From Little Machines to Big Themes: Thinking about Clocks, Watches, and Time at the National Museum of American History

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Résumé

La collection de montres et d'horloges du Smithsonian loge dans la section technique du National Museum of American History. Établie pour rendre compte de l'histoire technique interne des mécanismes d'horlogerie et des instruments de mesure européens, cette collection est aujourd'hui mise à contribution pour raconter l'évolution des façons de mesurer, d'utiliser et de percevoir le temps des Américains. Cet article examine comment et pourquoi les méthodes de collecte et d'interprétation de ces objets se sont modifiées au cours des cent dernières années et montre les défis en matière de présentation d'expositions et les avenues de recherche qu'amène cette évolution.

Abstract

The collection of clocks and watches at the Smithsonian Institution resides in the engineering section of the National Museum of American History. This collection, established to document the internal technical history of European clockwork and measuring instruments, is now called on to tell stories about the changing ways Americans have measured, used and thought about time. This paper looks at how and why approaches to collecting and interpreting these objects have shifted over the past one hundred years and outlines the exhibition challenges and research opportunities this shift poses.

I had last-minute jitters. We were installing the big tower clock at the entrance to the new exhibition, and as four burly colleagues began to manoeuvre the mechanism into the tiny room we'd built for it, it didn't look as though the clock was going to fit.

If things went as planned, the clock (Fig. 1) would settle in, begin to beat rhythmically and ring a bell on the hour. It would be gorgeous, a stunning combination of bright brass wheels on a base of painted wood faded to a dusty turquoise. And it could convey a compelling story about time in religious and secular life. Made in the first year of the nineteenth century by an allegedly suicidal clockmaker for the second meeting house of Westborough, Massachusetts, it later occupied the tower of the town hall.

If we had miscalculated, we'd be in big trouble. The exhibition, *On Time*, would open in a week. We were, quite literally, out of time.

It was soon clear the clock fit just right in its new home. As our clockmaker David Todd set to work to get it running, another worrisome train of thought ran through my head. Would the visitors due to stream through in a week's

time stop to look at it? Would they read the label? Would the clock evoke anything for them? Would they comprehend what this two-hundred-year-old machine stood for? Years ago, I had learned to regard such old clocks as not just "light machinery," as my predecessors in the museum had once categorized them, but also as symbols of our relationship with time itself. To me, these public clocks aren't just little machines. They are the idea of time made manifest. Would anybody else see it that way?

Reflections

It's too early to tell whether our visitors do indeed understand the intended lessons of the tower clock or the rest of the exhibition it introduces at the Smithsonian's National Museum of American History.[1] But with the opening now behind me, I find myself reflecting on how the exhibit came to be. Its story line traces how clock time, for better or worse, has become so important in American life. And my doubts about the efficacy of the tower clock in the exhibit are emblematic of deeper uncertainties about whether our publics are receptive to complex history presented through artifacts in a museum setting.

This cultural approach employed in *On Time* is a major departure from the museum's previous long-running exhibition about clocks and watches, which richly depicted the evolution of clockwork technology from the most primitive to the most modern. Like the new exhibition's tower clock, the museum's entire horological collection has undergone an interpretive transformation.[2] Once collected by the museum as impersonal machinery, clocks and watches can also reveal, we now know, much about social and cultural history, specifically, the changing ways Americans have measured, used and thought about time over the past three hundred years. That technical artifacts offer clues to culture may be obvious to academics who have been studying objects in context for a generation.[3] But for the Smithsonian, the new exhibit is the first acknowledgment in a permanent exhibition that clockwork technologies synchronize and interconnect with critical issues in American history.

These realizations inspire this look into the origins and development of the Smithsonian's horological collections. At its most fundamental, this inquiry is about who collected what, when, and why, a kind of institutional history seen through the lens of clock and watch collecting. Highlighting these collecting activities reveals the biases of my predecessors and throws my own into unvarnished relief. These experiences also illuminate the role the Smithsonian plays as an influential cultural institution in reflecting and shaping public knowledge of what is historically important.[4] Taking the long view on how our publics interact with our artifacts offers important lessons about what kinds of experiences succeed and what kinds do not.

Interpretive change has taken generations, through a process that operates at a very conservative pace, one I call, when I am at my most impatient, "museum time." The transformation — both behind the scenes and in public exhibitions like *On Time* — relies in part on a shift in the museum's mission, evolution in the field of the history of technology and what many of my colleagues refer to as the "professionalization" of museum curatorships at the National Museum of American History. This last is more accurately the hiring of historians instead of practitioners in a subject field, for example, hiring a historian of science instead of a pharmacist interested in the history of medicine.

To effect the most recent changes, we are in the process of reinterpreting timepieces already in the museum, redefining traditional collecting areas to embrace new themes, and mining the museum for objects other than clocks and watches to interpret those themes. The exhibition *On Time*, for better or worse, is the most recent expression of where thinking about the scope of the collection stands and our most recent effort to share that thinking with our publics. With this exhibition, we have taken just the first few steps in realizing a material and visual history of time in the United States through the Smithsonian's collections.

Founding the Collection

In October 1888 the head of the Smithsonian, Samuel P. Langley, sent home from a European research trip a small box of old scientific instruments. Among the miscellany a Parisian had sold him were some time-finding devices — three sundials, an astrolabe and a nocturnal. That same month, Tiffany and Co. of New York sold the Smithsonian eight "antique" English and Continental watches for "a beginning of a Horological Exhibit."[5] With these deliberate transactions the institution began to build a timepiece collection.

Fig. 1
Installing the tower clock, made by Gardner Parker in 1801, in On Time, *November 1999. (Courtesy Smithsonian Institution)*

The objects found a home in the U.S. National Museum, as the Smithsonian's museum operation was then called. By the late 1880s, when Langley became Secretary of the Smithsonian, the U.S. National Museum had its own building, the Arts and Industries Building, next to the Smithsonian's original "Castle" and considerable holdings, most of which pertained to natural history and ethnology.[6]

When Langley took a personal role in collecting objects for the museum, he was acting as a science practitioner, connecting to the material origins of his own research interests. An astronomer whose work focussed on the sun, he had come to the institution from a joint position as head of Pittsburgh's Allegheny Observatory and professor at Western University of Pennsylvania (now University of Pittsburgh). Astronomy's relationship to time was another of his special interests. At the observatory he pioneered in the sale of telegraphed time signals based on celestial observations. His customers were the important railroad networks criss-crossing the region.[7]

Langley's collecting interests set the museum on the path of interpreting clocks and watches as technical objects, rather than works of decorative art, as most other museums came to see them — the Walters Art Gallery in Baltimore and the Metropolitan Museum of Art in New York, to name only two. Additions to the Smithsonian's horological collections for nearly a century would follow that path, with a few exceptions.[8]

The exceptions began to occur already during Langley's tenure. The U.S. National Museum's director G. Brown Goode, his history curator A. Howard Clark and Clark's assistant Paul Beckwith, an officer in the military, pursued objects of everyday life as well as the personal effects, always described as "relics," of notable people in American history. Through the history collections, Goode was intent upon enshrining the material evidence of the country's Anglo-Saxon great men and their patriotic deeds. Joining the likes of the personal effects of George Washington and Ulysses Grant, an enormous plaster replica of the U.S. Capitol's statue "Freedom," and a variety of military weapons and medals were several watches. One, for example, a silver-cased watch with chatelaine was a trophy from the Revolutionary War, reportedly taken from a British soldier at the Battle of Lexington in 1775. Another, a gold-cased watch from about 1808, once belonged to Susan Henrietta Williamson, described in the collections records only as "third wife of Thomas Salter, son of Manassah Salter," to the collecting curator at least, prominent male citizens of the Early Republic.[9]

Goode's goal was to offer visitors a museum of record, an organized glimpse at knowledge as revealed in the "permanent land-marks of the progress of the world." What at first glance might have appeared to be only a Victorian superabundance of objects in glass cases with minimal labels was in fact a taxonomic arrangement calculated to convey an evolutionary view of human progress, from the most primitive to the most modern. "The people's museum," according to Goode, "should be much more than a house full of specimens in glass cases. It should be a house full of ideas arranged with the strictest attention to system."[10]

For early Smithsonian curators this approach applied just as well to human artifacts as it did to natural history specimens. When Langley sought old European watches for the museum, he had this systematic evolutionary scheme in mind. He advised one of his agents "to make a collection" of English watch movements "calculated to show the principal steps in watchmaking from the beginning to comparatively recent times..." And the museum exhibit was to be educational; the watches were to be selected to "instruct the public rather than to be of curious or professional interest."[11]

Such an "artifact encyclopedia," as historian John Staudenmaier has called it, had deep roots in Renaissance cabinets of curiosities and, in the nineteenth century, emerging national museums in Germany and England. Directly inspiring Goode and Langley were the Bavarian National Museum in Munich and the museum in London's South Kensington, the latter founded after the world's fair of 1851 at the Crystal Palace. In overt imitation of the English experience, Congress paid for the U.S. National Museum's new home, now called the Arts and Industries Building, to house existing Smithsonian collections and new things that arrived on dozens of train cars from the Philadelphia Centennial Exposition of 1876.[12] The move to establish an American national museum had all the earmarks of why collectors collect: it was the country's way of establishing a separate identity and worth, and preserving its idea of civilization for posterity.

These new artifacts helped shape instructional exhibits about the role of technology in American life and even gave the museum a basis for structuring its organization.

Fig. 2
Clock and watch exhibition in the Arts and Industries Building, about 1930. (Courtesy Smithsonian Institution)

A new Department of Arts and Industries became the museum's administrative unit for collecting objects related to transportation, textiles, pharmacy, manufacturing, graphic arts, coins and medals and associative objects from prominent Americans. Despite its obvious European roots, the U.S. National Museum was nevertheless distinctly American in outlook, with an approach characterized as an "insistent nationalism."[13]

The relationship of the museum to world's fairs and expositions continued for decades, and enabled the Smithsonian to ally itself with American industries to fill its collections and exhibitions. The New Haven Clock Company, for example, contributed more than three dozen pieces. Their gift laid the basis for the present holdings in inexpensive alarm clocks and throwaway watches, commonplace timepieces largely overlooked by museums elsewhere. The exhibition area (Fig. 2) accommodated the new clocks.[14]

In the first half of the twentieth century, clocks and watches entered the collections slowly. The horological collections were not a high priority for Carl Mitman, chief of the Department of Mechanical and Mineral Technology, but those objects he collected were illustrations of American industrial progress. Mitman, a mining engineer before he was a curator, focussed the museum's attention on the history of engineering and worked tirelessly to improve the public image of the engineering profession. He is largely remembered for writing more than 325 biographies of American technologists for the *Dictionary of American Biography*; the consolidation of nearly 10 000 technical objects, previously scattered in various departments around the Smithsonian, into the Department of Mechanical and Mineral Technology; and the campaign, ultimately unsuccessful, for a separate National Museum of Engineering and Industry.[15]

In the early 1920s, instead of relying on a horological curator to build the collection, the Smithsonian had an honorary (unpaid) "custodian," George Spier. Spier was born in Germany, trained there in watchmaking, and emigrated to the United States in 1872. He worked for a number of Washington, D.C., jewellers before setting up his own business in 1890. He helped found the Horological Institute of America, a professional organization set up to oversee watchmaking schools in the United States, and served as its first president. As the keeper of the Smithsonian's collection, he donated pieces, convinced others to do the same, and oversaw changes to the exhibition. Spier died in 1924.[16]

Industry was not the only source of artifacts during the first half of the twentieth century. As the enduring repository for government collections, the Smithsonian got first pick when the U. S. Patent Office divested itself of patent models in the early twentieth century. Like other parts of the museum, the horological collections benefited and preserved some of the country's earliest inventions. In 1926 the museum acquired about sixty horological models, including work by such notable clockmakers Noble Jerome and S. B. Terry.

In this period, the museum did not seek an alliance with academic historians. The emerging profession of historians focussed on documents, not things, and on the feats of great men at great events. As historian Gary Kulik has pointed out: "In collecting technology, consumer goods, and the commonplace, Goode placed the Smithsonian several generations ahead of the historians of the academy. But neither he nor anyone else had any way of articulating such leadership."[17]

A New Museum

Until after the Second World War, despite a continuous presence in the displays and study collections, the horological collections of the Smithsonian remained fairly insignificant, numbering under a thousand pieces. Watches far outnumbered clocks, and European pieces far outnumbered American ones. The size and scope would drastically change when Congress

authorized a new Smithsonian museum in 1954. The new museum was not precisely the National Museum of Engineering and Industry that technology curators had sought. Instead it was a hybrid. In an uneasy marriage, with unresolved issues of integration that persist even today, science and technology divisions joined with civil history divisions to present what was intended to be a unified story of America. The name of the museum did not specify the type of history, but American history and a celebratory approach to it was implied. Smithsonian secretary Leonard Carmichael would write hopefully of the museum-to-be: "the strands that have been woven together in the making of modern American civilization will be shown in a way that...will be unique and particularly appropriate to the special genius of our country."[18]

To open the Museum of History and Technology (MHT) called for filling its public halls with exhibitions and filling its then-ample storage areas with study collections. Every collecting area of the museum benefited from generous acquisitions budgets, but the horology collection grew especially fast. Between 1950 and the early 1970s, it expanded roughly ten times.

The chief architect of the new horology collection and the new museum's "Hall of Timekeeping and Light Machinery" was Edwin Battison. Hired in 1956, Battison was a machinist by training with twenty years of industry experience, a practitioner-curator with no formal history degree, unlike many of his colleagues hired at the same time. He and a network of contacts from the growing National Association of Watch and Clock Collectors scoured the Eastern United States for examples of the finest American and European clockwork. At what appears from today's perspective to be an impossible pace, he arranged for thousands of objects to enter the museum, some as donations and others as purchases, in the short span of about eight years. Collecting and exhibition work occupied most of his time, but he also did research. With colleague Robert Woodbury, he analysed the concept of interchangeable-parts manufacture by Eli Whitney. He also produced a monograph on the Auburndale timer, America's first inexpensive stopwatch, and co-authored a book on the clocks at Yale.[19]

In the early 1960s he took in some ready-made collections. Three were on "permanent loan," an ambiguous transaction category the museum no longer engages in, but one that many curators of that era found essential for speedy collection-building. Nearly a thousand pieces came from New York University's James Arthur Collection, a miscellany assembled by a Scottish émigré in the Smithsonian tradition of classifying watches and clocks as machinery. The Arthur Collection contained high-quality Japanese timekeepers as well as European and American clocks and watches, many of which remain highlights of the present-day collection. Several hundred more European watches, many with exquisite decorative cases, came from the Munson-Williams-Proctor Institute in Utica, New York. About three dozen extraordinary and complicated watches, commissioned early in the twentieth century by automobile magnate James Ward Packard, came from the Horological Institute of America (now the American Watchmakers and Clockmakers Institute).[20] Two other large collections came as gifts. IBM divested itself of scores of clocks, a collection that spoke directly to the firm's early days as the International Time Recording Co., manufacturer of factory punch clocks. From the estate of W. Carl Wyatt the museum received hundreds of American railroad watches, illustrating the full range of dial styles devised for easy reading of precise time.

Battison's affinity for machinery prompted him to expand not just the numbers, but also the scope of the horology collections to include tools. Through his efforts the museum acquired automatic machines that made Waltham watches and the horological hand tools and accessories of Boston clock and watch firm,

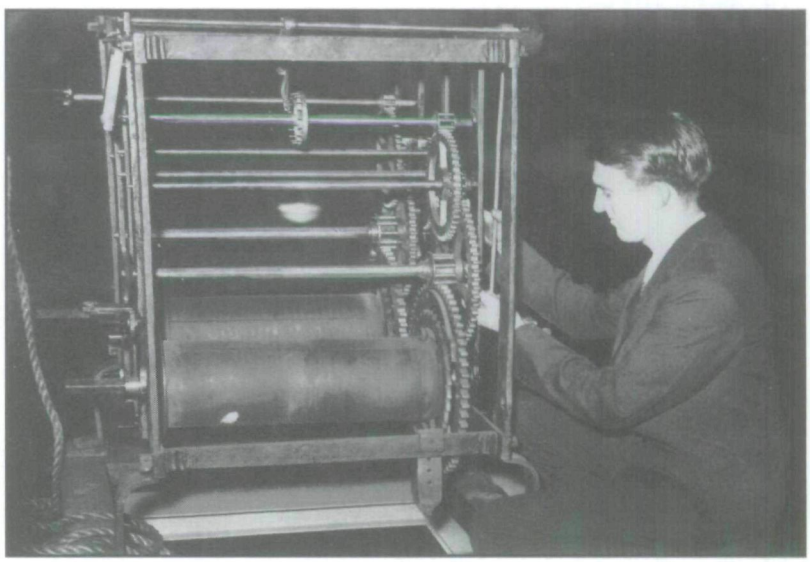

Fig. 3
Frank Taylor, as a staff member of the Mechanical Technology Division, installing the Frederick tower clock in the Arts and Industries Building, about 1931. Taylor would later become the first director of the Museum of History and Technology. (Courtesy Smithsonian Institution)

Fig. 4
The Frederick tower clock on display in the Arts and Industries Building, about 1931. (Courtesy Smithsonian Institution)

William Bond & Son, the latter numbering about 4 000 pieces.[21]

The new museum's horology exhibition was old wine in new bottles. Despite an airy and ample new space, vastly different from the cramped and shabby quarters in the Arts and Industries Building, the new display carried on the enduring Smithsonian tradition of systematically showing evolutionary progress, from the most primitive to the most advanced.

A tower clock was now the centrepiece. The most famous horological exhibit in the old Arts and Industries Building, the clock came to the museum in 1927 from the town of Frederick, Maryland (Figs. 3 and 4). Reminiscent of the London Science Museum's installation on its first floor of the Wells Cathedral Clock, one of the earliest known mechanical clocks, the American treasure had been prominently displayed separate from other timepieces and kept running in an open tower to demonstrate the basic principles of weight-driven machinery.[22] In contrast, the MHT building had actually been designed with a pit a full story deep to accommodate the clock's fourteen-foot pendulum and weight drop. Above it rose a grand structure to simulate the top of a European tower (Fig. 5).

Flanking the tower were cases full of clocks, watches, and working models to illustrate how select escapements work; down one side was the chronological development of European clockwork, the American pieces were on the other. Taking the organic relational model one step further, the clocks and watches were displayed adjacent to their close mechanical cousins, the "light machinery" — acoustic phonographs and mechanical typewriters. Around the corner stood the more distant cousins — the steam engines, turbines, and other heavy machinery of the Power Hall. Together these machines were celebrated as developmental milestones in the progress of U.S. technical know-how.[23] Much of the first floor of the new museum was filled with the artifacts of science and technology arranged according to their subject areas — halls of electricity, transportation, civil engineering, astronomy, mathematics and the like.

In the late 1950s, when planning for the new hall began, social and cultural historians had not yet begun to investigate clocks and watches as the instruments of social authority, that is, as a means of establishing and enforcing time obedience.[24] By Battison's day, though, regarding clocks and watches as a crucial part of the history of engineering was firmly entrenched both at the Smithsonian and in the growing literature on the history of technology. Many writers traced Western civilization's superiority in technology to the invention of the mechanical clock. They revealed the impact of the clock in Europe's Scientific Revolution, traced its lineage through the machinery indispensable for the British and American Industrial Revolutions, and suggested its role in forming modern time consciousness. Lewis Mumford had written as early as 1934 in *Technics and Civilization* that the "clock, not the steam engine, was the key-machine of the modern industrial age." Charles J. Singer's multi-volume *A History of Technology* appeared in 1957, with a substantial section by H. Alan Lloyd on the history of the mechanical clock. Aubrey F. Burstall, in his

history of mechanical engineering, called the clock "the first automatic machine" and D. S. L. Cardwell found clockmaking to be "the pinnacle of mechanical arts and the training ground as well as the inspiration for practitioners in other branches of mechanics."[25]

Even though generations of curators had collected European timepieces, overtly thinking about the history of clockwork within the context of academic European history was new to the Smithsonian's horological collection. This shift was partially the influence of the great European museums. MHT's first and third directors, Frank Taylor and Robert Multhauf, made detailed visits to and greatly admired Munich's postwar Deutsches Museum. Taylor had worked for the Smithsonian since 1922 and during his tenure at the institution earned a mechanical engineering degree from MIT and a law degree from Georgetown University. It was Taylor who would write a catalogue of the mechanical collections of the U.S. National Museum (1939), lead the postwar revisions of the museum's exhibitions, and head the new MHT.[26] In 1953, Taylor and the new Smithsonian's secretary, Leonard Carmichael, began hiring mostly university-trained historians, instead of retired scientists and engineers, to staff the new museum. One of the newly hired curators was Multhauf, whose influence on the direction of scholarship at the museum was profound. The first Ph.D. historian of science the Smithsonian ever hired, Multhauf saw the history of science and technology firmly embedded in global history, and he encouraged his staff to look for the European antecedents of American developments. He pictured the first floor of the museum as a three-dimensional textbook of the history of technology and science.[27] MHT's new *Hall of Timekeeping and Light Machinery* was an example of the new direction.

Another of the new staff was Silvio Bedini, who had a strong interest in the horological collections and scientific apparatus of all sorts. Bedini's prodigious outpouring of publications, even as he served first as the chief curator in the engineering collections and then as the museum's deputy director, offered deep background on some of the objects Battison was bringing in.

Bedini saw to it that the museum collected some choice pieces that he thoroughly researched — an Italian astronomical clock; a tall case clock by Peter Hill, one of the few African American professional clockmakers working in the United States in the early nineteenth century; an eitheenth-century English orrery, or clockwork-driven planetary model, by James Giles; and a Swiss-made *montre à tact*, a watch Helen Keller used to tell time by touch rather than by sight. For the museum's decorative arts collection he found an unusual clock with a tall painted-tin case.

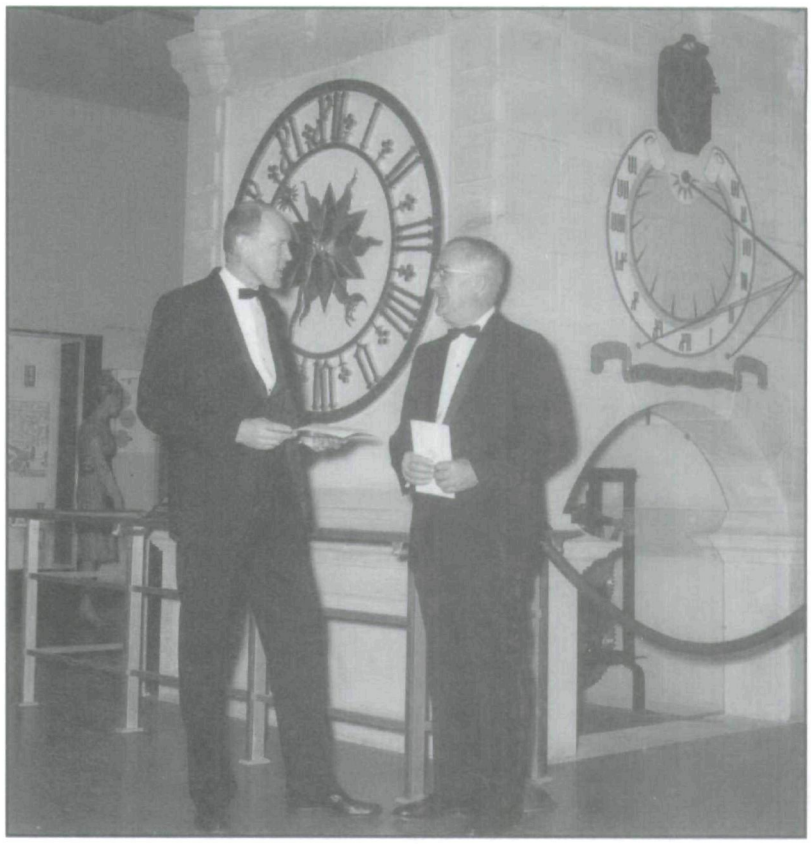

Fig. 5
Edwin Battison (left), curator of light machinery, and Donald Leverenz, of Elgin Watch Co., in front of the tower in the new Hall of Timekeeping and Light Machinery, *January 1964. (Courtesy Smithsonian Institution)*

The fullest expression of the trend toward seeking European antecedents came in Otto Mayr's research and attention to the horological collections. Mayr succeeded Battison as overseer of the horological collections in 1977. A German-born engineer with a history Ph.D., Mayr had investigated the development of feedback devices and the early history of clocks as automatic machines. He and art historian Klaus Maurice of the Bavarian National Museum collaborated on an international exhibition, *The Clockwork Universe: German Clocks and Automata 1550 to 1650*. They also edited a substantial book of articles to depict the rich culture and intellectual background from which the objects emerged.[28] Although recently "The Clockwork Universe" has been characterized as a kind of throwback exhibition because it celebrated a technological achievement, it was nevertheless the first attempt ever to place any horological exhibition at the museum in its cultural context.[29] The temporary

show was a harbinger of things to come. Mayr, who briefly served as MHT's acting director and went on to become director of Munich's Deutsches Museum, also added significant examples of European Renaissance automatons to the MHT collection before his departure.

A New Focus

But even as "Clockwork Universe" was opening in 1980, the museum faced a major change. The National Museum of History and Technology would become, under Director Roger Kennedy, the National Museum of American History. With the name change came a mission change. Although science and technology remained important, the museum would henceforth emphasize collecting and exhibiting the history of the United States.

Accompanying this change in the museum's mission was a gradual and uneven shift in the academic field of the history of technology. Internal technical histories — chronological narratives about a particular machine or invention — were giving way to considerations of the social dimensions of technology and the intersections of science, technology and culture. Museum work attracted academic historians in this period. In the case of the NMAH, the alliance with academia eventually produced a staff attentive to writing about and exhibiting science and technology in context rather than recounting the internal technical history of a particular set of inventions.[30]

Attention to collections and material culture studies fell out of favour with administrators as academically trained historians, with no museum background, began to swell the ranks and actively shape the museum's new exhibitions, which were largely concept-driven rather than inspired or informed by objects. In contrast to the new staff, long-time curators who were deeply immersed in collections-based research found themselves out of the mainstream.[31]

It was this mission shift and the lessons learned from colleagues inside and outside the museum practising in the field that influenced my thinking about how clocks and watches fitted into American history.[32]

The first product of this re-evaluation was a small temporary exhibition, "Inventing Standard Time." Opened in November 1983 to mark the one-hundredth anniversary of zoned time's introduction, this exhibition was squarely in the new fashion of concept-driven, rather than object-driven exhibitions. Rather than a clock and watch exhibition, "Inventing Standard Time" was deliberately crafted to show that time, like timepieces themselves, is a construction. It was during this project that I first encountered the difficulties of representing the idea of time with material and visual culture. In addition we were somewhat constrained by the exhibition space, which was reserved for displays of rare books and documents. From the New York Public Library we borrowed numerous documents, the paper trail of how nearly six hundred North American railroads voluntarily abandoned fifty regional times in favor of Intercolonial (now Atlantic), Eastern, Central, Mountain and Pacific Standard Railway Time. But the exhibition was also an opportunity to show the interaction of technology and American history, to show how time was determined astronomically in the nineteenth century and how the special machinery for telegraphing time signals enabled the entire nation to synchronize to a national standard time. We stretched the limits of the space to include not just paper and books, but also key pieces of that technology. The instruments Samuel Langley used at the Allegheny Observatory — his transit, his precision regulator, and even the telegraph switchboard — survive, and they came to the museum on loan.[33]

Once the exhibition closed, my colleague David Todd, who had been hired as the museum's clockmaker, and I undertook an object-based research project to reinterpret the contents of the workshop of William Bond & Son of Boston. Thanks to Edwin Battison's collecting efforts, it was our good fortune to have access to the horological tools and findings of those who had worked for the Bond firm in the course of its nearly two-hundred-year history. Our original plan was to prepare a straightforward catalogue and film David Todd using the tools.

Once we began to investigate, a wider story about the relationship of the firm, the Harvard College Observatory, and determining longitude and time for the United States government emerged. Battison had also acquired key pieces from the U.S. government's efforts to distribute time from both the U.S. Naval Observatory, the Weather Bureau and the National Bureau of Standards. Although they had been collected individually to demonstrate the technical improvements in precision timekeeping for scientific work, as a group they told a much different story — one about time distribution

systems and the internal bureaucratic wars to be the agency in charge of U.S. time.[34]

The history of public time in the United States was a new subject in the 1980s. Since then a whole interdisciplinary field of time studies has emerged in the humanities. Studying the changing ways people experience time is much easier now, thanks to books by historians — like Stephen Kern, David Landes, Michael O'Malley, Mark M. Smith — and sociologists and anthropologists, like Barbara Adam's syntheses and the journal *Time and Society*.[35]

We have not completely abandoned the study of chronological technical developments or in-depth studies of individual clocks. David Todd frequently undertakes detailed analyses of particular clocks or a family of timekeepers.[36]

To bring the collection up to date, we also have underway a study of electronic watches. In the mid 1980s, the museum's collection of timepieces still did not include any watches from the "quartz revolution" — the complete reinvention of the modern wristwatch that replaced mechanical works with electronics. This shift occurred in many consumer products beginning in the 1960s, and watches were among the very first. To correct this omission in the museum's holdings, we began in the mid 1980s to study the change, locate early examples, and track down the inventors. Thanks to generous financial support from the museum's Lemelson Center for the Study of Invention and Innovation, we conducted a series of oral history interviews with quartz watch pioneers and, through them, added significant watches to our holdings. A Web site summarizes our findings to date, and we are at work on a book-length study based on the interviews, consumer reaction, and the material evidence we have collected.[37]

We continue to look at clocks as machinery, as part of the invention and innovation process and manufacturing stream. We have the added responsibility to explore not only the inventors and the makers, but also the users, to inquire about who owns and uses time-related technologies, how and why.

We have also been looking at clocks and watches scattered in other divisions, where they were collected for completely different reasons. In the Political History collection, where things associated with famous or significant actors on the national political stage are stored, we found, for example, a watch that belonged to Susan B. Anthony, a notable crusader for women's rights in the nineteenth century. Anthony started her professional life as a schoolteacher and purchased the watch with some of her first earnings. Now that we know to look for it, the watch's chain is obvious in some nineteenth-century photographs of Anthony.

For another example of reinterpreting what we already have in the museum, summer intern Raechel Guest scoured the museum for watches that were given as gifts or awards. Her search uncovered many new stories about watches as treasured mementos and let us explore how and why watches became such popular gifts for Christmas, birthdays, graduations, weddings, and occasions of personal accomplishment or meritorious service. The engraved cases give a glimpse at some of the personal stories. There are touching family gifts, like the gold Waltham watch that went to "Grandma from Pearl and Richard" for Christmas in 1886. A watch inscribed, simply, "Silvia" was given by Thomas and Mary Ann Cresviston to their daughter when she graduated from high school in West Liberty, Ohio, in 1897. A tiny lady's watch with the monogram "A. F. S." engraved on its gold case was the gift of Philip Edgar Cadmus (1866–1932) to his financée Augusta Frances Stipp in 1906. Cadmus, a watchmaker, had his photo applied to the dial.

A Washington, D.C., policeman, Thomas Oriani, received an elaborate watch as a Christmas present from the jewellers on his 7th Street beat in appreciation for his work in watching their businesses. The inscription on a silver Waltham watch is a glimpse into the agony of the Civil War wounded: "Feb. 15, 1865/Presented to Dr. G. D. O'Farrell, USA, by the patients of Ward C as a token of regard and respect for his ability as a surgeon and unswerving integrity as a man." And another offers a hint of the perils of the open sea: "From/The President of the United States,/to/John R. McFaull,/Master/ of the Honduran Steamship Omoa,/in recognition of his humane service in effecting the rescue/at sea, on November 10, 1919,/of the master and crew of the American Steamship Thos. L. Wand." Irish-born McFaull moved with his Spanish wife to New Orleans in 1909 and they became naturalized citizens the year before his heroism won him a watch. Sharing stories like these with our visitors has widened the circle of those interested in timekeepers beyond a small and exclusive group of men interested in technical details.

We recognize that it is not always possible to retrieve new interpretations from objects in

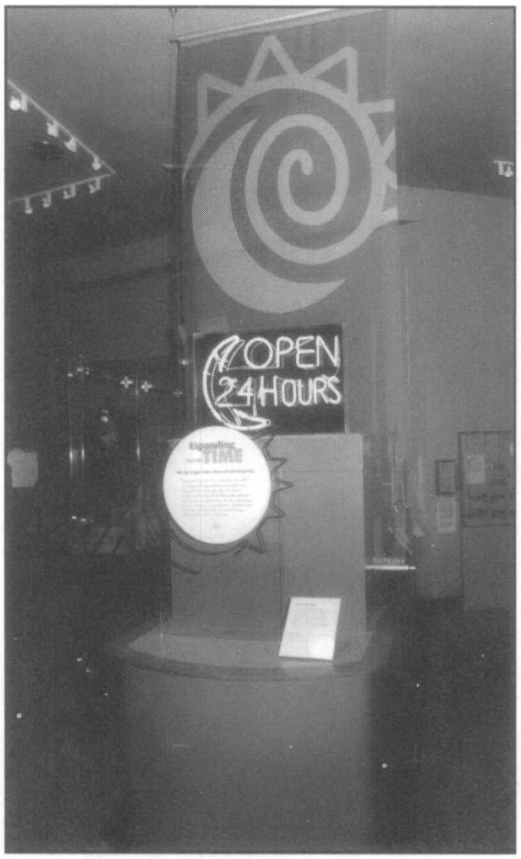

Fig. 6
Neon sign from Kinko's, a business services store in Washington, D.C., on display in On Time. *(Courtesy Smithsonian Institution)*

the existing collection. Most of these objects were collected for another purpose, specifically, to document the internal technical history of timekeepers, to emphasize breakthroughs and technological change from the point of view of the inventor or manufacturer. The numerous research and exhibition opportunities we have had, thanks to our predecessors' collecting efforts, suggest to us that broad and deep collecting for the future should be continued. But dwindling resources and storage space for objects at the Smithsonian signal that is impractical and unlikely.

New Themes and New Collecting

Nevertheless, we continue to collect, but in selective ways, and most selectively in categories of objects we already have. The most stunning recent example of this is the museum's acquisition of an eighteenth-century musical tall case clock. With plenty of tall case clocks already represented in our holdings, we were not seeking another. But this new clock is now on exhibit in *On Time* thanks to Silvio Bedini's long-standing interest in the work of Andrew Ellicott, a well-connected eighteenth-century man of science perhaps best known for the survey of the District of Columbia. Over the years in the course of his extensive research, Bedini contacted numerous Ellicott descendants. Those contacts proved invaluable when one branch of the family decided to part with the masterwork of Joseph Ellicott, Andrew's father. In 1769, the elder Ellicott, a clockmaker and millwright, built one of colonial America's most complex machines — a four-sided clock with a representation of the solar system that plays twenty-four tunes. Still in working condition, it is the supreme expression of eighteenth-century ideas about the relationship of time and the clockwork cosmos.[38]

Expanding into new fields is the most intellectually challenging task we face. We have taken the first steps, for example, to collect the material culture of the American response to the new millennium and the calendar change to the year 2000. For a real stretch, we have begun to collect materials related to the subject of time travel.

We also seek to document the twenty-four hour society. Our first object is a neon sign collected from a business services store in Washington, D.C., that stays open all night. This sign could be almost anywhere in urban or suburban America these days. With increasing frequency in recent years, signs announcing 24-hour operations have cropped up on the landscape. Sometimes they brighten the night with neon. But more often, in the fine print of door placards listing opening and closing times, the nation's supermarkets, convenience stores, retailers, and entertainments signal their readiness for a society too busy to sleep. We can buy, sell, play, and travel around the clock.

We have included the sign in *On Time* (Fig. 6), but the exhibition has only a tiny section devoted to the powerful story of how, gradually and unevenly, a 24-hour-a-day, seven-day-a-week society has been growing in the United States for the last two decades. The number of people now keeping what the U.S. Bureau of Labor Statistics calls "non-traditional" work hours is on the upswing. Most people, it's true, still work a standard week of about eight hours a day between roughly nine and five. But one third of full-time workers are on the job at other times. These non-traditional schedules are about equally divided between men and women, and part-timers are most often working evenings. As always, those with less education and less wealth have less choice, not only about what kind of work they do, but also when they work.

But we're meant to sleep after dark. Humans are biologically programmed to be active by day. Although some people's circadian rhythms are more adaptable than others, for most of us, a complex of internal body "clocks" operate on a light-dark cycle.

As we expand our activities into the night, the consequences for health and social services have yet to be determined, but evidence is mounting that there are serious risks involved in trying to change humans into nocturnal creatures. Critics point to the near meltdown of Three-Mile Island at 4:00 a.m., Chernobyl at 1:23 a.m., and Bhopal at 12:40 a.m.; the frequent trucking and airline accidents caused by sleep-deprived drivers and pilots; mistakes in hospitals caused by physicians on weird rotations; and a long list of other mishaps based on human limitations when it comes to round-the-clock operations. Some see a technical fix for such limitations where others see a sci-fi nightmare: the next medical frontier just might be manipulating the human body so that we won't need to sleep.

The trend has not gone unnoticed by social scientists. The pathbreaking work is sociologist Murray Melbin's *Night as Frontier: Colonizing the World after Dark* (1987). He identifies the characteristics of what he calls the "incessant society," and argues that there are identifiable parallels between colonizing space and colonizing nighttime. Others have begun to analyse labour statistics for trends in employment, to look for the impact increasing non-traditional work hours have on women and the family, and to explore the implications for social policy. When parents work at night, for example, how much nightcare is available to the children? Health researchers are beginning to document the physiology of swing shift workers, prolonged sleep deprivation, and jet lag. Specialists in the relatively new field of chronobiology are identifying the gene sites of our innate rhythms, our biological "clocks."

There is no systematic *historical* study of how we got to be a 24-hour society, not just because the change is so recent, but also because the subject is as huge and ungainly as American society itself. Exploring how we got this way will no doubt require interdisciplinary analysis and expertise. Historians of technology may want to take special note. In the recent two-decade shift to a 24-hour society, the role of technology is enormous.

Some quick examples: ATMs have done away with "banker's hours." They were first introduced as stand-alone dispensers in Rockville Center, New York, in 1969 and then networked beginning in the mid 1970s. Overnight delivery, telecommunications, computer networks and the internet provide virtually instant access at any hour to anywhere. CNN is the quintessential changemaker. An upstart satellite news network in the early 1980s, CNN earned distinction for international immediacy with its continuous 24-hour crisis coverage of Tiananmen Square and the Persian Gulf War. TV news addicts and internet users cannot avoid noticing how the new networks are altering perceptions of time and space. In a combination of hubris and vision, Swatch, makers of an ever-changing array of fashion wristwatches, is even proposing the replacement of our twenty-four time zones with a single universal time for the entire globe — an "Internet time." According to the Swatch publicists, this cyberspace day divided into 1000 parts serves notice that local time doesn't really matter anymore, at least on the Net. Unless, that is, that local time is the source of "Internet time," the time of the meridian at Biel, Switzerland, Swatch's headquarters.

Not just technology has changed, though. Attitudes and behavior have changed too. Beginning in the 1960s, under heavy lobby from large commercial chains, state after state repealed Sunday closing or "blue" laws. With their extinction came the expectation that we can shop any time of the day or night anywhere.

The changes going on around us offer an opportunity to play an active role in preserving evidence of the interactions of technology and culture in the changes. We might want to take oral histories from people at work and at play during the night, accumulate photographs of nighttime activities, and collect three-dimensional evidence. Where is the artifactual evidence besides the retail signs? Admittedly, it is difficult to rely on material culture to mark the shift, because most of the artifacts of the 24-hour society are just like those made or used any time of day. But collecting the artifacts of the night calls for field trips. I have vowed to visit a Kinko's in the middle of the night to collect a pile of the projects people struggle to finish at a time I wish to be asleep. I am searching for something I've seen only in photographs — a sign on a house door that says "Day Sleeper," a warning to the noisy folks who inhabit the daytime that someone who works the night shift lives there.

From these small bits of evidence, a larger more coherent picture of nocturnal activity may eventually emerge. Thinking about what we

might collect to document how, in our present hectic life, we try to get more time out of every day is part of extending the museum's timekeeping collection into a collection reflecting the material culture of time.

Mining the Museum

One of our goals in developing our exhibition *On Time* is to get our visitors to think about time in new ways. For most people, time is what the clock says. We want visitors to look at everyday objects for evidence of what the object imparts about time, clock time or other kinds of time. We want to provoke the question: what is that thing doing in an exhibit on time?

To that end, we put two such objects into *On Time* in prominent places. One, which introduces a section of the nineteenth century, is the skeleton of the most famous American racehorse of the nineteenth century. In the 1850s, the exhibit argues, the feats of that particular horse, Lexington, indirectly inspired the only American watch company, American Watch Company of Waltham, Massachusetts, to risk its new and shaky business on a peculiar horse timer, the first mass-produced stopwatch. We have juxtaposed the stopwatch itself with the skeleton: the stopwatch is from the engineering collection, and the horse skeleton from our sister Smithsonian museum, the National Museum of Natural History, where it has been part of the collection since 1875. Tiny and for the most part difficult to see in detail, watches are notoriously difficult to exhibit to any effect. With the juxtaposition, we hope the watch, in fact, becomes more visible and significant to our visitors.

Nearby is the other object, a General Electric monitor-top refrigerator from 1934. And again, the question we hope to provoke is: what is a refrigerator doing in an exhibit on time? This particular refrigerator has an impeccable time pedigree. In the 1930s, when refrigerator design was making the transition from the empty rectangle of the ice box to the multi-compartment appliance we recognize today, efficiency expert Dr Lillian Gilbreth advised G.E. to design the inside of the refrigerator to save the homemaker time. With movable bins up front for frequently-used perishables like milk, butter and eggs, and removable shelves, no one would waste a moment hunting for things in the back of the refrigerator. In the exhibition, the refrigerator is displayed with a filmed time-and-motion study conducted by the home economics department at the University of Connecticut. In the film, a woman is testing the quickest way to transfer eggs from the carton she bought them in to a special refrigerator tray.

One might argue that *On Time* did not go far enough in unpacking more commonplace objects for their time content. But for the first step in reinterpreting the subject of time, we stretched as far as we could. We suspect visitors still come in looking for an exhibition on clocks and watches, and we have provided enough of them so as not to disappoint. An interesting exercise might be to do a time exhibit sometime in the future with no clocks and watches, and instead other objects like the refrigerator and the horse skeleton that have time-related interpretations.

In *On Time* we strove for a real integration of objects and concept, in some cases using objects as evidence and in others using them as illustrations. Our inquiry was, from the very first, inspired by and informed by objects. The presentation techniques of *On Time* were further informed by new information about visitor behavior in our museum and new insights from observing how people use the internet.[39]

National Museum and National Collections

The Smithsonian's new secretary, Lawrence M. Small, recently expressed to the institution's staff his understanding of the powerful obligation that rests on the Smithsonian's collections. "In our collections," he wrote, "we keep the material record of what America has been." He further encouraged staff to use the institution's collections "to foster a shared understanding of the mosaic that is our national identity." Regarding the Smithsonian's public involvement, his goal is to make the institution "the most extensive provider of authoritative experiences that connect Americans to the nation's history and to their cultural and scientific heritage."[40]

To meet the secretary's goal, that is, to use objects effectively to communicate who we are as Americans, we need to explore further the interface between objects and people who visit museums. But pausing to reflect on the intellectual framework and content of the collections, either for curatorial projects or for visitor edification, is a rare event at the National Museum of American History these days. Exhibitions have been a preoccupation, as the museum has embarked on an ambitious program

to reinstall its three floors of permanent exhibitions. Long-overdue, but now-incessant, exhibition efforts have diverted resources and curatorial attention. These activities have benefited the collection only to the limited extent that new objects are acquired for display or that old objects are more thoroughly researched. In addition, exhibitions at the Smithsonian, at least during the 1990s, have often been synonymous with controversy. The high-profile protestations against *The West as America* at the National Museum of American Art, the National Air and Space Museum's *Enola Gay* display, and *Science in American Life* at the National Museum of American History have been seen as crucial skirmishes in the larger culture wars of the late twentieth century. They are, as historian David Thelen has written, "a struggle among claims to authority," highly politicized battles over whose version of history will be told in the U.S. national museums.[41]

Colleagues writing recently about these controversial exhibitions have pointed to the widespread declining significance of objects in museum exhibitions. They describe how and why since the early 1970s, Smithsonian exhibitions have shifted away from what they had been for generations — displays of objects arranged chronologically to tell a story of "bland positivism," a tale of autonomous progress shaping human society for the better. With the hiring of professional historians with training in documentary evidence and little interest in or understanding of artifacts, the exhibitions they have been producing are now "narrative vehicles" in which objects are clearly secondary to telling a story. A decade before these controversies erupted, another colleague attributed growing criticism directed to museum exhibitions to heavy-handed design.[42] The result in each case, dominant storyline or dominant design, has been the same — an imbalance between objects, ideas and design. Achieving that balance, and simultaneously communicating with the widest diversity of visitors to the museum, is unlikely without refocussing on the role objects play in attracting people to learning and accepting new ideas.

At the National Museum of American History, we have the enduring task to rise above the twin and contradictory criticisms leveled at us in recent decades. Some take us to task for our anti-intellectual reputation as the "Nation's Attic," a storehouse of oddities and artifacts of mindless popular culture. Others find us to be the generator of abstract, idea-driven exhibitions with historical interpretations that provoke public "division and suspicion" instead of understanding.[43] The way up, I'm firmly convinced, is through paying more attention in exhibitions, research and collecting to what historian Joseph Corn has called "the imaginative, affective, and social aspects" of the human-object experience.[44] This essay is my effort to refocus my own attention, after ten years of uninterrupted exhibition work, on the riches of the museum's collections and to revive my interest in mining their potential in inventive new ways.

NOTES

I wish to acknowledge the crucial role my colleagues Howard Morrison, exhibition developer, and Ann Rossilli, designer, have played in what is expressed here. They have helped shape not only the exhibition *On Time*, but also my thinking about how museum objects can and cannot communicate history to diverse publics.

1. *On Time* opened at the National Museum of American History, Smithsonian Institution, Washington, D.C., on 18 November 1999 and runs indefinitely. We have not yet conducted visitor surveys, and no reviews have appeared in academic journals. Press coverage of *On Time*, if it is any indication of public reception, shows that some print journalists got the exhibit's main messages and others did not. See for example the disparate views of three separate reporters in one local paper: Ken Ringle, "At the Tone the Time Will Be...History Museum Chronicles Clocks and Calendars," *The Washington Post*, 25 November 1999; Michael O'Sullivan, "Nothing to Set Your Watch For," *The Washington Post*, 31 December 1999; and Mary Quattlebaum, "The 'Time' of Their Lives," *The Washington Post Weekend*, 21 January 2000. The tower clock itself prompted grumbling among some of the inhabitants of Westborough, Mass., who think it should be returned to them. See Elaine Thompson, "Town Ponders Time's Flight," *Worcester (Mass.) Telegram and Gazette*, 12 November 1999.
2. NMAH Cat. 310382, Acc. 111628; today the museum's horological collections are the administrative responsibility of the Engineering Collections of the Division of the History of Technology.
3. More than ten years ago historian Joseph J. Corn wrote: "We now accept as a truism that technology cannot be understood without reference to the society in which it developed, that a society's

values, work styles, and even politics are embedded in the artifacts themselves, there to see if we only are helped to look." See his "Tools, Technologies, and Contexts: Interpreting the History of American Technics," in *History Museums in the United States: A Critical Assessment*, ed. Warren Leon and Roy Rosenzweig (Urbana and Chicago: University of Illinois Press, 1989), 255.

4. Susan M. Pearce discusses the utility of examining the history of museum collecting activities as social enterprises that shape knowledge in *Museums, Objects, and Collections: A Cultural Study* (Washington, D.C.: Smithsonian Institution Press, 1992), 89, 115–116.
5. NMAH Acc. 21295; Memorandum from [illegible] to G. Brown Goode, 12 September 1888, in NMAH Acc. file 21230.
6. For early Smithsonian history see Arthur P. Molella, "The Museum that Might Have Been: The Smithsonian's National Museum of Engineering and Industry," *Technology and Culture* 32 (April 1991): 238–240; Pamela M. Henson, "'Objects of Curious Research': The History of Science and Technology at the Smithsonian," and Gary Kulik, "Designing the Past: History-Museum Exhibitions from Peale to the Present," in *History Museums in the United States*, 7–8.
7. There is no modern biography of Langley. See Charles D. Walcott, *Biographical Memoir of Samuel Pierpont Langley, 1824–1906* (Washington, D.C.: National Academy of Sciences, 1912); Donald L. Obendorf, "Samuel P. Langley: Solar Scientist, 1867–1891" (Ph.D. diss., University of California, Berkeley, 1969); and Wallace R. Beardsley, "Samuel Pierpont Langley: His Early Academic Years at the Western University of Pennsylvania" (Ph.D. diss., University of Pittsburgh, 1978).
8. This paper will make no attempt to offer a chronology of the numerous name changes of the divisions that contained the horological collection, which always resided in the curatorial division responsible for technical objects and scientific apparatus. For such an administrative chronology, see the historical note in the finding aid to Record Unit 297, Smithsonian Institution Archives, records for the Division of Engineering, its predecessors and its successors.
9. Henson, "'Objects of Curious Research'," p. S256; Kulik, "Designing the Past," 8–9; NMAH Acc. 23380, Cat. 5704 (originally Cat. 97085), 15 July 1890; Acc. 51998, Cat. 11978, October 1910.
10. For an elaboration on the Victorian faith in objects as a source of knowledge see Steven Conn, *Museums and American Intellectual Life, 1876–1926* (Chicago and London: University of Chicago Press, 1998), 9, 254; G. Brown Goode, quoted on progress in Kulik, p. 8, and on the ideal museum in "Museum-History and Museums of History," in *The Origin of Natural Science in America: Essays of George Brown Goode*, ed. Sally Kohlstedt (Washington, D.C.: Smithsonian Institution, 1991), 306.
11. Samuel P. Langley to William Wesley & Son, 8 August 1890, file for NMAH Acc. 23500.
12. John Staudenmaier, *Technology's Storytellers: Reweaving the Human Fabric* (Cambridge, Mass.: MIT Press and the Society for the History of Technology, 1989), 226; Steven Conn, *Museums and American Intellectual Life*, 195.
13. Molella, "The Museum that Might Have Been," p. 240; *Annual Report of the Smithsonian Institution for the Year 1881*. Washington, D.C.: Government Printing Office, 1883, pp. 99–100; Kulik,12.
14. NMAH Acc. 101542, 14 June 1928. An internalist approach to collecting and exhibiting technical objects — that is, thinking about them in terms of chronological technical improvements without taking into consideration external factors — persists to this day in some form in the Smithsonian's technical collections.
15. Molella, 248.
16. *Report of National Museum*, 1924 (Washington, D.C., 1925), 34.
17. Kulik, 12.
18. Carmichael quoted in James Conaway, *The Smithsonian: 150 Years of Adventure, Discovery, and Wonder* (Washington, D.C.: Smithsonian Books; New York: Alfred A. Knopf, 1995), 306.
19. Edwin A. Battison, "The Auburndale Watch Company," *Bulletin 218, Contributions from the Museum of History and Technology, Paper 4* (Washington, D.C.: Smithsonian Institution, n.d.), 49–68; Yale University Art Gallery, *The American Clock, 1725–1865: The Mabel Brady Garvan and Other Collections at Yale University*. Essay and technical notes by Edwin Battison. Commentary by Patricia E. Kane. Forward by Charles F. Montgomery. Introduction by Derek de Solla Price (Greenwich, Conn.: New York Graphic Society, 1973).
20. Most of the James Arthur Collection remains at the museum today. The owners of the other two collections have reclaimed them. See Daniel Webster Hering, *The Lure of the Clock: An Account of the James Arthur Collection of Clocks and Watches at New York University* (New York: New York University Press, 1932); Daniel Webster Hering, *Key to the Watches in the James Arthur Collection of Clocks and Watches at New York University* (New York: New York University, 1934); Thomas R. Proctor, *The Thomas R. Proctor Collection of Antique Watches* (New York: n.p., 1907) and Frederick Towne Proctor, *The Frederick Towne Proctor Collection of Antique Watches and Table Clocks* (Utica, New York: n.p., 1913); and Henry Fried, *The James W. Packard Collection of Unusual and Complicated Watches* (n.p.: Horological Institute of America, 1959).
21. William Cranch Bond, owner of the firm in the mid-nineteenth century and first director of the Harvard College Observatory, made the first sea-going chronometer in the United States in 1812.
22. Lewis W. Phillips, *Science Museum Outline Guide to the Exhibits* (London: H.M. Stationery Office, 1931), 10.
23. An early and influential critique of this approach appears in George Basalla, "Museums and Technological Utopianism," *Winterthur Conference Report* (1973), 355–371.
24. The decade beginning in 1959 brought the attention of several disciplines to the subject of time. See Edward T. Hall, *The Silent Language* (Garden City, N.Y.: Doubleday,1959); Sebastian de Grazia, *Of*

Time, Work and Leisure (1962; reprint, New York: Vintage Books, 1994); Carlo M. Cipolla, *Clocks and Culture 1300–1700* (New York: Walker and Company, 1967) and E. P. Thompson "Time, Work-Discipline and Industrial Capitalism," in *Past and Present* 38 (December 1967): 56–97.

25. See for example Lewis Mumford, *Technics and Civilization* (1934; reprint, New York: Harcourt, Brace & World, 1962), 14; H. Alan Lloyd, "Mechanical Timekeepers," in *A History of Technology*, vol. 3, ed. Charles Singer et al. (Oxford: Clarendon Press, 1957); Lynn White, Jr., *Medieval Technology and Social Change* (London: Oxford University Press, 1962), 119–128; Aubrey F. Burstall, *A History of Mechanical Engineering* (London: Faber and Faber, 1963), 142; Donald S. L. Cardwell, *Turning Points in Western Technology* (New York: Science History Publications, 1972), 18–19.
26. Henson, p. S260; Robert P. Multhauf Oral History Interviews, 1974, Smithsonian Institution Archives RU9502, 29, 53, 54, 63.
27. Henson, p. S263.
28. Otto Mayr and Klaus Maurice, eds., *The Clockwork Universe: German Clocks and Automata, 1550 to 1650* (New York: Neale Watson Academic Publications, 1980); Otto Mayr, *Authority, Liberty and Automatic Machinery in Early Modern Europe* (Baltimore: Johns Hopkins University Press, 1986); see also *The Origins of Feedback Control* (Cambridge, Mass.: MIT Press, 1970) and a catalogue on the subject, *Feedback Mechanisms in the Historical Collections of the National Museum of History and Technology* (Washington, D.C.: Smithsonian Institution Press, 1971).
29. Robert C. Post and Arthur P. Molella, "The Call of Stories at the Smithsonian Institution: History of Technology and Science in Crisis," in *ICON* 3 (1997): 52.
30. Post and Molella chart this change in the NMAH in ibid., 55–56. For a fuller treatment of shifts in the field of history of technology see Staudenmaier, *Technology's Storytellers*.
31. Each group of curators muttered that the other was inept, and administrators joined in. One former museum assistant director wrote that most of the old-style curators "...brought to their work a reverence for the objects under their care that made a truly critical stance difficult." See Kulik, "Designing the Past."
32. I became a curator in the engineering collections in 1983, after nine years as a "museum specialist," an arcane title for a job that permitted me to work directly with the division's collections in three sections, Heavy Machinery, Light Machinery and Tools. I worked as an assistant to three engineering curators, Battison and Mayr, already mentioned, and Robert Vogel. My arrival was a departure for the engineering division. I had never been a practitioner in any of the fields that traditionally led to a technology curatorship at the Smithsonian. As an alumna of the Hagley Program at the University of Delaware, where I learned history of technology and museum studies in the Hagley Program, I am the first engineering curator with exclusively academic credentials in history, and I am the first female engineering curator.
33. See the exhibition booklet, *Inventing Standard Time* (Washington, D.C.: National Museum of American History, 1983).
34. To date, our research on this subject has yielded the following monographs: "Astronomy as Public Utility: The Bond Years at the Harvard College Observatory," *Journal of the History of Astronomy* 21 (1990): 21–36; reprinted in Owen Gingerich and Michael Hoskins, *Two Astronomical Anniversaries: HCO & SAO* (Cambridge, Mass.: Harvard Smithsonian Center for Astrophysics, 1990), pp. 21–36; "Partners in Time: William Bond & Son of Boston and the Harvard College Observatory," *Harvard Library Bulletin* 35 (Fall 1987): 351–384; and "'The Most Reliable Time': William Bond, the New England Railroads, and Time Awareness in Nineteenth-Century America," *Technology & Culture* 30 (January 1989): 1–24.
35. Stephen Kern, *The Culture of Time and Space 1880–1918* (Cambridge, Mass.: Harvard University Press, 1983); David S. Landes, *Revolution in Time: Clocks and the Making of the Modern World* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1983); Michael O'Malley, *Keeping Watch: A History of American Time* (New York: Viking, 1990); Mark M. Smith, *Mastered by the Clock: Time, Slavery and Freedom in the American South* (Chapel Hill: University of South Carolina Press, 1997); and, for example, Barbara Adam, *Timewatch: The Social Analysis of Time* (Cambridge, U.K., and Cambridge, Mass.,: Polity Press, 1995).
36. He has unravelled the puzzle of several generations of nineteenth-century gravity escapements invented by Richard Bond of Boston and has a work in progress on the clock Thomas Jefferson designed for Monticello.
37. Carlene Stephens and Maggie Dennis, October 2000, www.si.edu/lemelson/Quartz; see also Maggie Dennis and Carlene Stephens, "Engineering Time: Inventing the Electronic Watch," *British Journal for the History of Science* (forthcoming).
38. NMAH artifact cat. no. 1999.0276.01.
39. The structure and presentation styles of *On Time* were the result of collaboration with my colleagues Howard Morrison and Ann Rossilli. Informing our efforts were two recent visitor studies: Audrey E. Kindlon, Andrew J. Pekarik and Zahava Doering, "Visitors to History: A Report Based on the 1994–95 National Museum of American History Visitor Study," April 1996; and Randi Korn & Associates, "Discovering History in Artifacts: Results from Focus Groups," December 1997.
40. Lawrence M. Small, "Comments from the Castle," *The Torch* (March 2000): 3.
41. David Thelen, "A Participatory Historical Culture," in Roy Rosenzweig and David Thelen, *The Presence of the Past: Popular Uses of History in American Life* (New York: Columbia University Press, 1998), 190.
42. Kulik, 31.
43. Thelen, "Participatory Historical Culture," 190.
44. Corn, "Tools, Technologies, and Contexts," 241.