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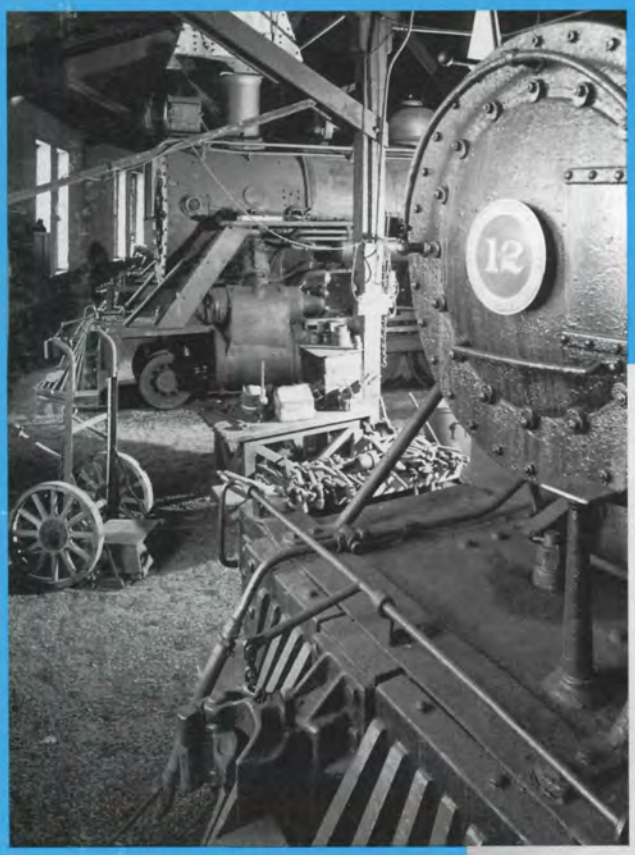

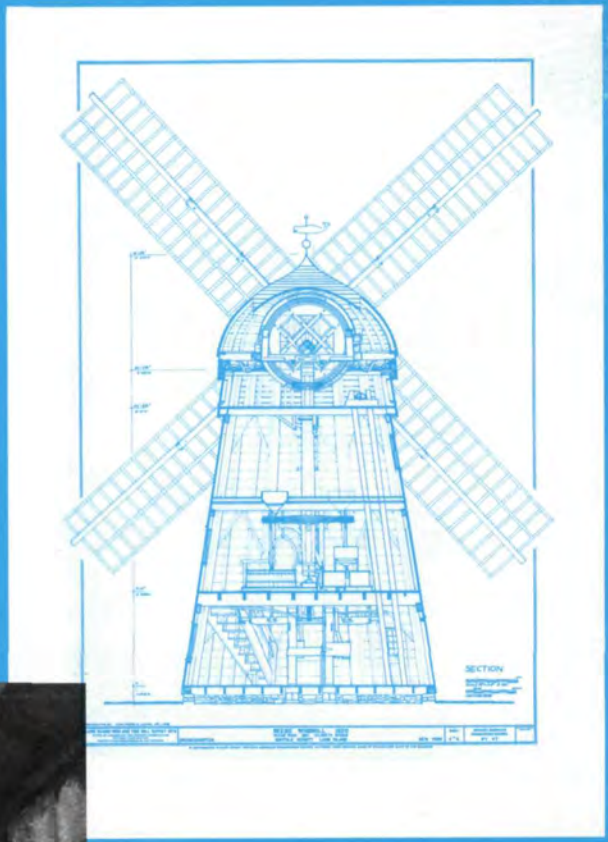

Thirty Years of Documenting America's Technological History

U.S. DEPARTMENT OF THE INTERIOR
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Information for parks, federal agencies, Indian tribes, states, local governments, and the private sector that promotes and maintains high standards for preserving and managing cultural resources

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Cover: Clockwise—section of the Beebe Windmill, Bridgehampton, New York, drawing by Chalmers G. Long, Jr., 1976; Eric DeLony and Charles Parrott get a grip on the cupola of the Troy Gasholder House, Troy, New York, photo by Robert Vogel, 1969; steam locomotives in the roundhouse of the East Broad Top Railroad shop complex, Rockhill Furnace, Pennsylvania, photo by Jack E. Boucher, 1986.

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Dean Herrin

HAER—Documenting Creativity

The Historic American Engineering Record (HAER) came into existence in 1969, almost four decades after the birth of its sister program, the Historic American Buildings Survey (HABS). HAER was created in the image of HABS, but with significant variations. The two programs, together forming a division of the National Park Service, both use large-format photographs, measured drawings, and written histories to document national landmarks, but HAER's emphasis on America's engineering and industrial legacy requires it to pay as much attention to function as to form. HAER has spent over 30 years not only recording historic technological sites, but also explaining how they worked, why what happened on these sites was important, and why Americans should care to preserve at least a portion of them.[1] This issue of *CRM* looks both to the past and to the future, exploring how HAER came into existence as well as new directions the program is taking now that the preservation of engineering and industrial sites has become more widely accepted.

Of all the early advocates for a program to document significant engineering and industrial sites, perhaps the most important and persistent was Robert Vogel, then Curator of Mechanical and Civil Engineering at the Smithsonian Institution. Both he and Eric DeLony describe in this issue the founding of HAER by the Smithsonian, HABS, the American Society of Civil Engineers, the National Park Service, and the Library of Congress. Since its creation in 1969, HAER has documented over 7,000 sites and structures, and has helped to establish the standards for the recording of technological complexes. While HAER still documents numerous individual sites around the country, much of the program's current work focuses on multi-year projects examining multiple sites representing broader and more contextual themes. Tim Davis' article, for example, describes HAER's Park Roads Program, now in its 12th year, which has examined roads, bridges, and related landscape features of many national parks. For the past three years, as Lisa Davidson relates, HAER has also conducted the Southern Textile Industry Project, which seeks to place southern textile mills, workers' housing, and other community structures in a larger regional and national perspective. Richard Anderson, Jr., Todd Croteau, and Jet Lowe write about HAER's Maritime Program, Anderson and Croteau relating the history of the program and showing the ways in which measured drawings in particular can reveal significant information, and Lowe discussing how a photographer approaches a maritime subject.

HAER has also documented diverse industries within various regions around the country.

HAER(Net)

The HABS/HAER Collection is available to the public in the Prints and Photographs Division of the Library of Congress, but all of the HAER collection—histories, drawings, and photographs—will soon be available online. Through a generous donation from the Shell Oil Foundation, the HAER collection is currently being digitally scanned by the Library of Congress for its American Memory web site <http://memory.loc.gov/ammem/hhhtml/hhhome.html>. Over 30 years of HAER documentation will be searchable by keyword, subject, and location. The HABS/HAER collections are among the largest and most heavily used of all the materials in the Prints and Photographs Division of the Library of Congress, and this online catalog will give the general public easy access to the collections.

Richard O'Connor describes how HAER has intensively studied the state of Alabama, producing documentation that testifies to its reputation as a bastion of southern industry. In Pennsylvania, as described by Christopher Marston, HAER teamed with West Virginia University's Institute for the History of Technology and Industrial Archaeology to research the oil fields of Allegheny National Forest. Most of HAER's work has focused on older engineering and industrial sites and processes, but Tom Behrens looks at HAER's documentation of more recent engineering, NASA's George C. Marshall Space Flight Center in Huntsville, Alabama. In the following articles, Justin Spivey and Dana Lockett reveal new techniques HAER has incorporated to study technological sites. While HAER documents engineering sites, rarely has HAER used engineering analysis to gather information about a structure. Spivey describes a project in which such analysis was successfully used to resolve questions about a bridge's mysterious design. Lockett discusses how HAER, without totally abandoning traditional hand-drawing techniques, is using computer aided drafting (CAD), photogrammetry, and other methods to assist in the production of drawings.

Part of the program's success comes from active cooperation with other organizations and institutions. West Virginia University's Institute for the History of Technology and Industrial Archaeology was started 10 years ago under the sponsorship of HAER, and the two organizations have enjoyed a mutually beneficial relationship since, as described by Dan Bonenberger. Since 1986, HAER has also enthusiastically worked with the United States Committee of the International Council on Monuments and Sites (US/ICOMOS) to employ preservation interns from other countries on HAER summer projects. As Ellen Delage, Director of Programs for US/ICOMOS, relates in her article, these students bring a wealth of talent and different perspectives to HAER projects and, in turn, become advocates for technological preservation and documentation in their own countries. HAER was modeled in part on Great Britain's industrial documentation programs, but through the years HAER has also been an inspiration to its British colleagues, according to Keith Falconer, Head of Industrial, Military and Naval Programmes in English Heritage. The final article in the issue is a bibliographic essay by Eric DeLony, Chief of HAER, describing the program's numerous project and program publications.

Architectural historian Reyner Banham has written of the "teeming fecundity" of technological invention, which has produced "a record—all too often ignored—of human creativity so multifarious, determined, and persistent that the only appropriate response is a decent humility."[2] In over 30 years of work, HAER has attempted to document that fertile and creative world, a world of grain elevators, machinery, and lean factories that inspired Modernist architects and painters; of structures and objects, brimming with variety, movement, and irregularity, that give form to the phrase picturesque eclectic; and of still other structures and sites that can only be called the unpicturesque eclectic, a motley assortment of utilitarian, vernacular, and nondescript buildings, towers, machines, and complexes, all of which together compose our modern technological world.[3] HAER will continue to work so that this record of human creativity is not ignored.

Notes

1 The HABS/HAER Collection is stored and available to the public in the Prints and Photographs Division, Library of Congress, Washington, DC. For an Internet catalog to the collection, and instructions on accessing the collection, see "Built in America" on the Library of Congress' American Memory web site at <http://memory.loc.gov/ammem/hhhtml/hhhome.html>. A list of all HAER projects conducted by the Washington office between 1969 and 1998 is included in *IA: The Journal of the Society for Industrial Archeology* 25, No.1 (1999):29-55. For additional information, see *IA: The Journal of the Society for Industrial Archeology* 23, No. 1 (1997), a special issue titled "Documenting Complexity: The Historic American Engineering Record and America's Technological History," and the HAER web site at <http://www.cr.nps.gov/habshaer/haer>.

2 Reyner Banham, "The Becher Vision," in Bernd and Hilla Becher, *Water Towers* (Cambridge, MA: MIT, 1988), pp.7-8.

3 Carroll L. V. Meeks, *The Railroad Station: An Architectural History* (New Haven: Yale, 1956), pp.1-2.

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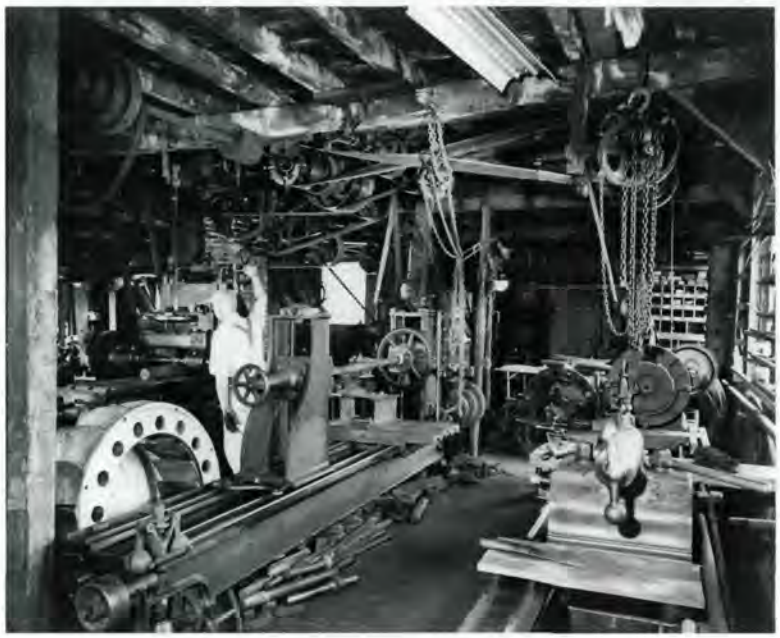
Robert M. Vogel

The Prehistory of HAER, 1965-1968

The genesis of the Historic American Engineering Record was a rather long and at times inchoate one with roots that reached deeply into its cousin-like organization, the Smithsonian Institution. From some indefinite time in the 1960s there had developed an unofficial symbiotic relationship between the Historic American Buildings Survey—principally on the part of chief James C. Massey and photographer Jack Boucher—and those curators at the Smithsonian's Museum of History and Technology (now the National Museum of American History) who dealt with matters of engineering history. This relationship, which was based quite naturally on the numerous interests common to both organizations, led to periodic casual discussions on the possibility and desirability of undertaking HABS-type recording surveys, not of the sort of structures that HABS had typically been recording since its inception in the early WPA period—houses and other buildings on an essentially domestic scale—but of purely industrial buildings. Here the focus would be less on the space-enclosing fabric itself than on the manufacturing equipment within, and where possible, on the process itself, including the building proper where it was of a distinctly "industrial" character. The concept was not an entirely new one, for over the years both the HABS and the Smithsonian's Division of Mechanical & Civil Engineering (M&CE) had conducted a number of such surveys. The HABS archival holdings contained drawings, photographs, and other records of a number of small flour mills and timber bridges, for example, while the M&CE in the early 1960s had made measured field drawings of several 19th-century timber and iron bridges. Even earlier, several historians of technology had recorded sites and structures of historic engineering interest, in some cases publishing the results. Of these, perhaps the best known is Greville Bathe of Philadelphia, who in the 1930s and 1940s had published several books of his drawings, photographs, and observations of a number of historic iron works, and other industrial sites and structures.

The tradition within the engineering fold can be said to reach back even further, for seniors at Rensselaer Polytechnic Institute, one of the nation's earliest engineering schools, from at least the mid-19th century were required to produce an illustrated thesis examining some existing engineering structure, frequently one of historic interest. In many if not all cases this work included measured drawings. The thesis of one student, for example, thoroughly described Roebling's 1855 Niagara Railway Suspension Bridge, while another's fully analyzed the Great Burden Wheel in Troy, New York, the most powerful water wheel ever built, anywhere. This immense prime mover was by then abandoned but still intact, and the thesis provides the only complete record of it.

By 1965, the HABS and M&CE principals determined that the time had come to mount an experimental survey of a fairly elaborate factory as a means of determining whether work of this sort could be practically conducted on a regular basis. This author, who was the M&CE curator, had been aware for some time of a small manufacturer of water turbines in West Stafford, Connecticut—the C.P. Bradway Machine Works. Although theoretically still in operation under the direction of the son of the firm's founder, a



Machine shop of the C.P. Bradway Machine Works, a small manufacturer of water turbines in West Stafford, Connecticut, in July 1965. Photo by the author, 1965.

man in his eighties, the place was in fact moribund; production had long ago ceased but happily all machinery and equipment remained in place. As is typical with any manufacturing facility, there had been additions to both building and equipment over the years, but the last major structural change had been the construction of a high erecting bay in 1920. Little had been added or removed thereafter, leaving an outstanding example of a typical small New England machine works of, practically, the 19th century.

Bradway was fully measured, photographed, and documented through oral history during a week in the summer of 1965 by a contract photographer and a crew of three: a HABS architect, the M&CE curator, and an engineer-surveyor. The funding for transportation, per diem, photography, and the engineer's salary was provided by the Museum of History & Technology, while the National Park Service contributed the time of the architect, who also prepared nine sheets of finished drawings. All field notes, negatives, tracings, and other records were placed with the HABS collections at the Library of Congress, and the project was given a regular HABS survey number (HABS No. CT-280). Thus, the Bradway project may be considered the first of the pre-HAER surveys.

All concerned saw the effort as a clear success. While it generally followed traditional HABS guidelines in that the (frame) building was recorded, far less detail was covered and far fewer photographs were taken than would have been the case had the building itself been the focus of the exercise. Instead, the bulk of attention was devoted to the machine tools, other production equipment, and the extensive system of power-transmission machinery, for every machine, on both floors, was belt driven; there was not a single electric motor in the place. (The prime mover was a 1928 Chevrolet engine.) A historical report covered the evolution of the firm from its beginnings in 1875, and the complete process by which the turbines were designed, built, marketed and installed.

There was further agreement that the undertaking should be repeated, as indeed it was, the following summer. The 1965 format was repeated, with the same crew except for a different HABS architect. The target this year was Dudley Shuttles (later D. T. Dudley & Son Co.) of Wilkinsonville, Massachusetts, one of the last American firms producing wooden shuttles for power looms. As with Bradway, Dudley had been formed in the 19th century, and used older machinery in its production processes. The firm was selected for surveying as the advent of the shuttleless loom within the textile industry and the rapid spread of these efficient machines meant the eventual radical reduction in the use of the shuttle. In fact, Dudley folded within several years of the survey. Some of its buildings survive, but without a trace of the industry that occupied them for nearly a century (as also is the case with Bradway).

The Dudley Survey format was essentially that used in the Bradway project, the recording of the building subordinated to that of the highly specialized manufacturing machinery and production sequence, and their interrelationship. One innovation was contracting with a local graphic artist to prepare detailed isometric drawings of several of the more unusual of these machines.

With these two small surveys of industrial firms complete and apparently useful, the time was at hand to consider something more ambitious. It was no secret within the small circle of historians of technology and industrial archeology that far too little attention had been paid historically to the systematic recording of industrial structures, with the exception of picturesque flour mills and covered timber bridges. Discussion between the Smithsonian and the Park Service soon suggested that the textile industry, the first in America organized on the factory system—that is, conducted within purpose-built structures—would be a logical place to start, with New England, the initial and until the 1930s principal locus of the industry, the logical starting venue. Thus was initiated the real pre-HAER program: the New England Textile Mill Survey (NETMS).

NETMS was organized very much like a traditional HABS summer-long survey, with seniors drafted from several architectural schools to do the recording and produce the finished drawings. The Smithsonian's curator of engineering acted as the team historian, and a team photographer rather than a contractor did the photography. As a number of its major buildings were soon to be demolished, the survey concentrated on the vast complex of the [former] Amoskeag Manufacturing Co., of Manchester, New Hampshire, that at its height was the largest textile producing firm in the world on a single

Dudley Shuttles, of Wilkinsonville, Massachusetts, was one of the last American firms producing wooden shuttles for power looms. Shown in this photograph from 1966 are part of the team that documented the site, Robert Vogel on the left, Tom Rick, and Russell Keune on the far right. Second from the right is Howard Pellatt, owner of Dudley Shuttles at the time, and seated is Mrs. Chase, the wife of the former owner.

site. The greater part of the summer was spent recording the buildings that, so far as could be determined, were to come down in the near future, and producing ground plans of the remarkably extensive Amoskeag site.

Following the coverage of Amoskeag, several weeks were spent measuring two other important structures in Lawrence, Massachusetts—the Lawrence Machine Shop, the city's sole stone mill building and the only one dating from the site's organization in 1845 that had been essentially unaltered, and the Pemberton Mill, the 1861 replacement of the original that had spectacularly collapsed and burned the year before. In the summer's final week or so, two of New England's most interesting early mills were recorded—the 1825-50 Crown & Eagle in North Uxbridge, Massachusetts, and what has been reckoned the oldest mill in continuous textile production in the U.S.—the timber-frame Lippit Mill of 1811 in West Warwick, Rhode Island.

The product of the summer's work was some 50 sheets of finished drawings of the Manchester and Lawrence mills. Time ran out before the finished drawings of the Crown & Eagle and Lippit mills could be undertaken, but completion of the field notes and photographs ensured that a lasting record was made of these two significant industrial structures of indeterminate future.

Thus was completed the first summer-long project to record solely industrial buildings. As with the two smaller surveys, all involved felt that the exercise was a successful and extremely useful one that bore repeating, if only to be assured that such ventures were feasible on a regular and long-term basis. This led to a continuation of what became known as NETMS I, the organization of NETMS II in the summer of 1968. The format was identical to the 1967 project, only the venues differing.

Of the major New England textile complexes, it was determined that after Amoskeag, the next most endangered was the great collection of 19th- and early-20th-century mills in Fall River, Massachusetts. The city center and the earliest mills already had succumbed to the ramming of I-195 right through the city's heart. As the mills—nearly all of granite—had been widely dispersed throughout the city, however, many had been spared, including some of the most interesting, both architecturally and structurally. The earliest surveyed, the Metacomet Mill of 1847, dated from nearly the beginning of the textile industry in Fall River, and was the sole survivor of the water-power period. All the later mills, being distant from the Quequechan River, were steam powered.

As with NETMS I, the summer's work concluded afield. Several early Rhode Island mills were recorded—in Woonsocket and Allendale—and as well the mills of Harrisville, New Hampshire, widely regarded as the best preserved textile-mill town in New England.

While many more summers could justifiably have been spent recording the many remaining New England mills of one degree or another of importance, clearly the two NETMS projects (not to say the two smaller ones that preceded and inspired them) produced a collected record of enormous value. From this it was evident that such work should continue on a formal, fully organized basis, again following the HABS model. And so, with the tri-partite agreement entered into by the Park Service, the American Society of Civil Engineers (joined later by the Mechanical Engineers), and the Library of Congress, the Historic American Engineering Record was born. The Mohawk-Hudson Area Survey—its first official summer-long recording survey—was mounted the very next (1969) summer.

Robert M. Vogel is Curator Emeritus, Division of Engineering & Industry, National Museum of American History, Smithsonian Institution.

Eric DeLony

HAER and the Recording of Technological Heritage

Reflections on the Beginning

An abundance of industrial and engineering sites still dotted the American landscape in the 1960s, despite the onslaught of "progress" in the form of freeways and urban renewal. America retained a wealth of bridges, dams, canals, factories, power plants, and other engineering and industrial structures of historic interest. Many historic sites maintained by the National Park Service (NPS) and the states reflected engineering or industrial themes.[1] But even though numerous historic sites had survived, preservationists realized that the future held little hope that many objects of engineering and industry could be saved as historic monuments.

Preservation through documentation was a viable alternative, however. The Historic American Engineering Record (HAER) was created in 1969 by the National Park Service, the Library of Congress, and the American Society of Civil Engineers (ASCE) so that documentation on outstanding works of engineering, industry, and technological processes could be preserved.

A number of people working in Washington, DC, in the 1960s were interested in the history of technology and the emerging field of industrial archeology (IA), and were instrumental in helping to create the HAER program. Robert M. Vogel, the curator of Mechanical and Civil Engineering at the National Museum of History and Technology, Smithsonian Institution, was one of them. An early advocate of an engineering documentation program, Vogel had attended some of the first industrial archeology conferences in England. Organized by Kenneth Hudson and Angus Buchanan at Bath University, the establishment of IA as a new field of study was debated. Subsequently, Vogel convened a similar seminar at the Smithsonian on April 11, 1967, to launch the American equivalent of an IA movement, based generally on British practice.[2]

Another key player during these formative years was James C. Massey, chief of the Historic American Buildings Survey (HABS) and the first chief of HAER. In cooperation with the Smithsonian Institution, HABS initiated several recording projects in the late 1960s that varied from its normal focus on historic architecture. Vogel had approached Massey and HABS seeking the help of NPS in recording the Bradway Machine Works in Stafford, Connecticut, and the Dudley Shuttle Works in Wilkinsonville, Massachusetts. Along with students from the University of Maryland's College of Engineering, in 1966 he recorded the Bollman Bridge at Savage, Maryland. This project brought in the ASCE because, simultaneous with the recording, the bridge was designated as the first ASCE national historic civil engineering landmark.

Also actively working for recognition of engineering heritage at the time was Neal FitzSimons, an engineer in the senior executive service responsible for the protective structures program of the Pentagon. Since engineering school at Cornell, FitzSimons had been interested in the history of civil engineering and, after moving to Washington, worked to establish a program on the history of civil engineering within the ASCE. FitzSimons was appointed to a Task Committee to study his proposal and, in the spring of 1965, the Board of Direction approved the establishment of a permanent Committee on the History & Heritage of American Civil Engineering (CHHACE) chaired by past president Gail Hathaway. Shortly after CHHACE was formed, Hathaway and FitzSimons began discussions with the NPS and the Library of Congress to establish an engineering documentation program.[3]

On October 3, 1967, in a meeting with Massey and NPS associate director of design and construction Johannes E.N. Jensen, Gail Hathaway formally presented FitzSimons' pro-

posal for the establishment of a new program to record historic engineering works as a cooperative venture with ASCE. The proposal fell on sympathetic ears, since Massey had a personal interest in industrial architecture, and, over the previous few years, had promoted HABS recording of textile mills and small industries in collaboration with Vogel and the Smithsonian. Before going along with the idea, however, Park Service Director George B. Hartzog, Jr. wanted to ensure that the program not duplicate the work of HABS, and that other disciplines, such as landscape architecture, would not seek similar treatment. In response, Ernest A. Connally, director of the recently established Office of Archeology and Historic Preservation and Massey's boss, got assurances from Raymond L. Freeman, a prominent Washington landscape architect and NPS official, and from Gail Hathaway that there would be no pressure for the establishment of similar programs from the landscape architects or the other engineering disciplines.

HAER team members David Bouse and Charles Parrott ascend a hook-and-ladder to measure the cornice of the Troy (NY) Gasholder house in 1969. Photo by Robert Vogel, 1969.

With strong advocates for an engineering documentation program within the Park Service hierarchy, a tri-partite agreement to establish HAER was ratified on January 10, 1969, with the signing of a document similar to the one that established HABS in 1933.[4] Securing funding for the new HAER program was the next step. Congressman George Mahon (D-TX) of Lubbock, chairman of the House Appropriations Committee, made certain that the $79,000 line item for HAER was in the NPS fiscal year 1970 budget. Success in securing the appropriation was due in no small part to Jerry Rogers, who had worked with Ernest Connally to help set up the National Register of Historic Places. Like Connally, Rogers was a Texan who recently had returned to Texas to start a new museum of western ranching history at Texas Tech in Lubbock.[5]

During the summer of 1970, R. Carole Huberman was hired as the first HAER Washington office employee, followed by architect Donald G. Prycer who worked on HAER's Commonwealth of Virginia recording project that same summer. Eric DeLony, hired in January 1971, was the first permanent employee, and Douglas L. Griffin, an industrial engineer from Neal FitzSimon's office at the Pentagon, was HAER's first supervisor beginning in May 1971.

The Mohawk-Hudson Area Survey conducted during the summer of 1969, and headquartered at Rensselaer Polytechnic Institute in Troy, New York, was HAER's first official project. Unlike traditional HABS surveys which treated mills primarily as architectural phenomena, the Mohawk-Hudson Survey devoted as much attention to the machinery and the industrial processes as to the architecture. The Mohawk-Hudson Survey, done in collaboration with the Smithsonian, was intended as a demonstration project, a pioneer endeavor in historical research integrating engineering history, local history, and landmark preservation studies into a single research and recording operation. Following the success of the Mohawk-Hudson Survey, a project was fielded during the next summer to record the Baltimore & Ohio Railroad, investigating the historic remains of America's first major trunk-line, and another to document a selection of industrial and engineering sites in Virginia.

Documentation of the Erie Railroad in 1971 required aerial reconnaissance. The intrepid air team included, left to right, Jack Boucher, Eric DeLony, Chester Liebs, Jack Waite, Robert Vogel, and pilots Anthony Hill and Jack Colborn. Photo by Jack Boucher, 1971.

Since then, HAER has worked to create a national archive of America's industrial, engineering, and technological achievements. In its first 30 years, over 7,000 sites, structures, and objects have been recorded with over 65,000 photographs, 800 large-format color transparencies, 54,000 data pages, and 3,000 sheets of measured and interpretive drawings, all transmitted to the Library of Congress. Some of the sites recorded serve as the foundation for subsequent preservation efforts that transform communities and the way people think of the industrial work place. Steel mills, factories, foundries, and the canal, road, and rail infrastructure now are beginning to be thoughtfully regarded and preserved with new insights.

Because of its governmental authority and national scope, HAER is recognized as the national standard against which engineering and industrial heritage documentation in the United States is measured. A critical component of the standard is the creation and maintenance of a national archive of records at the Library of Congress.[6] Significantly, HAER's documentation is in the public domain. Materials from the collection can be used without restriction other than the courtesy of a credit line citing the delineator, photographer, or author, and the Historic American Engineering Record, National Park Service. Much as the Smithsonian Institution is referred to as the "nation's attic," the drawings, photographs, and histories that comprise the HAER collection might be considered the national memory of engineering and industrial achievements. In this context, the process of documentation becomes a powerful tool, and the collection can be appreciated when one realizes that it was designed to last for many generations.

HAER produces documentation with the help of partners. In addition to the support of the NPS, HAER, through its tri-partite agreement, has the backing of two other notable institutions—the Library of Congress and the American Society of Civil Engineers.[7] The groups that cosponsor HAER documentation projects, such as other federal agencies, state and local governments, historical societies, private industry, and individuals, are also considered partners. Donations from these partners augment HAER's annual appropriation from the Congress. Avoiding exclusive reliance on federal funding gives the program great flexibility and makes the role of partners important. Donations and shared funding are based on the premise that all sectors of society (government, business, industry, and individuals) should participate in a national preservation effort. Participation, especially financial, multiplies the effect of the program. More importantly, it encourages partners to recognize the concept of industrial heritage documentation, and by extension, a commitment to preserving significant attributes of the engineered environment.[8]

During its first 30 years, HAER has established national documentation standards, cultivated numerous cooperative relationships with a variety of entities, adopted an entrepreneurial philosophy for greater flexibility, and created an international training and documentation program. Through its federal authority, national standards, summer recording program, and Library of Congress archives, HAER has furthered recognition of the oft-forgotten contributions of engineers, industrialists, and laborers.

Notes

1 By 1969, over 68 engineering, industrial, and maritime sites had been recognized and commemorated as national historic landmarks, as national and state

parks, or as historic sites. See the Catalog of National Historic Landmarks (Washington, 1987).

2 Vogel later directed several early industrial archeology surveys for HABS, including the two New England Textile Mill Surveys. He was project director of the Mohawk-Hudson Area Survey, HAER's pilot project, and continues to support the program to this day. He is mentor to the author. See Robert M. Vogel, *A Report on the Mohawk-Hudson Area Survey* (Smithsonian Institution, Washington, DC, 1973), 1.

3 Hathaway was a prominent Army Corps engineer and a member of the American team that helped save the temples at Abu Simbel on the left bank of the Nile from the reservoir of the Aswan Dam. A few years later he passed the presidency of CHHACE to FitzSimons. See Neal FitzSimons, "History and Heritage Programs of the American Society of Civil Engineers," an unpublished paper, on the formation and the activities of the CHHACE Committee.

4 HABS was established in 1933 as a New Deal project to employ out-of-work architects. Selected engineering works and industrial buildings were recorded during its initial phase and later when the program was reinstituted and funded in 1957 as part of the National Park Service's Mission 66, a program designed to upgrade the national parks following the Korean War and World War II.

5 Dr. Connally suggested that had the HAER appropriation been postponed one year, it may not have passed because of the mounting expense of the Vietnam War. Another interesting development surrounding the establishment of HAER was the understanding that in return for Mahon's support, the Water Resources Center at Texas Tech would receive several grants from the Park Service to survey historic engineering and industrial sites in the Southwest. For the results of these surveys, see *Water for the Southwest: Historical Survey and Guide to Historic Sites* (American Society of Civil Engineers, Committee on History & Heritage of American Civil Engineering: New York, N.Y., 1973). On behalf of ASCE, FitzSimons testified before several Congressional committees in support of establishing HAER.

6 See Robert Kapsch, ed., "Secretary of the Interior's Standards & Guidelines for Architectural & Engineering Documentation," *Federal Register*, 48:190, (Thursday, September 29, 1983), 44730-34; and John A. Burns, ed., *Recording Historic Structures* (American Institute of Architects Press: Washington, DC, 1989), for both quality and performance standards. The HAER collection is in the Library of Congress rather than the National Archives, the usual repository for Executive Department records, because there was no National Archives when HABS was created in 1933. The HAER collection was "piggybacked" onto the HABS collection. The National Archives created Record Group 515 in December 1992 to hold the administrative files of HABS/HAER.

7 The Tri-partite Agreement, outlining the HAER mandate, was signed in 1969 by the three entities creating the program: the National Park Service, which is charged with the day-to-day operation of the program; the Library of Congress in which the collection is reposed; and the American Society of Civil Engineers, which advises the program and provides support through its national membership. In 1987, support of the program was expanded through a protocol that included the other founding engineering societies: the American Society of Mechanical Engineers; the Institute of Electrical and Electronics Engineers; the American Institute of Chemical Engineers; and the American Institute of Mining, Metallurgical & Petroleum Engineers.

8 Courses in the history of science and technology had been taught within the College of History, West Virginia University, since 1976. In 1989, Dr. Emory L. Kemp formalized these curriculum initiatives by establishing the Institute for the History of Technology & Industrial Archaeology (IHTIA), as an affiliate of the West Virginia University Research Corporation. Partially funded through HAER, it offers additional flexibility toward preserving engineering and industrial heritage by working with HAER and the National Park Service to expand the documentation mandate.

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This article was adapted from Eric DeLony, "HAER and the Recording of Technological Heritage: Reflections on 30 Years' Work," *IA: The Journal of the Society for Industrial Archeology* 25, No.1 (1999):5-28, with permission from the publisher.

Michael Masney on the B&O Roundhouse in Martinsburg, West Virginia, in 1970. Photo by the author, 1970.

Tim Davis

HAER Documents America's Park Roads and Parkways

HAER is now in its 12th year of documenting America's national park roads and parkways. Initiated in 1988, HAER's NPS Park Roads Program aims to create a detailed visual and textual record of the historically significant roads, bridges, ancillary structures, and related landscapes that comprise an important aspect of the cultural heritage of the national park system. As with all HAER documentation projects, the park road studies combine large-format photography, historical narratives, and measured and interpretive drawings. Yellowstone, Yosemite, Glacier, Zion, Acadia, Great Smoky Mountains, Blue Ridge Parkway, George Washington Memorial Parkway, and Gettysburg are among the 30 parks that have hosted intensive documentation efforts, which are underwritten by the NPS Park Roads and Parkways Program with funding provided by the Federal Lands Highway Office of the Federal Highway Administration, U.S. Department of Transportation. HAER has also documented individual road-related features in a number of additional park units. This comprehensive interdisciplinary survey has produced a wealth of information on bridge and highway engineering techniques, landscape design issues, park management strategies, and related cultural concerns and social practices.

Belcher Curve, on the Blue Ridge Parkway, near Rocky Knob recreation area in North Carolina, showing how rustic design elements and agricultural easements blur distinction between parkway and bordering properties. Photo by David Haas, 1997.

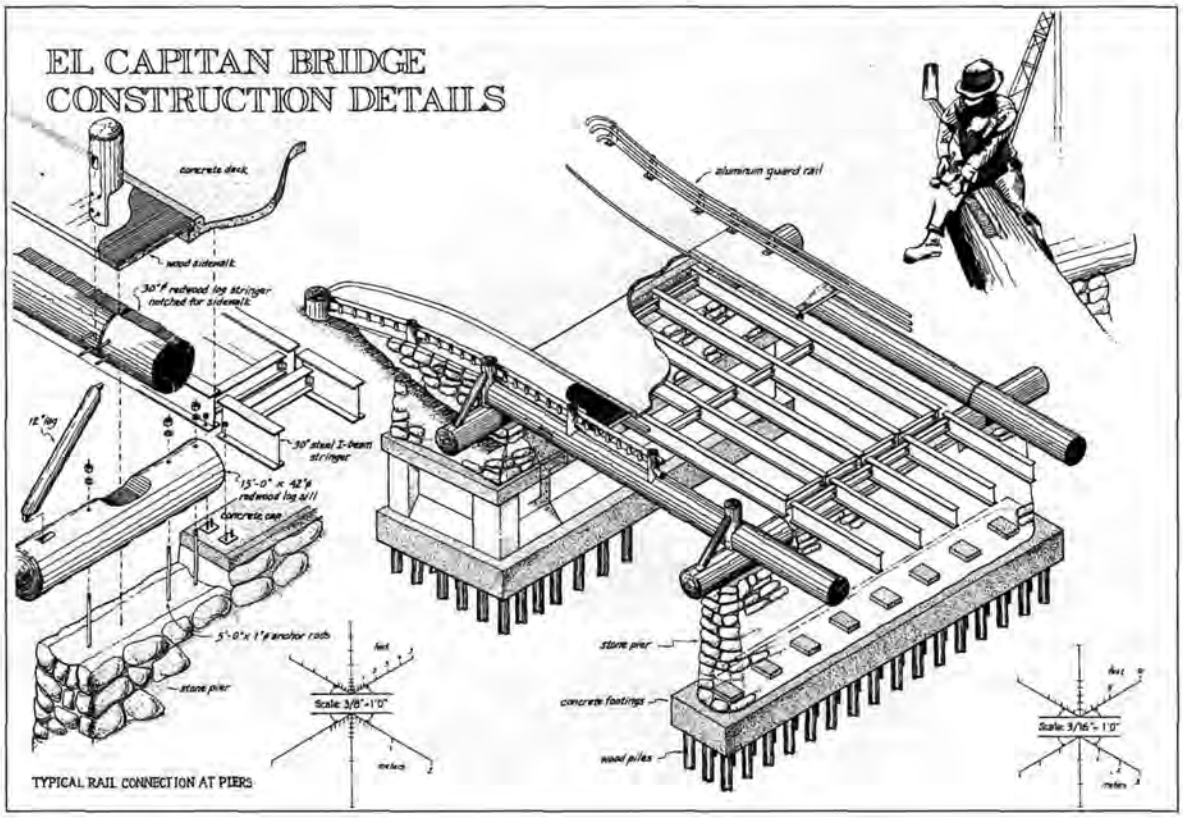
The National Park Roads Program is a natural outgrowth of HAER's emphasis on documenting engineering structures and infrastructure developments that fall outside the range of traditional architectural studies. Culverts, road alignments, guardwalls, and paving technology are not necessarily the first concerns that leap to mind when considering the corpus of American design, or even the history of construction in the national parks, but park road development is an important chapter in the annals of American civil engineering, landscape architecture, park management, and social history. Road and bridge construction in the national parks involved impressive feats of civil engineering. Many technological developments first employed in park road development were later applied to broader highway construction practices. The same is true of roadside landscape design policies, which were pioneered in park road development and eventually spread to more utilitarian usage. The HAER Park Roads Program documents the evolution of these practices through detailed exposition of construction methods, design strategies, and road- and bridge-building technology.

The HAER Park Roads Program also reflects the growing interest in cultural landscape studies along with the increasing awareness that even such seemingly natural environments as national parks are complex cultural constructions, with rich and varied human histories that shed insights into a variety of social, technological, and environmental issues. While natural resource concerns tend to dominate the NPS management agenda, and roads are often portrayed as intrusions in the park environment, park road development has played an integral role in the development of the national park system. Not only did the encouragement of motor tourism provide the public support needed to protect and expand the park system, but, for many visitors, the view from the road has long been the dominating element of the national

park experience. By providing access, choreographing visitors' movements, and framing vistas, park roads strongly influence visitors' perceptions of natural and cultural resources. In fact, the subtle layout and organic unity of many park roads blurs the distinction between natural and cultural resources, an artificial dichotomy that is gradually giving way to a broader understanding of the complex relations between social, cultural, technological, and biological processes. By articulating these complex relationships through innovative interpretive drawings and providing detailed archivally based research to underscore the historical significance of park road development, the HAER Park Roads Program has played an important role in expanding the ways in which park roads are viewed by cultural and natural resources managers alike.

The history of the HAER Park Roads Program exemplifies the rapid evolution of ideas about the nature and significance of park roads. Not only has the focus broadened significantly from its early emphasis on purely engineering matters, but the strategies of graphic representation have grown increasingly expansive and creative as well, as have the uses to which the documentation has been put. While early projects focused on park bridges and other individual engineered structures such as culverts and viaducts, the program gradually expanded to address broader issues of landscape design, highway engineering, and cultural history. As the program progressed, field teams began to develop interpretive drawings of construction processes, landscape design techniques, topographical experiences, and evolving historical processes. Historians complemented historic structure reports with more comprehensive narratives situating specific examples of park road development within broader social and cultural contexts. HAER has revisited several parks that were documented early in the program's development in order to augment technical bridge-oriented drawings with illustrations of broader landscape design and transportation history issues. HAER has also moved beyond the boundaries of the national park system, employing state department of transportation funds to document parkways in Connecticut, New York, Oregon, and California. During the summer of 1999, a pilot project was undertaken to investigate approaches to documenting the Lincoln Highway in Pennsylvania. This ambitious project would push historic road documentation to yet another dimension by encompassing vernacular cultural landscapes and commercial architecture as well as conventional design and engineering issues.

HAER park road research is intended to play an active role in cultural resource management. While the original sets of HAER drawings



El Capitan Bridge Construction Details, Yosemite National Park, California. Early drawings produced by the HAER Park Roads Program focused on individual examples of bridge construction and other technical details; note use of rustic overlay to disguise modern steel girder span. Drawing by Marie-Claude Le Sauteur, 1991.

and negatives are permanently stored in the HABS/HAER collection at the Library of Congress, copies are provided to the cooperating parks. The drawings, photographs, and histories can be used by engineers, landscape architects, maintenance personnel, and cultural resource specialists to inform debates on management, preservation, and rehabilitation issues. By calling attention to the historic importance of park roads and providing detailed baseline information, HAER documentation projects have shaped management decisions in several parks. HAER documentation helped guide rehabilitation efforts in Yosemite after the destructive flooding of January 1997, for example, and HAER's 1997 fieldwork in Vicksburg National Military Park convinced park managers to reconsider plans to replace a notable collection of historic Melan-arch bridges with nondescript modern concrete box culverts. The HAER National Park Roads project has also contributed to the growing commitment on the part of the National Park Service and the Federal Highway Administration to adopt planning and development policies that attempt to maintain and extend the character of classic park roads by adapting traditional park road design techniques to new construction and reconstruction.

HAER documentation can play a particularly important role in the area of interpretation, where the attractive graphics and detailed historical narratives can serve as the basis of engaging and informative exhibits and wayside panels. HAER has developed interpretive brochures for many parks, which present the history of park road development in concise and accessible terms. In 1998, HAER joined forces with the National Building Museum in Washington, DC, to produce a major exhibition showcasing the program's first decade of work. The exhibition was viewed by over 25,000 visitors and received major awards from the George Wright Society and the Vernacular Architecture Forum. Plans are currently underway to produce a substantial book based on HAER's park road research.

The HAER Park Roads Program has played an important role in chronicling the history of park road development, articulating its characteristic design details, and underscoring its cultural significance. Through its continually expanding scope, innovative graphic techniques, meticulous historical research, and widespread practical applications, the HAER Park Roads Program extends the HABS/HAER legacy while making important contributions to the growth of cultural resources management as both a practical endeavor and an increasingly rigorous academic field.

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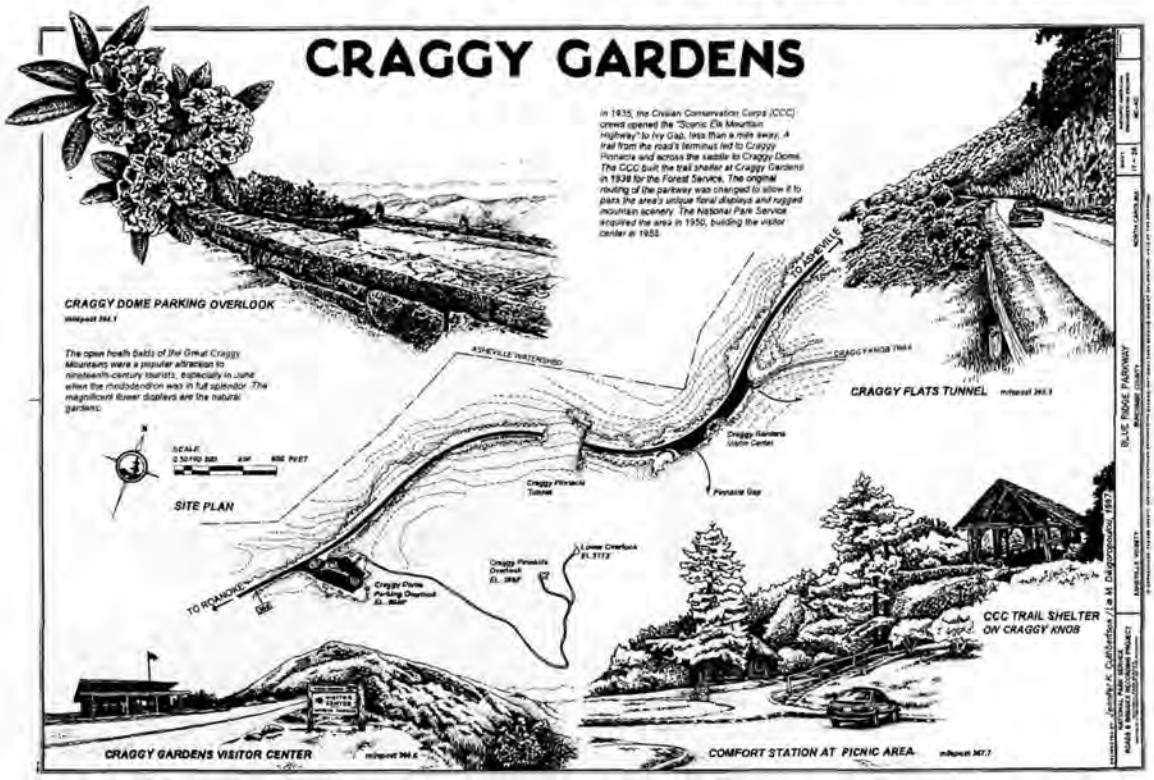


Craggy Gardens, Blue Ridge Parkway, near Asheville, North Carolina. Later drawings illustrate the program's expanded focus; this example combines design details and road alignment with vignettes portraying the motorist's perspective and broader aspects of the surrounding cultural landscape. Drawing by Jennifer K. Cuthbertson and Lia M. Dikigoropoulou, 1997.

Lisa Pfueller Davidson

Through the Mill

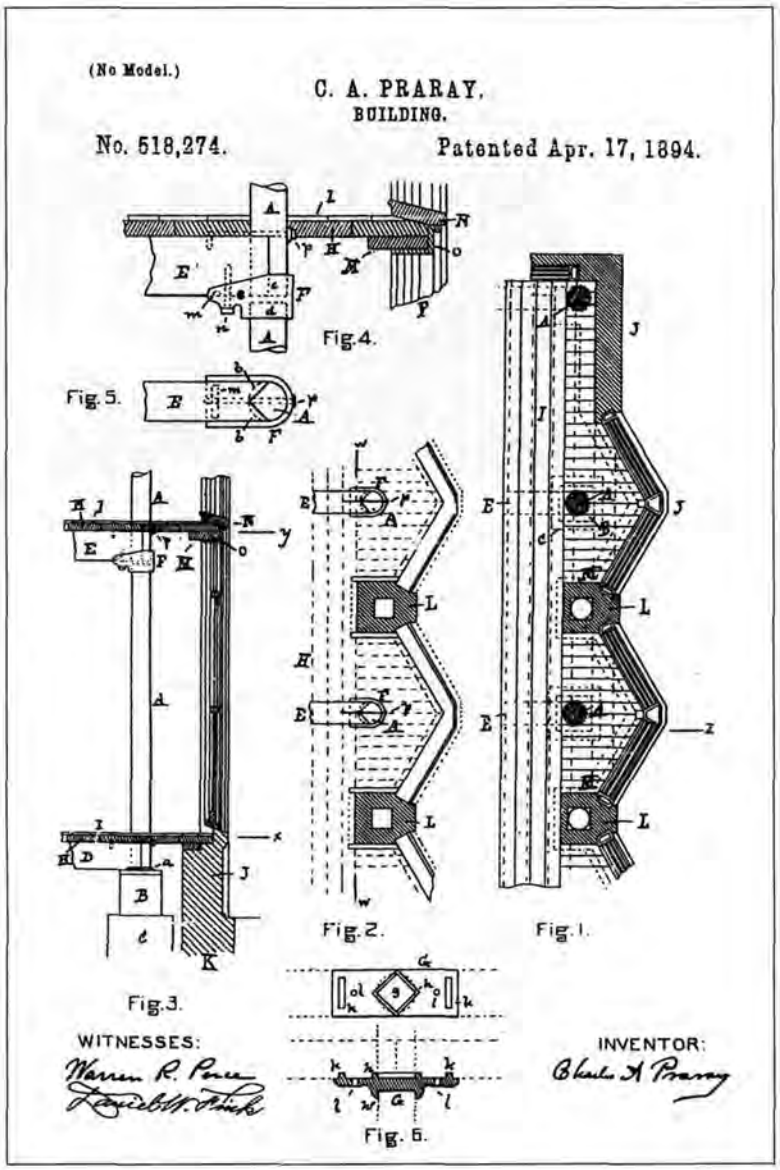
Documenting the Southern Textile Industry

Gothic Revival worker housing in Graniteville, South Carolina, built c.1848. Photo by Jet Lowe, 1998.

The development of the textile industry created a unique industrial landscape in the Piedmont area of the southeastern United States. Particularly during the "New South" growth of the late-19th and early-20th centuries, construction of mills, worker housing, and community buildings reshaped many southern towns. The Historic American Engineering Record documented several southern textile mills in the 1970s, but since 1997, HAER's Southern Textile Industry Project has attempted a more comprehensive and contextual regional documentation program. Mills, worker housing, and community structures have been studied and recorded in LaGrange and Hogansville, Georgia; Valley, Selma, and Huntsville, Alabama; and Graniteville, South Carolina. The most recent project examined mills in Gaston County, North Carolina. A database of textile directory information has been created, research information, inventories, and bibliographic materials gathered for a study collection, and a typology of southern textile mill housing prepared as part of the project. Most importantly, relationships have been developed with state historic preservation offices, local historical organizations, textile companies, regional universities, National Park Service regional staff, and others to insure a broad-based and inclusive examination of a regional industry. The artifacts of this industry often are deceptively ordinary; decades of use frequently cause historic features to be hidden by additions or changes. When examined more closely, however, southern textile mills, housing, and related town structures can reveal important aspects of local history that enhance the larger regional and national historical narrative.

Combined study of both mill industrial complexes and surrounding residential and commercial structures has been crucial, given the integrated nature of southern textile mill town development. Often the housing, community facilities like schools and gymnasiums, and commercial structures were all built and owned by the textile company. Intense interest in the history of the mill and workers in many of the places HAER has documented also indicates the vital importance of the history of the southern textile industry to the local community. In one community, for example, HAER researchers arriving at a mill early one morning were surprised to be greeted by a large welcoming committee of town officials and members of the local historical organization, all of whom wanted to express their gratitude for HAER's interest in "their" mill. People in southern mill towns recognize the importance of textile industry history to their own sense of place, even as these mills close and face uncertain futures. Many mills have already been demolished or drastically altered. Before vestiges of the industry disappear forever, the Southern Textile Industry Project aims to study these important sites and structures that defined life and work in numerous southern towns and cities.

The remarkable survival of one of the earliest southern textile mills at Graniteville, South Carolina gave HAER an opportunity to include an important antebellum example in the Southern Textile Industry Project. Erected in 1846-49, the Graniteville Mill took its name from the blue granite quarried locally to build the two-and-a-half story mill building and waterpower canal. Entrepreneur William Gregg envisioned Graniteville as an important southern industrial prototype, proving the viability of cotton textile production to diversify the predominantly agricultural regional economy. The original mill, now enclosed within a sprawling industrial complex, stands as evidence of this



Charles A. M. Praray's patent drawing for a "new and useful improvement in buildings," 1894. United States Patent Office, Patent No. 518,274, 17 April 1894.

ambitious early southern manufacturing project. In the surrounding town of Graniteville, Gregg created the entire infrastructure of housing, hotel, shops, and railroad access for a complete mill village. Surviving examples of original Gothic Revival cottages show Gregg's belief in the civilizing influence of tasteful houses on a community of new industrial laborers. The themes of entrepreneurship, technology, and community building revealed by Graniteville's story continue across HAER's other Southern Textile Industry Project sites, highlighting the regional and national significance of local history.

Looking at textile industry structures and technology in the South also complements the extensive body of HAER documentation previously done on the textile industry, mainly focusing on New England. The national scope of the HAER program provides opportunities for broader regional and national analysis of local sites often not feasible for research being conducted on the state or local level. Southern textile growth also included important cross-regional transfer of textile expertise and technology. An unusual textile mill structural system patented by Charles A. M. Praray in 1894 illustrates the potential for linking discrete local documentation projects into a larger regional and national framework.

In 1997, HAER began researching Dixie Mill in LaGrange, Georgia, leading to the rediscovery of a mill design system patented by Providence, Rhode Island mill engineer Charles A. M. Praray in 1894. In April 1894, while he was working for Charles Makepeace & Co. in Providence, Praray received a patent on a "new and useful improvement in buildings." In both structure and appearance Praray's patented building system differed substantially from conventional slow-burning mill architecture. The "Praray Improved System of Construction" called for the support columns and outer walls to be built on two separate foundations, making the walls of the mill non-load bearing. Unusual triangular bays formed the exterior walls to allow more natural light into the mill and provide horizontal bracing.[1]

Praray built only five mills using his patented system, all located in the South. Local historians were unaware of the patented design for mills in LaGrange and Douglasville, Georgia; Selma, Alabama; and Haw River, North Carolina. Praray's patent was part of the larger context of mill architecture experimentation in the South during the late-19th century, including the first electric powered mill in Columbia, South Carolina in 1893. In this instance, HAER documentation revealed inventive mill construction taking place in the South, and possibilities for new regional and national perspectives on the southern textile industry.

Praray first used his "improved building method" in 1895-1896 when building Dixie Mill in LaGrange, Georgia. During the 1940s, the Praray walls were removed and Dixie Mill was expanded laterally. By this time, improvements in artificial lighting made natural light less important, and many mills began to brick in windows to increase air-conditioning efficiency. With the distinctive triangular bays gone, Dixie

Mill lost its most visible feature of the Praray patented system of construction, camouflaging this unique mill structural system within a series of conventional additions and alterations. Because the interior frame supported the original portion of the mill independent of the walls, the skeleton of Praray's structural system remained largely intact.

After designing Dixie, and also while still working for Makepeace, Praray designed two patented mills for the Thomas Holt Manufacturing Company in Haw River, North Carolina.[2] Praray built another patented mill for Georgia Western Cotton Mills at Douglasville, Georgia outside of Atlanta. The windows have been bricked-in, but the Praray walls are still intact, giving the mill in Douglasville a deceptively modern appearance that caused it to be overlooked in a Georgia Department of Transportation survey of historic resources along Route 20.

Another Praray patented mill opened in Selma, Alabama, in 1897. Eighteen months later the mill was expanded with a matching 100-foot-long addition.[3] The Selma Cotton Mill changed owners frequently during the early-20th century and by the 1940s had been converted to a cigar making plant. Today the original mill is still used by Phillies Cigar Co. The Praray design is remarkably intact, including many of the original windows, giving the best view of the original appearance of a Praray patented mill structure.[4]

Phillies Cigar Co. (formerly Selma Cotton Mill), Selma, Alabama, built c.1897 using Praray's patented building system. Photo by Jet Lowe, 1998.

Only the five patented mills built between 1895-99 remain as evidence of Praray's contribution to mill construction innovation taking place in the New South.[5] Although Praray's long-term impact on textile mill design was minimal, uncovering his story suggests that there are many others still unrevealed that could contribute to a more nuanced, cross-regional analysis of the southern textile industry. As HAER's Southern Textile Industry Project is attempting to demonstrate, individual historic textile industry sites, from the antebellum innovation at Graniteville to the Praray patent mills, are better understood when viewed through the national context of industrial development.

Notes

1 Makepeace was listed as assignee of one-half of the patent. Charles A. Praray. "Building," United States Patent Office, Patent No. 518,274, (17 April 1894); William Whittam, Jr. Cotton Spinning, (Providence, RI: Charles A. M. Praray Co., 1898), I-III.

2 First Praray built a large addition on the pre-existing Thomas Holt Mill. Holt Manufacturing must have been pleased because the company had Praray design the Cora Cotton Mill nearby around the same time.

3 Sanborn Map Company, Selma, Alabama, (New York: Sanborn Map Company), 1898, 1903, 1925, 1944.

4 One other Praray patented mill was designed for African-American entrepreneurs in Anniston, Alabama, but never constructed.

5 In 1898, Praray left Makepeace's firm and founded C.A.M. Praray and Co., Architects and Mill Engineers, also based in Providence."A New Firm of Mill Architects and Engineers," *Providence Journal of Commerce* 6:3 (March 1898): 61. Praray continued to work doing renovations and standard mill buildings until his death in 1910.

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Richard K. Anderson, Jr. and Todd A. Croteau

Futtocks, Buttocks, and Duck Tails

HAER's Maritime Program

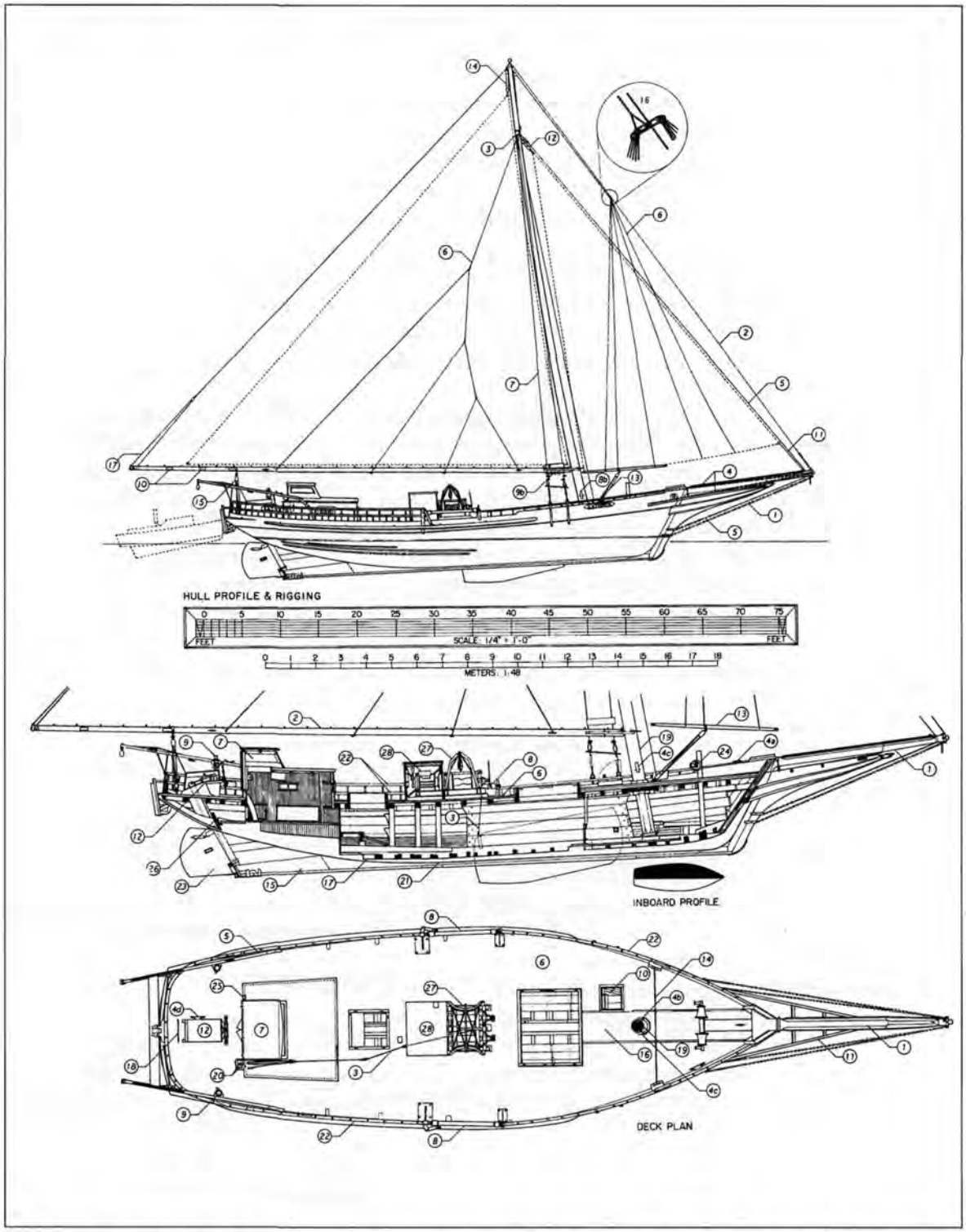
Nationwide interest in maritime history and the preservation or replication of historic ships and small craft has grown substantially in recent years. It has become apparent that physical preservation of large ships will not be feasible in many cases, and that documentation– "preservation on paper"– will prove to be the most reasonable preservation method available. Where physical preservation of a ship is undertaken, in most cases detailed documentation must be made before stabilization, repairs, or other measures can be safely undertaken. Such documentation is also a form of insurance against partial or total loss of a significant vessel should some catastrophe occur to the vessel itself.

Americans have always held an interest in their maritime history; however, efforts to preserve its largest *physical* expression—the ships—have lagged behind preservation of small craft, artifacts, written historical documents, and folklore, with only a few important exceptions. Led by the private and public sectors since the 1960s, the national movement to preserve historic buildings has encouraged a similar movement in maritime history on local and national levels.

The impetus for the development of a HAER Maritime Program lies with the Standards Committee of the National Maritime Heritage Task Force which met between September 1982 and December 1983 under the auspices of the National Trust for Historic Preservation. The HAER Maritime Program was one of several related programs created in response to a 1985 Congressional mandate to "inventory maritime resources, recommend standards for their preservation, and recommend private and public sector roles for that preservation." Vigorous discussion among American maritime museums, professionals, interest groups, and the National Park Service ensued in meeting the goals of this mandate. A national inventory of preserved historic vessels over 40 feet long was completed by the National Maritime Initiative of the NPS, with the cooperation of numerous agencies and museums. In 1987, the National Register of Historic Places published specific instructions for nominating vessels to the National Register. The Historic American Engineering Record produced *Guidelines for Recording Historic Ships* in 1988 in accordance with the established *Secretary of the Interior's Standards for Architectural and Engineering Documentation.* The Museum Small Craft Association began development of guidelines for documentation of historic small craft in 1988; *Boats: A Manual for Their Documentation* was published in 1994 by the American Association for State and Local History. In 1990, the maritime preservation program within the National Park Service published the *Secretary of the Interior's Standards for Historic Vessel Preservation Projects* and *1990 Inventory of Large Preserved Historic Vessels.* Many of these publications were to form a part of the National Trust's planned *Manual for the Documentation of Historic Maritime Resources,* which was to have included guidelines for documenting all types of maritime-related tangible and intangible resources. The Department of Maritime Preservation in the National Trust was disbanded in 1993, and this publication was not issued.

HAMMS

The documentation of historic ships has a long history reflecting the influence of numerous motives, traditions, and important individual authorities. In documenting ships, HAER is building on the work of the Historic American Merchant Marine Survey (HAMMS), a 14-month program administered from 1936 to 1937 by the Smithsonian Institution as part of the Works Progress Administration. Modeled on the HABS program, HAMMS put naval architects and others idled by the Great Depression to work making records of vanishing historic vessels with the intention of providing future naval architects a useful base-line record of American ship design evolution. For its time, it was a monumental effort, and deserves great credit. Of the 426 ves-



Profiles, plans, and sections offer a more standard "architectural" view of a vessel. Profiles delineate the hull form, underwater features, freeboard, spars, rigging, and sails. Inboard Profiles are similar to longitudinal cross-sections showing the vessel from the centerline out. In this case, a small "pushboat" is used for power dredging and is dashed at the stern. Plans show deck arrangements and Sections show the relationship of decks to each other as well as framing details. The 1901 Skipjack Kathryn *is a national historic landmark and one of 22 historic vessels that comprise the only surviving commercial fishing fleet working under sail in the country.* Kathryn's *construction represents a transitional design from round bottom hulls to those with hard chines. Documentation was supported by the Chesapeake Bay Maritime Museum with assistance from the CAMM Sally Kress Tompkins Maritime Internship. Drawing by Shawn Brennan and Martin Peebles, 1995.*

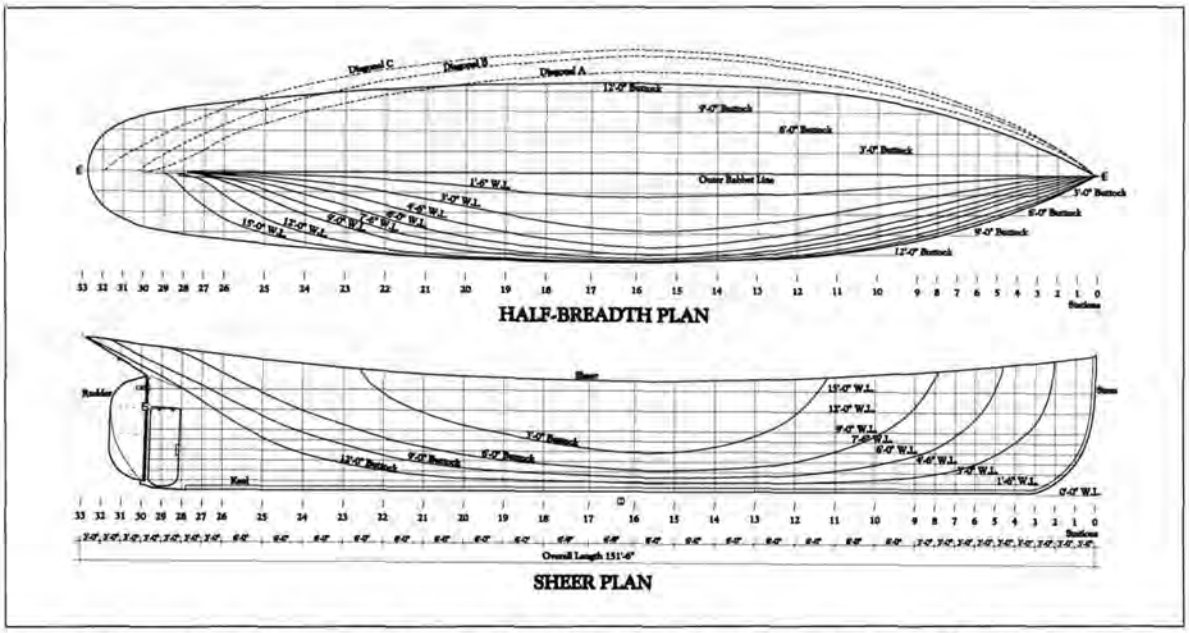
sels included in the survey, only two survive in 2000. (The HAMMS Collection is located in the Division of the History of Technology, National Museum of American History, Smithsonian Institution, Washington, DC. Selected HAMMS drawings were reproduced full-size and published in seven volumes by the Ayer Company of Salem, New Hampshire in 1983.) HAMMS surveys worked from half-models and old drawings as well as extant vessels, and the records vary widely in quality due to the varied skills of HAMMS recorders and the frequent lack of convenient, adequate project verification data in the Survey drawings. Some of the Survey's weaknesses are undoubtedly due to its very short life span and consequent lack of time to refine and stabilize its methodology.

Since the close of HAMMS, hundreds of historic vessels have disappeared without adequate documentation. It is hoped that the HAER program will help prevent similar losses, and in many cases be a prelude to the physical preservation of many worthy vessels for posterity.

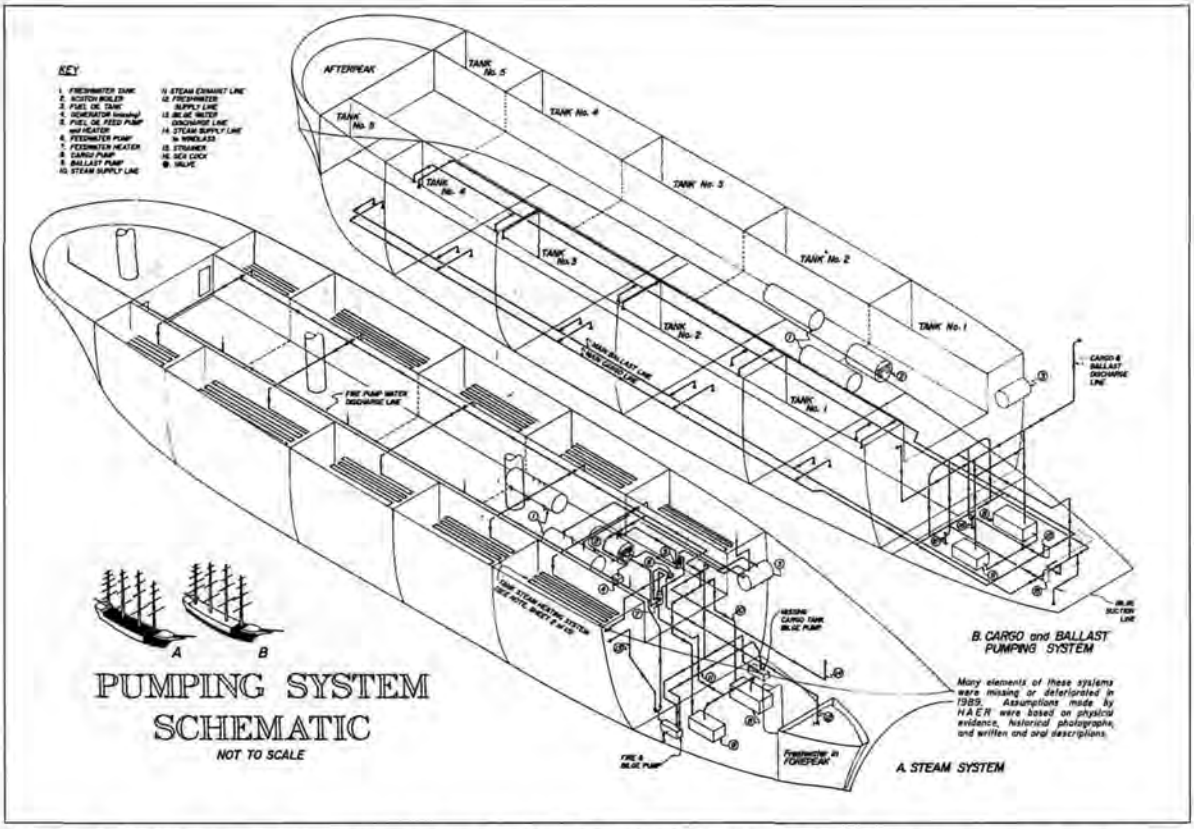
HAER Maritime Documentation

Each component of HAER documentation—drawings, historical reports, and photographs—has inherent strengths the others lack, so that an integrated "package" focused on a specific site or ship becomes a powerful documentary tool; the ship itself is examined and treated as a document every bit as important as historical records. Since all documentary efforts are necessarily selective and interpretive, the HAER guidelines help to elicit and capture the significant aspects of each vessel and present them as clearly as possible.

The main factor determining documentation practice is, of course, significance. HAER documentation focuses on large vessels of national significance as determined by national inventories, other suitable research, or designation by the Secretary of the Interior as national historic landmarks. This scope includes significant survivors of regional and local vessel design. HAER documentation is also site-specific, and records what is significant about each site and vessel. Where design is important—as it is expected to be in the majority of cases—hull shape and/or vessel construction and propulsion is highlighted as significance dictates. Measured drawings may not be required in some cases, since significance may inhere in some non-design facts, such as historical events or associations with important persons. Existing drawings and records



Lines drawings are probably the most definitive and widely used forms for delineating the shape of a vessel. A series of Cross Section measurements are made along the hull similar to slices in a loaf of bread. These sections are then connected with longitudinal lines called Water Lines and Buttock Lines that define horizontal and vertical planes respectively. A Table of Offsets lists the actual measured locations of points along the hull. From the lines or table of offsets a hull can be reconstructed in three-dimensional form. The use of photogrammetry to record the hull measurements saves considerable field time and cost. The drawing shown here depicts the lines of the 1907 ocean-going steam tug Hercules. *Located at the San Francisco Maritime National Historical Park,* Hercules *is a national historic landmark and remains in operating condition, serving as a museum ship interpreting themes of steam technology and San Francisco Bay history. Documentation was supported by the San Francisco Maritime National Historical Park. Drawing by Dana Lockett, 1997.*



Schematic or process drawings interpret a ship's systems or functions. Using axonometric, perspective, or illustrative techniques, HAER can graphically represent how a vessel operates, explain complex movement of cargo, or show how the vessel worked the water. Though often based on field measurements, this type of drawing relies heavily on the historical research component. Utilizing written documents and historic photographs or drawings, HAER delineators can illustrate processes no longer extant or in operation. The 1878 ship Falls of Clyde, *a national historic landmark located at the Hawaii Maritime Center, was originally operated as a four-masted square-rigged cargo ship. Converted to a sailing oil tanker in 1907, it carried bulk petroleum products to Hawaii and molasses back to California in the same tanks. This drawing illustrates the relationship of the pumping system to the complete vessel. Drawings by Todd A. Croteau, 1989.*

may also be sufficient to document historic conditions. Interpreting the vessel's function is also paramount to the understanding of its design and significance. HAER documentation describes the processes performed or the role the vessel plays in its environment.

In general, HAER documentation seeks to document vessels more than 30 feet in length that are floating, or in some manner laid up out of water (e.g., in a dry dock, on a marine railway, as hulks on a beach.). Half-models may also be considered. While documentation of small craft is encouraged and is not excluded from the HAER collection, HAER concentrates on the documentation of larger vessels, principally because they are more susceptible to loss. Small craft—vessels less than 30 feet long—tend to find their way into museums or other protective care much more easily than larger vessels.

The HAER Maritime Program also encompasses a variety of marine resources, in addition to specific vessels. Land-based, maritime-related sites can be documented for HAER using the traditional HAER approach. These sites include lighthouses, shipyards, transfer facilities, seafood industries, and many others. Documentation has also included archeological sites of maritime interest, whether underwater or underground. Preferred resources include substantially intact hulks, whether sunk, buried or beached, and for which contemporary documentary sources (e.g., records, photographs) can be found.

Technology for Drawing Vessels

Vessels possess few straight lines in their design and pose a difficult task for measuring with traditional techniques. HAER is utilizing emerging computer technologies to facilitate recording the complex curvature of ship hulls for lines drawings, expanded hull plans, and other features. Many vessels are surveyed while in dry dock with limited time available for measuring. The use of CAD, photogrammetry, Total Stations (or digital transits), laser scanning devices and three dimensional modeling programs has signifi-

cantly reduced field time for taking lines off a large ship from one week to two days. These tools make it possible to record vessels within a few hours, where tides, dangerous conditions, or other factors may affect field time. The drawback to many of these technologies is that the instruments can only record what they see, whereas the hands-on approach can overcome a variety of obstructions.

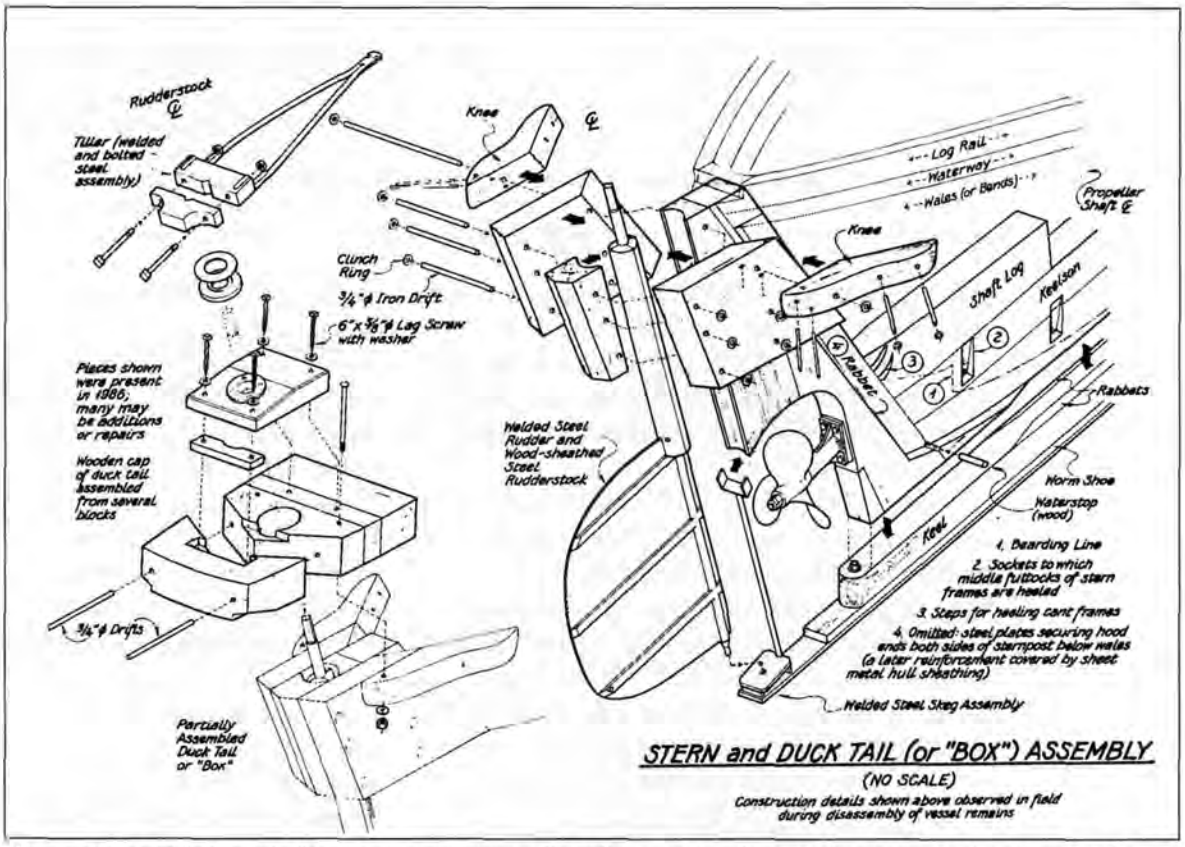
The Future of Maritime Documentation

Attempting to document a large variety of vessel types throughout the country, HAER partnered with the Council of American Maritime Museums (CAMM) in 1990 and developed the Sally Kress Tompkins Maritime Internship. CAMM and the Internship promote the documentation of maritime resources nationwide and encourage museums to take the lead in preparing these records. One such activity includes the cooperation of the Mystic Seaport Museum and South Street Seaport, which received a grant from the National Center for Preservation Technology and Training to purchase a Total Station, develop guidelines for its use on vessels, and make it available for use by CAMM member institutions and other qualified groups. HAER is participating in this grant and has recorded 10 vessels since its inception. HAER will continue to encourage contributions of water craft documentation from throughout the country to represent the diversity of America's maritime heritage.

Richard K. Anderson, Jr. is a former HAER architect now in private practice in Sumter, South Carolina.

Todd A. Croteau is an architect with the Historic American Engineering Record, National Park Service, Washington, DC.

This article was adapted from Richard K. Anderson, Jr., *Guidelines for Recording Historic Ships* (Washington, DC: National Park Service, 1995, second edition, reprinted by the Council of American Maritime Museums), with additional comments by Todd A. Croteau.



Construction details illustrate the various components, fastenings, and building techniques used in the assembly of a vessel. Regional differences are revealed by material choices and arrangement of parts such as frame futtocks. The 1896 Bugeye Louise Travers *was built by James T. Marsh who was known as the inventor of the "Duck Tail" or "Box" stern. A significant development in ship design, the Duck Tail Stern provided protection for the rudder assembly on sharp-sterned vessels. This vessel was recorded by HAER prior to and during demolition nearly a century after its construction. In 1986 it was considered beyond economical repair and was cut into three sections for study and subsequently burned...but not at sea. Documentation was supported by the Calvert Marine Museum and the National Trust for Historic Preservation. Drawing by Richard K. Anderson, Jr., 1990.*

Jet Lowe

Working the Lights

Photography, Documentation, and Coast Guard Buoy Tenders

Historians, architects, photographers, and industrial archeologists working in the field often use photography as a means for recording and understanding our industrial and maritime heritage. If our photographic interpretations are successful, the medium of photography can be instrumental in expressing as well as gaining understanding of the importance and significance of these resources. The photographic tools used for these purposes usually range from 35 millimeter single lens reflex (SLR) cameras to heavy 5x7 studio cameras such as those used by HABS/HAER photographers. For work not destined for the HABS/HAER collection at the Library of Congress, the large majority of professionals in our field use either conventional SLRs or, because of their ease of use and vest pocket portability, point-and-shoot cameras.

The technology of cameras and film in the last decades has improved, while the everyday skills of those using these more sophisticated instruments has declined. Part of the blame can be assigned to both the sophistication of the SLRs and snapshot cameras equipped with highly capable automatic metering, built in flash, and relatively decent but slow lenses. Due to the minimal mental energy necessary to produce an image that is at least properly exposed and focused, many of us shoot more film and think less about what we are photographing with these cameras. Turning this decision making over to the camera casts a veil between the person taking the picture and the genuine understanding and perception of the subject matter at hand. It is important, therefore, not to rely excessively on the camera to do our seeing for us, as the camera will always absorb more than we see with our own eyes. Documenting with a plan of action will always yield the greatest result in the often limited time available.

Professionals using photography to study a variety of cultural resources should use photography not as a tool to compress or lessen time in the field with the resources at hand, but rather as a means to decelerate and better absorb in some meaningful way our subject matter. The use of a large format 4x5 or 5x7 camera has a way of forcing this on the photographer. Each time the large format photographer sets up, he or she has to ask if this photograph is worth the five minutes or five hours necessary to create it. Although not all those working in the field have the inclination or constitution to conduct large format documentation, one can adopt a more deliberate large format approach in smaller formats and achieve more satisfying, useful, and publishable results. One way to go about making more deliberate photographs in the smaller formats is to use a tripod. Even most point-and-shoot cameras have sockets for tripods. In addition to slowing down the photographic process, use of the tripod will make it possible to shoot during much lower light levels than a hand-held camera will allow, with better results under a considerably expanded array of lighting conditions. The other positive effect of tripod use is to impose a more disciplined way of shooting, which benefits a photographer even when a tripod is not used. Whether using a tripod or not, try to be conscious of what is happening at the edge of the frame of all of your images.

Another simple question to ask oneself constantly in the picture making process is: "Why am I taking this picture?" There may be any number of answers to this question, which is a good sign. Asking this question will help avoid the mindlessness of a lot of photographs we are now seeing. This extra attention to a medium we have grown to take so much for granted will help answer another question: "So what?" By exercising greater care and attention to the way we make our images, we will be addressing that question by allowing the cultural resources we are seeking to preserve speak for themselves much more easily.

Before illustrating how this actual process might work in producing a set of photographs for the Historic American Engineering Record, I would like to encourage awareness of two major components of the picture-making process in documentary still photography. The first component is the craft and skill involved in the camera work. Extra care, whether with point-and-shoot or 8x10 will yield results that will not only provide more information in these images but will also help in the creation of more persuasive slides, measured drawings made from field photos, and general documentation. This extra focused attention might involve no more than a careful review of the camera's capabilities in the manufacturer's manual or it could mean taking a course in black and white printing, or it may mean carefully studying how the masters of the medium have historically framed their subjects.

The other equally important component of making useful images involves gaining as much knowledge as possible of the subject before getting in the field to shoot. On many occasions this is not possible and the field time taking the pictures often turns out to be an important investigative phase of our research. Nevertheless, research in advance of working in the field will sharpen your eyes on site. One should develop a strategy for each subject based on the time and budget to accomplish the photography. Be sure to allow some time to enjoy and absorb the area or subject before photographing so you can pace yourself to the time you have to work once you begin taking pictures. If photography is used to slow your visit rather than speed it up your comprehension of the resource can be immeasurably enhanced.

Working with a 5x7 view camera in the cramped spaces of a buoy tender definitely slows the speed of documentation. On the opposite page are a few photographs extracted from a series of around 50 images made of each of two Coast Guard buoy tenders, one in Mobile, Alabama, the other in New Orleans, Louisiana. We also studied two vessels moored at the Coast Guard Yard at Curtis Bay, Maryland, near Baltimore. The series of photographs of all four buoy tenders should illustrate the various adaptations made over time to very similar vessels. Three of the images on the following page are taken from the series studying *White Sumac*, of New Orleans. This vessel is scheduled to remain in commission for several years. It was thus fully outfitted for maintenance of close-in shore and coastal buoys and was occupied by a full crew at the time the photographs were made. Being able to document a vessel or technology in its viable as opposed to archeological state represented a rare opportunity for HAER. It was thus important to obtain as thorough a document as possible.

Each vessel required approximately 50 images to give a knowledgeable viewer an understanding of the shape, texture, and technology of a buoy tender. Average shooting time for each vessel was 2 ½ or 3 days, usually commencing in the forward sections of the vessel and working backward to the rudder details in the stern, complemented by a full set of exterior views. The pace was necessarily slow, but this slowness helped me considerably in the long run by providing me the extra time necessary to adjust to the shoot's complexity.

The buoy tenders included here started out as yard freighters with the U. S. Navy during the latter part of World War II. They were converted to buoy tending duties in the late 1940s and early 1950s. Buoy tenders are a class of vessels in the Coast Guard black fleet charged with maintenance of close-in shore aids to navigation, such as buoys, channel markers, and lighthouses. They are also versatile enough to handle some search and rescue tasks usually connected with natural disasters such as hurricanes. Like many engineering subjects, their tasks are taken completely for granted until these disasters, natural or otherwise, interrupt their function. These ships are as utilitarian as tug boats, yet their function is all important to the maintenance of smooth maritime commerce and recreation. HAER's photographic documentation helps to explicate this significance.

Jet Lowe is the staff photographer, Historic American Engineering Record, National Park Service, Washington, DC.

Photos on page 25 by the author.

White Pine *conducting maintenance work on midbay lighthouse in Mobile Bay. Crew is removing ladder from lighthouse for repairs.* White Pine *crane and winch are in foreground. To avoid getting in the way of a very active crew, this shot had to be taken without a tripod. Bright light enabled stopping down for depth of field while maintaining a relatively fast shutter speed.*

Two moored buoy tenders at the Coast Guard Yard at Curtis Bay in Maryland, White Holly *on the left and* White Sage *on the right. The black hulls are a way for the Coast Guard to designate the functional and utilitarian nature of its fleet that tends to lighthouses, buoys, gongs, bells, whistles, and most all maritime navigational devices. Note the different hull construction built around the same shape but probably reflecting construction in different shipyards.*

Working the Lights

Interior of hold #1 of White Sumac, *showing maintenance and replacement parts for buoys and navigational devices. The river buoys in the center of the picture are made of foam, damage-resistant to direct hits from ships. Based in New Orleans, this ship is responsible for maintaining aids to navigation along rivers and estuaries of the Gulf Coast.*

Left, buoy deck of White Sumac, *with crane controls in foreground, doubtless the single most important piece of equipment on the vessel. Buoys are lifted on to deck and lashed with chains seen over the hold in middle ground. A lot of the maintenance activity that can be done while still at sea, such as scraping barnacles, is done on this deck. Serious repainting and recoating of buoys is done in a shop back at the yard. This photo was taken from the starboard side of the exterior bridge deck Right, detail of #1 hold of* White Sumac *showing hull framing detail as well as storage of buoy lamps.*

Richard O'Connor

More than Cotton
Industrial Alabama

The mining and metal industries of the Birmingham District, the chemical and space industries of the Muscle Shoals/Huntsville corridor, the ubiquitous textile and railroad industries, and the native industries of cotton gin manufacture and brickmaking, suggest that Alabama's reputation as a bastion of southern industry is at least as important as its cotton heritage. In over 20 projects, HAER has developed an archive of historical reports, drawings, and photographs that testify to the diversity, longevity, and national significance of the state's industrial heritage.

One of the most important industrial regions in the state is the five-county area around and including Birmingham. Seven years ago in *CRM*, University of Alabama/Birmingham industrial archeologist Jack Bergstresser reported on the activities of the 1992 summer teams documenting the heritage of the Birmingham Industrial District, the first since the Sloss Furnaces project in 1976.* Cosponsored by the Birmingham Historical Society, under the direction of Marjorie White, teams of students and scholars recorded railroad lines, metal working industries, coal and coke works, and a variety of "less-traditional" engineering sites, such as company housing, and archeological remains of mine sites. The combination of infrastructure survey and extensive site recording established the primacy of iron-related industrial activity, and laid the foundation for additional work in the District.

Documentation over the next three years focused on the Birmingham District's rich metallurgical heritage. In 1993, HAER documented Tannehill, the state's first blast furnaces. Constructed originally in 1863, Tannehill's furnaces were destroyed two years later by Union forces, and were subsequently rebuilt in their original stone configuration. In 1995, a team recorded some of the newest iron-melting technology in the state, the electric induction furnaces of Southern Ductile at Bessemer. Housed in a historic iron foundry, Southern Ductile produces a general range of castings in ductile iron, an innovation dating from 1948 that yields iron far less brittle than that cast by traditional means. Stockham Valve, recorded in 1994, produced iron, bronze, and steel castings. This company was once one of the country's largest valve and fittings makers, but is now out of business.

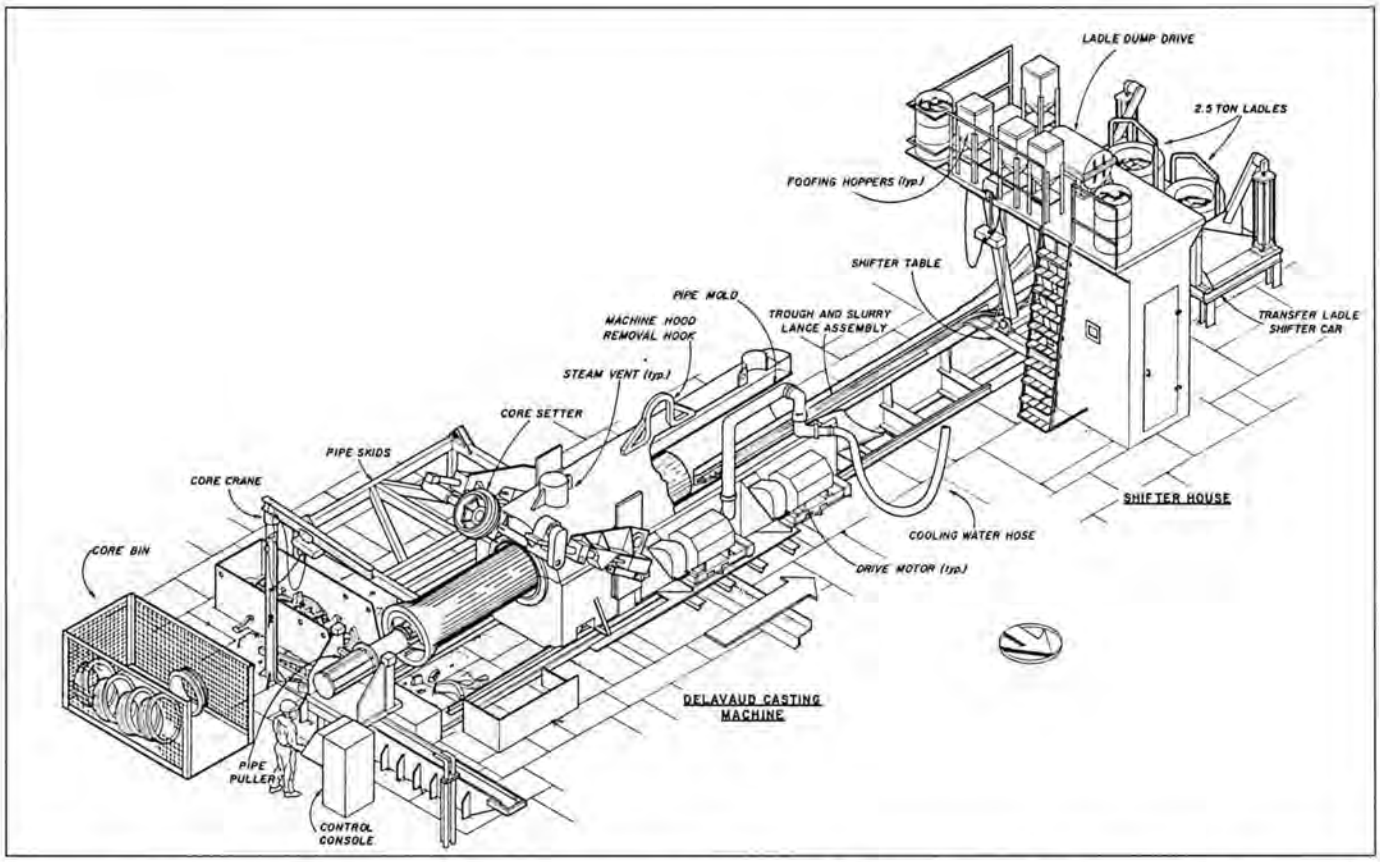
At U.S. Pipe and Foundry's Bessemer plant, HAER recorded in 1996 the evolution of cast-iron pipe production from pit to centrifugal casting. The Bessemer plant began pipe production in 1888, using the pit casting process and pioneered the development of deLavaud centrifugal casting in the 1920s. Documentation traced the evolution of cast-iron pipe production through a series of historic photos in the plant meeting room, production records, technical information, and physical evidence of jib crane supports and hot metal. Since U.S. Pipe owned and operated Sloss Furnaces for a good part of the 20th century, this project was, in effect, a continuation of HAER's first documentation in Alabama at Sloss Furnaces.

Simultaneously, federally funded industrial developments in water power, chemicals, and the space industry were recorded in a series of projects centered along the Tennessee River corridor. At Wilson Dam, built during World War I but part of the TVA system since the 1930s, HAER recorded a rare 1943 Oilostatic transmission system, 1927 oil circuit breakers, and a 1925 turbine, as the site was undergoing renovation and artifacts were being tagged for removal. Wilson Dam served as the primary power source for U.S. Nitrate 1 and 2, large plants planned to provide explosive-grade nitrates for World War I ordnance. Completed after the war ended, they later supplied nitrates for domestic fertilizers and ordnance compounds for World War II. HAER documented the nitrate production process at U.S. Nitrate 2 in 1994. In articles elsewhere in this issue, Tom Behrens discusses recording projects at Huntsville's Marshall Space Flight Center and Lisa Davidson describes aspects of Alabama's textile history encountered in HAER's Southern Textile Industry Project.

The 1997-98 documentation of Continental Eagle Gin Company and Guerney Mills, flanking Autauga Creek in downtown

Prattville, brought HAER to Alabama's earliest and longest-operating industrial sites. Daniel Pratt learned the art of cotton gin manufacture in Georgia in the 1820s, and founded the Pratt Gin Company on Autauga Creek in south-central Alabama the following decade. Bringing with him architectural skills and tastes cultivated in his native New Hampshire, Pratt built classic New England-style mill buildings—narrow, heavily fenestrated, post and beam, brick structures—with cast-iron lintels and sills from his own foundry. The oldest buildings in both complexes were built c. 1848. The 1854 dog-legged building in the Continental complex contains a unique radiating truss system supporting the ceiling of a postless third story. The project documented remains of several power systems, including waterwheel and turbine head-and tail-races, and shafts and pulleys, and determined that Continental Gin (successor to the Pratt Gin Company) operated for a time on power supplied simultaneously by water, steam, and electricity. A twin-blade 1870s Victor Water Turbine was located and documented at Guerney. Pratt's success in the gin business was significant for the later industrialization of the Birmingham area, where his son-in-law, Henry deBarteleben, developed extensive iron, coal, and real estate interests. The attention HAER brought to the Guerney Mill complex contributed to its recent purchase by a local group intending to rehabilitate and renovate the structures.

At Montgomery, the state's capital, preservationist Rev. Andrew Waldo called HAER's attention to the Western of Alabama (WofA) railroad shop complex, and an abandoned set of brick kilns. Among the earliest railroads in Alabama, the WofA was critical to the South's efforts in the Civil War, and was the central cotton and industrial goods shipper in central Alabama throughout the late-19th and early-20th centuries. The shop complex has been abandoned for over a decade, but is the focus of recent preservation efforts to establish a railroad museum. The bee-hive brick kilns of the Jenkins Brick Company, now operating modern tunnel kilns at a nearby North Montgomery site, were built in the 1920s by Georgia kiln maker M.M. Minter, whose systems of waste heat utilization connected kilns by labyrinths of tunnels, and were installed in brickyards from Quebec to southern Georgia. The Jenkins kilns are among



Axonometric of a deLavaud centrifugal casting machine producing cast-iron pipe, U.S. Pipe and Foundry Co., Bessemer, AL. Drawing by Eric S. Elmer and Jennifer Bruns, 1996.

the last remaining of this unique system. Kim Harden of the Alabama Historical Commission, Carole King of Landmarks Foundation of Montgomery, and Mike Jenkins of Jenkins Brick Co., all headquartered in Montgomery, helped with various parts of these projects.

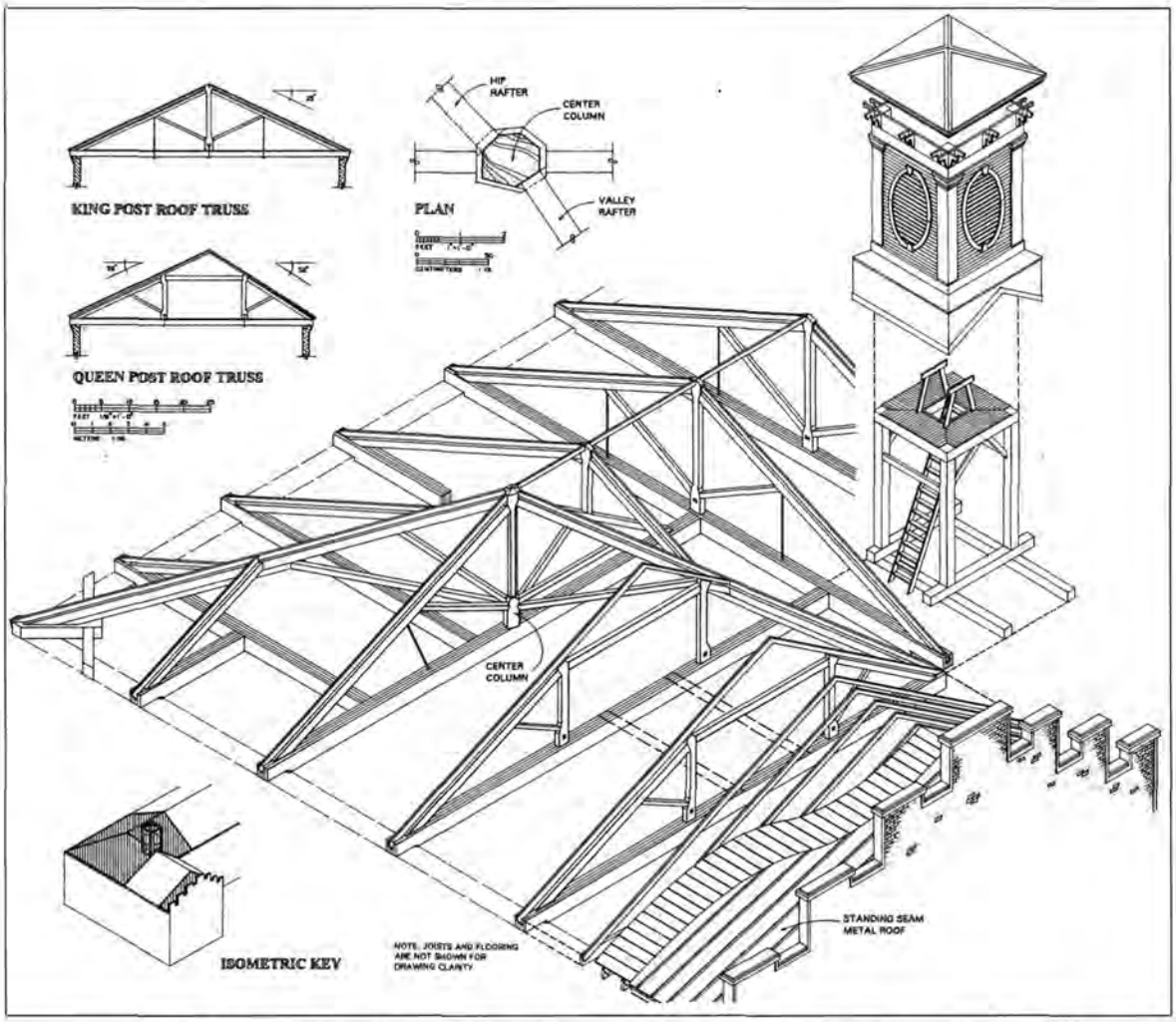
In several instances, HAER has taken a step back from intensive, site-based recording projects to concentrate on broader surveys and context studies. Marjorie White and the Birmingham Historical Society developed an extensive aerial survey of the District's industrial resources, with Jet Lowe, HAER staff photographer, and published *Birmingham Bound*, an extensive industrial atlas of the region, based on HAER documentation. Jack Bergstresser researched and wrote exceptional context studies of the Birmingham Industrial District's coal and iron ore mining, and blast furnace iron production, ably illustrated by architect Richard Anderson's detailed drawings. Finally, working closely with the Alabama Historical Commission, Georgia Institute of Technology historian LeeAnn Bishop Lands surveyed endangered industrial sites throughout Alabama, providing brief historical reports and field photos of sites considered at-risk. Hopefully, both the context studies and endangered sites survey will be prototypes for future projects in other states and regions.

HAER plans to continue recording Alabama's industrial heritage, with the surveys pointing to future intensive recording projects. Even after nearly a decade of recording in Alabama, the historic industrial resources of entire regions of the state have yet to be fully documented.

Note

* Jack Bergstresser, "Birmingham Industrial District," *CRM* Vol. 16, No. 3 (1993):21-2.

Richard O'Connor is a historian with the Historic American Engineering Record, National Park Service, Washington, DC.



Axonometric of 1854 building showing radiating truss at transition from king- to queen-post truss, Continental Gin Company, Daniel Pratt Cotton Gin Factory Complex, Prattville, AL. Drawing by David Gole, 1997.

Christopher Marston

Allegheny Oil Powers

Documenting Endangered Cultural Resources in Allegheny National Forest

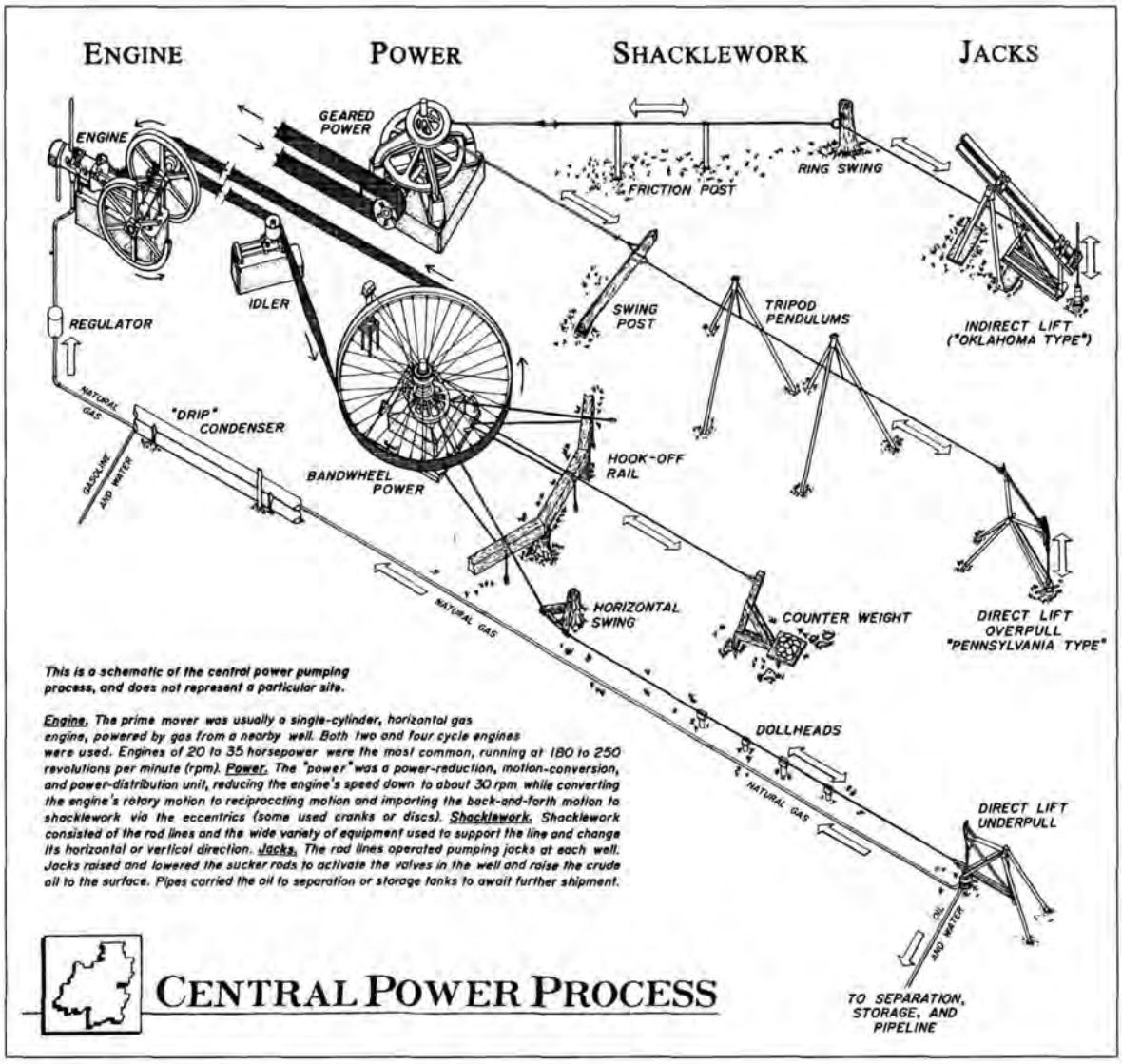
When Col. Edwin Drake drilled 69 1/2 feet through rock and sand to tap oil trapped below Oil Creek, Pennsylvania in 1859, it signaled the birth of the modern oil industry. Oil and petroleum would soon become so useful a product that transportation, technology, and society would never be the same again. But what are the monuments to the beginnings of this industry, and are any of the thousands of pieces of equipment used for the drilling, pumping, barreling, and piping of oil documented or preserved for future generations? While the Commonwealth of Pennsylvania has created an outdoor museum with several operable artifacts at the Drake Well Museum, few examples are preserved *in situ.* Some oil barons' houses and oil-related commercial districts have gained National Register status, yet few technological sites have received federal designation.[1] Until recently, the Historic American Engineering Record (HAER) had documented only a handful of oil sites.[2] Finally, in 1997, HAER received authorization to document six historic oil pumping sites within the boundaries of the Allegheny National Forest (ANF), and entered into a tripartite agreement with Allegheny National Forest and West Virginia University's Institute for the History of Technology and Industrial Archaeology (IHTIA).

The HAER team approaching the Lockwood powerhouse. Photo by the author.

A four-county, 500,000-acre federal reserve, Allegheny National Forest is located in the heart of oil country, just up the Allegheny River from Oil Creek, the site of Drake's Well. The Oil Creek field was the first of several fields in western Pennsylvania to be drilled for oil, part of an oil seam that stretched from New York to Tennessee known as the Appalachian Field. The particular grade of oil in this region became known as Pennsylvania Grade crude oil, a high-grade, higher-gravity oil, which became a valuable lubricant for automobiles, airplanes, and other industries. The region boomed from 1860 to 1900, an era when Pennsylvania led the nation in oil production. While other fields rose to maturity elsewhere in the country, the northwest Pennsylvania region sustained a relatively small but profitable share of production into the 20th century. Oil wells had originally been pumped by a single oil rig per well, each of which required a "prime mover," usually a steam engine, to power the machinery, or "string of tools," to drill and pump through rock to recover the oil. A "central power" utilized only one prime mover, and distributed power to pump 8 to 15 different wells at a time. Previously abandoned wells were made economically viable again with the development of central powers, a regionally-significant operation that dominated secondary oil recovery technology from the 1880s to the 1940s; some managed to stay in production well into the 1960s and 1970s. The remains of these central power complexes remain scattered throughout the landscape in northwestern Pennsylvania, and it was these artifacts which became the central resource in the HAER documentation project.[3]

The HAER project focused on six representative central power complexes dating from ca. 1890 to 1940. The sites were treated with level-one HAER documentation: measured drawings

The central power pumping process operated in a variety of ways in the northwest Pennsylvania oil fields, as shown by this schematic. Drawing by Eric S. Elmer, 1997.

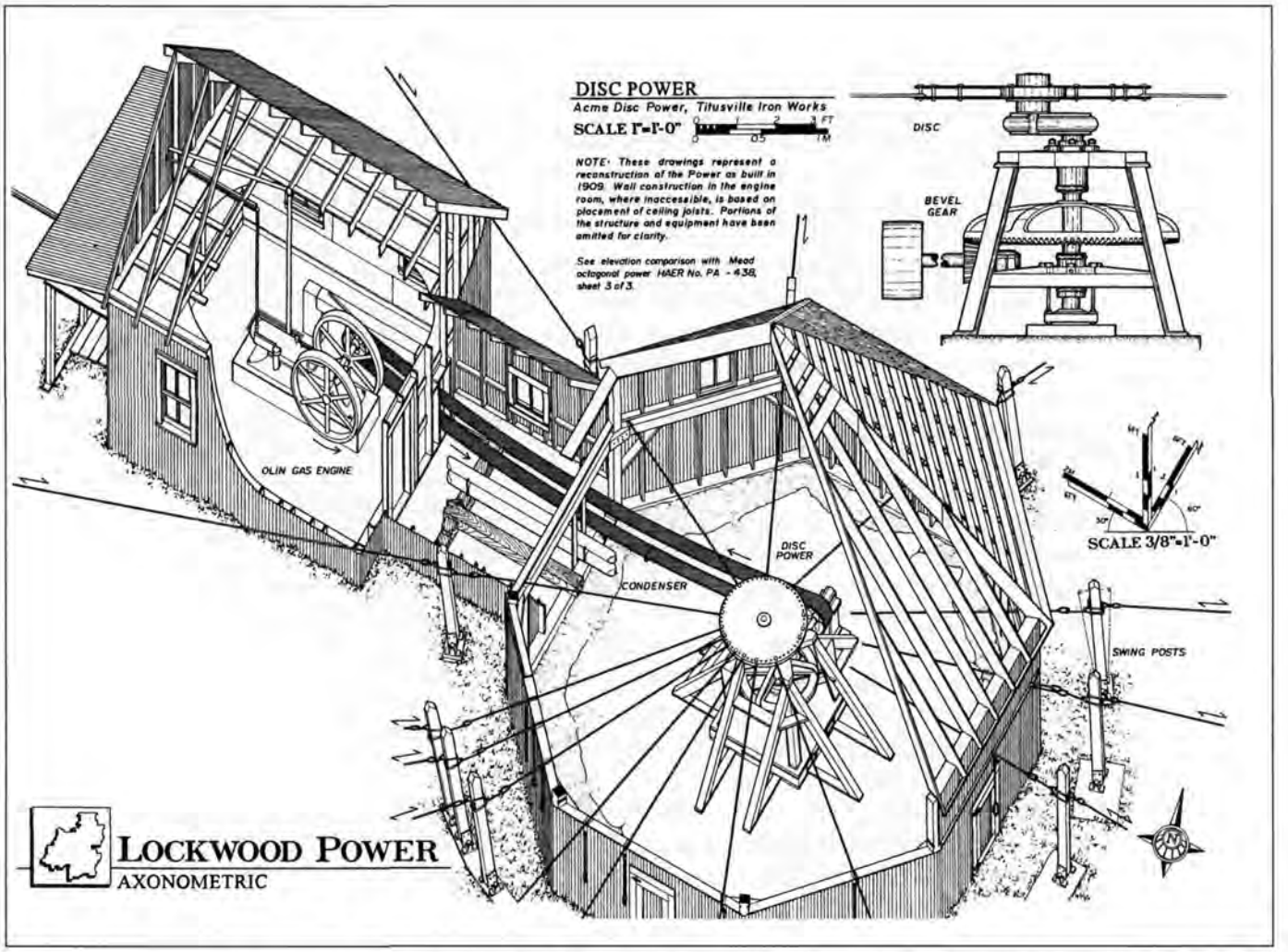


of all machinery and structures, large-format photographs, and historical reports, all placed within a larger historical context that located extant artifacts in the development of the history of petroleum production, especially in its roots in northwestern Pennsylvania. These sites were deemed to be of the highest structural integrity following the results of a 1995-96 cultural resource survey of thousands of artifacts—rusting jacks, rod lines, tanks, engines, and powerhouses scattered throughout the forest—led by ANF Heritage Resource Program Leader Rick Kandare, and historian Phil Ross.[4] The survey canvassed the entire four-county forest, looking for five structural features:

- powerhouse structure—enclosed and protected the machinery from the elements
- prime mover—gas or hybrid (converted steam) engine
- power—a power-reduction/motion-conversion/power distribution unit
- shacklework—a system of rod lines and supports radiating out over the landscape
- pumping jacks—connected by rod lines, located over each well

Of these, only about 20 sites had the full five features, and six of these were chosen as representative examples, each showing differences in structure or technology.

The central power complexes operated on the same general principles. A prime mover (gas engine) supplied power to a central power (either geared or bandwheel) which slowed down the engine speed while converting the engine's rotary power to reciprocating power, as eccentric gears produced a back and forth motion on 8 to 15 rod lines radiating out from the power. These rod lines were a component of the shacklework extending up to a mile out from the central power, where they connected to pumping jacks located 1,500 to 2,000 feet above pre-drilled pools of oil. The jacks activated valves in the



An axonometric view of the Lockwood Power (built in 1909), near Warren, Pennsylvania, showing the spatial relationship of machinery to structure inside a typical octagonal power. Drawing by Eric S. Elmer, 1997.

underground wells and raised the oil to the surface where it was stored in tanks.

While each site had similar features, each had differences in the machinery, structure, or type of power, reflecting the fast pace of change in technology during this 50-year period. The Geer-Tiona Power (HAER No. PA-441) is the oldest surviving structure (c.1890), and features a 12-foot handmade wooden bandwheel operating up to 8 rod lines, built on an angled foundation that lay parallel to the sloped hillside. Golden Oil Power (HAER No. PA-440) features a structure sheathed with lap-wood siding and a corrugated roof comprised of three sheds linked together dating from 1920. The ca. 1900 Lilly gas engine is a hybrid, having been converted from a steam engine by the addition of a new cylinder. It drove a bevel-geared Bessemer Co. power, with two overslung crank and gear eccentrics working 8 rod lines. Lockwood Power (HAER No-437) was constructed in 1909 by the South Penn Oil Co., operating until 1960. It features an Olin engine and an Acme disc power, which actuated 8 rod lines. Mead Power (HAER No. PA-438), also built by South Penn in the same period, operated 11 wells and used a Franklin valveless engine to run its Titusville geared double-eccentric power. Both Lockwood and Mead powerhouses feature a unique octagonal form over the central power unit. According to the project's historian, Michael Caplinger, this highly aesthetic form was relatively easy to construct, provided spacious access around the circumference of the power, and was sheathed in corrugated tin siding. The eight-sided triangular roof panels formed a rigid, sectional cone, which proved a superior rigid form to withstand high winds and heavy snows in the region's harsh climate. Mallory Lot 6 (HAER No. PA-436) dates to 1939 and is housed in a long rectangular shed. The largest survivor, its Cooper-Bessemer gas engine ran an 18-foot steel bandwheel power with underslung eccentrics. This site has been preserved by ANF and is open to the public. By far the most accessible of the six sites, Mallory has been renamed "The Old Powerhouse" and its

equipment has been repainted and labeled with interpretive signs.

The field team included Eric Elmer, HAER (U. Cal-San Luis Obispo); Paul Boxley, Scott Daley, Kevin McClung, IHTIA architects; Arturs Lapins, ICOMOS architect from Latvia; John Nicely, IHTIA photographer, and Michael Caplinger, IHTIA historian. This author served as project leader with Phil Ross providing onsite expertise. The drawings were designed to show the relationship between the machinery and the structure, and included comparative plans, sections, elevations, and details, as well as cutaway axonometrics. Photographs documented each site in its current condition, from exterior and site views to machinery details. Select historic photos were also included. Historian Michael Caplinger wrote an overall contextual history of the oil industry in Pennsylvania, as well as historical reports on each site.

Oil leases continue to operate on Allegheny National Forest and other sites in the vicinity. Today, these wells are pumped by electrically-operated pump jacks which are much more economical and less maintenance-intensive than central powers. However, it not hard to find a vestige from the central power-era nearby, a reminder of the significance of an era and the importance of documenting a vanishing element of our nation's oil heritage.

Notes

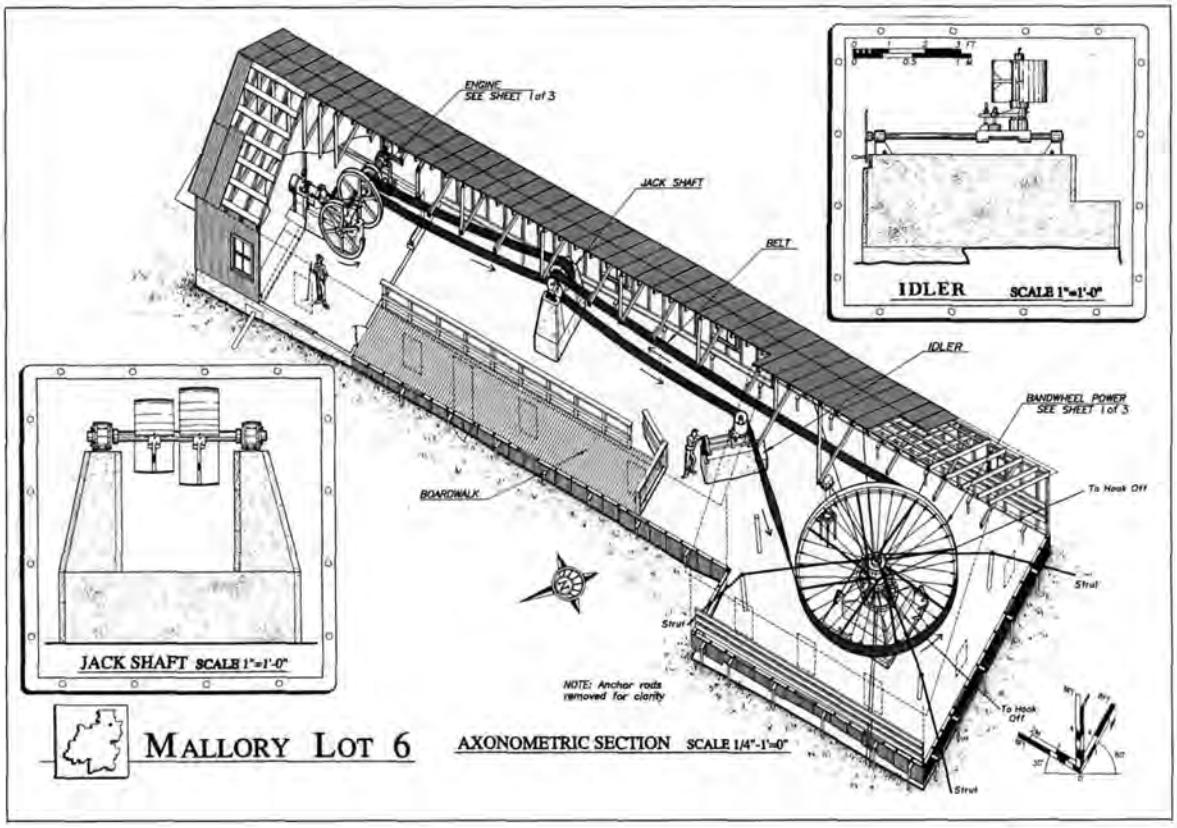
1 Coolspring Power Museum and Bradford Oil Museum in western Pennsylvania also house historic oil equipment. However, all these artifacts have been moved from their original site. The Drake Well is a national historic landmark.

2 U.S. Department of the Interior, *Historic American Engineering Record* (HAER), No. WV-9, "West Oil Company: Endless Wire Pumping Station," Prints and Photographs Division, Library of Congress, Washington, DC.

3 For further information, see Michael Caplinger, U.S. Department of the Interior, *Historic American Engineering Record* (HAER), No. PA-436, "Allegheny Oil Heritage Project: A Contextual Overview of Crude Oil Production in Pennsylvania," 1997, Prints and Photographs Division, Library of Congress, Washington, DC.

4 The results of this survey were used as primary documentation for Ross' book, *Allegheny Oil: The Historic Petroleum Industry on the Allegheny National Forest* (Warren, Pennsylvania: United States Department of Agriculture, Allegheny National Forest) 1996.

Christopher Marston is an architect with the Historic American Engineering Record, National Park Service, Washington, DC.



The bandwheel of Mallory Lot 6 Power, near Klondike, Pennsylvania, has been preserved as "The Old Powerhouse" by Allegheny National Forest and is open to the public. Drawing by Arturs Lapins, 1997.

Thomas M. Behrens

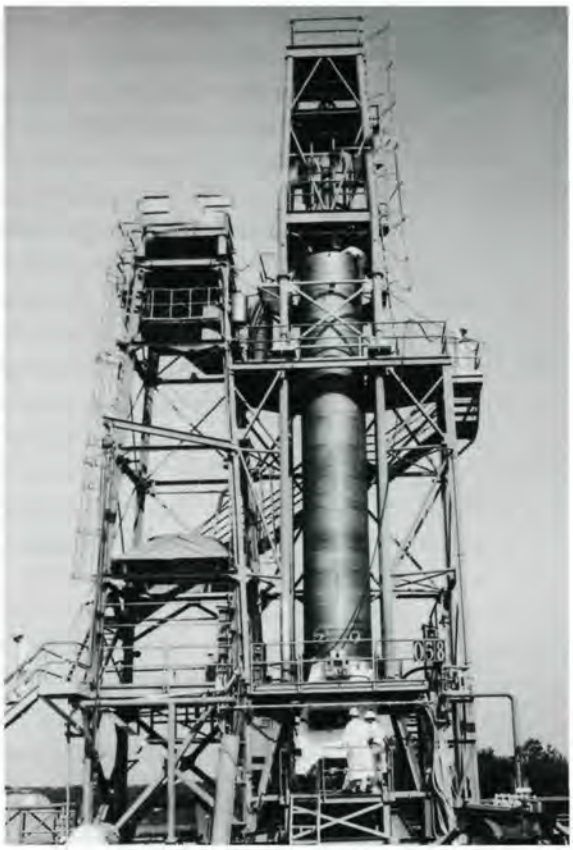
Small Steps and Giant Leaps

HAER Documentation of Static Test Facilities at NASA's Marshall Space Flight Center

On May 5, 1961, the eyes of the nation, and much of the world, focused on Cape Canaveral, Florida. The United States launched a Redstone rocket booster, sending a Mercury capsule containing America's first astronaut into space. On July 16, 1969, the world's attention again turned to Cape Canaveral (now called Cape Kennedy) where a mammoth Saturn V booster assembly was launched. The Apollo 11 mission was on its way to fulfilling the nation's commitment of landing a man on the moon and returning him safely to the earth before the end of the decade. The quest for the moon captured the nation's imagination and the astronauts became instant American heroes. Lost in the shadows created by this limelight were the brilliant and dedicated scientists and engineers who turned the theories behind sending humans into outer space into reality.

Almost 30 years later, the contributions of these unsung heroes of the early American space program were the focus of an intensive documentation effort by the Historic American Engineering Record. During the summers of 1995 and 1996, HAER conducted two documentation projects at NASA's George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. Both of these projects focused on the documentation and interpretation of the static test stands and related facilities where liquid rocket engines and booster assemblies were developed and tested.

Throughout the summer of 1995, HAER documented the Redstone Rocket Test Stand. The development of the Redstone rocket was one of the military's programs to design and test liquid propelled missiles. This static test stand was also referred to as the "interim test stand" because it was constructed as a temporary facility to be used while the slow bureaucratic procedures for the funding and construction of a permanent facility were in process. Constructed by the Army in 1953, the interim test stand and observation and control tanks were very modest facilities due to fiscal constraints. Very little money was spent on construction, and the majority of construction material was salvaged from surplus equipment at the Army's Redstone Arsenal, which would later encompass the MSFC campus. The interim test stand was expanded on an "as needed" basis, again using salvaged material, and continued to operate through the transfer of the rocket research and development program from the U.S. Army to the newly formed NASA in 1960, and ended several months after Alan Shepard's flight into space in 1961. By the time the testing program moved to the facilities at the East Test Area, originally designed for the devel-



Historic photograph of the east elevation of the Interim Test Stand. Engineers and technicians are seen preparing the booster assembly for a test run in May 1957. Photo courtesy NASA-Marshall Space Flight Center, photographer unknown.

The static test tower in the East Test Area, Marshall Space Flight Center. The first stage of a Saturn I booster is on its side to the right of the static test tower. Photo by Jet Lowe, 1996.

opment of the Redstone booster, the next generation booster design, the Jupiter/Juno rocket, was nearing completion and ready for static testing.

The East Test Area was documented by HAER during the summer of 1996. Dr. Wernher Von Braun, director of the rocket development team, had recognized that the political process involved in getting large facilities built could be slow and cumbersome. Because of this insight the East Test Area was over-designed and planned for easy expansions to meet future needs. Even with the larger rocket engines already into the research and development phase, the transition to the East Test Area was seamless as a result of the forethought that went into the design of the new facilities. Subsequent modifications and expansions were made with relative ease as the space program expanded and the focus of its mission became clear. Operations at the East Test Area began with the testing of a Juno booster assembly with a maximum thrust of 150,000 pounds and ended with the testing of a single engine for the Saturn V booster with a maximum thrust of 1.5 million pounds. Adaptations to the East Test Area were swiftly made to accommodate rapid developments in liquid rocket propulsion.

Documenting these sites at MSFC presented challenges both common and unusual for HAER documentation projects. Most documentation projects undertaken by HAER which deal with science and technology have to go beyond simply recording the historic resource. These recording projects need to include a significant level of interpretation to explain engineering concepts to the general population. It is often necessary to explain a process, assembly, or operation of the resource being documented in order for the historic significance to become clear. Typically, the sites that HAER has documented in the past interpret an industrial process where raw materials enter the process, proceed through several stages, and a finished product emerges at the end. However, the documentation at MSFC involved interpreting a research and development process in which the end product was knowledge, which was then taken as "raw material" back to the beginning of the process. This type of process is more challenging to convey because it is a continual process of learning and testing new ideas. Although the association of these sites with such defining moments in the nation's history as the Apollo 11 moon voyage relieved us of having to convey their historic significance, it was still necessary to explain through words, graphics, and photographs a process that had no clear beginning or end, but was so critical to the success of the Man In Space Program. The relatively young age of the site assisted us in our endeavors. Both of the MSFC facilities that HAER documented were less than 50 years old. Normally the sites HAER documents are at *least* 50 years old and more often over 100 years old. The historical significance of the facilities was part of the reason for this deviation and enabled us to conduct interviews with many of the engineers and technicians who worked in these facilities and obtain first-hand accounts of the activities that occurred during the research and development of the rocket propulsion systems. Recording such a modern site has also provided a potential to expand our primary documentation to include historic motion picture footage. NASA filmed many of the static test firings as another form of monitoring for later analysis and through the generosity of MSFC, HAER was able to copy several of these tests onto video tape which will be included in our documentation package.

When HAER documents sites of historic engineering significance that are still in active use, we have the challenge of trying to capture the moment of significance amidst constant change. The young age of the facilities again helped. Within the disciplines of science and technology, evolutionary leaps forward occur rapidly. When we wait for sites to become his-

toric, strictly from a chronological standpoint, they become much more difficult to understand and interpret as a significant cultural resource. Evidence of significant events or technologies are consumed by newer technologies and processes. Progress and innovation are the keys to success in these fields. However, these priorities are contradictory to conservation and preservation efforts. Although HAER's focus is on documentation and interpretation, we are keenly aware of the delicate balance between preservation and progress in the engineering fields. Practical considerations of efficiency, productivity, and the need to remain competitive, coupled with advancements in technology, often overshadow concerns of preserving our cultural heritage. Through our documentation we try to raise the level of awareness and sensitivity to our technological heritage, hopefully inspiring efforts in which conservation and advancement coexist.

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Justin M. Spivey

Engineering Methods in Historical Research

How does it work? This is a question frequently asked in preparing HAER documentation, especially when a site or structure derives its historical significance from function rather than form. Historians and delineators consult technical literature and solicit expert advice to bolster their understanding of unfamiliar technological artifacts. But what if the artifact is equally unfamiliar to an expert in that technology? When researching the Lower Bridge at English Center, Pennsylvania, built in 1891, historian Mark M. Brown noted that its appearance resembled both a suspension bridge and a truss. Upon asking three engineers to characterize its behavior, surprisingly, he received three different answers. Taking an unusual opportunity for in-depth engineering study, HAER solved this mystery. During the summer of 1998, Dario A. Gasparini, Thomas E. Boothby, Stephen G. Buonopane, and I analyzed and load-tested the Lower Bridge.[1] Our work shows how quantitative analysis can enhance documentation by providing information to reveal the designer's intentions, evaluate the success of the design, and place it in a context of engineering technology and creativity.

The Lower Bridge's design was appropriate to methods and materials available in 1891, and therefore foreign to the different circumstances of modern engineering and construction. According to Donald Friedman, structural engineer and author of *Historical Building Construction,* "Advances in analysis and design were so rapid, especially before the 20th century, that a few years' difference in the date of construction could make a tremendous difference in a building's structure."[2] This is no less true of bridges. Modern analysis, while capable of determining an older structure's behavior, must be informed by the original designer's knowledge and intentions. Period textbooks and design manuals tell only what the academic community thought about structures, but the question remains how much of this information was incorporated into actual conceptualization and design.

In the case of the Lower Bridge, records identifying the designer or describing the design process have yet to be found. Without direct documentary evidence, we had to "reverse engineer," or infer the designer's thoughts from physical evidence offered by the structure itself. Engineering is a subjective art, influenced by such inconsistent human aspects as skill, judgment, and creativity. While engineers use precise mathematical tools and objective scientific laws, they also make assumptions and approximations in predicting the behavior of complex systems. The effort of

shaping a structure, like tool paths on a metal part's surface, is often visible in the product. Reverse engineering makes it possible, and desirable, to critique a structure and evaluate its designer's knowledge and sophistication.

Engineers must make compromises among competing factors to produce an attractive, economical, functional, and safe design. The design process often begins with a listing of constraints. For the Lower Bridge, historical research identified some possible constraints. English Center, once a logging and tanning town, is located in north central Pennsylvania's Little Pine Creek valley. Spring floods on the creek transported logs downstream 30 miles to Williamsport. A particularly violent flood, however, destroyed English Center's Upper and Lower bridges in June 1889. Lycoming County commissioners selected Dean & Westbrook, New York engineers and contractors, to design and build new spans.[3] Records of the commissioners' quibbling over the number and cost of bridges, and the contractor's repeated requests for payment, indicate that budget was a controlling factor in the design. High material costs at that time pushed design toward material efficiency, even at the expense of complex fabrication. Rough terrain between English Center and the railroad in neighboring Pine Creek valley imposed another constraint, in the way of material transportation costs. Finally, because replacement bridges without piers in the creek bed would more likely survive future floods, the Lower Bridge needed to span 300 feet.

These constraints motivated the designer to produce a design that combines a suspension bridge's efficiency with a truss's stability. Catenary eye-bar chains, the defining feature of a suspension bridge, efficiently carry loads in tension. This part of the structure, while capable of supporting its own weight (dead load), is not stable under moving loads or wind (live loads). Stout vertical members and slender diagonal rods, resembling a truss, add stiffness and stability. The combination of suspension and truss systems is an indeterminate structure, meaning that the force carried by each member depends on the properties of all members. Exact analysis would be infeasible without a computer.[4] We set out to determine how, then, the designer might have conceptualized, designed, and devised an erection sequence for the Lower Bridge.

Our work began with a study of suspension bridge forms.[5] Suspension bridges are capable of spanning great distances because tension is a more efficient use of metal than compression or bending. But while a suspended chain or cable is stable for downward loads, upward loads are problematic. Observing that moving loads and wind tend to oscillate suspension bridges, engineers have long recognized a need for additional stiffening. Deck-stiffening trusses or girders have dominated popular and technical literature during the 20th century, obscuring a number of viable alternatives developed previously. Pittsburgh's Point Bridge, the country's fourth-longest span when completed in 1876, had stiffening trusses attached to its catenary chain. Alternately, the truss could run the entire depth between catenary and deck, a system used on the Lower Bridge. These two spans are reminders of alternatives to the conventional, deck-stiffened suspension bridge form.

In June 1998, we created a computer model of the Lower Bridge and conducted load testing of the actual bridge to verify the model. Using strain gauges installed on various members of the bridge, we collected data as a truck of known weight traveled across the span. We converted strain gauge data to force results, and these compared favorably against results from the computer model. We then analyzed the model with some of its members removed, to gain insight into how an engineer might have approached the structure in 1891. Late-19th-century textbooks suggested analyzing indeterminate structures as a combination of two parallel, determinate structures. This procedure is approximate at best, but entirely plausible for the Lower Bridge.

Lower Bridge at English Center, Pennsylvania, showing prominent catenary eye-bar chain and diagonal truss members. Photo by Joseph E. B. Elliott, 1997.

Detail of vertical member (labeled U11-L11 in drawing on next page), with strain gauges installed for load testing. Photo by author, 1998.

The Lower Bridge's designer likely first considered the bridge, without diagonal members, under dead load. Construction during the summer of 1891, when the creek was low, could have proceeded on temporary wooden scaffolding in the creek bed. If built from the deck up, the stocky vertical members would support the eye-bar links. Once connected to the towers, this system could support its own weight. Without the diagonals connected, it would be a determinate structure, free from stresses caused by members slightly too long or too short. The designer could have specified an erection procedure to take advantage of this. The next step is less certain because the diagonal rods were designed to allow tension adjustment.[6] If tightened while scaffolding supported the bridge, the diagonals would help carry forces from the bridge's own weight. It would have been safer to assume that the diagonals would not remain tight enough to help, however, leaving the vertical members to carry the entire dead load. Our analysis of the model without any diagonals shows that the force in the chain is fairly uniform along its length. This is characteristic suspension bridge behavior, which the designer seems to have recognized. Consistent with the uniform force carried under dead load, the chain has a constant size (and strength) across the span.

The designer would then have considered another determinate structure, adding only those diagonals that ascend outward from mid-span toward a tower. (Adding all diagonals would create an indeterminate structure. Although the remaining diagonals help carry asymmetrical loads, they would not be considered at this stage of design.) Regardless of when the diagonals were tightened, they would be responsible for the truss action that stiffens the bridge under live loads. Modern load-testing and analysis show that diagonals carry tension forces from a moving load up to the eye-bar chain, compressing some vertical members. Member sizes chosen by the designer are consistent with these forces, showing that he anticipated truss action. Diagonals increase in size (and strength) toward mid-span. Unlike the slender hangers on a conventional suspension bridge, which can take only tension, the Lower Bridge has stocky vertical members capable of taking compression.

This reconstruction of the design process illustrated the thought required to achieve this structure on a rural site in 1891. Rather than avoid structural indeterminacy, the designer used it to gain material efficiency. In its member sizes, this unique structure reflects its designer's sophisticated understanding of its behavior at various stages of completion. (Another round of modern analysis would determine the particular load cases and stress limits used to size members, and further assess the designer's knowledge and skill.) The Lower Bridge's stiffening system as built uses about 40 percent less material than would a conventional deck-stiffening truss of equivalent length and stiffness. Also, because the eye-bar chain carries tension, it does not need overhead lateral bracing as found on ordinary trusses. For a 300-foot span, this design creatively combines a suspension bridge's efficiency with a truss's stability.

Reverse engineering is a recent addition to HAER documentation, and it holds great promise for identifying and celebrating the human effort and insight behind America's historic engineered structures. Previous HAER engineering studies of bridges have involved structural analysis and micrographic analysis of metals.[7] This study is the first to include load-testing, and future studies might take advantage of technologies such as non-destructive evaluation of concrete reinforcement. These methods could enhance HAER documentation of other structures, including dams, canals, mills, and large buildings. Modern engineers could also help in documentary research, deciphering their predecessors' design notes or interpreting older methods such as graphic analysis of structures. Although engineering study can increase appreciation of structures as historic artifacts, many are still in active use, like the Lower Bridge. Hopefully engineering study will also increase understanding of how these structures work,

leading to maintenance and rehabilitation with due respect for the original designer's intentions.

Notes

1 U.S. Department of the Interior, HAER No. PA-461, "Lower Bridge at English Center," 1998, Prints and Photographs Division, Library of Congress, Washington, DC. HAER is grateful to the Pennsylvania Department of Transportation and the Pennsylvania Historical and Museum Commission for co-sponsoring this work. Gasparini is a professor of civil engineering at Case Western Reserve University; Boothby is an associate professor of architectural engineering at Pennsylvania State University; and Buonopane is a structural engineer with Simpson, Gumpertz & Heger in Arlington, Mass.

2 Donald Friedman, *Historical Building Construction* (New York: Norton, 1995), 8.

3 Dean & Westbrook replaced both Upper and Lower bridges in 1891. The Upper Bridge, demolished in 1932, resembled the Lower Bridge.

4 Determinate structures are considerably easier to analyze, even without a computer, because forces do not depend on member properties.

5 Gasparini, et al., "Stiffening Suspension Bridges," in *Proceedings of an International Conference on Historic Bridges* (Morgantown: West Virginia University Press, 1999).

6 As the bridge stands today, some diagonals are tight and others are loose, with no regular pattern.

7 The author knows of only three other HAER studies involving quantitative analysis: HAER No. IA-89, "Structural Study of Concrete Arch Bridges," 1996; No. IA-90, "Structural Study of Iron Bowstring Bridges," 1996; and No. PA-478, "Structural Study of Pennsylvania Historic Bridges," 1997. The last included the micrographic analysis.

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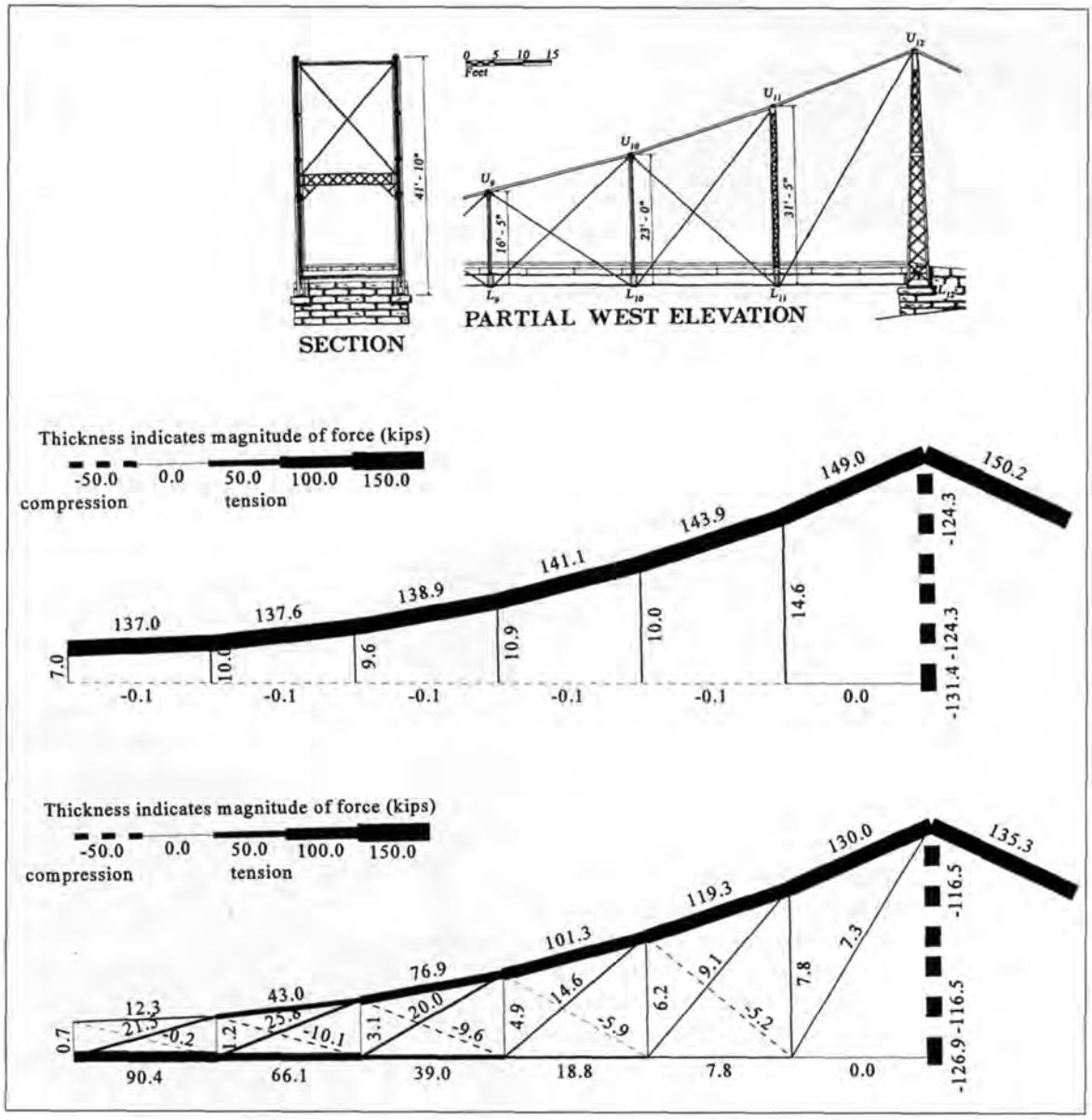


Top: Section and partial west elevation of Lower Bridge. Drawing by Jonathan Cherry and Michael Falser, 1997. Middle: Force results (kilopounds) from computer analysis of model without diagonal members, under dead load, showing nearly constant force in eye-bar chain. Drawing by author, 1998. Bottom: Force results (kilopounds) from computer analysis of model with diagonal members, under live load of 25 pounds per square foot, showing increasing forces in diagonals toward mid-span. Drawing by author, 1998.

Dana Lockett

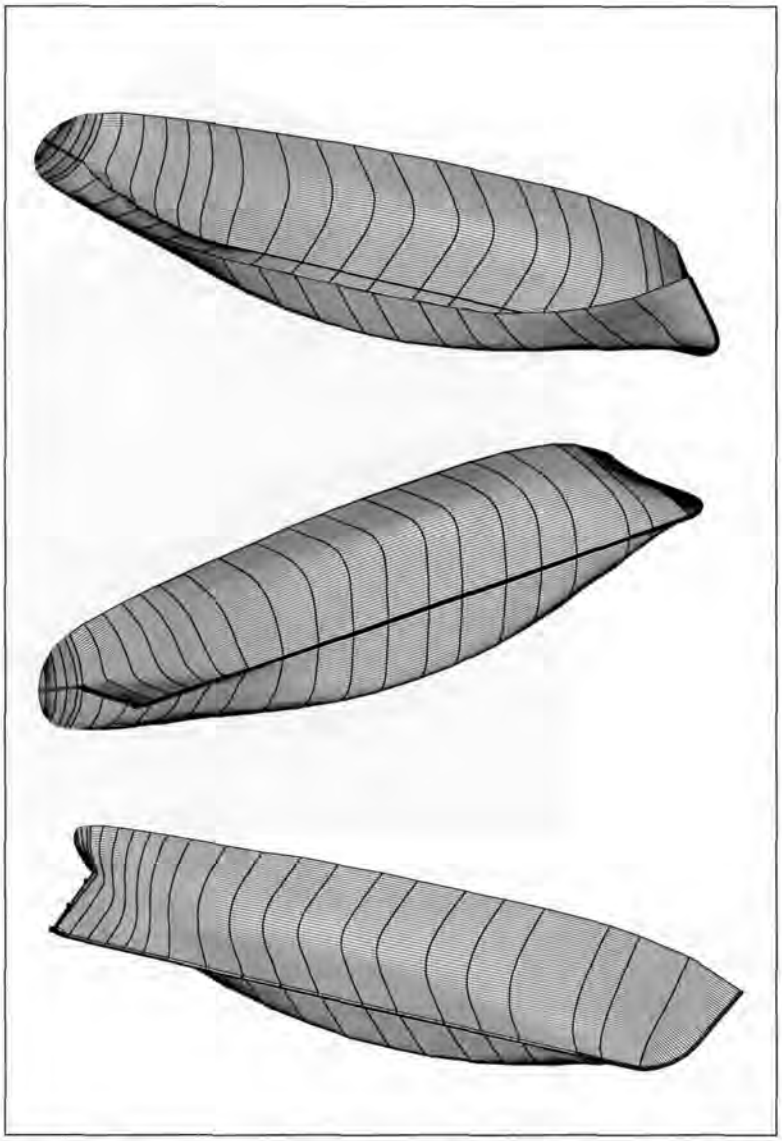
Recording Industrial Sites with CAD Technologies

The Linhof Metrika camera shown in this photograph was used to capture large format images of Eppleton Hall, *shown in the background, which were used in the photogrammetric process. The photographs were digitized to aid in the generation of AutoCAD drawings. Photo by Todd Croteau, 1995.*

As technologies advance, more and more architectural establishments are creating and storing digital data to distribute information to their clients and the public. In the summer of 1991, the Historic American Buildings Survey began its first documentation project, the Lincoln and Jefferson Memorials, to be completed solely with the use of computer aided drafting (CAD).* Shortly after this multi-year project was completed, the Historic American Engineering Record began using CAD technology on projects conducted in the Washington office CAD studio. As of 2000, in addition to the traditional hand drafting teams of students spread out across the country, HAER is operating selected CAD projects in temporary field offices staffed with student architects. HAER is embracing digital media and discovering new techniques that will allow the best documentation and interpretation of America's industrial heritage.

When HAER began documenting sites with the use of AutoCAD, the National Park Service's standard program for computer aided drafting, projects were most frequently delineated in the Washington, DC office, or occasionally contracted out to organizations with CAD capabilities. A team of staff architects would measure a structure or site and return to the office to create the set of drawings in a studio of workstations utilizing AutoCAD. The steam tug *Eppleton Hall* was among HAER's first structures to be drawn with CAD, in 1996. The San Francisco Maritime National Historical Park sponsored the project so that it would have a more comprehensive set of drawings. The vessel was measured by hand in the traditional manner and also with the aid of photogrammetry. Photogrammetry allows one to derive two- and three-dimensional measurements of a structure from a single or multiple photographs, greatly reducing time spent in the field. While still in the learning phase of photogrammetric techniques, HAER gathered information on the vessel in both manners to insure the collection of all necessary information and to abate the need for further visits to the site. Using PhotoCAD, a photogrammetric software that works inside of AutoCAD, and typical CAD drawing techniques, team architects were able to create a set of lines drawings and three-dimensional hull models to add to the existing set of plans and profiles, as well as a complete new set of drawings in digital format. Original drawings were scanned and then placed in AutoCAD files as raster images or converted into vector entities. The files were then placed in title blocks in the standard HAER format and plotted onto sheets of Mylar. Normally, HAER provides only hard copies of the drawings to sponsors, but with CAD, digital files will be delivered and used in facilities management programs or curatorial records as they can easily be updated to reflect changes without having to create an entirely new drawing.

Photogrammetry and AutoCAD were also used to help gather information and create preliminary drawings for a summer team of hand drafting architects at Big Bend National Park in Texas in 1997. The Mariscal Quicksilver Mine and Reduction Works was part of HAER's hard-rock mining initiative to document outstanding



The steam tug Eppleton Hall *(1914) was one of the first HAER projects completed with the use of computer aided drafting. These three-dimensional hull models show the form and curvature of the ship's hull from several views by capturing images of the same drawing from different angles. Drawing by the author.*

remains of America's mining industry. To aid the team during the measuring and drawing phase of the project, staff architects took photos of the site and researched existing topographical maps that could be used to create a three-dimensional model of all the structures and their relation to one another within the landscape. This model was created in AutoCAD before the team's arrival in the park so that team members could focus on individual structures, the actual process of extracting mercury, and the steps through which the substance moved through the site. Once the team had determined which views to use in final drawings, the three-dimensional model was rotated to a particular angle and plotted to allow hand tracing of the structures in their proper positions within the steep site. The details of the structures were then added to the drawings from information collected by the team.

Having completed several projects within the Washington office, HAER decided to extend its use of CAD into the field with a full team of student architects working at CAD stations for a three-month period. In June 1999, seven architects and one historian began documenting the Jenkins Brick Company and the Western of Alabama Rail Shops in Montgomery, Alabama, as the first CAD team to operate totally on site for HAER. In preparation for the project, computers and peripheral items were rented from a local company, tables and chairs were purchased to accommodate the CPUs with their monitors, and an office space with the room and electrical power to run the equipment was acquired from Old Alabama Town. One computer was set up with Internet access to allow team members to perform research and communicate with the Washington office while the other CPUs were equipped with AutoCAD, Release 14. The sketching and measuring phase proceeded until enough information was accumulated and drawings could be assembled. Existing drawings such as maps were scanned and placed into the CAD drawings eliminating the time it would take to redraw or trace this needed element. A scanner also provided a means of digitizing photos to be used in a photogrammetric program, PhotoModeler, that uses raster images, viewable on a monitor, to obtain three-dimensional points, lines, and surfaces of any given subject. With this technology, the team was able to photograph and retrieve information from roof trusses and large structures that were inaccessible to hand measuring. While three-dimensional drawings can be useful in showing multiple views of a single structure, this project's supervisor chose to include particular isometric views that best described the structures along with typical plans, elevations, and sections. The delineators' attention to detail and textures made this a remarkable set of drawings for the project's sponsors and for the HAER collection.

HAER is currently researching new technology that will facilitate the production of documentation while still adhering to its strict standards. As with any hand drawn project, CAD projects also vary widely depending on the delineators and their particular techniques used to create drawings. Programs are becoming more and more advanced with methods of drawing, limited only by the creativity and determination of the user. One innovation that has come to HAER's

attention is the development of three-dimensional laser radar scanning and imaging. Instead of scanning photos and using photogrammetry, the laser can scan the structure directly in the field and collect thousands of data points from which accurately scaled 3D drawings can be extracted. While the considerable expense of this system prevents HAER from taking advantage of it presently, laser scanning is a potential method of quickly gathering data in the field. Surveying technology has also progressed over the past few years. HAER has now purchased an electronic Total Station that can be used to survey the topography of the landscape as well as architectural features. The Total Station uses an infrared or laser beam to find distances between points or the location of a group of points relative to one another. This machine has been used to measure the lines or curvature of ship hulls at the San Francisco Maritime National Historical Park and also the fortified walls of Old San Juan in Puerto Rico. After points are gathered with the Total Station, the information may be downloaded into a CAD program to create a three-dimensional representation of the structure. With new courses in digital technology now being offered in universities and part of required curriculums, many students are coming to HAER with CAD experience that will inevitably lead to more projects being composed in a CAD environment, without excluding, however, all hand drawn components.

Note

* See Mark Schara, "Measuring Buildings for CAD Measured Drawings—The Lincoln and Jefferson Memorials," *CRM*, Vol. 16, No. 3, 1993, pp. 8-9.

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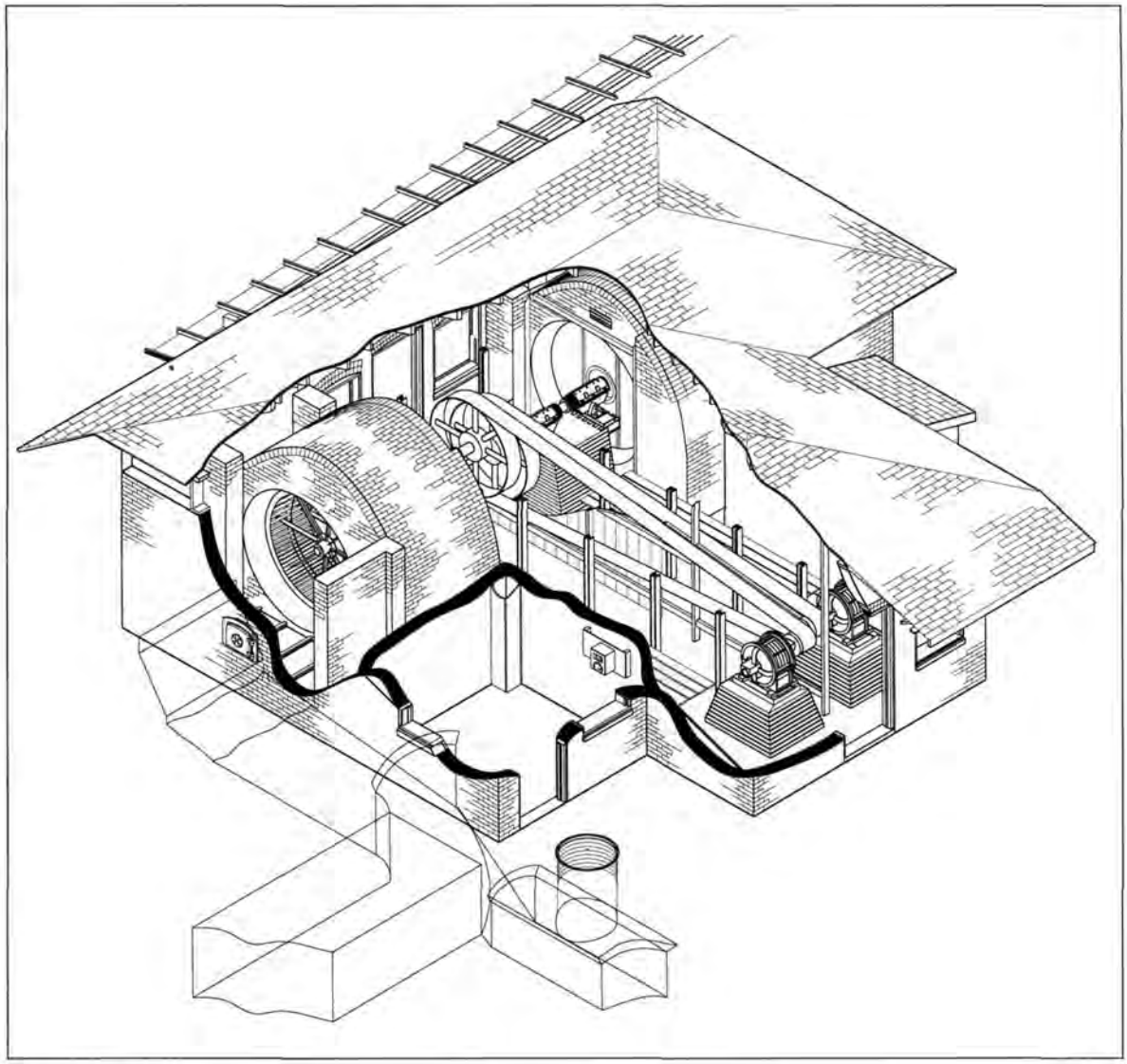


The Main Dryer Fan House at the Jenkins Brick Company (1906), Montgomery, Alabama, is one of few remaining structures still intact. This isometric cutaway of the fan house illustrates the delineator's attention to detail and the versatility of CAD techniques. Drawing by Sarah Goode, 1999.

Dan Bonenberger

The Institute for the History of Technology and Industrial Archaeology, and HAER

A Ten-Year Retrospective

As covered bridges go, the one in Philippi, West Virginia, was large, handsome, and quite historic. Union and Confederate forces had clashed at the bridge in the opening days of the Civil War. It survived the war to stand for nearly 130 years, but on a cold night in February 1989, the 1852 Philippi Covered Bridge burned. All around West Virginia, a state born of the Civil War, people mourned the loss of this cherished monument.

Within days of the fire, Governor Gaston Caperton announced that the bridge would be rebuilt to its Civil War condition. To complete the work, West Virginia University Provost William Vehse launched the Institute for the History of Technology and Industrial Archaeology (IHTIA) with Professor Emory L. Kemp at the helm. The arrangement came as no surprise, for in the preceding decades Kemp had established programs in the history of science and technology and in public history at WVU and had positioned the University as a regional center and national leader in preserving and interpreting the industrial foundation of American society.

The new institute had a clear and unique mission: research, teaching, and service in the history of technology, industrial archeology, and the preservation of historic engineering works. Now, at the close of its first decade, IHTIA has completed over 10 million dollars in projects sponsored by a broad array of private and public interests ranging from local historical societies to federal agencies. Among these, the greatest sponsor by far has been the Historic American Engineering Record (HAER), a program of the National Park Service, which has funded about one-third of IHTIA's work.

For 30 years, HAER has documented significant historic industrial sites and engineering structures with large format photographs, ink-on-Mylar measured drawings, and written histories. HAER documents sites with summer field teams comprised mostly of architecture and history of technology students supervised by professionals. These methods were refined by HAER's elder sibling, the Historic American Buildings Survey (HABS), which dates back to 1933. It was through this program that Professor Kemp had arranged and managed the documentation of industrial sites and structures in central Appalachia in the 1960s. These projects were different than most at HABS, for they not only documented structures but often interpreted processes. After helping to establish the HAER program, Kemp worked with Eric DeLony and others to explore new methods of industrial documentation and preservation. By 1975, HAER had completed motion picture documentation of the Seneca Glass Works and the Bretz Coke Works, two anachronistic industries in West Virginia's Monongahela Valley.

Throughout the 1990s, IHTIA and HAER helped pioneer new methods in industrial archeology using such tools as computer-aided drafting (CAD), close-range photogrammetry, the analysis of historic photographs with PhotoCAD to produce accurate restoration plans, and Geographical Information Systems (GIS) to produce more accurate and affordable maps and site plans. In recent years, both organizations have exploited the three-dimensional applications of CAD, and IHTIA has used a new ArcView GIS application to create three-dimensional representations of historic industrial landscapes. Many of these tools and methods have become conventional while others, like GIS, are attracting great interest.

Several of IHTIA's interdisciplinary staff of professionals and students have worked on HAER summer projects, normally in the role of historian or field supervisor. Likewise, former HAER summer interns have gone on to work at IHTIA's headquarters in Morgantown, West Virginia. Over the past decade, IHTIA has employed nearly 100 people, including student interns, graduate research assistants, post-doctoral and visiting fellows, and a wide range of profes-

The Philippi Covered Bridge was built as a link on the old Fairmont to Wheeling turnpike, modern U.S. route 250. The rebuilding of the bridge after a fire in 1989 helped launch the Institute for the History of Technology and Industrial Archaeology. Photo by John Nicely, IHTIA.

sionals including architects, engineers, historians, videographers, graphic designers, landscape architects, photographers, writers, and editors.

Where documentation is the primary mission of HAER, for IHTIA it is only a means to an end. As a unit of West Virginia University's Eberly College of Arts and Sciences, its mission goes beyond pure research and documentation to include service and teaching. Thus HAER-type documentation is completed as a step toward the preservation of important industrial structures and as an interpretive tool to enhance scholarly studies and public outreach in the history of technology. Aside from HAER documentation, IHTIA fulfills its mission by completing historical and industrial resource surveys, contextual histories, historic structure reports, historic landscape reports, historic furnishing reports, and national historic landmark and National Register of Historic Places nominations. It produces video documentation, designs brochures and exhibits, and publishes technical reports and historical monographs. IHTIA staff has helped in the stabilization and restoration of over three dozen structures, and has organized and participated in numerous conferences, seminars, and workshops. In addition, the staff has responded to nearly 500 requests for service, sharing resources and expertise in documenting, interpreting, and preserving America's industrial past with students, academic scholars, the general public, and private industry. It is feasible to talk in broad terms about the range of these projects and describe a few of the more intriguing efforts in some detail.

During its first five years, IHTIA focused mainly on the preservation and interpretation of sites in West Virginia, the Upper Ohio Valley, and the Mid-Atlantic region, but also invested a great deal of energy in its teaching mission. In the summers of 1992 and 1994, IHTIA taught its first field schools in industrial archeology and edited the text book, *Industrial Archaeology Techniques* (1995, Krieger Publishing). IHTIA hired an Associate Director for Education, Michal McMahon, to teach courses in the history of technology at WVU, Records Manager Larry Sypolt began teaching a course on archival management, and several staff historians collaborated with Professor Barbara Howe to teach segments in public history courses. Today, WVU offers courses in the history of science, the history of technology, industrial archeology, public history, historic preservation, archival management, historic site interpretation, environmental history, and a variety of related disciplines.

Because of the many inquiries about its work, the Institute makes copies of some project reports available to the public through its Technical Report Series. This series includes landscape documentation and restoration studies, historic structure reports and a historic furnishing report, a structural analysis of the patented Bollman suspension truss, oral histories of early-20th-century oil and gas workers, an archeological and historical survey of a historic turnpike, and a historical context for coal mining in northern West Virginia. In 1992, IHTIA established a monograph series with *The Alexandria Canal, Its History and Preservation* and followed two years later with *Cement Mills Along the Potomac.*

Among the most notable of IHTIA's early outreach efforts was the Society for Industrial Archaeology's (SIA) annual conference and tour, held in 1993, in Pittsburgh, Pennsylvania. In partnership with HAER and the SIA Three Rivers Chapter, IHTIA helped organize the conference and paper sessions. Dr. Kemp and his associates at WVU had organized the SIA annual meeting in Wheeling in 1988, along with the accompanying *Wheeling Port of Entry, An Industrial Guide.* This was followed in 1992 by the extensive industrial survey of Fairmont, West Virginia, which included documentation of over 70 industrial sites in this historic coal mining, railroading, and manufacturing center, resulting in the publication, *Industrial Fairmont, a Historical Guide.*

In 1995, the Hay Creek Valley Historical Association, a non-profit group of over 1,000 enthusiasts, hired IHTIA to help them restore the 1798 Joanna Furnace complex. After com-

The Vance Farmhouse (c.1854) at West Virginia University, headquarters for the Institute for the History of Technology and Industrial Archaeology. Photo by John Nicely, IHTIA.

pleting field measurements, IHTIA produced a series of five drawings documenting the extant remains of the iron furnace and related structures. In 1996-97, the contract was renewed and IHTIA produced two restoration drawings that used supplemental measurements derived using PhotoCAD analysis of historic photographs. In the third phase, 1997-98, IHTIA produced two isometric drawings: an interpretive cut-away of the entire furnace complex showing the ironmaking process, and a detailed restoration drawing for the blower-engine house, the boiler, and hot blast stove. With the drive and enthusiasm of the dedicated Hay Creek Valley group, the next decade is sure to witness the full restoration of this historic site in the hills of Berks County, Pennsylvania, 50 miles west of Philadelphia.

IHTIA continued its work documenting, interpreting, and preserving historic transportation works with the 1997 publication of Michael Caplinger's *Bridges Over Time: A Technological Context for the Baltimore and Ohio Main Stem at Harpers Ferry, West Virginia,* that contains many historic photographs and drawings of the structures and sites around this crossing. It was followed in 1999 with Thomas Hahn and Emory Kemp's *Canal Terminology of the United States.* This heavily illustrated monograph, the first to explore the historic jargon of canal boatmen in the United States, was sponsored by HAER and the American Canal Society.

Nineteen ninety-nine was a busy year for IHTIA in organizing conferences and workshops. The 150th Anniversary of the Wheeling Suspension Bridge, the world's first single-span of over 1,000 feet, was celebrated with its restoration and an International Historic Bridges Conference attended by nearly 200 historians, engineers, and preservationists. The complete proceedings were published prior to the conference through a new relationship with West Virginia University Press. Senior Project Coordinator Lee Maddex organized the 1999 Ironmasters Conference at WVU. In addition to the many papers presented, the conference included a hot metal tour of Wheeling-Pittsburgh Steel's Steubenville South Works, and the LaBelle Cut Nail Plant, which still uses 19th-century machinery. Anachronistic industries like LaBelle were the focus of a workshop in Shepherdstown, West Virginia. IHTIA will expand a survey of anachronistic industries over the next two years and is placing the first year results on its web page. HAER provided seed money for the two conferences and underwrote the workshop and survey.

A decade of research has put IHTIA in a position to share its expertise on industrial works and trends on a national level. Much research over the past five years in particular has been completed with this broader focus in mind. In 2000, the Institute will complete the research to produce historical contexts for two of America's greatest industries: Michael Workman's study on coal and Maddex's on iron and steel. In addition, a recently completed set of measured drawings exploring coal mining techniques in both the anthracite and bituminous fields should prove valuable to students of the U.S. coal industry. Larry Sypolt's *Preservation Resource Guide for Public Works Professionals* was financed and published in 1998 by the American Public Works Association and the National Center for Preservation Technology and Training (NCPTT). His *Civilian Conservation Corps: A Selectively Annotated Bibliography* will be published in 2000 by Greenwood Publishing Group, and his historical context on CCC construction is also nearing completion.

IHTIA's work on the historic oil industry began with a local project, and like so many others, has expanded broadly. This started with a study of the endless wire system of the Volcano field, near Parkersburg, West Virginia. Oral history interviews were recorded in 1993 in northwestern Pennsylvania where the U.S. oil industry began. Four years later, IHTIA returned to the region with HAER to complete a series of 14 measured drawings, focused mainly on the old power houses that remain in Allegheny National Forest. In 1999, IHTIA traveled to Ontario, Canada with a field team and is currently completing a series of seven drawings that explain and

interpret the anachronistic jerker-line system of pumping oil that operates on the Charles Fairbank property in much the same manner as it did in the 1880s and using much of the original equipment. IHTIA is organizing an industrial archeology field school in Ontario for the summer of 2001 to further document and interpret this surviving historic industry, and it has also begun writing a historical context for 19th-century oil pumping in North America to share this work with a wider audience.

The Institute continues documenting and interpreting 19th-century turnpikes and roads with work on the Midland Trail and the National Road. In 2000, IHTIA will complete its fourth project for the Midland Trail Association, producing several short interpretive videos in collaboration with the Walkabout Company. These vignettes, interpreting the intrinsic qualities of this southern West Virginia highway, will be shown in a series of roadside kiosks. Next in the IHTIA Monograph Series is the long-awaited analysis by former IHTIA Associate Director Billy Joe Peyton of the construction of the original stretch of National Road, from Cumberland, Maryland, to Wheeling, West Virginia. This work will feature photos and measured drawings completed by IHTIA along with images of artifacts, including early photos, drawings, and written documents discovered during the Institute's historical resource survey.

The National Road entered the Ohio River Valley by crossing the mountains that make up the watershed of the upper Potomac Valley. Later in the century, the Baltimore and Ohio Railroad and the Chesapeake and Ohio Canal were built along similar routes in the Potomac corridor, competing for commercial dominance in central Appalachia. These three routes served as the conduit of settlement and directly influenced the economic development of the region. As we enter the 21st century, they are being rediscovered as a means of economic development through the public's growing enthusiasm for heritage tourism. Much of IHTIA's decade of research on the transportation corridor will be disseminated on the Internet.

The historic structures and sites recorded by HABS/HAER and IHTIA, those on the National Register of Historic Places, and those designated as national historic landmarks will be entered into a GIS database along with significant engineering works. The data will be displayed via an Internet web page that is being produced in cooperation with the Resource Management Division of the WVU College of Agriculture, Forestry, and Consumer Sciences. It will serve as a tool for heritage tourists and a model for developing similar tools for other regions and routes. This comes on the heals of another collaborative effort among branches of WVU. IHTIA has worked for years with the WVU College of Engineering and its Constructed Facilities Center developing new non-destructive testing methods for historic structures and the use of Fiber-Reinforced Polymers (FRPs) in the rehabilitation of historic structures. FRP rods were seamlessly integrated into the historic beams of the Barrackville Covered Bridge during its recent restoration, and FRP decks have been approved for two pending projects.

As IHTIA enters its second decade it will continue to seek new ways to fulfill its mission. It will continue its relationship with HAER, using the traditional methods of industrial archeology and preservation, exploring new technologies, cooperating with other branches of the National Park Service, other units of WVU, and with the Library of Congress. It will continue to seek new partnerships and contracts with other agencies, public and private, that are working toward similar goals.

Dan Bonenberger is Chair of the Board of Directors for the Institute for the History of Technology and Industrial Archaeology, West Virginia University, Morgantown, West Virginia.

The 1904 Thurmond Depot of the Chesapeake and Ohio Railroad in the New River Gorge of West Virginia. HAER documented the site in 1988. IHTIA followed with historic structures and furnishings reports in 1992. Photo by Robert J. Hughes, 1990.

Ellen M. Delage

The International Connection

HAER and the US/ICOMOS International Summer Intern Program

In 1983, US/ICOMOS cosponsored with HABS/HAER an international seminar on architectural and engineering documentation. US/ICOMOS, the United States Committee of the International Council on Monuments and Sites, is one of 100 national committees of ICOMOS, the international, nongovernmental organization dedicated to the preservation and conservation of the world's cultural heritage. US/ICOMOS fosters heritage conservation and historic preservation at the national and international levels through education and training, international exchange of people and information, technical assistance, documentation, advocacy, and other activities consistent with the goals of ICOMOS.

Out of that collaboration grew the idea to work together on a regular basis through the HABS/HAER summer field teams. The pilot year of the US/ICOMOS International Summer Intern Program was 1984. Four young architects from Canada and Japan were placed on HABS teams; the next year the program expanded significantly with six participants from the U.K. and Germany, all assigned to HABS teams, and an equal number of U.S. interns heading out to those same countries. It was in 1986 that the first interns worked with HAER, and this has become the numerically strongest partnership and a highly successful one. The Program has grown over 17 years to include internships with NPS regional offices and parks, as well as other nonprofit organizations, and a long list of exchange countries. At the end of 1999, 387 interns from 51 countries had participated in the Program.

Since 1986, US/ICOMOS interns have been a part of the great majority of HAER teams across the United States. They have participated in all areas of HAER's exploration of new fields: maritime documentation, historic bridge projects, iron and steel industry, roads and parkways, hydroelectric and railroad projects. In this way the interns have been exposed to two principal features of HAER documentation: process and context.

"But I'm an architect," is often the applicant's response to the offer to join a HAER team for the summer. Soon, however, the US/ICOMOS intern learns the unusual nature of the work of HAER and the uniqueness of its objectives in the context of a national program of cultural resource documentation.

Why is this partnership a good thing? The US/ICOMOS International Summer Intern Program fills a need in the profession and renders a service to participants and to sponsors. The Program is a unique educational effort that extends the network of education, international exchange, and understanding to the next generation of preservation professionals. The Program

Wang Bing, from China, was a team member on the New York State Historic Bridges Survey, 1994.

Albert Aflenzer of Austria, measuring part of a gold mill at Bald Mountain, South Dakota, 1992.

benefits the global community by insuring a continuing dialogue between nations, by internationalizing preservation education, and by introducing young members of the profession to the intellectual and practical network that will continue their education and help them to find creative solutions to the conservation problems that they encounter in their daily work.

The total immersion in a foreign culture, the daily interaction with colleagues in a professional setting, the hands-on work—all these elements contribute to a more profound professional and personal experience. Neither a classroom setting nor a thoughtfully constructed travel itinerary can offer the same opportunities.

"The US/ICOMOS internships are the Fulbrights of the preservation world," according to Eric DeLony, Chief of HAER. "I had the opportunity to accept a fellowship after completing my studies at Columbia University to study the history of the industrial revolution in the U.K. I returned from England with a completely different view of what our heritage is." The importance of this experience and its impact on the development of his career, DeLony believes, explains his personal dedication to the US/ICOMOS program and his eagerness to integrate ICOMOS interns into all the HAER teams.

In what way is the work of HAER different than it would have been without US/ICOMOS interns? How has the participation of the interns affected either the process or the product of HAER documentation?

Although some interns have previously participated in projects documenting industrial structures, both traditional and post-industrial, the HAER emphasis on process, not solely construction, is a new experience for most. The typical reaction of interns is surprise and disappointment at the discovery that an entire summer will be spent documenting a structure that is modern by their standards, and usually not an aesthetically pleasing one at that. Inadvertently playing the devil's advocate, the intern's plaintive "why are we doing this?" often leads to a deeper understanding on the part of the U.S. team members. The need to explain and justify a project forces the team members to think about their work on a different plane.

The need to illustrate process makes the collaboration between architects and historians all the more critical. This close consultation is also at times a new element. Historian Richard

Terry, from the U.K., worked on the Avery Island Salt Works Recording Project in 1989. "Working with architects on a recording project was something new to me. I have gained a deeper appreciation of drafting techniques which are readily transferable to my archeological work in England." The need to articulate verbally and graphically how something works stretches the traditional architectural view of documentation.

The immediate reaction of interns is not always one of incomprehension. On the contrary, the participation of interns from certain institutions and countries with a developed program of industrial archeology has brought a highly sophisticated and perceptive viewpoint to some projects. Interns from programs at the Ironbridge Institute in the U.K. and the Technical University of Vienna, for example, have brought unique perceptions and skills to the HAER teams.

An area where HAER has pioneered an aspect of landscape documentation is in its parkways and park roads and bridges surveys. In these projects, not only is the construction process of bridges exposed through peeling back the layers,

Oliver Schreiber of Austria, preparing a drawing of the Roebling Works, New Jersey, 1996.

but the engineering objects are seen as less than the sum of their parts. They are viewed in the context of the landscape that surrounds them.

Here, industrial archeology meets cultural landscape studies. Most international interns studying landscape architecture have experience in documenting historic gardens; a few have worked on rural cultural landscapes. The parkways projects force an examination of this new category of cultural resource where the importance of nature and of engineering are equal.

Describing her work to document Chickamauga and Chattanooga National Military Park, Anna Sniegucka of Poland explained, "For me, it was important to show how the new roads influenced the landscape. The [drawing] sheet analyzed the existing road system and illustrated the problems and potential of the park and its road system."

In general, US/ICOMOS interns are older and more advanced in their studies than their U.S. teammates. The HABS/HAER summer program and the US/ICOMOS International Summer Intern Program have evolved differently. While HABS/HAER has become an opportunity for relevant summer work for college graduates in architecture, landscape architecture, engineering and history, the US/ICOMOS program offers a range of different internships for participants with different skill levels and degrees of professional experience. A cordial competition between participants in the two programs, according to Tom Behrens, a HAER architect and US/ICOMOS Intern to Croatia in 1997, heightens the performance level.

There are other repercussions of this program. Cooperation with US/ICOMOS is a marketing tool for HAER, for example. The participation of US/ICOMOS interns also makes HAER an international activity of the National Park Service. The presence of international interns generates interest on the part of sponsors and helps to validate local support for the site in question. "For me, it was surprising to see how the local townspeople were interested in our work," Ms. Sniegucka explained. "The local paper printed information about the project and we were celebrities for the summer."

The partnership between HAER and US/ICOMOS is successful for many reasons. Katie Dugdill of the U.K. summed it up neatly:

> Taking part in the US/ICOMOS International Summer Intern Program gave me the opportunity to exchange ideas at an international level with other like-minded professionals in the workplace. The project allowed me to adapt my skills and knowledge of landscape design and develop further my ability to observe and record the landscape in a historical context. Indeed, it was a privilege to work for a highly-regarded institution, which has taken me one step further from university into the professional field. I was given the chance to contribute to the recording and understanding of a historic site and to sustain one of America's cultural legacies.

In the end, it's the caliber of the work and the success of the projects that validate this partnership.

Ellen M. Delage is the US/ICOMOS Director of Programs, Washington, DC. She has managed the International Summer Intern Program since 1988.

Keith Falconer

HAER, an Inspiration Across the Atlantic

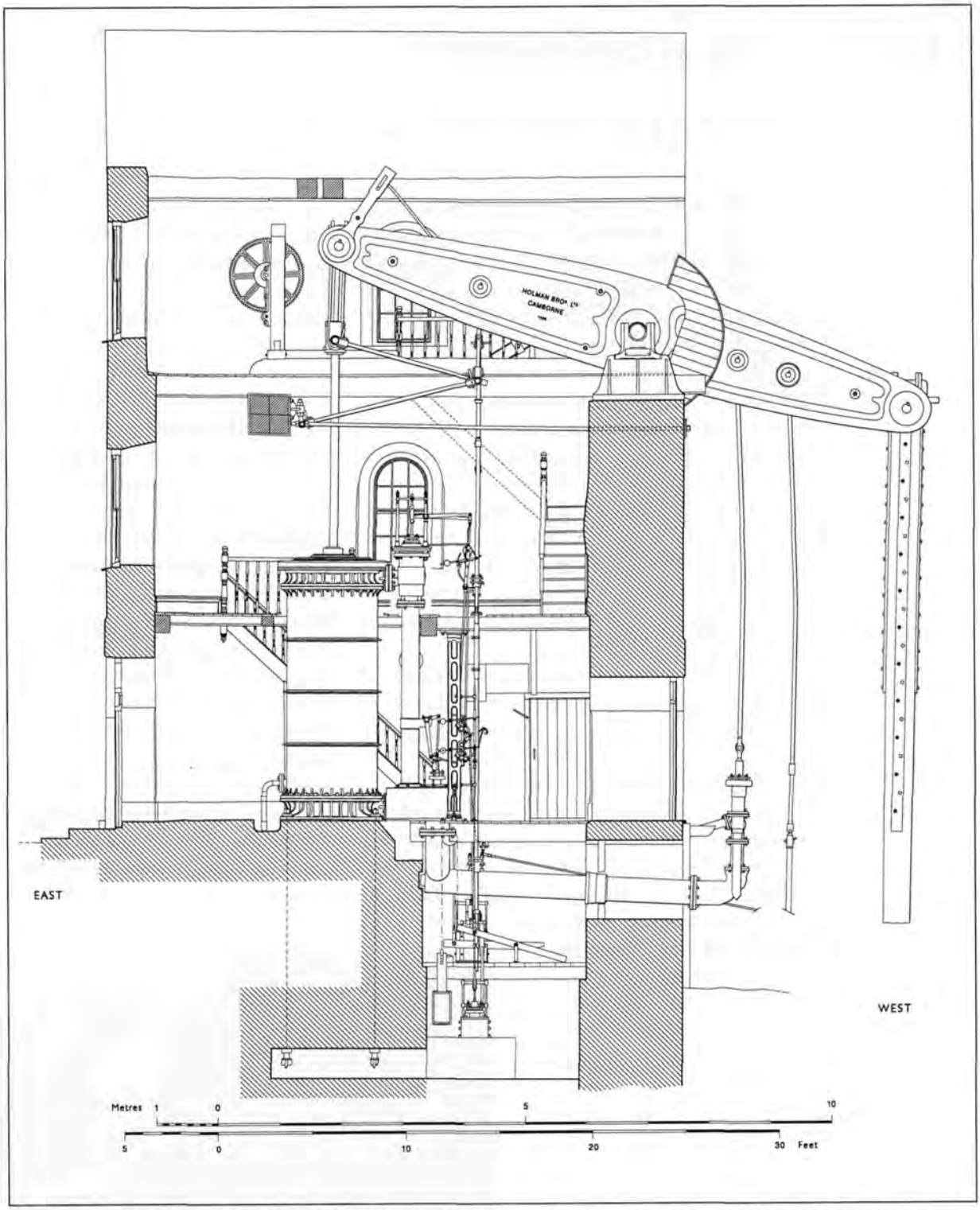
I seem to have known, and had a fond regard for, HAER all my professional life! When, in 1971, as a fledgling industrial archeologist, I was appointed to conduct Britain's Industrial Monuments Survey I was joined at the University of Bath by Eric DeLony. Eric, funded by a Fulbright scholarship, was on a year's leave from HAER to study industrial archeology in Britain and we were to explore the novel subject together. We attended the first British National Industrial Archaeology conference in Bradford, Yorkshire and traveled the length and breadth of the country looking at the iconic sites such as the Ironbridge, Coalbrookdale furnace, the Forth Rail Bridge, and a host of lesser sites—the stuff of the Industrial Monuments Survey.

Our host at Bath was the eminent industrial archeologist Dr. R.A. Buchanan who had done so much to set the subject on a national footing and was to be such a good friend of many of the founding fathers of industrial archeology in the United States. Since 1965, Angus Buchanan had managed the National Record of Industrial Monuments (NRIM), a collection of the rather basic Council on British Archaeology (CBA) 8 x 5 inch field cards designed as an aid to the Survey. Originally, the CBA had distributed some 30,000 cards to volunteers around the country in the hope that they would be returned for copying at the University of Bath and the original returned to the fieldworker. Copies would be deposited at the University, with the Survey in Beaconsfield, and with the National Buildings Record in London. The cards were arranged topographically and then by an industrial classification designed by Angus Buchanan.

However, disappointingly few of the cards were returned satisfactorily completed, as the format proved too small to contain much useful information, some were in pencil and some came with photographs attached. The geographical coverage was also very patchy. The state of technology of photocopying at the time was so primitive that many of the flimsy copies were almost illegible and the photographs just a blur, therefore these cards were never to be as useful a national database as had been envisaged. There were exceptions. Some cards were completed in exemplary fashion and contained line drawings, which copied well, and these cards have remained a unique source of historic information of sites often long gone. HAER learnt from the tribulations of the NRIM and was not to make the same mistakes with its record card system. The format was appreciably larger, the cards were completed by trained fieldworkers, and the original cards were retained. HAER also introduced a novel, cross-referencing retrieval system utilizing inventory cards with a pierced surround worked by rods.

At that time, in a typically *ad hoc* British fashion, the results of the Industrial Monuments

Nineteenth-century peg benches still in use in a Jewellery Quarter workshop in Birmingham, England. Inspired by the work of HAER photographers, this process record photograph is taken in a consciously 'image' fashion—quite different from the traditional architectural record view taken in years gone by. The peg bench in the foreground still has its original gas fittings, and techniques have changed little for two centuries. Photo by English Heritage, 1999.



A CAD-generated drawing of the Cornish beam engine brought to Goonvean in 1910 to pump Goonvean Clay Works in Cornwall, England. Surveyed using a reflectorless, Total Station EDM theodolite, the information captured electronically and by hand measurement in such an exercise can be manipulated and printed in 2D, at any scale and showing arrangement or detail as required. Drawing by N.R. Fradgley and M.J. Williams for English Heritage, 1999.

Survey were considered by a panel of experts drawn from various government agencies and national museums. In an arbitrary "thumbs up or down" procedure the fate of sites could be determined in a variety of ways. They could be recommended for protection as ancient monuments or historic buildings, they could be recommended for recording or museum preservation or could be consigned to the scrap heap. It was those recommended for recording that concern us here. Recording of historic sites on mainland Britain was the responsibility of the three Royal Commissions for Historic Monuments—one each for England, Scotland and Wales. These Royal Commissions had been founded in 1909 to compile an inventory of the nation's historic buildings and archeological monuments and for much of their existence had worked to a cut-off date of 1707—of not much relevance to most industrial sites!

By the 1960s, more recent material was being considered, and indeed, on this side of the Atlantic the Commissions in Scotland and Wales were leading the field in industrial recording, though only through the initiative of a few dedicated individuals such as Geoffrey Hay and Douglas Hague. In those two countries the recommendations for drawn recording did not fall on stony ground, but in England a few photographs had to suffice. The Scottish Royal Commission's magnificent book *Monuments of Industry* was published in 1986 as a celebration of Geoffrey Hay's pioneer work in this period.

Thus in the 1970s, how I envied the detailed recording of selected sites undertaken by HAER in its summer programs! Fortunately, this situation was to change when Dr. Peter Fowler was appointed Secretary of the English Commission in 1979. One of Peter Fowler's first acts was to have a Royal Commissioner appointed with specific responsibility for industrial archeology. In the event, Angus Buchanan was to be that Commissioner. The Industrial Monuments Survey and the National Record of Industrial Monuments were soon absorbed into the English Royal Commission and industrial recording surged ahead.

Faced with the vast task of recording an industrial culture that was disappearing before our very eyes, and with no tradition of organizing a cheap skilled workforce through summer programs as HAER does, the English Royal Commission had to explore other ways of effective recording. At the regional level, it supported surveys conducted by field staff recruited under the banner of the Manpower Services Commission (an unemployment relief scheme), and it collaborated with the local archeological units on thematic surveys of specific building types. In addition to professional academic advice the Commission provided photographic and survey drawing support to these surveys. Some of the surveys were to produce books that have since become classics of industrial archeology—*Liverpool's Historic Waterfront, East Cheshire Textile Mills, Cotton Mills in Greater Manchester, Yorkshire Textile Mills,* and *Workers Housing in West Yorkshire.*

Meanwhile, the Commission itself worked on a national canvas, focusing its resources on buildings threatened by alteration or demolition. With the products of HAER to provide a model to emulate, the Commission undertook the recording of some of the most significant industrial sites in the world—Ditherington Flax Mill, Shrewsbury, the first fire-proof iron framed textile mill; Arkwright's pioneer mills at Cromford; North Mill, Belper, the classic English fire-proof mill; and the magnificent iron framed Stanley Mills in Gloucestershire. This work has been summarized in the issue of *Industrial Archaeology Review* (Vol. XVI, No 1, 1993) dedicated to the Commission's work on the textile industry. This period was to see the transition from traditional hand survey and drafting techniques to electronic survey and CAD and today laser operated, reflectorless EDM surveys are translated on screen into fine line drawings or even 3D models. The Commission field photographers, inspired by the work of photographers such as HAER's Jet Lowe, have, over the last decade, also transformed their approach to photographic recording. The very fine, but neutral, recording of elevations and architectural details is now enhanced by adventurous images capturing people and processes.

The merger of the Royal Commission with English Heritage in April 1999 brings together all the main government strands in the documentation and protection of the industrial heritage. In the coming years, under the chairmanship of Sir Neil Cossons, an admirer of HAER and a lifelong friend of Eric DeLony, we can look forward to an exciting portfolio of industrial archeological recording and conservation initiatives.

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Eric DeLony

Thirty Years of Documenting Engineering and Industrial Heritage through HAER Publications

HAER was established to document America's engineering, industrial, and technological heritage with measured and interpretive drawings, large-format photographs, and written histories. The drawings, photographs, and histories, primarily compiled by student architects, engineers, and historians during the summer months, become part of the national collection at the Library of Congress, as an archive of our technological heritage. A review of publications by and about HAER reveals the program's evolution over the last three decades.[1]

The first publications were brochures providing basic information about the program, and catalogs revealing the riches within the collection—the types of sites, structures and objects recorded and the number of drawings, photographs and data pages produced. Standards and guidelines instructing field teams and others on compilation of documentation followed. Later, reports, articles, documentary films, and publications stemming from the projects were produced.

The first brochure was printed in 1970, a year after the program started, and updated in 1972, 1978, and 1990. Catalogs and listings of the sites, structures, and objects in the collection were produced in 1972, 1976, 1983, and 1985.[2] The 1976 catalog contained annotated entries for the 514 sites recorded as of the end of 1975. Currently, information on the HAER program and documentation can be retrieved online. The collection is being scanned and digitized as part of the Library of Congress' National Digital Library, and can be accessed through the Library's "Built in America" web page at <http://memory.loc.gov/ammem/hhhtml/ hhhome.html>.

Ten years after its founding, HAER published the first field guidelines. Simply titled *HAER Field Instructions*, these were updated and republished in 1996 as *Recording Historic Structures & Sites for the Historic American Engineering Record*. The field instructions are comprehensive and thorough, providing advice to field teams on analyzing and evaluating the site, and on the preparation of written reports, drawings, and photographs. They also cover coordination between the various disciplines working on projects, presentations to the client and the public, critical planning, and instructions for efficient field work. Nearly half the publication is dedicated to examples of HAER drawings, critiqued to explain what is desirable and what should be avoided. *Recording Historic Structures* was published by the American Institute of Architects Press in 1989. Profusely illustrated with drawings and photographs from the collection, it provides background information for both HAER and its sister program HABS, and includes a series of case studies of various documentation projects. Other standards and guidelines include *How to Complete HAER Inventory Cards* (1978), completed when the program was sponsoring statewide and area inventories, and *Guidelines for Recording Historic Ships* (1988), to promote documentation of the nation's floating vessels and other maritime resources, such as shipyards, marine railways, lighthouses and other navigational devices.

Selected HAER projects have been published, helping inspire recognition of the importance of industrial and engineering sites. The *Report on the Mohawk-Hudson Area Survey: A Selective Recording Study of the Industrial Archeology of the Mohawk and Hudson River Valleys in the Vicinity of Troy, New York, June—September 1969*, was published by the Smithsonian Institution Press in 1973. This report of HAER's first official project is now considered a classic, helping to establish industrial archeology as a separate discipline in the United States. Robert M. Vogel, then curator of Mechanical and Civil Engineering at the Smithsonian Institution, served as project direc-

tor. The report includes drawings, photographs, and histories of a wide variety of engineering and industrial sites, and provides important background information on the selection of sites, the costs of the survey, measuring and drawing time, private sector support, and methodology.

In 1973, *Great Falls/Society for Establishing Useful Manufacturers Survey: A Report on the First Summer's Work,* reviewed the results of one of HAER's first multi-year projects. This effort involved documentation of industrial sites along the three-tiered system of water-power canals at the Falls of the Passaic, established by Alexander Hamilton as a demonstration of his vision of America as an industrial society. In addition to the work in Paterson, HAER fielded multi-year teams in the former textile city of Lowell during the summers of 1974-1975. Both communities considered themselves "birth places" of the American Industrial Revolution, and in the 1970s there was much interest in promoting the revitalization of these depressed industrial areas as historic districts. The results of the two summers in Lowell were published in 1976 as the *Lowell Canal System.* Subsequently, the Great Falls SUM District in Paterson was designated a national historic landmark, and Lowell eventually became a national historic site administered under a federal, state, and local partnership. Both sites served as models for future endeavors to bring landmark designation to outstanding historic industrial districts, and for the concepts of industrial heritage corridors and areas. During the 1980s and 1990s, industrial heritage areas and corridors have been aggressively promoted in other depressed former mill towns, and industrial and transportation districts and corridors.

While pioneering new ways to look at large industrial districts, HAER promoted the concept of comprehensive area, state-wide, and subject inventories during the 1970s. Approximately a dozen inventory projects were published that covered water resources in the American Southwest (1973), and engineering and industrial sites in Florida (1973), Oklahoma (1974), New England (1974), Long Island (1974), North Carolina (1974-75), Delaware (1975), Cleveland, Ohio, (1975, 1978), Lower Peninsula of Michigan (1976), Upper Peninsula of Michigan (1978), Lower Merrimack Valley (1976), Rhode Island (1978), Connecticut (1981), and Boston (1984).[3] Inventories were designed to promote an awareness and inclusion of engineering and industrial resources within the state and National Register surveys being conducted by state historical societies and preservation offices. HAER also believed that, once engineering and industrial sites had been identified, documentation projects would follow, recording the most important and threatened sites. The inventory/documentation combination worked in North Carolina, Cleveland and Long Island, but not in the other areas, primarily due to lack of funding. Today, many states include engineering and industrial resources in their statewide surveys, but there still exists a need for intensive documentation of the most significant resources.

The last of the comprehensive inventory projects was undertaken in the 1980s and 1990s as part of a new Park Service initiative on industrial heritage areas and corridors. Heritage areas and corridors were the result of Congressional appropriations to revitalize depressed industrial areas through heritage tourism and other economic incentives. HAER was asked to evaluate and help define the character of these areas by inventorying the historic industrial resources. Two areas that received assistance from HAER were the Illinois & Michigan Canal National Heritage Corridor, a water route linking Chicago with the Mississippi River, and America's Industrial Heritage Project (AIHP), nine southwestern Pennsylvania counties focusing on the themes of railroading, mining, and the iron and steel industries. Today there are over a dozen designated heritage areas and corridors in the United States, many based on industrial and transportation themes. HAER work in some of the early

HAER Exhibit Opens Oct. 26, 2000

Celebrating 30 years of HAER engineering heritage documentation, the National Building Museum (405 F Street, NW, Washington, DC 20001)—with funding from the ASCE, the National Park Service, and other leading engineering firms and individuals—will mount a comprehensive 3,000-square-foot HAER exhibit curated by Laura Greenberg. After hanging in Washington for six months, the exhibit will travel throughout the United States to science and industry museums, historical societies, schools of engineering, and other locations. Along with the exhibition, HAER, the Building Museum, and ASCE are planning a symposium on engineering heritage documentation. This will be a retrospective review of engineering heritage documentation and preservation over the last 30 years and what may be anticipated in the future.

heritage areas and corridors resulted in a series of publications and in-depth recording projects.[4] HAER spent three summers, 1985-1987, recording engineering, architectural, and industrial resources in the I&M Canal corridor, and nine years, 1987-1995, in AIHP. Sponsored by the Steel Industry Heritage Corporation, HAER set up its first multi-year field offices in Homestead, Pennsylvania, documenting primarily the iron and steel industry of the Monongahela River valley.

HAER also directly promoted revitalization of historic properties through "rehab-action" projects. A phenomenon of the late 1970s, when HAER was part of the Heritage Conservation & Recreation Service (HCRS), a new federal agency that combined recreation, cultural, and natural resources, the goal was the revitalization of depressed industrial communities through funding from tax incentives for rehabilitating historic buildings and making buildings energy efficient. The results of rehab-action projects were a series of booklets produced for local distribution to generate interest in revitalization.[5]

HAER has documented a number of military sites including Wright-Patterson Air Force Base, Ohio; Langley Naval Air Station, Virginia; Philadelphia Naval Shipyard; and along with HABS, over 70 US Army Materiel Development and Readiness Command (DARCOM) munitions research, development and storage sites throughout the U.S. Publications include *The Engineering of Flight: Aeronautical Engineering Facilities of Area B, Wright-Patterson Air Force Base, Ohio* (HABS/HAER, National Park Service, U.S. Department of the Interior, 1993); *Last Line of Defense: Nike Missile Sites in Illinois* (NPS, 1996); and individual reports on the 74 DARCOM installations.

Other publications based on recording projects reflect special efforts by the staff or cosponsor, and the availability of funding. For example, in 1977, Douglas Ross, Chairman of the Woodstock (Vermont) National Historic Landmark Commission, used HAER's report, drawing, and photographs to publish a booklet, *The Elm Street Bridge* (1977), on an 1870 Parker truss threatened with replacement. Because of Ross' efforts, Elm Street Bridge was one of the first successful bridge preservation projects, using federal highway funds to rehabilitate a historic bridge for continued vehicular use.

Another publication, *Historic Bridges of Montana*, illustrates a major HAER initiative to save the historic bridges of the United States. Authored by Fred Quivik, the report was based on field work that produced approximately 500 HAER inventory cards for railroad and vehicular bridges built in Montana before 1945. Sponsored by the Montana Highway Department, Montana State Historic Preservation Office, and Montana Historical Society, the survey was a prototype for other states conducting inventories to identify historic bridges that might be affected by the national bridge replacement program. Several other states—Idaho, Colorado and Arizona—used HAER inventory cards in conducting statewide bridge inventories.[6]

In addition to working with different state departments of transportation to identify and record America's historic bridges, HAER, in cooperation with the Federal Highway Administration and the Federal Lands Highway Program, began the comprehensive documentation of historic bridges throughout the national park system. Over a 10-year period, beginning in 1988, HAER has fielded recording teams in many of the major national parks having historic road systems. Initially focused on bridges, HAER soon realized that the actual road was part of a larger cultural context that helped define how visitors experienced and perceived the park. Consequently, documentation was expanded to include landscape features, view sheds, plant materials, and other park elements. HAER architects, landscape architects, and historians discovered the indelible relationship between landscape architects and engineers working for the Bureau of Public Roads (BPR) that crafted the beautiful parkways like the Blue Ridge and Rock Creek. Park service landscape architects set the design and aesthetic standards and BPR engineers perfected the working drawings and specifications so that park roads enhanced the landscape. In addition to the drawings, photographs and histories, HAER teams produced interpretive brochures for the public. We live in an age of infrastructure improvement and just as the primary and secondary road systems are being rehabilitated, park roads are undergoing massive change. As we conclude our work on the roads in the great national parks, HAER's Park Roads and Bridges Program will publish a comprehensive review of over a decade of work.[7]

In 1982, following a survey of the Quincy copper mining region in the Upper Peninsula of Michigan, the Quincy Mine Hoist Association

HAER's NPS Park Roads Program has published several brochures disseminating the results of documentation efforts to the public.

published a book on the results of that project written by the two project leaders, HAER historian Larry Lankton and project historian Charles Hyde. In that same year, Terry Reynold's *Sault Ste. Marie: A Project Report,* on the world's longest horizontal-shaft hydroelectric power plant, was published with funding from the cosponsors. The same held true for *The McNeil Street Pumping Station Museum* (1981) and *Kennecott, Alaska* (1987). Shreveport, Louisiana architect Bill Wewer, the primary motivator for the McNeil Street project, used the HAER survey as a vehicle for successfully nominating the pumping station as a national historic landmark, transforming it into a city museum. At Kennecott, project leader Robert Spude and Sandra McDermott Faulkner, of the NPS Alaska Regional Office, in cooperation with Cordova Historical Society, Cordova, Alaska, republished the drawings, photographs and historical report produced by the HAER team as *Cordova to Kennecott, Alaska* (1988) a simple solution that could be a model for other HAER projects.

Other co-sponsors have also assisted in publishing HAER documentation. Following three summers of HAER work (1974-1977) recording the wind and tide mills of Long Island, New York, the project's cosponsor, the Society for the Preservation of Long Island Antiquities, worked with W.W. Norton & Company of New York to publish *Windmills of Long Island.* Project historian Robert Hefner became an expert on the preservation of windmills, and to this day, the Long Island windmill drawings remain "classics" of the HAER collection often used for illustrations, exhibits, and postcards. Also, after five years of HAER work in Birmingham, Alabama, Birmingham Historical Society director Marjorie White mounted an impressive traveling exhibition of the HAER documentation of that city's famous iron industry and manufacturing works. The exhibition was accompanied by a cleverly designed publication that reproduced the drawings and photographs in large-format with historical commentary.[8]

Articles originating from HAER projects have been published in some of the leading technical journals and magazines, such as *IA: The Journal of the Society for Industrial Archaeology, American Heritage of Invention & Technology, Technology & Culture: The Journal of the Society for the History of Technology,* and the proceedings and national reports of TICCIH, the International Congress for the Conservation of the Industrial Heritage, *Monuments Historiques,* and *La Revue.*[9] There are too many to enumerate, but a partial listing is available in *Historic American Buildings Survey/Historic American Engineering Record: An Annotated Bibliography* (1992) compiled by James C. Massey, Nancy Schwartz, and Shirley Maxwell.

The results of HAER recording projects also have been published in hardback, coffee-table style books. *Industrial Archeology: A New Look at the American Heritage* by Theodore Anton Sande was the first in 1976, followed by *Industrial Eye: Photographs by Jet Lowe from the Historic American Engineering Record,* published by The Preservation Press, National Trust for Historic Preservation in 1986. *Landmark American Bridges* (1993) by Eric Delony was next. The bridge book was a joint venture between HAER and the American Society of Civil Engineers (ASCE), one of the constituent groups that helped found the program in 1969. Significantly, ASCE secured a commercial co-publisher, Little Brown Publishing Company, Boston, Bulfinch Press, helping documentation from the HAER collection reach a larger audience. HAER historian Dean Herrin currently is working on the second book of this nature which examines 19th-century engineering and technological achievements that have been recorded over the last 30 years by HAER.

The preservation of America's engineering and industrial heritage was slow in arriving, but there can be no doubt that these resources are now considered part of the thoughtful preservation of our built environment. The publications highlighted in this essay, and others to come, will

help insure that the sites, structures, and artifacts of our technological achievements will not be forgotten.

Notes

1 For a selection of articles on HAER projects see *IA: The Journal of the Society for Industrial Archaeology* 23:1 (1997), a special issue titled "Documenting Complexity: The Historic American Engineering Record and America's Technological History."

2 All HAER catalogs are out-of-print, but *America Preserved: A Checklist of Historic Buildings, Structures & Sites* (Washington, DC: Library of Congress, 1995) is available. In 1995, the HAER collection was reproduced on 870 silver halide positive-reading microfiche by Chadwyck-Healy, Inc., Alexandria, VA.

3 Few if any of these publications remain in print as they were all designed to be inexpensive, brief annotated listings of the sites identified. Rarely were more than 500 copies printed. Copies may be available through interlibrary loan at local libraries.

4 *An Inventory of Historic Structures within the Illinois and Michigan Canal National Heritage Corridor,* multiple volumes (1985, 1987, 1987); Gray Fitzsimons, ed., *Blaire County and Cambria County, Pennsylvania: An Inventory of Historic Engineering and Industrial Sites* (Washington, DC, 1990); Sarah Heald, ed., *Fayette County, Pennsylvania: An Inventory of Historic Engineering and Industrial Sites* (Washington, DC, 1990); Nancy S. Shed, author, and Sarah Heald, ed., *Huntingdon County, Pennsylvania: An Inventory of Historic Engineering and Industrial Sites* (1991); Margaret M. Melroony, *A Legacy of Coal: The Coal Company Towns of Southeastern Pennsylvania* (Washington, DC, 1989). While the I&M publications are out-of- print, one may be able to get copies of the AIHP studies from AHDC, PO Box 565, 105 Zee Plaza, Hollidaysburg, PA 16648.

5 Donald Stevenson, *Lockport, Illinois: An HCRS Project Report* (Washington, DC, 1980); T. Allan Comp, *Butte, Montana: A Project Report* (Washington, DC, 1981); Charles Leach, and T. Allan Comp, *Rehabilitation: Claremont 1978: Planning for Adaptive Use and Energy Conservation in an Historic Mill Village* (Washington, DC, 1978); Donna M. Ware, and James Vaseff, *Lehigh Canal: An HCRS Project Report* (Washington, DC, 1981); James Vaseff, and Hugh McCauley, *Rehabilitation: Fairmount Waterworks 1978: Conservation and Recreation in a National Historic Landmark* (Washington, DC 1979); T. Allan Comp, *Rehabilitation Danville 1978: A Strategy for Building Reuse and Neighborhood Conservation* (Washington, DC 1979). All these reports are out-of-print.

6 See Eric DeLony, "Bibliography of State Historic Bridge Inventories," *IA: The Journal of the Society for Industrial Archaeology* 16:1 (1990): 68; and "HAER's Historic Bridge Program," *IA: The Journal of the Society for Industrial Archaeology* 15:2 (1989): 57-71.

7 HAER Historian Timothy Davis published "Rock Creek and Potomac Parkway, Washington, DC: The Evolution of a Contested Urban Landscape," in *Studies in the History of Gardens & Designed Landscapes, An International Quarterly* 19:2 (April-June 1999): 123-237; and "Mount Vernon Memorial Highway: Changing Conceptions of an American Commemorative Landscape," in *Places of Commemoration, Search for Identity and Landscape Design,* Joachim Wolschke- Bulmahn, ed., (Washington, DC: Dumbarton Oaks, 2000).

8 Philip A. Morris, and Marjorie L. White, *Birmingham Bound: An Atlas of the South's Premier Industrial Region* (Birmingham, AL: Birmingham Historical Society, 1997).

9 *Monuments Historiques: Etats-Unis,* No. 173, Mars-Avril 1991, was dedicated to historic preservation in the United States including a brief article on bridge preservation by the author. *La Revue,* No. 19, Juin 1997, was dedicated to "Images du Patrimoine Industriel des Etats-Unis," a Franco-American exhibition sponsored by the Ecomusee du Creusot-Montceau, Musee des Arts et Metiers and the Marie du 3rd Arrondissement, Paris.

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