Science and technology are defining characteristics of our society and, in striving to meet the needs of the public for meaningful narratives about the past, public historians need to pay more attention to their history. Museums, with their educational mandates and historical collections, should be an obvious vehicle for fulfilling this role. The situation, though, has been complicated by the science center movement which emphasizes transcendent scientific principles. The ability of historians and curators to demonstrate the explanatory power of history and make good on the promise of object-based exhibitions and programs

1. Neil Postman, *Building a Bridge to the Eighteenth Century: How the Past Can Improve Our Future* (New York: Alfred A. Knopf, 1999), 115. The full quotation from which the title is taken is:

We must take to heart the sage remark of Niels Bohr, one of our century’s greatest scientists. He said, “The opposite of a correct statement is an incorrect statement. The opposite of a profound truth is another profound truth.” By this he means that we require a larger reading of the human past, of our relations with one another and the universe and God, a retelling of our older tales to encompass many truths and to let us grow with change.
will depend on meeting significant institutional and intellectual challenges. It will also depend on support from the wider public history and museum communities.

As the volatile and violent twentieth century drew to a close, many thoughtful people expressed concern about the loss of the unifying narratives that had once given meaning and purpose to our lives. In 1999, Neil Postman wrote that

we are living just now in a special moment in time, at one of those darkening moments when all around us is change and we cannot yet see which way to go. Our old ways of explaining ourselves to ourselves are not large enough to accommodate a world made paradoxically small by our technologies, yet larger than we can grasp.2

His solution to this loss of direction was a call to craft a new narrative, one that was larger and more inclusive than our existing ones. Others agreed. Physicist Ursula Franklin argued that over the course of the century, technology had “muddled or even destroyed the traditional social compass.” In this context, nothing short of a “global reformation of major social forces and of the social contract” could bring some sense “of security to the world and its citizens.”3 Cary Carson told a Winterthur Conference in 1993 that what the public needed and wanted from historians was a “candid, coherent, inclusive” story and that it was our responsibility as professionals to help create a “unified narrative” of the past.4 David Thelen and Roy Rosenzweig, having demonstrated the public’s great interest in the past, pointed to the need for “common narratives” that give meaning and context to “intimate worlds” and personal experiences.5 Henry Glassie, following the lead of Bronislaw Malinowski, argued that it was the role of historians to tell “stories that function as social charters,” that help people understand their lives and their worlds.6

All of these writers have their own particular ideas about how to build this narrative and about how it will differ from and improve upon older, now inadequate, stories. But they all seem to agree on certain fundamental principles. First, a point that will come as a blinding glimpse of the obvious to historians but which cannot be taken for granted in a time and a place where newness counts for so much: we cannot and must not discard the past. It is really the only foundation upon which we can build and, for all the disappointments and disasters it contains, there is much in our collective experien-

2. Postman, Building a Bridge, 115.
ence that is valuable, enlightening, and useful in understanding our place in the present world. Re-reading, revising, and expanding the meaning of our stories is second nature to historians, but this process and its importance need to be explained in terms that others can understand and embrace.

Most of these writers also agree that any useful re-reading of the past must be based on a broader definition of history than that which many of us learned in graduate school. There can be no doubt that in the last forty years, diversification and specialization within the academy have significantly enhanced the breadth and depth of our understanding of the past. Professional historians have opened up and explored many previously neglected fields, and our craft is much the richer for it. But diversification and specialization have not yielded uniformly positive results. We have, in a sense, “shattered” the past and sorted the pieces “into neat little piles of splinter histories,” each presided over by a group of experts who too often research, write, and publish for one another. Moreover, while we may have brought “new people and new sources” into the historical fold, Henry Glassie has argued persuasively that “we accept them only insofar as they can be accommodated in the rules of narration implicit in the old story we tell.” That story is a linear one, committed to change and always looking for signs of modernization, of “progress that leads, inevitably, to us.”

So if our existing view of history is inadequate, what do we need to do to fix it? And what are we to do in the meantime with all the shards and splinters of the past that we have so meticulously unearthed and collected? Well, rather than try to offer you some grand plan for fixing history—a project that is certainly beyond my abilities, not to mention your patience—I thought that I would deal with one field that definitely needs to have an important place in any larger reading of the past—science and technology—and about how museums of science and technology can help to make this vital subject a more compelling component of our perspectives on the past.

A Singularly Important Pile of Splinters

For many, perhaps most of you, the history of science and technology is just one of the many specialized fields that are now part of the multi-faceted discipline of history. It has no greater claim to your attention than any other

10. Indeed, the history of science and technology is more marginalized than most specialized fields. In Canada, for example, most history departments do not offer undergraduate courses in the field and very few can support advanced courses or graduate supervision. And unlike other specialized areas of study like women’s history or the history of indigenous peoples, science and technology are seldom incorporated in any meaningful or sustained way in survey courses and textbooks.
field, except insofar as it relates to the work you are doing in your own subject area. If, however, historians are concerned with expanding and revising our reading of the past in order to help make sense of the world we live in, then the history of science and technology becomes critically important.

There is no escaping the fact that science and technology, taken together or even taken separately, are a defining characteristic of the twentieth century, especially in the post–Second World War era. It hardly needs saying that most of us in the developed world are utterly dependent on technology. It not only fulfills our basic physical needs but also makes our communities livable, our jobs doable, and our leisure time enjoyable. Thanks to science and technology we live longer, safer, and more comfortable lives. They also make our economies more productive and efficient, which in turn sustains our standard of living, though sometimes it undermines it, as well. As Ursula Franklin so aptly put it, we are all living in the house that “technology has built,” and most of us would not, even if we could, choose to live outside of it.11

The influence of science and technology, of course, goes much deeper than its visible products. Many of the great accomplishments of modern times—in fields such as medicine, pharmacology, biochemistry, and mechanical, biological, and electronic engineering—“were made possible by the consistent application of the aims, assumptions, and procedures of natural science.”12 As a consequence, the scientific method came to be and is still valued above all others as a way of describing and understanding our world.13 As professionals, we seek to follow science’s precise, objective, self-correcting model and to claim the “certain knowledge,” authority, and prestige that it confers.14 As citizens, we tend to privilege explanations based on scientific study, expert analysis, and statistical data over our own judgments based on personal experience, anecdotal evidence, and common sense. We may live our lives and make our choices as irrationally as ever, but in our social discourse we feel the need to justify our actions according to scientific reason.

Technology and its pervasiveness in our lives have also shaped the way we see and interact with the world. For example, we have come to desire and expect technology to solve our problems and improve our lives. We expect it to be reliable, efficient, and user-friendly. We also expect it to be accessible, affordable, and portable. We expect it to be able to do things that are not possible with other technologies.


13. According to Ursula Franklin: “Today scientific constructs have become the model of describing reality rather than one of the ways of describing life around us” (The Real World of Technology, 31).

14. Henry H. Bauer, Scientific Literacy and the Myth of the Scientific Method (Urbana: University of Illinois Press, 1992), 34; Postman, Technopoly, 159. Even in the humanities, including history, scientific method and quantification have had a significant influence on both theory and practice.
pect a never-ending cycle of improvements in its capabilities—faster computers, more effective drugs, safer cars—without questioning whether these enhancements are necessary or even useful. More importantly, governments, businesses, and other agencies and institutions have transferred the standards used to evaluate systems and devices—efficiency, speed, predictability, standardization—to our lives. They speak of people and institutions needing to be more efficient, of service needing to be faster and more reliable. In order to understand and solve problems or assess merit, institutions seek to quantify and rank everything, from knowledge to consumer confidence, according to measurable standards. Baffled by all this, we effectively surrender and become complicit in it.

The enormous transformative power of science and technology and its pervasive influence in our lives has also given rise to great public anxiety, suspicion, and fear over the last thirty years. In many fields, the rapid rate of change has outpaced our legal, regulatory, political, and social responses to new technologies. Genetically modified foods and stem cell research, for example, have been around for many years, but we are only beginning to debate the appropriate uses for these technologies. Though we depend on it more than ever—perhaps because we depend on it so much—many of us increasingly mistrust science, and our mistrust seems to grow with the rate of change. In the United States there has been a religious backlash against some of its most fundamental teachings, while in Europe, the reaction has been more specific and has included, among other things, a rejection of nuclear energy in several countries and a strong resistance to genetically modified foods.

History and Public Understanding of Science and Technology

Clearly, there is an acute need for greater public understanding of science and technology and public historians and heritage institutions need to pay

15. In chapter 8 of his book Technopoly, Neil Postman discussed what he called “invisible technologies,” of which language is the “most powerful.” He then goes on to explore in detail how the “language” of statistics has become all-pervasive in our society and is now considered both objective and authoritative when in fact it is neither. See pp. 123–43.


17. Concern about the level of public understanding of science and technology is longstanding and widespread. Many national governments and multi-national bodies like the Organization for Economic Cooperation and Development have studied (statistically, of course) the state of public knowledge of science and technology, have generally found it wanting, and have attempted to develop policies to improve it. The underlying premise of most of this analysis is that public funding and support for science and technology are essential to economic competitiveness and growth and to the solution of intractable problems like poverty, starvation, and disease. See, for example, Jon D. Miller, “Public Understanding of Science and Technology in OECD Countries: A Comparative Analysis,” a paper presented to the 1996 Symposium of Public Understanding of Science and Technology, Tokyo, 5 November 1996, revised 8 February 1997. Public understanding of science also figures largely in the European Union’s Lisbon Agenda. See Jane Morris, “A salutary lesson for science museums,” Editorial, Museums Journal (March 2005): 4.
more attention to this need. Museums of science and technology must take a leading role in making their subjects and their collections a part of our larger conversation about the past and, indeed, about our culture. This may seem obvious to historians who take the explanatory power of history for granted, but it cannot be taken for granted in the wider world of science and technology or even that of science and technology museums.

Science and technology museums were largely an outgrowth of the great industrial age that spanned the nineteenth and early twentieth centuries. Created by governments that believed strongly in the power of technology to transform and improve society and enhance national power, their original purpose was to showcase great national achievements and to educate the public about the pivotal discoveries and inventions that led to the current advanced state of knowledge and development. Exposure to these stories of success and progress would, they believed, encourage citizens to embrace and promote the values of a forward-looking industrial society and would help to justify the exploitation and rule of colonial societies. This, in turn, would help the nation establish an important place for itself on the world stage.18

This promotional, celebratory outlook was reinforced by the fact that museums of science and technology were often staffed by curators who came from science and engineering backgrounds. As Doron Swade has pointed out, “The fundamental tenet of orthodox science is the compelling belief in a single objective reality.” Transferred to the realm of history, this belief tends to turn a complex, contingent, and imperfect reality into a clear linear process marked by a series of pivotal advances that lead inevitably to our current, superior state of scientific understanding.19

In this context, the past is illuminating only insofar as it shows our progress, in more or less a straight line, towards the present. As one critic put it, science museums have had a tendency “to stand at the present and from there to offer views of the past, the present or the future.” The image of the past these institutions portrayed was a “dead” one, filled with “ideas and machines that had been superseded by their betters.”20 This outlook permitted, perhaps even encouraged, a kind of condescension about our predecessors, their ig-


norance about the way the world worked and their misguided attempts to understand and control it. It also perpetuated an over-simplified view of history in which science and technology evolved according to their own internal dynamics—the natural curiosity of researchers, the engineer’s desire to solve a technical problem or improve on an existing device—without reference to the societies and cultures in which the advances were taking place.21

The role of history in museums of science and technology was further marginalized by the emergence of science centers beginning in the late 1960s. The science center movement was inspired, in part, by Cold War fears of Soviet scientific supremacy and concerns about growing public mistrust of science and some of its products (e.g. thalidomide, DDT, nuclear weapons). Advocates of science and its benefits believed that greater public understanding of scientific principles would naturally produce greater confidence and support, including encouraging more young people to pursue careers in science and engineering. Science centers were an important tool in this campaign to improve so-called scientific literacy and public support for scientific research.22

While their basic educational mission was not unlike that of most science and technology museums,23 their notion of what constituted literacy and their methods of achieving it were quite different. Science centers sought “to cajole and delight the public into understanding”24 by recreating the process of experimentation and letting visitors ‘discover’ for themselves the wonder of science. These experiments consisted of carefully crafted and often very sophisticated interactive displays, each of which was intended to explain a basic scientific principle or process.

Interactivity was central to the science center model for both practical and philosophical reasons. Its proponents were convinced that interactivity would help them “to bridge the gulf between popular culture and the esoteric world of science and technology,” by reaching out to and teaching visitors of all backgrounds and levels of education the most important concepts in modern science. They also believed that it acted as a democratizing force that “empowered” visitors to participate in the scientific process rather than just observing it. Using this technique, science centers would make people believe that they


23. The mandate of the Canada Science and Technology Museum Corporation, for example, stresses the educational mission of the institution much more explicitly than its heritage role. According to An Act respecting Museums, Statutes of Canada, 1990, 38 Elizabeth 2, c. 3, p. 9, the mandate of the Corporation is:

To foster scientific and technological literacy throughout Canada by establishing, maintaining and developing a collection of scientific and technological objects, with special but not exclusive reference to Canada, and by demonstrating the products and processes of science and technology and their economic, social and cultural relationships with society.

could understand the natural world and give them the confidence to make well-informed decisions about public policy issues.25

Though costly to build and operate, science centers proved to be enormously popular around the world. In 1972, there were already 17 listed; by the year 2000, there were 450, most of which were built after 1980.26 Fuelled in part by the continuing concern of international organizations, national governments, industry, and the science and engineering communities with scientific literacy, they also benefited from the growth of tourism and recreation as well as expansion of non-school-based educational activities. Their emphasis on lively and exciting display techniques, on the active participation of visitors, and on the present rather than the past set science centers apart from most established museums of science and technology, where interactivity was usually limited to displays of working artifacts.

Buoyed by the remarkable popularity of science centers and by a strong sense of mission—scientific and democratic—some science center advocates boldly declared that history and historical artifacts were not only outmoded, but also unhelpful in imparting “useful” scientific knowledge. At the base of this claim was the belief that the only science that really matters is that which is relevant in the present day. It is much less important to dwell on how we got there than it is to impart a basic understanding of the essential principles that underpin our knowledge of the natural world. Some in the scientific community might even have gone further, arguing that the past is best forgotten when the future is unfolding so quickly around us. For people with this mindset, “historical museums were cemeteries of knowledge” rather than useful tools in explaining science to the public.27

As for artifacts, they were, according to the more extreme proponents of the science center approach, merely “relics” of the past. Far from conferring “a unique understanding” of the subject on display,28 as some in the museum community argued, objects placed limits on what kinds of stories could be told and what methods could be used to tell them. They represented concrete links to specific times, events, places, and people. To move beyond these stories, to capture the grand sweep and timeless meaning of science and technology, exhibitions had to move beyond artifacts. Moreover, according to these


critics, objects are particularly “impotent” in dealing with modern science and technology, which is “too complex, esoteric and alien” and its material culture too “mundane” to “mobilize understanding or interest.”

This critique of the historical perspective and artifact collections had a significant impact on many museums of science and technology. It coincided with a major re-examination of the role of all museums, especially publicly funded ones, in society. Under pressure to re-invent themselves to serve a wider and more diverse public, the example of science centers with their interactive, participatory displays became an important model. This push by governments to democratize and popularize museums was reinforced in the 1980s and 1990s by funding cuts that drove museums to seek more and more outside funding and to sell themselves more vigorously in an increasingly competitive arts and leisure marketplace. Many in the museum business became, and remain, convinced that slick, exciting, “hands-on” exhibitions were the key to attracting both sponsors and visitors. Artifacts and other more traditional elements, often pejoratively associated with old-fashioned elitist and lifeless showcase displays, increasing came to be seen as secondary in the process of exhibition design and development.

By the 1990s, however, the science center movement was itself being subjected to a searching critique from within its own ranks as well as from the outside. This critique arose, in part, from immediate practical concerns including falling attendance. Some observers “pointed to the repetitiveness of the contents and strategies of communication” of many of science centers around the world. Another critic noted that, in the absence of unique collections, they had to rely upon rapid and innovative exhibition renewal to attract repeat visitors, an expensive proposition given the requirement for sophisticated interactive technology and in an era of sharply reduced public funding.

Critics also began to ask more fundamental questions about science centers. Some questioned how well they had succeeded in achieving their stated

30. Barry, “On Interactivity,” 98, 101–2, 104–5, and 112; and Galluzzi, “New Technologies,” 107. The impact of this critique was especially profound for museums of science and technology, which tended to see themselves as motivated by the same goals and appealing to the same audiences as science centers. In response to the challenge, some museums, like the London Science Museum, created science center areas within their institutions (Launch Pad). Many others made interactives the focal point of their exhibitions and began to place more emphasis on current science.
32. According to Bradburne it is only the addition of new science centers that has kept attendance figures growing overall. Without these numbers, it becomes clear that many “are seeing their visitor numbers fall annually—often dramatically in the case of ‘middle-aged’ institutions” (p. 123).
goals, that is, to teach the basic principles of science to a general audience. By the 1990s, researchers had begun to cast doubt on the efficacy of the interactive approach to learning. They substantiated what critics had long suspected: that “many interactives function as simple amusements or distractions and/or experimental games for the scientifically well-educated,” rather than as effective educational devices.

Other observers have pointed out that “there is no evidence that public confidence in science has risen” as a result of the creation and operation of science centers in countries around the world. Nor, apparently, can they claim much success in having made science “a more attractive option to students and graduates.” Indeed, one critic suggested that far from providing “a grounding in basic science for their visitors,” they actually were better at conveying a sense of the ‘magic’ of science.”

At a more basic level, many people have questioned the link between understanding scientific principles and making informed decisions about science and technology. Even if science centers can find a way to impart the necessary knowledge to their visitors, this will not necessarily equip people to make the “right” choices about the scientific and technological issues facing society. Most, if not all, of these issues are not simple questions of fact but complex ethical and social problems that require people to make value judgments about what is good or bad for them and their communities. Indeed, even the most highly trained scientists disagree about how best to apply the new knowledge and technological capabilities they have created.

Other critics took this argument further, asserting that the science center approach not only did not equip people to make informed decisions, it actually gave them a distorted understanding of the process of scientific research and technological innovation and no sense of its place in our culture. By presenting only “de-contextualized” and “disembodied” principles, these institutions cut science and technology off from both the societies and the cultural assumptions that generated them and the specific processes by which they were discovered or invented and refined. This created an unrealistically simplistic and one-dimensional perspective that made science into little
more than “a canon of accepted truths.”40 Thus visitors only learn about those ideas and achievements that “have stood the test of time” and nothing of “the trial and error, backing and filling, dismantling and rearranging that actually took place in the past, be that centuries ago or just a few years ago.”41 They also learn nothing of the debates and controversies that have characterized the process, the mistakes and misjudgments that scientists have made, the sometimes sinister uses to which their knowledge has been put, or even the unintended negative consequences that have come from their ability to manipulate the natural world.42

This critique arose from and was fuelled by developments in both the academic and museums communities. Within the academy, a relatively new field that came to be known as science, technology, and society (STS) was created by sociologists, anthropologists, and social historians interested in the cultural context and meaning of science and technology. At the same time, historians of science have broadened their field beyond its original focus on the history of ideas and of great scientists and “revolutionary discoveries” to include a new focus on instruments and on “scientific, technical and industrial heritage.” Historians of science and technology have also begun to explore cultural areas once considered “completely separate from science” such as the use of scientific instruments in the creation art.43 New trends in material culture studies and new interest in the different social, cultural, and political roles museums have played and can play in society have added to the ferment and have put curators and historians at the center of it. All of these things have given rise to a renewed debate about what public understanding of science and technology really entails and how best to work towards its achievement.

The Power of Objects

In the context of this renewed debate, curators and historians have begun to craft a new and broader definition of public understanding of science and

41. Bauer, Scientific Literacy, 36
42. In the mid-1990s, perhaps as a result of these criticisms, some science centers created exhibitions dealing with the social and cultural context of science and technology. In 1996 the Ontario Science Centre opened A Question of Truth, an exhibition that presented science as “a human and social activity, located within culture and dominant worldviews.” P. Livingstone, E. Pedretti, and B.J. Soren, “Visitor Comments and the Socio-Cultural Context of Science: Public Perceptions on the Exhibition ‘A Question of Truth’,” Museum Management and Curatorship 19, no. 4 (December 2001): 358. Around the same time, Vancouver’s Science World created Mine Games, a display “where the subject of earth sciences was transformed into a forum for debate on the future of the mining industry.” Bradburne, p. 120. As all these authors pointed out, these exhibitions or installations, though successful, are still the exceptions to the rule and have not led to a wholesale reconsideration of the established science center orthodoxy. See Bradburne, “Dinosaurs and White Elephants,” 120.
technology as it applies to their institutions. They maintain that what the public needs is not "more scientific facts" and textbook principles but "a proper understanding of the nature, workings and achievements of science," one that equips them "to evaluate its validity and consider its implications and politics." Only by understanding the place of science and technology in our culture can people enter into a meaningful "public debate about science."  

History and historical collections, of course, must play a central role in fostering this kind of intellectual engagement. They offer the opportunity to interpret science and technology as a series of endlessly intricate, subtle, and ambiguous stories that are inextricably woven into the cultural fabric of society. A historical perspective can also show that science and technology are, above all else, human endeavors shaped not only by historical circumstances and events but also by human character—intellect, ingenuity, creativity, and enterprise, as well as tradition, bias, ambition, greed, and foolishness. Finally, a historical perspective helps people to see that "knowledge is a quest, not a commodity; that what we think we know comes out of what we once thought we knew; and that what we will know in the future may make hash of what we now believe."  

Objects offer a unique and compelling way to tell this complicated story. The history of science and technology is as richly documented by its tools and products as by its ideas and intellectual processes. By "parsing" the material remains, we can show that the history of science and technology is not a tidy story wherein the best system or device always emerges clearly from a logical process of invention, refinement, and production, unaffected by politics, commerce, and culture. If we look inside—and encourage our visitors to look inside—our technologies, we find change, but it is change based on compromise and competing human agendas and values rather than the best possible solution to a problem. What we also find inside our devices and systems is evidence of continuity and persistence, a "necessary intermingling of the old and the new." This gives rise to questions about the choices we have made, whether we might have followed alternative technological paths, and where they might have led us.  

In addition to the plentiful and complex concrete information that they contain, the artifacts of science and technology also have cultural meanings that change with time, context, and interpretation. Like all objects created by and

46. Postman, Building a Bridge to the Eighteenth Century, 169–70. Postman argued "that science, like any other subject, is distorted if it is not taught from a historical perspective."
47. Ken Arnold, "Fact and Fancy: Art in the Presentation of Science," in Lindqvist (ed.), 97. For a compelling and almost poetic justification of the artifact as a unique source of knowledge and understanding see Glassie, Material Culture, pp. 41–47.
for humans, they embody and convey relationships with and between people and, when exhibited, visitors establish new relationships with them. Because of this, as Simon Schaffer has pointed out, “the objects of material culture are incapable of transmitting a single, sempiternal meaning which survives throughout all their possible uses.” Their meanings are “fluid and unexpected” and depend a great deal on “audiences’ and end-users’ own culture.”

While this ambiguity bothers those who see science as “a single objective reality,” many curators and historians see it as an opportunity to portray science and technology in all of its richness and depth. Precisely because they have so many possible meanings, objects can help us to challenge traditional divisions and classifications that tend to separate science and technology from other cultural endeavors such as art and music. For example, there is no reason why we cannot present the material objects of surveying, charting, and map-making as art. Equally, we can take some of the same artifacts, alter their context, and show the role they have played in exploration, conquest, and colonization. In a different display, they could help our visitors understand the origins and cultural meanings of measurement and standardization. In a specifically Canadian context, we could explore the influence that map-making has had on our sense of nationality and of our perceptions of our geography and of our sovereignty over, and ownership of, what is still a largely, uninhabited wilderness.

**Facing the Challenges**

Mapping out the intellectual origins and outlines of a problem and suggesting what ought to be done to solve it are always much easier than developing a workable strategy for actually doing it. Many critics and observers agree that the public needs to know more about science and technology and how it has shaped their lives and their world. They also agree that in order to fulfill this mission, museums need to change their approach to public programs including exhibitions, in order to reflect the complex realities of science, technology, and society more accurately and compellingly. Curators and historians have argued persuasively that history and historical collections can and should be the primary means for reaching out to and engaging the public in a meaningful discussion of science and technology.

The question then becomes: Can we transform these “stirring ambitions”

52. For an interesting discussion of the how art and science can work together to create innovative and interesting exhibitions, see Arnold in Lindqvist (ed.), 87–105.
and “pious aspirations” into successful exhibitions and other public programs? I believe we can, but only by recognizing and overcoming the many serious challenges that confront us. The most insidious of these is a lack of conviction, notwithstanding professions to the contrary, that the history of science and technology is interesting and relevant and that artifact-rich exhibitions can be appealing, informative, and marketable. This underlying doubt and uncertainty not only permeates large segments of society, but can also, surprising as it may seem, even be found among certain staff at museums of science and technology.

In order to counter these misconceptions, curators and historians need to take risks and to try new techniques and approaches to exhibit development. On a general level, some have argued that museums of science and technology need to pay more attention to the aesthetics of the exhibition medium and treat their displays as an “art form” as well as a tool for communicating with the public. More specifically, they need to depart from or “disrupt traditional science museum formats” that provide linear accounts of history which, though relatively “straightforward” for curators to create and visitors “to read,” often serve to reinforce “ingrained assumptions about development and progress.” In their place there should be at least a few exhibitions that, among other things, deal with controversial subjects, provoke reflection and debate, take a stand on an issue or group of issues, or incorporate objects and ideas from other fields such as anthropology, art, and popular culture. As Ken Arnold has argued, exhibitions need to cater to the public desire for familiarity but they also should strive to provide “something unknown, unrealized, unimagined and even unpopular.”

The requirement to create innovative and provocative exhibitions, however, raises another potentially significant obstacle. It takes time and money to develop, design, build, and staff exhibitions of any kind. In the current environment and the foreseeable future, that is likely to mean finding outside sponsors. Museums of science and technology often look for outside financial support within related industries, institutions, and government departments—organizations that may well have a vested interest in the subject of the exhibition. While they may not demand a direct say in what stories are told, they will, in all likelihood, be reluctant to sponsor critical or provocative exhibitions that might lead visitors to question scientific and technological developments or the institutions that generate or profit from them. It will there-

fore require clear vision and strong leadership and support at the highest levels to make these more controversial exhibitions a reality.

Another important challenge is that of collections. If we are going to make artifacts the focal points of these new, expanded stories, we will need to address our approach to collecting. We will need to adopt a wider view of what qualifies as science and technology. This may entail a re-examination of the traditional—and somewhat arbitrary—disciplinary divisions which define our institutional mandates, missions, and areas of expertise and which distinguish the particular role of science and technology museums from that of other museums and cultural institutions. This does not necessarily mean breaking down the divisions between science and technology and other fields of human endeavor and collecting indiscriminately. It may only mean looking at and presenting our existing collections in different ways.

We will also have to grapple—or, more accurately, continue to grapple—with the difficulties of modern collecting. Here the challenges are many. The pace of change and the cost of new devices are significant. Also, there is an impulse to embrace the new before we know for certain whether it is of lasting or even fleeting importance. Political and market pressures only add to the difficulties here. Also we must deal with the “[e]xtremes of scale, complexity, increased abstraction, and uniformity of appearance,”59 that characterize much modern technology. What, if any, stories can these devices and systems be made to tell? As well, modern collecting has to encompass process as well as products. For example, many of the technologies we depend on would be useless pieces of plastic, metal, and wire if it were not for software. Software can be many things depending on how you look at it. From an artifactual point of view, it is “literally, a virtual object,” nothing more than a set of “rules” that govern how other machines and systems work. If, however, we collect the gadget without the “guts,” what do we have? Software is also “a creative output” and sometimes a valuable intellectual property. This too poses a challenge to our traditional ways of collecting and presenting objects.60

By far our biggest struggle though is the struggle to achieve a wider recognition of the innate, inextricably human and poetic aspect of scientific and technological endeavor. History, we all know, is a messy place because it is a place inhabited, crafted, recorded, and interpreted by people. The goals, needs, and motivations of human beings are never entirely rational or entirely clear. Science and technology, as a human endeavor, is like that, too, though many of its practitioners, advocates, and dependents do not see it that way. Historians, especially public historians, need to bring their understanding of ambiguity and uncertainty to bear on this field if we are to create and “sustain an influential public culture of science.”61

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