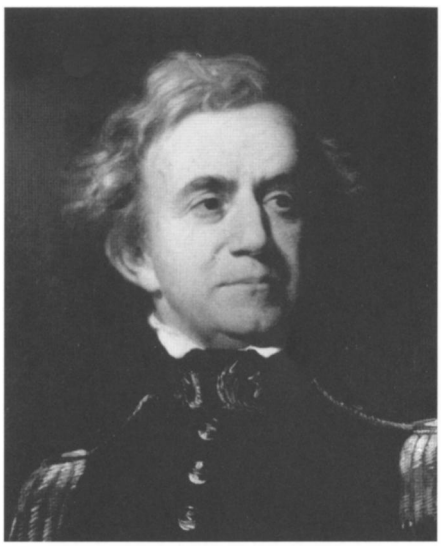

Fig. 7. *Joseph G. Totten.* Courtesy of United States Military Academy, West Point, New York.

the Napoleonic Wars. His intuition was rewarded in part, when documentation eventually surfaced of a French engineer, Jean-Xavier Bureaux de Pusy (1750–1806), who, while in exile in America with Lafayette, had been consulted in 1801 regarding harbor defenses for the Port of New York. Although Bureaux de Pusy recommended pozzuolana for hydraulic work, no substantive evidence has been found for the implementation of his advice.[46]

An obviously critical figure in the development in America of structural engineering generally and of cement and concrete technology specifically was Joseph Totten (1788–1864), military engineer and eventual brevet major general and chief of engineers of the United States Army. In 1973 Peterson wrote to a Park Service historian in Manhattan that he was "working on a history of concrete before 1860 and one of the first things I learned was the importance of the work done by Colonel Totten at Fort Adams, Newport in 1825–1838."[47] Peterson then asked his New York correspondent, "How did Col. Totten first become acquainted with European practices in 'hydraulic' construction? On learning that Totten (after graduation from West Point in 1805) had an early tour of duty on the New York waterfront I have been wondering if trass was used in connection with piling work on the waterfront structures like Castle Clinton." Here

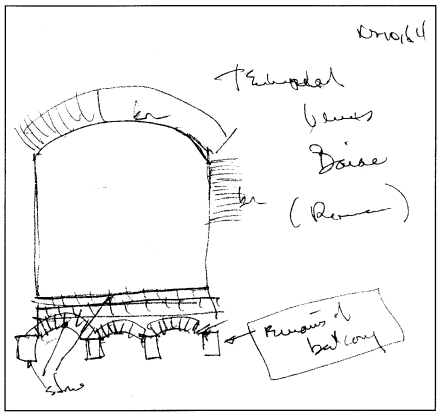

Fig. 8. Charles E. Peterson field sketch of Roman building in Baiae, near Pompeii, November 1984, showing an almost 80-year-old with remarkable sureness of eye and hand, if, as always, indecipherable handwriting. Charles E. Peterson Concrete Research Notes, Box 6, Folder 51, The Athenæum of Philadelphia.

Peterson was fishing for a link between Pusy and Totten, but there were to be no bites on that particular line. Another link, mentioned in the same letter, was more promising: "I also know that Totten in the 1820's was in touch with canal engineers like Canvass White who became famous for his innovations with native hydraulic cement on the Erie Canal c. 1820."[48]

Peterson often emphasized the personal side of architectural and engineering history, as exemplified by the title of one of his later books, *Robert Smith: Architect, Builder, Patriot, 1722-1777*.[49] Canvass White and Joseph Totten (Figs. 6 and 7) both represented heroic figures to Peterson, for reasons beyond their professional achievements: the former, despite chronic ill health that caused his premature death, served with distinction in the War of 1812; the latter lived to a greater age but died while in the service of his country during the Civil War. That both men contributed greatly to the development of the profession and art of civil engineering in America must have seemed to Peterson a natural consequence of their animated intelligence and public dedication.

Towards a Monograph

As early as 1966, Peterson had considered writing an article on the history of cement and concrete.[50] By the early 1970s he had determined to write his own monograph. As we have observed, one likely impetus in Peterson's literary ambition was McKee's deliberate exclusion of most of the history of cement and concrete from his *Early American Masonry*, published in 1973.[51]

In a request to view the Canvass White Papers at Cornell University, Peterson noted that "through the studies of Professor Harley McKee of Syracuse many of us learned about White's great contribution to the history of American concrete. My problem now is to take the scraps of information I have collected over the years and write a dissertation on the subject, one phase of which was the Erie Canal experience."[52] He was similarly humble in pursuing the papers of John Jervis (1795–1885), engineer of New York City's water supply: "What a pity no one has ever done full-dress biographies of Jervis and White! I can only do a sketch on American Concrete to carry forward the interest generated years ago by Turpin Bannister and Harley McKee."[53]

As fortune would have it, Peterson was already preoccupied with planning a major symposium commemorating the 1974 bicentennial of the Carpenters Company of the City and County of Philadelphia and in the meeting's aftermath was to edit and publish the papers presented. The resulting 1976 publication was the monumental *Building Early America: Contributions toward the History of a Great Industry*. The symposium and book were to largely monopolize five years of Peterson's life.

By the spring of 1975, however, Peterson had also managed to compose an outline for a concrete monograph and write and revise drafts for several of the sections.[54] His trip to Spain and Morocco in the fall of 1975 was, of course, largely related to the concrete story, as was a subsequent expedition to the Mediterranean in 1984, to study the sources and uses of pozzuolana in Italy (Fig. 8) and the corresponding volcanic cements of the Greek island of Santorini.[55] Having published his magisterial study of the development of iron and steel structural sections in the 1980s, and done much to document the development of sawmills and the industrialization of wood construction, he viewed the concrete text as a logical sequel. Ongoing correspondence, research, and travel were reflected in additional drafts, some of them revised as late as 2003.

In the last years of his life Peterson was largely kept home by the physical infirmities of age, but his wits remained undiminished. Encouraged by such friends as Roger Moss of the Athenæum of Philadelphia, Peterson finally found the time and research assistance to complete and publish several deferred manuscripts, including the Robert Smith monograph. The concrete text was to be the capstone project. Through the good works of engineer Nicholas L. Gianopulos and Dr. Moss, funding for the work was obtained from the National Center for Preservation Technology and Training of the National Park Service in 2004, shortly before Peterson's death.

One of this article's peer reviewers observed that Peterson was "ever the antiquarian" but, this author would argue, one who grew in technical discipline as a professional historian. He was indeed, in numerous respects, a nineteenth-century figure, on one hand a kindred spirit to Viollet-le-Duc or William Morris, but on the other an active participant in furthering the new fields of material culture and the history of technology.

Above all, despite his self-cultivated misanthropic persona, Peterson was the unrivalled communicator in his field, a man whose most effective research method was to create and enthuse a community of like-minded correspondent researchers and to be a mentor and colleague to at least three generations of scholars and preservationists privileged — as I was briefly — to know and work with him.

DAVID GREGORY CORNELIUS, AIA, PE, is an architect, structural engineer, teacher, and independent architectural historian. He is currently editing Charles E. Peterson's concrete research papers.

Acknowledgements

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Nicholas L. Gianopulos, senior consultant, Keast & Hood Co., Philadelphia, and Hilda Sanchez, for many years assistant to Mr. Peterson, were highly instrumental in establishing the project. The Athenæum holds copies of Mr. Peterson's concrete research; Mr. Peterson's original papers now reside in the National Trust for Historic Preservation Library Collection at the University of Maryland, College Park. I also acknowledge the assistance at the Athenæum of Eileen Magee, assistant director; Bruce Laverty, curator of architecture; and Michael Seneca; and the assistance of my readers, including Lori Aument, of John Milner Associates, Philadelphia.

Notes

1. No copy of Peterson's original letter to the PCA is in his files relating to concrete research. Boase's reply is in the Athenæum's Charles E. Peterson Concrete Research Notes, Box 2, Folder 7 (hereafter CEP CRN 2:07, etc.).

2. W. Maynard Barksdale is writing a biography of Charles E. Peterson (hereafter CEP). For now, an excellent narrative of Peterson's Park Service wars can be found in Constance M. Greiff's *Independence: The Creation of a National Park* (Philadelphia: Univ. of Pennsylvania Press, 1987). The malls were the Gateway Mall in St. Louis and Independence Mall in Philadelphia, both of which imposed oversized settings for relatively modest historic buildings (the Old Courthouse and Independence Hall, respectively) at the general expense of historic urban fabric.

3. It must have been an intense day: also on the agenda were Lee H. Nelson's "Eighteenth Century Framing Devices with Special Emphasis on Early Cut Nails," the handout for which has attained biblical status with preservation professionals, and Penelope Hartshorne's similarly canonical "Paint Color Research and Restoration."

4. Peterson made the request of McKee on Dec. 7, 1960, who responded rather delinquently four months later: "This subject, as you, interests me more than my lack of accomplishment would indicate; I feel that it is a deep, involved and confusing topic which cannot be treated lightly." McKee to CEP, Apr. 2, 1961; CEP CRN 3:21.

5. On May 31, 1961, Peterson wrote to the Park Service architect at Fort Laramie, soliciting an American Note on its lime-concrete ruins: "Among other things, I am getting more and more concerned with the development of architectural concrete in the United States. A little has been written about it, but mostly by art historians who glance over its structural characteristics, sources of supply, etc. I have started a small movement to correct some of these things. Most important is having Professor Harley McKee of Syracuse, who works for us [i.e., the *Journal of the Society of Architectural Historians*] and is close to the history of the Erie Canal, work out some of these matters, especially in the earliest years." CEP to Robert H. Gann, Fort Laramie National Monument, Wyo. CEP CRN 4:29.

6. CEP to Clarissa McKnight, Associate Editor, *Concrete Construction*, Elmhurst, Ill., Sept. 2, 1966; CEP CRN 2:11.

7. From the title of the lecture it is apparent that by 1966 Peterson had already defined the terminal year of his own historic interests, which he maintained for most of his later research into the history of building technology. The 1860 date served the history of cement and concrete well, predating the artificial-cement industry in America (if not quite Britain) and the development of ferrocement (the systematic engineered reinforcement of concrete with steel). Peterson thereby avoided duplicating most of the work of historians such as Sigfried Giedion, Ada Louise Huxtable, and Peter Collins, who essentially picked up after, or shortly before, he left off. Circular letter from CEP, Subject: History of Cement/Concrete, Nov. 30, 1966; CEP CRN 3:25. By *encyclopedia* Peterson was presumably thinking more in terms of Diderot, one of his more useful sources, than of the *World Book*.

8. Joseph Aspdin (1779–1855) was for many years recognized as the inventor of the sintering process used for making modern artificial hydraulic cements, which were patented by him in 1824 under the brand-name "Portland," although recent scholarship has somewhat diminished the primacy of his claims. Louis-Joseph Vicat (1786–1861) was a French military and civil engineer and the author of *Recherches expérimentales sur les Chaux de Construction, les Bétons et les Mortiers ordinaires* (Paris, 1818), revised in 1828, and translated into English in 1837. Vicat's book, although not the earliest on the subject, is widely credited with being the first exhaustive and scientifically viable resource on limes and cements, reflecting contemporary developments in chemistry and mechanics. Harley J. McKee, "Supplementary Notes on Mortar, Lime, Natural Cement, Concrete, and Plaster" (typescript), Mar. 22, 1967. The following year McKee returned to lecture again and issued a revised "Explanatory Notes on Mortar, Lime, Natural Cement, Concrete, and Plaster" (typescript), Apr. 17, 1968. At Peterson's request McKee followed up by sending his related research notes, an "impressive bundle" (no less than 32 single-spaced pages), comprised of definitions of individual topics, such as natural cement, followed by annotated citations in the primary literature. All three of McKee's documents are located in CEP CRN 2:11.

9. Harley J. McKee, *Early American Masonry: Stone, Brick, Mortar and Plaster* (Washington, D.C.: National Trust for Historic Preservation, 1973). A second partial fulfillment, not by intention but serving admirably by default, is *Building Early America* (Radnor, Pa.: Chilton, 1976), which was edited by Peterson.

10. McKee to CEP, Apr. 2, 1961; CEP CRN 3:21.

11. Circular letter from CEP, Subject: History of Cement/Concrete, Nov. 30, 1966; CEP CRN 3:25. Similarly Peterson wrote a few months later, "Semantics [has] probably been the basic trouble tracing the concrete story from its true beginning two thousand years ago." CEP to Robert E. Koehler, Editor, *AIA Journal*, Washington, draft, Jan. 26, 1967; CEP CRN 2:11.

12. Marion Elizabeth Blake, *Ancient Roman Construction in Italy from the Prehistoric Period to Augustus*, Carnegie Institution Publication 570 (Washington, D.C.: 1947), 327. Blake wrote two further volumes on construction in the early and late Roman Empire.

13. The meeting was organized by ACI Committee 120, History of Concrete, chaired by Howard H. Newlon Jr.; cosponsors were the Association for Preservation Technology, National Park Service, and National Trust for Historic Preservation. The occurrence of the meeting attested both to the increasing validation of historic preservation and to the pre-Bicentennial zeitgeist also displayed in *Building Early America*.

14. McKee to Newlon, Oct. 2, 1974; copy to CEP in CEP CRN 2:16. McKee wrote an excellent accompanying paper, "Historical Development of Hydraulic Cement," of 20 pages including footnotes; it was not, to this writer's knowledge, published, but a copy is in the CEP CRN 3:25. Newlon encouraged Peterson to produce something similar, relating specifically to the Middlesex Canal: CEP to Newlon, Apr. 14, 1975; CEP CRN 2:16.

15. McKee continues: "There have been two major lines of development. One deals with natural materials often classed with sand, that had been formed by volcanic action, possessing hydraulic properties. Among these, the pozzolana used by the ancient Romans is most familiar. The second line of development begins with natural hydraulic lime and natural cement and progresses through artificial hydraulic lime and portland cement." McKee, "Historical Development of Hydraulic Cements," 1-2.

16. In one of his last letters to Peterson (McKee to CEP, May 20, 1975; CEP CRN 3:22), McKee admonished amidst more emphatic underlining: "You may be getting careless in the use of term <u>hydraulic</u>. Cement or mortar is hydraulic <u>if it will set and harden under water, or in damp locations</u>. Some mortars and plasters would not set and harden under water, but if allowed to harden in a dry place, they would then resist water very well; this could be the case with reference to a cistern." Correcting Peterson's comments on William Weston, an English engineer working in America in the 1790s, McKee went on to say: "I would feel more comfortable if you had said that Weston had a durable material for waterproofing cisterns, rather than saying that he was using hydraulic cement."

17. American Notes, *Journal of the Society of Architectural Historians* 11, no. 4 (1952): 32-33. Albert C. Manucy (1910-1997) was both a keen observer of architectural physical evidence and well-read in Spanish and English primary sources. He was to write monographs on the fortresses of St. Augustine and San Juan and his finely delineated guide *The Houses of St. Augustine* (St. Augustine: St. Augustine Historical Society, 1962) remains in print.

18. Manucy's cover letter reads: "The enclosed data on tabby will interest you. It came to light

while we were researching to do a sketch diagramming tabby wall construction for the Frederica museum." Manucy, Castillo de San Marco National Monument, to CEP, Eastern Office, Oct. 4, 1956; CEP CRN 3:22.

19. The field of tabby history and preservation has been extensively broadened in the last 15 years through the work of Lauren B. Sickels-Taves and her collaborators. Peterson corresponded with Dr. Sicklels-Taves in the early 1990s, to exchange information and, doubtless, encourage yet another researcher at a critical early point in her work: Sickels-Taves, electronic correspondence with the writer, Jan. 10, 2006.

20. Peterson was to discover that, just as portland cement is integral to modern concrete, the durability of historic concrete (as broadly defined by him to include monolithic poured or formed construction, employing rammed earth, rubble, and similar materials) was frequently dependent on the use of materials with hydraulic properties.

21. "Tabby/Tapia/Tabiya/Tabbi: Notes Assembled Preparatory to a Visit to Morocco," Nov. 5, 1975; CEP CRN 5:43.

22. A parallel conclusion was being reached by Peter Collins in his *Concrete: The Vision of a New Architecture*, 2nd ed. (Montreal: McGill-Queen's Univ. Press, 2004): 21-25, wherein Collins identified François Cointeraux (1740-1830), French theorist of pisé or rammed-earth construction, as the key progenitor of modern concrete construction. Opportunities for discussion between Peterson and Collins were limited by rather frosty relations between the two men; Peterson, however, expressed respect for Collins's concrete scholarship to this writer.

23. "Tabby/Tapia/Tabiya/Tabbi," CEP CRN 5:43. By the late 1960s, Peterson was seeking to take the history of hydraulic cements and concrete construction in the Americas even further back, prior to European incursions. That story, although an interesting one, is too involved to be included in this article, but includes Peterson's study of Hohokam caliche concrete in Arizona (best exemplified by the Casa Grande monument), and his support for research by David S. Hyman into Mayan cements: CEP CRN 5:38.

24. Although the preferred modern spelling of the name of the city is *Tanger*, Peterson and the sources he consulted generally used the older *Tangier*, and so does this article for consistency.

25. Peterson continues: "I have just about given up on the Spaniards. It seems to be a point of honor not to know anything about the Moors. The fortress at Niebla should be too big to overlook but they haven't admitted to me that it exists." CEP to Carleton Coon, Gloucester, Mass., Dec. 2, 1975; CEP CRN 7:61. In 1976 the Spanish Ministerio de Educacion y Ciencia finally provided Peterson with the paper "Las Murallas de Niebla"; CEP CRN 5:45.

26. CEP to Thomas F. Glick, Boston University, Dec. 26, 1985; Glick to CEP, Jan. 6, 1986; CEP CRN 5:45.

27. Thomas F. Glick, "Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World" in B. Hall and D. West, eds., *On Pre-Modern Technology and Science*, 148 (Malibu: Undena Publications, 1976); a copy is with Dr. Glick's letter in the CEP CRN.

28. The last variant is not necessarily a malapropism. If a terrace, as is often the case, is a flat paved surface over a habitable space below, the supported assembly must have some resistance to moisture.

29. The Middlesex Canal was chartered in 1794 and completed in 1804. The canal provided an outlet in Boston Harbor for the products of the Merrimac watershed, not initially, as one might suppose, Lowell textiles, but New Hampshire lumber. Robert J. Kapsch, *Canals* (New York: W. W. Norton , 2004): 16. McKee again wrote to CEP on Aug. 11, 1967, reporting new information about the Middlesex Canal and the use of trass cement in its Merrimack locks, learned at a canal historians' meeting the week prior: CEP CRN 5:37. McKee cited conversations with Middlesex Canal Association historian Fred Lawson and a study by Christopher Roberts, *The Middlesex Canal 1793-1860* (Cambridge: Harvard Univ. Press, 1938). The critical documents on the construction of the canal are shared between the Alumni Memorial Library of the Lowell Technical Institute and the Baker Library of Harvard. Peterson perused both collections in 1973.

30. A particularly valuable resource was Joh. Hartog, *Geschiedenis van de Nederlandse Antillen IV: De Boven windse Eilanden* (Aruba, 1964). Peterson rapidly devoured the book and then wrote to Hartog "to ask you about the earliest use of Statia tras. The oldest record we have found is the import for the stone masonry of the Middlesex Canal in Massachusetts, when a schooner was sent down especially to procure it. We know that Tras was also used in the Trenton, New Jersey bridge over the Delaware in 1804. I haven't looked yet to see if it came from Statia or Holland." CEP to Joh. Hartog, Aruba, Jan. 15, 1968. Hartog was unable to determine when the exports began but stated that they were definitely occurring by 1746-47. CEP CRN 5:39.

31. CEP, circular letter, "A Study of Hydraulic Mortars and Cements," May 25, 1973; CEP CRN 4:27.

32. CEP manuscript, "Cement for Versailles, 1685," July 13, 1973; CEP CRN 5:43.

33. Peterson's major source was E. M. G. Routh, *Tangier: England's Lost Atlantic Outpost, 1661-1684* (London: John Murray, 1912). He also revisited some of the primary public records used by Routh and was able to discover a major antecedent for the Tangier mole in the Mole Nuovo (1638) at Genova. Lacking the time to publish his findings himself, Peterson shared them with Michael M. Chrimes, Librarian of the Institute of Civil Engineers, who summarized them in the ICE Panel for Historical Engineering Works (PHEW) *Newsletter* (Dec. 1992), 4-5.

34. Smeaton's discoveries, although made around 1756, were unfortunately not published until 1791, shortly before his death. The British development of natural cements in the late eighteenth and early nineteenth centuries, as a prologue to the artificial cements of Aspdin and others, was already well known by the 1920s and is definitively summarized in A. J. Francis, *The Cement Industry 1796-1914: A History* (Newton Abbot: David and Charles, 1977). But the extent to which Joseph Parker's cement was available and applied in the early United States was largely discovered by McKee and Peterson. One tantalizing footnote is that Parker, after selling his patents and works to the Wyatt family, immigrated to America and then disappeared from history. Did Peterson seek some genealogical link to Obadiah Parker, the early American concrete pioneer? The records are mute.

35. CEP to Howard Newlon, Mar. 5, 1973, CEP CRN 2:16. Peterson would shortly discover parallel contemporary developments in Canada by British military engineers and the constructors of the Rideau Canal: "The canal engineers, again, were the cement pioneers — as in the USA as well." CEP to A. J. H. Richardson, St. Jean, Quebec, Aug. 26, 1974; CEP CRN 4:28.

36. Naturally occurring hydraulic cements, as McKee and Peterson found, are more common than generally supposed. The discovery of natural cement by Andrew Bartow and Canvass White in Onondaga County, New York, in 1818 is the classic example of a phenomenon repeated time and again: a need (a construction project requiring hydraulic materials) combined with the perceptive eye of some individual (usually an engineer responsible for that project) to reveal the right combination of stone and clay in a propitious location (such as a geological formation disturbed by the initial excavation for the work).

37. CEP to Richard Wright, Dec. 21, 1972; CEP CRN 4:36.

38. Peterson would have been highly gratified, as both a preservationist and a historian, to learn of the recent commercial revival of Rosendale natural cement — first discovered and exploited during the construction of the Erie Canal — and by the historic scholarship sponsored by its new owner, Edison Coatings, Inc. The first major project using the revived cement was a demonstration restoration for the National Park Service of Fort Jefferson, Florida, a major Totten fortification.

39. "Our Founding Fathers Experiment," chapter in CEP's concrete manuscript, third draft, Apr. 9, 1975; CEP CRN 5:40.

40. Edwin Morris Betts, ed., *Thomas Jefferson's Garden Book* (Philadelphia: American Philosophical Society, 1944): 541, 583-584, 586-587, 600-603, for 1815-1820. On pages 583-584 Betts comments that "It is doubtful if Jefferson's cisterns were ever fully satisfactory." Peterson's notes on Betts are in CEP CRN 3:17.

41. Travis McDonald, Poplar Forest, to CEP, July 27, 2004; CEP to McDonald, Aug. 3, 2004.

42. Peterson was evidently fluent in French and got by in Italian. For documents in Dutch, he received invaluable research and translation assistance from his untiring Columbia colleague, Theodore Prudon; see, for example, Prudon's rendition of some 20 pages from A. Heerding, *Cement in Nederland* (1971): CEP CRN 5:42. Peterson's personal assistant, Hilda Sanchez, assisted with some Spanish texts.

43. CEP to Darwin H. Stapleton, May 16, 1975, Papers of Benjamin Henry Latrobe, Maryland Historical Society, Baltimore; CEP CRN 3:25.

44. "The Misfortunes of Latrobe," CEP monograph chapter, third draft, Apr. 9, 1975; CEP CRN 5:40.

45. CEP to Edgar P. Richardson, Philadelphia, Feb. 16, 1977; CEP CRN 3:21.

46. Bureaux de Pusy, "Memoire on the Subject of Fortifying the Port of New York" (1801), New-York Historical Society, United States Military Philosophical Society Papers 1, n. 6; transcript in CEP CRN 3:24. Peterson first learned of "the Frenchman with the extraordinary name of Bureau de Pusy" from Norman B. Wilkinson, Director of Research of the Hagley Museum, where there are extensive archives relating to I. E. du Pont's contacts with the French émigré community: CEP to Wilkinson, Aug.13, 1973; Wilkinson to CEP, Sept. 4, 1973; CEP to Wilkinson, Oct. 8, 1973; CEP CRN 2:08.

47. CEP to Ricardo Torres Reyes, Federal Hall National Memorial, New York, May 22, 1973; CEP CRN 3:21. Peterson's research on Totten fills several folders of the CEP CRN.

48. Interestingly foreshadowing the Army Corp's oversight for inland waterways in the next century, which was to become its major occupation. "The relations of engineers like Baldwin, Canvass White, Totten and Weston need to be worked out. These fellows did a lot of travelling." Circular letter from CEP regarding Fort Adams, June 4, 1973; CEP CRN 3:22.

49. Charles E. Peterson, with Constance M. Greiff and Maria M. Thompson, *Robert Smith: Architect, Builder, Patriot, 1722-1777* (Philadelphia: Athenæum of Philadelphia, 2000).

50. In December 1966 and January 1967 Peterson corresponded with Robert E. Koehler, editor of the *AIA Journal*: "I enjoyed reading the article on the evolution of concrete in the November 1966 issue of the *Journal*, but I believe that you should have gone back further to begin the story of this important material. Concrete was one of the great inventions of the Roman builders and its history in the New World — in the form of lime concrete — began in Columbus' time." So begins the January 26 draft of an article-length letter that Peterson initiated in response to Koehler's suggestion, but evidently did not complete; CEP CRN 2:11. The draft serves as a snapshot of Peterson's knowledge at the time, leaping rather precipitously from Ponce de Leon (1505) in one paragraph to Orson Squire Fowler (1850) in the next. Peterson was to soon do much to fill in the three-century gap.

51. "The undersigned is planning to complete a study of Early American concrete by the end of this year." CEP to Douglas P. Adams, Middlesex Canal Association, Charlestown, Mass., Apr. 20, 1973; CEP CRN 3:24.

52. CEP to Gould P. Colman, Manuscripts and University Archives, Cornell University, Dec. 20, 1972; CEP CRN 3:21.

53. CEP to Richard N. Wright, Onondaga Historical Association, Syracuse, Sept. 24, 1973; CEP CRN 3:21. For a work on the subject prior to McKee, see Robert W. Lesley, *History of the Portland Cement Industry in the United States* (Chicago: International Trade Press, 1924), which, despite its title, has useful information on the natural cement industry as well; excerpts are in CEP CRN 3:17.

54. The manuscript for the concrete monograph comprises Folder 40 of Box 5, CEP CRN, with additional manuscript sections scattered elsewhere in the boxes.

55. This essay uses Peterson's preferred spelling, "pozzuolana," whereas contemporary English usage usually drops the *u*. Papers relating to the 1984 European trip comprise most of Box 6, CEP CRN.

Credit for Fig. 6: Portrait of Canvass White, Hugh Bridport, not dated, oil on canvas, 35¼ by 27 inches. Munson-Williams-Proctor Arts Institute, Museum of Art, Utica, N.Y., 58.104.