

Abode of the Modern Muse: the Science Museum

Thomas K. Simpson

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1. Introduction

The museum as grove of the Muses

In a society suffused with the sciences and their companions, the technologies, it is perhaps time to take our science museums more seriously than we have done in the past. We have always prized and delighted in these halls of wonder and investigation, but we may not have thought enough about their special role as the forum in which we meet to contemplate the sciences and reflect on their role in our past, present, and future lives.

It may be helpful to begin by reconsidering the word museum. We inherit it from the Greek *museion*, which means the temple or abode of the Muses initially, more likely a hill or a grove than a building. We are reluctant to admit that ancient words may have force for us today, but the Muses are timeless: we meet them whenever we are moved by music, or moved to compose—and “musics” may take many forms. The range of the ancient Muses was reflected in their titles and responsibilities—Erato, singing of love; Calliope, Homer’s Muse, of epic verse; Urania, the astronomer. Dance, comedy, and tragedy all belong to their company; but they all in turn follow in the train of Apollo (who is himself as much tempted as tempter), and they are all, finally, one Muse who entrances and inspires us, whatever channel this inspiration may flow in.

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Our modern *science* is distinct enough, perhaps, from anything the ancients knew to deserve a Muse of its own, so without producing a new name out of the hat, let us simply say that this modern Muse is our form in which the old Muse of the human spirit takes brilliant new life. The new Muse is at work throughout our society, wherever the sciences and technologies are flourishing, but the science museum is the special place we dedicate to reflection on the sciences, and display and wonder at their works. I will argue that the science museum, for all the fun and celebration it is capable of inducing, is also in the most literal sense a sacred space. In any grove in which one Muse has appeared, we might well be on the lookout for the others, and this caution applies to the science museum as well: for our Muse of the modern sciences keeps close company with Urania, Calliope, and the Muse of tragedy, Melpomene, as well.¹

Meet the Muses

There was one very special summer's day when Socrates took Phaedrus to meet the Muses, just outside the walls of ancient Athens. To get a closer look at these divinities whose service I believe we still honor, we might well join them; it will be a little like going bird-watching with an expert, for we soon see that Socrates is remarkably familiar with this terrain. The event is reported by Plato in the dialogue simply titled *Phaedrus*.² Phaedrus is a young man, full of the passions and enthusiasms of youth; today it might be the prospects of digital technologies or the mystique of black holes; for him it was the wit and intriguing techniques of the new art of rhetoric, the current rage in Athens. Phaedrus thus arrives as a young devotee of the Muses; he is carrying a book with him, a prized display of the skills of the orator Lysias, which he is impatient to recount. Together he and Socrates make their way along the stream Ilyssus—the stream of both love and discourse—to the shade of a plane tree favored by the Muses. Lysias' art in this case has been demonstrated in a tricky argument to the effect that it is better to yield to the entreaties of a non-lover than to those of a lover, for the lover will make irrational and enslaving demands, while the non-lover keeps a cool and level head. Phaedrus does not realize that, read in this grove of the Muses, such an argument is blasphemy, as not only Erato, but all the Muses are true lovers—and it is a

special offense to Socrates, whose life is one of philosophy, the unwavering love of wisdom.

Socrates, *curator* we might say in this sacred grove, assumes the role of *psychagogos*—leader of souls—to guide Phaedrus' spirit gently but surely to a higher sense of service to the Muses. He first wins Phaedrus' attention and respect by matching Lysias' effort with a far superior speech to Lysias' own point—taking care, however, to first cover his head to make clear that his heart is not in his words. He takes care, as Lysias had not, to define this Eros, the “love” which is being decried. It is the “left-handed” love, characterized by grasping, need, and deprivation. Won by this first speech, Phaedrus is now ready for a reversal in the *palinode*, the second, opposite speech, which Socrates gives, now in behalf of true love. This time Eros is rightly characterized as generous, not acquisitive or transient, but timeless because devoted to what is true, beautiful, and good. Mankind's deep confusion is between lasting devotion and passing delight. If the science museum is indeed the sacred grove, the same confusion will rend us there between the passing delights of fascinating technologies and those things for which we should truly care.

In the branches of the plane tree, cicadas have been singing lustily through the heat of the day: one could succumb to their charms and sleep away the afternoon. These are siren voices with which the Muses test and mock us. The real power of the Muses is something altogether different, awakening our spirits and stiffing true devotion to things worthy of our love. This picture is painted by Socrates—and as it unfolds, we recognize that the truer Muse is awakening in Phaedrus' breast—in a myth of the soul as a chariot drawn by two horses. The charioteer, *nous*—intuitive intellect, capable of grasping truth—is devoted to the highest, most beautiful and eternal things, but the chariot is drawn by two very different horses in the everyday world of opinion, one of which serves the charioteer well, while the other fiercely grasps the delights of the moment. Phaedrus is won, at least for this day, and the victory of Socrates in the sacred grove means that the Muses in the highest form have begun to stir in Phaedrus' heart.

It is of the essence of this dialogue that Socrates loves, not only that which is truly beautiful and good, but Phaedrus himself. The grove is

a place of friendship and caring; this is the secret working of the Muses, and at the same time, the secret of true teaching and learning. It is a mystery, not something which can be achieved by cleverness or guaranteed by methodical design. And it is not simply a happy tale, for the notes of epic and tragedy sound in that grove as well. Few of Plato's *Dialogues* are as sensitive to the moment and the passage of time as this one; as we turn away, back to the city, we are painfully aware of the likely transience of Phaedrus' insight.

The science museum may be such a mystic grove, and Phaedrus a young visitor arriving at the door. If so, we must bear a heavy curatorial responsibility to offer more than the fascination of a clever exhibit, or graphic attractions, to the wonders of modern technology. Cicadas are everywhere, as we know, in the modern world. There is a *wholeness* about the grove of the Muses which we need to consider carefully, for if the Muses abide in one another's company, then even if our attention is to a new Muse attired in a fresh white lab coat, we know the others are present as well. Thought will be led by the Muses past any boundary by which we may seek to contain it. Despite its name, and however inconvenient, the science museum cannot finally be about "science" alone. If the spell works, then thought will range from the science we offer to all the contexts in which it is embedded, and through all the modes of coloration, from celebration through, it may be, to despair.

2. The Alexandrian museum as paradigm

The Great Museum of Alexandria and its works

What has become known to the world as the "Great Museum of Alexandria," with its even more famous Library, was only one component of a bold concept of Alexander the Great—the concept of a city of a new sort within which a Museum would be the jewel, and of a new world order, of which Alexandria would be the symbol and the focus. This plan, including the detail of the city, Alexander seems to have laid out in one winter in Egypt, at the outset of his campaign to the extreme bounds of the known world. In one of its roles, the Museum of Alexandria was very much a science

museum, and a brief consideration of it may be of help in considering what a *museum* may be, and yield in the process certain principles which will aid in characterizing instances of science museums closer to our own time.³

As the hub of Alexander's new world order, Alexandria was to be a center of commerce; facing the Mediterranean on one side, and the system of the Nile on the other, it was destined to flourish as a center of trade between the West and the East. At the same time, it was to become a center of commerce in ideas, full counterpart to its economic function and equally important in shaping the new world. Alexander died after the close of his first great cycle of campaigning, and the political world-order he envisioned was never achieved. But, remarkably, Alexandria went on to play that role as intellectual focus of the world in much the way he must have intended, so that for centuries this Museum remained a vital institution of a remarkable kind.

The histories appear to agree that the conception of the city was Alexander's own, and that he laid out the site personally. It joined its commercial, political, religious, and intellectual functions in one coherent and dramatic design. One long axis paralleled the seacoast, while a major cross-street linked the seacoast with the Nile harbor. The result was a grid of four elongated quarters, one being reserved as the center of government. During Alexander's lifetime, it was the palace of the Macedonian governor he had appointed for Egypt; when, following his death, his Macedonian governor, Ptolemy, proclaimed himself king, this quarter became the royal palace. At the far end of the long axis was the Serapeium, the temple which reproduced in Alexandria its predecessor in Memphis, and thus became the spiritual center of Egypt.

The Museum was a prominent feature of the royal quarter of the city; it included accommodations for some thirty members of an academic community, with rooms and colonnades for lectures, thought, and conversation. There were facilities to dine together, and above all perhaps, a library to be gathered, as a resource for thought, from all comers of the world.⁴

From Aristotle to Alexandria

If we ask ourselves how Alexander happened to give such prominent place to this vision of the Museum, we are led back to Athens and to two schools there, the Academy of Plato and Aristotle's Lyceum—and thence, finally, to the grove of the Muses under whose auspices Socrates conversed with Phaedrus. The term “school” is misleading, just as the term “museum” is. The word *schole* means “leisure”—a term even more confusing for moderns. “Leisure” is not a *time* of doing *nothing*, but rather, an activity in which one is doing one's *most*; correspondingly, Aristotle speaks of “waging peace” as one would speak of “waging war.”⁵ The root sense is of *freedom*—not simply as lack of restraint, but as the fully implemented opportunity to act to our full human capacity, without constraint of necessity. It is not something one thinks of doing alone, but in the polity, or in company and conversation.

The Academy, then, as a school, was a place of such leisure in which students and teachers in fellowship were enabled to pursue to the fullest that conversation between teacher and student which constitutes true teaching, or among the teachers themselves, which constitutes the pursuit of learning at the highest level men can conceive. To close our circle of terms, we need only add that such a *school* is a *museum*; for it is the place in which the presence of that Muse which presides over Socrates' inspired love of learning is most strongly felt. We do not, today, readily think of *reason* as occurring in a sacred place, or involving a sense of mystery; our reductive notion of reasoning draws too much upon computers or the operation of formal logics. In truth, the Muse most of all leads thought, and insight is a matter of grace, not design. These must be thoughts of the kind Alexander had in mind when he envisioned a *museum* as the centerpiece of the new city—a place sacred to the Muses, like the schools of Athens but on a new, world scale.

Though these thoughts link back to the Academy, the connection is far more direct to Aristotle and the Lyceum, equally a fellowship of learning and quite literally named for a sacred grove, that of Zeus Lykeos. The lives of Aristotle and Alexander are woven in a most remarkable way, for Alexander had been Aristotle's student for three highly formative years, apparently between the ages of 14 and 16. It is nearly impossible today

to imagine what these meetings would have been like, what curriculum they would have followed. We infer that they read Homer together, for Alexander carried his copy of Homer, edited by Aristotle, through his campaigns; this was not a question of light reading, but empowerment, for Alexander had reason to think of himself as descended from Herakles on his father's side and from Achilles on his mother's. But we can be confident that they followed some serious line of teaching which addressed virtue and led to the politics—for Aristotle would not have treated lightly the responsibility of educating a brilliant young man destined to take up his father's campaigns throughout Greece, and into Persia as well. Without attempting to paint Aristotle as father to Alexander's plan for a rational, peaceful, and unified world-order, we can be sure that Aristotle and Alexander conversed at length about the nature of man as both rational and political. Aristotle's must have been the last words of formal teaching Alexander heard, for he was soon carried off by unhappy affairs at the court; and he was only twenty-one that winter in Egypt when he laid out Alexandria with its new museum. If we had time, we could trace a fascinating pattern of relations between Aristotle and his former student. Let it suffice to say here that it was a former student of the Lyceum, Demetrius, who served as advisor to Ptolemy I of Egypt in bringing the Museum into being.⁶

It is hard to visualize how the great Museum actually functioned, and most of all, perhaps, it is difficult to clarify the notion of that crucial component, the "library." It was apparently a collection of books, rather than a special building; but then, the term "book" itself may carry misleading suggestions. Homer sang long before anyone thought to write him down: in this sense, the Muses do not need books. Manuscript books represented an effort to capture on papyrus an ephemeral stream of thought; and in vigorously pursuing a search for books for the library wherever they were to be found, the Ptolemies were perhaps not so much acting as bibliophiles as attempting to gather the wits of the world as a resource for new and ongoing thought at the Museum. Vast efforts were made in copying works, so that Alexandria became a center for the publication of handwritten books, while the traditional art of the Egyptian scribe must have been co-opted from the elegant production of hieroglyphs to lowly trafficking in the alphabet. Nobody knows how large the collection became, nor is a

“volume” quite such a stable measure in the world of scrolls as in that of stacked-up books. Yet it tells us a great deal to hear informed estimates of a peak of some 500,000 volumes. We should perhaps think of the library in organic terms, rather as a garden than a depository, for it must have been in constant flux, and its role was to nourish the work of the members of the Museum and to absorb new thought as it unfolded.⁷

The Alexandrian science museum

The project of the Alexandrian Museum was to bring to light in a single forum as much of the world’s ongoing work as it was able to gather, in a company of minds able to bring this immense collection to life in a new order of intellectual advance. Heretofore, schools like the Lyceum and the Academy had gathered what they could from traveling philosophers or the books of other schools. Now, in Alexandria, what had been limited and fragmentary would become organized, on a world scale. A new kind of insight arises, a new perspective of a whole which had not before been visible, Thus just as we have come to see the Library as a living thing, the interplay of lesser treatises and partial contributions would give rise to a new order of intellectual life. Since our concern is with science museums, we might mention three giants of this Alexandrian era, through whose vision we are able today to contemplate as ordered wholes the domains we know as classical geometry and astronomy—Euclid, Apollonius, and Ptolemy. Their work spans more than four hundred years, evidence of the endurance of the Alexandrian project.

It will be enough to consider very briefly the work of Euclid, whose name—if not in truth his great book, the *Elements of Geometry*—is so well known to all.⁸ He was there in the first years of the Museum project, and indeed it was to Ptolemy I that he is reputed to have said, tellingly, “There is no royal road to geometry”—for there is no alternative, if one is to know geometry, to bringing one’s own mind, step-by-step and sometimes with great difficulty, to perceive the light of truth in the unfolding systems of demonstrations. Most of the world, academia by no means excepted, has elected the “royal road” and thereby missed the geometry; little of the work as a whole is read, or its content understood, in our modern colleges.

Euclid nonetheless provides an excellent window for us into the workings of the Museum, for he was able to draw together there a number of scattered segments into the one dramatic system. The very concept of an ordered deductive structure needed to be seen, displayed in a paradigm of completeness with a beginning, middle, and end. The mystery of the irrational, in one aspect close to the secrets of Eleusis, together with Eudoxus' key which opens this to the contemplation of mind, and Theaetetus' brilliant reconciliation of the irrationals within a system of the rational, a wondrous victory of the mind over chaos—all these Euclid had to gather and give them place within an ordered body. The pieces were there to *be* gathered, but *geometry* as a body of thought had yet to be composed. It is easy to miss the originality of this typically Alexandrian work: not a matter of assemblage, but of conception, at a new level of intellectual insight.

Euclid's achievement throws special light on the concept of the museum more generally: for the sacred grove is a space reserved for such speculative review, for reading works in search of their relations (the meaning, after all, of *collection*). In Alexandria, it meant intellectual adventure, the projection on the intellectual plane of Alexander's political dream of a world fully in touch with itself. The earlier work of ancient learning—of the dramatists, of the Academy, and the Lyceum—is often seen as heroic, and the Alexandrian phase as a kind of mopping-up. In the same way, perhaps, the work of science museums is thought of as second-order, following upon the heroic work of the research centers and universities; no one would claim a Nobel prize for mounting an insightful exhibit! But it goes beyond apologetics to urge that the role of the museum in its serious mode should rise to the highest intellectual plane—when the works it interprets are read through and grasped individually, and the curator's constructive work is ready to begin.

There is an implication here for the museum visitor as well. Just as the Library is an organic center of new growth, so Euclid's work is of no use on the shelf: generations of students read the *Elements* at Alexandria, each making the same voyage Euclid himself had laid out. One such student, at a second generation's remove, was Apollonius of Perga; he in turn became a great composer: for Euclid had not comprehended *geometry*, but only its *elements*. In his own brilliant adventure of the *Conics*,

Apollonius, like Euclid a collector, took the mind to a new level of vision; and of course we know that his system was destined ultimately to become the foundation of Newton's own *System of the World*.⁹ Every powerful interpretation of the world, assimilated by new generations of minds, becomes a springboard for the insights of the future.

The Alexandrian paradigm

The time has come to consider what the Alexandria Museum may have to tell us about the essence of the concept of the "science museum." Are there principles here, insights concerning the nature of the museum itself, especially in application to science, on which we might ground our inquiry into the science museum in our own time? Let me venture some suggestions, however outrageous they may seem or remote from ready applicability today.

[1] *The museum is a sacred space.* I begin with what may be the most difficult principle of all, yet critical to each of the museums we have looked at. The museum is defined by its special relation to the Muses, who are collectively the underlying principle inspiring the human mind, spirit, or soul to dance, sing, speak, or compose works of myth or reason. The museum is not a place of merely technical works, produced by the application of system or method, whether an art of rhetoric or our "scientific method," alone. Something fundamental, some love reaching beyond method is summoned inducing fresh production, a new and unpredictable life of the spirit to arise. We know no better today than men did then, the answer to the question of the origin of such vitality, such spontaneity and imagination. Dedicated to the celebration and invocation of this mystery, the museum is inherently a sacred space.

Is this Muse truly a sacred source? Moderns might be more inclined to regard such a principle as a matter of genetics or the hormonal system than as a mystery of which we might stand in awe. Yet whatever theories we might contrive out of genetics or physiology to account for such phenomena, our inner feeling of possession by the Muse remains one of mystery and awe. Some force—of creativity, of insight, of memory—is sensed moving among us in a museum, not by our own efforts; and in its presence we are at once humbled and exalted. We may not agree with

Homer in ascribing such experiences to the immanence of the gods, and may hesitate to call our museums sacred places, but if in these special halls we invoke something for which we care greatly, and which we cannot simply command, its coming will allow us to share the feeling of mystery. The ancients had a very strong sense of the presence and power of mystery; we may not. But we will have a museion only to the extent that we share that ancient sense of awe, and recognize to some degree the sacred character of the groves in which we work.

[2] *The museum is a fellowship.* In the presence of such mystery the Museum must be, fundamentally and primarily, a fellowship, a community as the Academy and the Lyceum were. This is a difficult lesson for our busy, competitive modern world; we are proficient at creating assemblages of people, but there will be no museion unless we are committed to the belief that in this special place we share one Muse, and finally speak, or sing, with a single voice. The museum will then be a place of true conviviality, based on a sense of sharing a common source, and embarking on a common enterprise.

[3] *The museum is universal.* It is fundamental to the concept of the Alexandrian Museum that it be universal, that it belong to everyone. It belonged to Alexander's brilliant design that Alexandria be the center and focus of the world, in that by its nature it addresses its work to all mankind. Politically Alexander's project was aborted, but the concept remained with the Museum and gave essential life to its work. Euclid produced the Elements, not for Ptolemy I, or for Egypt or for Greece, but for the human race. Whatever the location or specification of a museum, it will partake of the Alexandrian spirit only insofar as it thinks of its work as undertaken on behalf of mankind, deeply and fundamentally searching for our common humanity.

[4] *The museum is political.* Museums, to make institutional life easier, or to avoid serious complications, often assert that they are "non-political"; curators may even imagine that they are being truer to the museum concept when they remove their work from "politics." Alexandria teaches us, on the contrary, that it is of the essence of the museum to be political—that it should be, in principle, a function of a body politic. Alexander housed his Museum within a complete city, of which it was an integral,

organic part. It is true that his city was meant in turn to be part of a coherent political world, and that in literal terms, he failed to bring that about. Yet the Museum remained a political concept, belonging to its city, which in turn belonged to the world. Otherwise put, the Museum cannot stand alone, and not just because it needs economic support. More deeply, it is political because, in its universality is presupposed the common political membership of all humanity. As in the case of Alexander's failed political project, that universal polity may yet be unrealized in practice. The museum may well run ahead of the world in this: the museum may harbor the future world government. But if it were not presupposed in principle—if the members of the museum did not feel that they were by the same token members of the common body of mankind—universality would receive only lip-service. This is not romance or illusion; we are speaking of the realities on which the museum must be based, the soil from which it grows. Though we are still far from a political constitution for mankind, yet in a working sense, a functional spirit, every true museum today is a museum of the future and belongs deeply to a real polity still awaiting formal recognition.

[5] *The museum is a place of collection.* As we conceived Euclid as a great collector, one who read many works in order to discover and compose the insight latent in them, the museum more generally provides a place of reflection in which the world can gather to collect its wits. In Alexandria, centuries after Euclid, the astronomer Ptolemy collected data and observations and found in them a System of the World of a new order. The museum's collecting function is easily misunderstood: it does not stop, as it often seems, with conservation, preservation, and display (though these functions of guardianship are important)—the essential meaning of the museum's collecting begins with the stage of interpretation in which the world's treasures begin a new life, revealing their meanings as they are read together, and a whole emerges which is a new revelation of the Muses.

[6] *The museum remembers.* As the Library in Alexandria was an inherent component of the Museum, and it must be so with any true museum. A museum cannot be a thing of the moment; it has a mission to tell a story, and thus to reach into the past and remember the elements which will compose the tale. In this sense, Homer is our model; the museum

is a place in which the epic of our time is, always being spun. The Greek chorus was always alluding to a past too dark to name, and in the same way the museum reaches for the origin myth which society finds it difficult to confront. Having a library is, as we have seen, not at all a banking operation: we saw that it was more like gardening. The Museum, then, must have an organic library with which the Museum works in its effort to aid us in comprehending the work which the world is doing, and to hold in the balance of thought the future story which we with our lives are attempting to tell. It is unnecessary to remark how much more difficult, and at the same time more important, this responsibility is for the science museum, dealing as it does with the impetuous modern Muse and her siren-song of progress.

[7] *The museum makes music.* If the museum is to follow the ancients in devotion to the Muse, we need hardly add that its ultimate purpose will be to sing as Homer sang. As the song will have sacred and mystic origins, no one will be able to design the outcome. If the sense of the sacred is lively, then the Muse will choose the song. In other words, if the other principles have been attended to, wonderful things will emerge from the museum, and these will be of a sort which we could not design in advance and would not want to. We will recognize this "song" as a stirring within the body of the institution, a stirring which spreads with a thrill of recognition among all who enter its doors. The museum will take organic form as a living thing whose works unfold as insights no one could have specified in advance. Such is the mystery of the Muse, whose immanence is the mark of the true museum.

The history of the human race is written in the history of its song; Euclid's composition, built on elements as mystic as they are clear and strung by threads of insight, is not in the same form as the dances and verses of Aeschylus. But the differences are fewer than the unities. Today, the notes of quantum mechanics are strange, and yet for a while remain in the hands of a priesthood, but its compositions are a music nonetheless and sing of the cosmos in terms strikingly resonant of those of Ptolemy or the *Timaeus*. The Museum must be open to all such song, and must achieve interpretations of even the deepest and widest theories by which all will be able to hear, and share the thrill of comprehension.

[8] *The Muse is one.* We met in the Phaedrus the suggestion that there is finally just one Muse, enchanting us in many guises. The departmentalization of the Muses, as the Muse of this or that, is a convenience for the taxonomy of mythologies, but it is deeply misleading. This proposition is companion to that of universality, but appears more directly in our modern scene in the supposed departmentalization of knowledge and the fragmentation of both the university and the arts. I have urged that the members of the Museum must constitute one community; that Euclid be aware of the tragic forms in which irrationality is housed; that Ptolemy be moved by the deepest human reasons for studying astronomy. Every work of the museum, albeit the special responsibility of a few or only one of the members, will be of final interest to all, and will in some sense belong to, and be a work of, the whole.

Alexander's Museum is frequently referred to in texts as a "university," and in the root sense of the term, it was just that. But we have so utterly abandoned the meaning of the term, so lost the unity of our "universities," that the term today means the very opposite of its etymology. Our universities are fragmented, fissured assemblages of people and facilities: they are brought back together by contract, or by good intentions to do things in common, but we have lost the grounds of community. The museum today, by some mystery of rebirth, must defy the university and rediscover our human community. The museum today, just as it must be the world community of the future, must anticipate the university, not simply mirror it, and constitute itself the reunited university of the future.

These "principles" are by no means definitive, are offered merely as suggestions drawn from our ancient models, in the hope that they may serve as guides to reflection on the tangled experience of the science museum in the modern world, to which we turn now.

The first Smithsonian

In 1835, a court in England processed a most unusual bequest, that of a certain James Smithson. By virtue of a slender thread of the deaths of other potential beneficiaries, he had, to everyone's complete surprise, left to the United States of America a very sizable estate, to be used, he said, "for

the increase and diffusion of knowledge among men.”¹¹ The Congress of the United States for its part had great difficulty in deciding whether to accept such a benefaction from abroad, but in time it assented and the estate was reduced to a chest of gold sovereigns which was escorted to these shores.

This was a chest of pure potentiality, as no clue had been left for the gold’s use beyond the cryptic formula of the will itself. A powerful voice throughout the long period of the ensuing Congressional debate was that of John Quincy Adams, who fought off a stream of pragmatic schemes which would have dissipated the funds, asserting his own historic sense of the importance of science to the growing nation. The ultimate decision of the Congress was to create the Smithsonian Institution, which came into being by an Act of Congress in 1846. That Act created an institution, with the President of the United States and all the cabinet as members, together with a Board of Regents to whom it was left to decide the appropriate use of the funds in accord with the terms of the bequest. The composition of this board, which has undergone only minor change to the present day, reflects the ambivalence of the new Institution itself—at once a public trust of the highest order, its membership to include the Chief Justice and the Vice-President of the United States, yet in its judgments and actions otherwise independent of the United States Government.¹² The first Regents, in turn, were much influenced by the firm convictions of the American scientist Joseph Henry, whom, after they had heard his views, they appointed to be the first Secretary of the Smithsonian.¹³

Some sense of Smithson’s own intention, and his conception of the bequest, may be drawn from a review of the scant details we have of his life. Smithson, though born of aristocratic and wealthy parents, was an illegitimate son, and was thereby barred from a career in the church, political service, or the military. Much of his life was spent abroad, and though he graduated from Oxford he could have no position in the aristocracy, nor could he hope for any of the careers to which it was the key. Not surprisingly, he is known to have strongly distrusted the institution of monarchy. He turned to science in search of a path his shadowed status would allow him, his interests being mainly in chemical analysis and geology. He assisted, of all people, the recluse Henry Cavendish; he was early in life

a member of the Royal Society, and later he became a founding member of the Royal Institution. It appears that in Paris he was acquainted with leading scientists of the French scene and came to share certain basic convictions of the Revolution, including the prospect of a rational and democratic future for all the members of mankind. His simple characterization of an institution “for the increase and diffusion of knowledge among men” incorporates exactly this conviction. And his making the donation to the United States “to found” this institution, similarly bespeaks a confidence that the future lay with the new experiment in democracy.¹⁴ The notion of “diffusing” knowledge is more important than it may seem: the traditional, aristocratic British schools and colleges had nothing to do with “diffusing” knowledge, but, quite the contrary, confined it to strictly aristocratic channels. Thus the bequest in its aim to *increase* knowledge speaks to a confidence in the progress of mankind, and in its aim to *diffuse* this knowledge affirms faith in a new era of democracy. We sense that Smithson’s bequest is deeply political in character.

In Henry’s own interpretation of the bequest, formulated as a proposal to the Regents entitled “Plan for the Organization of the Smithsonian Institution,” we see this political principle reflected. Like every great oracle, Smithson’s bequest reveals the character of its interpreter.¹⁵ Henry’s proposal displays a decisive mind, capable of very political insight and strong convictions. The bequest is not a gift, he says, but a trust; it is not intended for national or local purposes. The United States has accepted this trust on behalf of mankind, and Henry’s elaboration of means for “increase” and “diffusion” of knowledge is shaped throughout by that initial understanding. A corollary is that the Congress is not called upon to support the Smithsonian financially: the Institution will belong to mankind; its resources will consist of its own gold bars (albeit now recast as coin of the realm), and the interest thereon.

The previous decade of incoherent American debate had shown that any integrity of the institution, or fidelity to its purposes as defined as Henry had delineated them, would depend on the Institution’s strict autonomy. The Institution was to *report* to the Congress, and the Congress, in its function as *trustee*, would insure fidelity to the founding Act, but the Smithsonian Institution would go forward, as an activity of mankind, according to the judgment of its own Board of Regents. This world-citizen-

ship, reflected in the Institution's avoidance of designation as a "national" enterprise, has long since been lost, and Henry's insistence upon it now seems prophetic in view of the straits into which the Smithsonian has fallen in recent years, as we shall see.

As the composition of the Board of Regents suggests, the new Institution was accorded great respect. When after great delay the construction of a building was authorized, it was placed directly on the new Mall; presumably in order to announce its exceptional and timeless character, it was built in the form of a late 12th-century castle, and has been known as the "Castle" ever since. This was conceived as the residence of the Secretary, and the Henrys lived and entertained there until his death, in turn possibly suggesting, a scientific counterpart to the political White House.

If all of this suggests some cryptic allusion to the Egyptian Alexandria, we might remember that the laying of the cornerstone was declared a public holiday, celebrated with a mile-long civic parade, with the President and his cabinet in formal attendance. Moreover, the cornerstone was laid by a Masonic Grand Master wearing an apron, like that of an Egyptian priest, which had been presented to George Washington by the Grand Lodge of France. It was worn, of course, not as a costume but as a badge of office appropriate to this civic ceremony.

A year later, at the end of the same Mall, the cornerstone of a new obelisk was laid in honor of the Father of his Country. Remembering this, I believe we are justified in thinking that, in its lofty and political conception, its universality as a trust for mankind, and in the strongly mystic allusions at its founding, there was an inner bond between the remarkable creation of the Smithsonian and certain of those principles we found exemplified in the Museum of Alexandria. Some Muse from the past was surely presiding at its inception.¹⁶

Henry's Plan for the Smithsonian Institution is notable, not only for what it proposes but for the many possible functions which it sheds. On the one hand his Plan is immensely ambitious—in addressing all mankind, but also in taking all knowledge as its province. Although "knowledge" is understood in terms of science, Henry's conception of the spec-

trum which this entails is arresting. The arts are politely dismissed, envisioning only the provision of an empty room in which other institutions might wish to mount exhibitions. In addition, Henry's delineation of the work of the Library limits it strictly to support of scientific work. Yet within the span of "science" we find a vast horizon, including both a "Physical Class" and a "Moral and Political Class." Although we know that Henry believed deeply in the value of pure science, as distinct from its applications, the first class includes "physic," "natural history, agriculture," and "application of science to arts." The second class ("Moral and Political") is even more Baconian in its inclusiveness, including "ethnology, statistics and political economy," "mental and moral philosophy," and "a survey of the political events of the world."

Henry's own most original and fundamental scientific contribution had been in the investigation of electrical induction and the discovery of self-induction, which he shared with Michael Faraday, though only Faraday is normally credited. But he had had wide experience in other fields, stemming in part from early participation in an exploratory expedition surveying the course for a road across the state from West Point to Lake Erie, and his own interests were wide-ranging. The fact that the new institution was not national did not make it the less American, in taking the new continent as its field of investigation. Henry conceived exploration of this new continent as an investigation on behalf of mankind, just as Smithson must have understood the American polity to be an experiment in democracy on behalf of the world.

Thus, to look ahead, we will not be surprised to find one of the most appropriate and representative of Henry's ideas to be the investigation of the weather over the American continent: a corps of observers would be established, ultimately ranging from Canada to Mexico, to gather information which would serve as data for the new science of meteorology. This project would introduce the first daily weather maps, bringing crucial advice to farmers. In time, this task was shifted from the Smithsonian to the Weather Bureau, a distinct entity of the United States government, leaving the Smithsonian free to break new ground in other areas.¹⁷

In the same spirit, the Smithsonian would early embark on the investigation of the mound cultures of the Mississippi—to penetrate the

mystery of these obscure human ancestors—while in the category of ethnology the Smithsonian would embark on what would become a massive series of studies of the peoples of this new world. However misconceived, we know that what became the work of the Bureau of Ethnology (still under the Smithsonian) gathered immense bodies of information on cultures which were perceived as rapidly being “lost,” together with corresponding studies of the philology of their languages. Some of the work for which the Smithsonian has been best known over the years has been in the area of objective recording and study of these people, recorded as specimens of humanity.¹⁸

There must be some inner connection between this notion of the scientific study of peoples, and the genocidal operations which were simultaneously underway. How far back, how deep down, does this syndrome of yoked enterprises run: objectively knowing, and viciously destroying? The ethnologists had nothing to do, we might suppose, with the destruction of the peoples they had undertaken to study: quite the contrary, they lived closely with them, and imagined themselves to care for them. The venom must lie with this new principle of *objectivity*: just as the rest of nature is taken as *object*, for systematic ordering, so these peoples were being addressed as taxonomic problems. How far back, indeed, and how far forward, does this problem run? We will meet it again, in various ominous forms.

In many ways, we can find impressive likenesses between Alexander’s project and Henry’s. Each is political, in the broadest sense of addressing mankind as a whole, and looking to a new, more rational and unified human community. Each is wide-ranging, taking all learning as its scope. Each is the work of an institution created specifically to grant freedom and opportunity to a few who will exercise it on behalf of all, and each in its own way emphasizes widespread diffusion of the result. The difference, it seems to me, marks the watershed between ancient learning and the way in which modern science understands itself. Learning in Alexandria, however it involved observation, came ultimately from within: it was the work, finally and primarily, of thinking *mind*, only aided by observation. The Smithsonian, belonging to a new era, is assembling observations, gathering and dispersing information, but it is not primarily truth-producing. Knowledge is thought to have become objective, with

mind, now merely analytic and logical, playing a noble but secondary role.

There is a more interesting Muse at work, but not in Washington. This Muse presides over the entire West, among the explorers and observers, comprehending a domain of new discovery in which excitement runs high and new findings are everywhere. In its time, Alexandria was the center of its world; Washington in this new prospect merely floats on the civilized tide. Perhaps we should imagine the Museum turned inside-out, and the soul as well. Mind was once, as in Alexandria, the generative center; now energy has shifted to the observing senses, ranging the theater of the world, endlessly recording the peoples it finds and detailing their cultures, as if it were enough for science to observe precisely and analyze, and thereby conclude that it gathered truth.

There remains, however, some sense in which, though such analysis fills volumes, human truth remains invisible in it. James Smithson, we are told, liked to do chemical analyses of the petals of flowers, to learn about their colors. There is a lovely myth that Smithson once analyzed a lady's tear: he was able to catch only half the drop, but it was enough, he soon knew the repertory of salts which it contained. And what was the source of that demi-tear? Was the lady much consoled, we wonder, to have a consort able to explicate exactly the elements in her tear? Truth does not quite lie, it would seem, in the direction of such objectivity.¹⁹

III. The museum as cabinet of collections

Natural History and the great collections

Joseph Henry, as we have seen, had fended off to the best of his ability the role of collector which was being thrust upon the Smithsonian from all sides. The Patent Office was acquiring a growing collection of inventor's models, and a succession of exploring expeditions was bringing back samples from the far reaches of the new-found West, in unmanageable quantities. Not only was the storage and exhibiting of this aggregation outside the central concept of the Institution's function—it was not, in Henry's view, conceived as a *national* institution, or a museum in the limited sense of a showplace of exhibits—but to take on this role would

require a new order of funding, beyond the resources of the Smithsonian endowment. Henry prized the autonomy of the institution; he wanted to “mingle its operations as little as possible with those of the general government,” recognizing, prophetically, that to do so would:

... annually bring the Institution before Congress as a supplicant for government patronage, and ultimately subject it to political influence and control.²⁰

The design for the new building, however, contained provision for an exhibit hall which had to be utilized, and Henry brought in for the purpose an assistant with special responsibility for dealing with the collecting and exhibiting function. This was Spencer F. Baird, later to succeed Henry as Secretary of the Smithsonian. Baird brought with him a passion for Nature, and for collecting the productions of Nature, and with his arrival an altogether different phase of the Smithsonian’s history began to unfold. Henry in his own work had been doing what we would call “physics” and think of as pure science, experimenting with electricity and magnetism. Baird had by contrast grown up under the spell of the naturalists, Audobon, Titian Ramsey Peale, and John Toerry: as a youth, he had been awed by a portfolio of Audobon’s illustrations of birds. He had corresponded with Louis Agassiz at Harvard on the subject of fish, and he had come to Henry with a recommendation from James Dwight Dana at Yale. He brought with him to the Smithsonian a love of Natural History, and he set the Smithsonian on the track of becoming the nation’s Natural History museum. It would yield up the autonomy Henry had thought essential, to become in effect the partner and counselor to the government in searching out the resources of the world which was opening up. Without sacrificing fidelity to most of Henry’s original convictions, the concept of the science museum was shifting in fundamental ways.²¹

We live in an era in which the great museums of “natural history” are less prized, their carefully organized and labeled cabinets of specimens, their dioramas of creatures in the wild, now spurned and rejected. The very halls of the dinosaurs themselves, which seized the imaginations of so many generations, prove less moving to viewers accustomed to the more literal excitements of ever-new orders of computerized photorealism. Museum professionals and the public alike tend to make this judg-

ment. The director of one of Europe's classic natural history museums, closed for dismemberment at the time he wrote these words, says that they have been left behind by history:

... natural history museums ... did not adapt themselves to the conceptual evolution that accompanied the birth of biology and because of this they became anachronistic institutions. Their exhibitions maintained, and in some cases still do, a poetic and aesthetic view which reflects a way of studying nature that ceased to exist over a century ago.²²

The writer of those words was committed to a large-scale replacement of his natural history museum by something of another sort, directed to "concepts" and the imparting of information, a project for which the specimens would no longer be needed.

We, on the other hand, will be interested to know what the natural history museum was in its period of full flourishing, and if we can, to recapture something of the "poetic and aesthetic" view which it is assumed that history has closed to us. The beginning, I think, is in a love which is said to have been lost: Baird, and the natural historians who followed him, loved nature. They prized and cared for the wild things they collected; they stuffed them only as a way of exhibiting Nature in her plenitude to those who could not join in the trips they themselves were constantly making into the wilderness, or upon the oceans. They formed great study collections, and above all they classified what they and thousands of others brought back. But it would be a mistake to imagine that they preferred the classification scheme, the specimens in their cabinets, to the thing itself. Today, we find only their cabinets, to us perhaps desiccated or boring; but they rejoiced in the life reflected in these same collections. We implied earlier that the Muse deserted Washington for the field and the explorations; perhaps now we should recognize that in this full blossoming of the spirit of natural philosophy, the Muse returned to claim the Castle which had been built for her.

As our critic has pointed out, these scientists of an earlier age were not focusing on questions of physiology, of underlying chemistry or causality; their immense research effort took the form of identifying and classifying what their eyes were seeing. The collections were indeed

research tools, but for the purpose of comprehending precisely, by types and clues, what the scope of Nature was proving to include. The resulting scholarship took the form of great, handsome, publications, whether compendia such as Baird's *Mammals of North America* (1859) and *Birds of North America* (1860), or intricate series: the findings of the Wilkes United States Exploring Expedition, which returned from a round-the-world cruise in 1842, were published in a series of twenty volumes, the last of which was not completed until 1876. Enthusiasm for this work was infectious, not least of course for the adventuring involved: Baird gathered his own lyceum, the "Bairdians," some of whom lived for years in the towers of the Castle building when they were not on the trail or on the high seas.²¹ There was, it is true, an admixture of sheer competition in the aggregation of these collections. At its best, however, it was indeed as if the very Muse of the Lyceum had returned, to induce once again the ancient admiration of the organism in its wholeness, so lost, and so dreadfully needed, in our own day. Critics who fault these careful observers for their innocent admiration of the appearances of things, and for failing to put Nature to the Baconian torture, are right in perceiving a return to Aristotle, though perhaps quite wrong in faulting it.

Baird came to the Smithsonian in 1850, when the Gold Rush was lending new fervor to the sweep of expeditions to the West. Baird was soon becoming de facto an adviser to the government in the matter of expeditions, counseling on the design of instruments, the plan of observations to be taken, even training scientific members of the expeditions, and then, in the end, absorbing the findings into the Museum's collections and publishing the outcome. In the case of an Alaska expedition, the specimens included copper and gold, and the Institution's testimony was influential in tilting the decision toward William H. Seward's purchase of Alaska. In an age of inventorying a continent, the Smithsonian was proving of service close to the seats of power, and it became feasible for a later Secretary to extract funds from Congress for the construction of a Natural History building. It would take the form of a Grecian temple of Nature with its great rotunda; it would hold generations to come in awe of its dinosaurs, its great, stuffed elephants, and the whale.²⁴

The Smithsonian was now walking a precarious ridge line between Smithson's intention of service to humanity, and partisan service to the

government of the United States, though for Baird and the Secretaries who followed him, the easy identification of the two may have felt it so natural that it would trouble them very little. They were all, I believe, devout Christians of one stripe or another, and shared a sense that they were dealing with divine work. The last of this series, Charles D. Walcott,²⁵ was a prominent geologist; he became a strong defender of Darwin but retained the belief that divine guidance was at work in evolution as well. Science was still conceived as natural philosophy, a body of learning in which one man could become competent and progress. Successive Secretaries were all scholars, each specializing in a special field of interest—ichthyology, ornithology, geology—but each was prepared to address all aspects of the collection as a member of one “natural history” community. In this sense, the tradition of universality we found in Alexandria could be seen to remain intact.

One way to deal with a mystery at second-hand is by way of the words of a witness, so let me testify: I have felt the Muse of natural history, and not so long ago at that. As of this writing-, they have not yet got around to destroying the classic collection at the American Museum of Natural History in New York City.²⁶ I recently visited two galleries at that museum, entering first one of the classic halls, and then deliberately selecting one of the most modern. The older, classic space was the Hall of African Mammals: a broad, darkened hall circling past a sequence of great, luminous glass cases, deep within each one of which stood an animal group, caught in some critical moment of its day. We stand with a pride of lions on a height; they, but now we as well, are looking keenly into the valley below, where a herd of zebras can be made out, grazing. All eyes—theirs, and ours too—are riveted. It is the very point of attack. Yes, the distant scene is quite evidently painted, albeit expertly, on canvas; indeed, the animals are products of the taxidermist’s skill, though this is evidently a high art. Lend just a grain of credence, and the experience becomes gripping.

Would a film be better? A television crew zooms readily to real zebras, nature programs in an undying stream permit us to watch as “real” lions leap, and “real” blood runs. Is the “real” thing, seen while eating popcorn in the living room, better? Or, if we lend that credence which the modern world disdains, have we not caught in these dioramas the *vir-*

tue, the life, of those fellow-creatures at the moment which Galen, with a physician's sensibility, calls the *crisis*—and thereby caught the act itself?²⁷ The act must be ours—high-technology cannot *give* it to us, because we are not speaking of a donation. Old toys had it, unpainted maple buses or simple dolls with faces to be supplied by the imagination: a child provided that, in the “play” of a less literal era. In the same way, the natural history museum invoked the Muse, and the Muse in turn inspired the imagination; the experience was one of presence, wonder, delight, and deep respect.

As I watched, the silence of the little-frequented hall was broken by the arrival of a class of high-school students: full of energy and highly motivated by materials they had firmly in hand. It was a kind of race, a competition quite literally to check off information. In the full spirit of a competitive age, they made short work of their task, full of excited conversation and noticing, *lending*, nothing. Only a loser might have fallen behind, to look.

The modern hall, by contrast, is the latest word in deconstruction. Here old dinosaur displays are disassembled, stripped of tiresome vestiges of mythology; as misguided constructions are taken apart, the principles are intelligently explained by which science now corrects such errors of the past. Put back together, the once-awesome creatures have become instead mechanical constructions of the information age. It is not that the old constructions were not corrected from time to time, but such improvements took us closer to what we could grasp of the ancient living creature. Now, the deconstruction has become the point. The spell has been broken; the exhibit will come apart and be readjusted routinely, as new evidence comes in. For the jaded children, a racy time-lapse sequence on a computer screen suggests how readily these things come together and fall apart.

The Director we spoke of earlier, complaining that people find science boring, planned to replace his banished exhibits with what are called today “conceptual” displays, arranged by media experts and implemented by tested theme-park marketing techniques. Everyone was to get a measured dose of “information,” together with a reward of “entertainment.” The project must by now have been opened; it was indeed

professionally guaranteed to be a success in the terms in which it was conceived. Yet we must wonder if the fickle Muses have remained with it or elected to live in groves more reminiscent of their ancient homes.

The nostalgia of which I am unabashedly guilty will get us nowhere: one cannot live in an era which no longer exists, and it would be poor strategy to make the attempt. Yet we need to inquire earnestly about the presence of the Muse, without whom we have exhibits and visitors, but no museum. Is Nature *something*, or has it been only an illusion? If one who lingers feels something strongly in the presence of the old tableaux, and responds with a surge of desire, to speak or write or dance, or scream—is that not evidence of the presence of *something*? We may yet feel this in the wilderness, on a mountain peak, on a quiet night in the backyard if the stars are exception-ally brilliant, or there are northern lights. That wholeness, and the sense of the sacred place—the sense the tableaux conveyed of an alert organism, more than the sum of its parts—which belonged to the early *miseion* may still be invoked today; the evidences are everywhere. Museum displays cannot be blindly carried over from the past, but the wisdom of the past need not be abandoned in the designs of the future. An excess of deconstruction wantonly banishes the Muse and leaves us with an enterprise which, however successful, is no museum at all. This is evidently a thought to which we must return.²⁸

IV. The didactic museum

The Deutsches Museum

The Smithsonian collection of arts and industries emerged as something of a jumble; like the Science Museum in London, it arose to a large extent as a receptacle of objects left over from great exhibitions, together with a variety of inherited items. No one plan gave rise to it, or impressed any single conceptual form. The case was very different with a museum which came into being a little later, the Deutsches Museum in Munich, first proposed in 1903.²⁹ Though similarly a product of the industrial revolution, it was the brainchild of one powerful figure, Oskar von Miller, a German

electrical engineer whose own field had been the important technology of long-distance power transmission. Germany had been formed into a single nation during his lifetime, and there was a strong impulse to give expression to the new national consciousness through the exhibition of those sciences and industries which were distinctively German accomplishments. Mechanical and civil engineering, with the development of the steam engine and the railroads, belonged to England, but in the natural sciences, and in certain other industries, electrical and chemical, Germany had taken a lead. Von Miller's concept, accordingly, was of a museum which would feature the "masterworks" of German engineering, together with supporting exhibits which would make clear the developments of which they formed a part and the scientific principles on which they were based.

This identification of the Deutsches Museum with German industry was important, not only in the design of the exhibits, but in the support which they received. Individual industries took responsibility for their corresponding halls, funding and maintaining them on a regular basis and contributing new equipment for exhibits. Emphasis was placed throughout on engineering as such, and from the beginning the museum had the special support of engineering societies, which were, during this same period, actively concerned to establish the dignity of the profession of engineering among the academic professions, and not incidentally, to woo engineers away from any potentially disruptive association with unionizing labor.

The exhibits were of a very high quality; many of the machines on display were in working order and provided with electric motors which made it possible to see them spring into action. Exhibits were typically actuated with push-buttons, anticipating the interactive exhibits of the future. It was a highly disciplined museum in the sense that its original charter was clear, the purpose of each exhibit was well-defined and the planning, organization, and funding of the whole were achieved through the genius of a single personality. It depended on an interesting mix of private and public support—materials for construction of its building, which was not able to open until after World War 1, in 1925, were contributed, and transported without charge by the German railroads. It had early taken this character as an organically civic museum, thoroughly

identified from the beginning with capitalist industry as well as the engineering societies. This at the same time defined its excellence, and placed an unquestioned boundary around its role. It celebrated industry and engineering in a masterful, intelligent, and unquestioning composition of displays.

The Deutsches Museum became a recognized paradigm of the fully-achieved science and industry museum. The halls were clear and clean, shining with the beauty of the machines which fascinated the eye and delighted the mind with their balanced and intelligible motions. If a science museum is in some special way a sacred grove, a place of reflection apart from the affairs of the city, the Deutsches Museum presented itself as such a grove, a place of dignity, awe, and wonder. It placed triumphs which had already entered history in an orderly, progressive series, and became in turn the paradigm of such arrangement, by which technological history may be presented as an intelligible developmental order.

The difficulty is, of course, that such a series is linear and single-minded—exactly, indeed, the intention of the Deutsches Museum. The message of such an exhibit can be clear, proud, and unambiguous: that of orderly progress through science and engineering. Lifting this principle to the highest plane, it confirmed as an ideal a dogma which becomes the more dangerous as it is the more difficult to question. For this is authoritarian history, an engineer's vision of the role of his industry. It is a comedy of never-ending advancement in a world in which truth demands that the tragic face of this same vision be acknowledged. If the tragedy had not become overwhelming in the first World War, it was certainly destined to become so for the entire world in World War II and its aftermath. The world is dangerously unsafe in the hands of such authoritarian, unquestioning history. In a very telling remark, one author points out the connection this conforming history was to have with National Socialism:

The [Deutsches Museum's] dependence on industrial money also brought serious disadvantages, especially in the matter of setting industry and technology within their social context. Any suggestion that capitalism might not always work for the common good or that industrial relations in Germany had ever been other than faultless would not have been tolerated by the paymasters on whom the

Museum depended, a consideration which became even more important as the National Socialist Party increased its control over the life of Germany. Under these circumstances, the temptation to concentrate on 'pure' technology and to disregard the social implications of technical change were very great.³⁰

There must be some warning of more general importance here, for such single-minded and disciplined thinking is of the sort which brought its practitioners before the courts of human justice: it is not humanly permissible to follow single lines of thought without larger and critical explorations, having always to do with justice and human welfare. Machines are not built, and do not function, in sterile isolation from human origins and human applications. In fact, as we shall need to discuss later, technology does not in truth *have* such a linear history: the one-dimensional line of progress is an artifact of the historian too little questioning of the story he is telling. Von Miller began with a strong conviction about the story which his museum *ought* to tell, a story which would celebrate and strengthen the new Reich. It may have done its work all too well. But there is no longer anything specifically German about this paradigm: understandably, it remains a tempting recourse everywhere for museums of science and technology pretending to an "apolitical" stance, or avoiding consideration of the moral implications of their exhibits. The temptation to embrace this simplification is virtually universal; what appears at first a fascinating, sacred grove of "pure" technology all too easily becomes a craven retreat from the full light of human reality, and no true dwelling place for the Muses.

One might well respond that the museum of science and technology is not meant to do *everything*, or to house all thoughts. That might be true if critical thoughts about technology were lively elsewhere. The trouble is that such museums are designed to teach us things that *seem* to be everything but aren't; these are the places we go—and often take great pains to make sure our children go—to meet the world that science and technology create. But this leaves out the question we ought to be asking about what sort of world that is. The Muses do not factor in this way: one cannot think thoughts of one sort about technology on Mondays and Wednesdays, and thoughts of another sort on Tuesdays and Thursdays. These museums are stimulating places, and our thoughts,

and those of our children, should race, and do race, while we are under their spell. But the kind of spell they cast, the story they tell, is of the highest importance, and it is not to be left to the engineers to design for us according to a selective vision of progress. We can prize and delight in the classical exhibits of the Deutsches Museum, and in the technologies they presented; we do; but it is the Muses themselves who whisper to us not to let such exhibits, or such technologies, stand alone.

V. The diaspora

The Smithsonian was taking shape at a time when the concept and the practice of science were undergoing immense transformations, driven in the end by the forces of the Industrial Revolution. On the one hand, an upheaval within science was shifting its world from one of natural philosophy, in which science was still to be thought of as a connected whole in which one could hope to be interested and even proficient, into the specialized areas of competence which are the hallmark of our modern academic world. The appearance of specialized graduate schools within academia sealed this separation and at the same time provided a new domain of advanced study in which research could be pursued. Concurrently the modern corporation, another product of the same history movement, was aggregating resources which made possible the great corporate research laboratories of the modern world. Scientific societies proliferated to occupy and certify the new niches appearing in the academic world. Almost at the same time as the Smithsonian Institution, and similarly under the leadership of Joseph Henry, the American Association for the Advancement of Science, late-coming counterpart to the British Association, brought scientists of this new era together in a semblance of the old fellowship. But in the end we must wonder whether the concept of community within the sciences remains sustainable.³¹

All this was in the domain of research and the “expansion” of knowledge. In the field of “diffusion” the phenomena were equally overwhelming: new technologies of printing and mailing made it possible to publish magazines such as *Scientific American* and the *National Geographic*, which served in effect as museums -in-print. Systematic public education, with some rudimentary attention to mathematics and the sciences, became

a feeble approximation to the channel of democratic diffusion of knowledge Smithson probably intended. Radio and now television complete this outpouring onto a scattered flood-place of “diffusion,” often of little depth, admittedly, but in extent beyond any measuring.

These are all functions which were once embraced in the simple concept of the “museum”—as in the Academy, the Lyceum, the Museum of Alexandria, or even the early Smithsonian. Within the contemporary scene, we may tend to think of the science museum as just one more in a vast range of alternative modes of diffusion, blurred utterly by the modern sophistic of commercial advertising and the “media” industry in general. Within this *diaspora* of what is carelessly termed “information” does the museum have no longer any special role, is it charged with no special responsibility? Might we not argue that the case is precisely the opposite: with the diaspora, the problem of collecting our human wits becomes ever more pressing? Is there not a new urgency to draw upon the long tradition of the museum to bring together the parts of this shattered intelligence into some sort of larger comprehension? Separate readings, specialized conversations, will not do this trick: we need to assemble in that one special forum, the museum—still the sacred grove, still awesome and universal—to revive a larger human conversation in which we may regain some sense of wisdom, some comprehension of what we are doing, and why. By way of only a few, perhaps rather random samples, we will see now some forms this effort has been taking in more recent times.

VI. The new era

Frank Oppenheimer and the Exploratorium

With the launching of the Exploratorium in San Francisco in 1968, something new came into the world of science museums, a fresh vision which has offered an alternative approach to the science museum through-out much of the world. It was very much the product of the vision of one man, Frank Oppenheimer, who in the aftermath of World War II was seriously concerned about the place of the sciences in a democratic society.³²

The hallmark of the Exploratorium is the interactive exhibit, centering on the visitor's involvement and sense of discovery. Oppenheimer's ambitions for the Exploratorium are revealed in the several levels of the criteria he spelled out by which prospective exhibits were to be judged:

They must give the viewer the opportunity to react with them and to explore and manipulate them. They must be of value to a broad spectrum of visitors, including young and old, professional and lay, and to people who have lived in both barren and enriched environments. The individual exhibits as well as the Exploratorium as a whole must be of value at a variety of levels which range from relatively superficial sightseeing through a broad and deep understanding. The exhibit material must provide a multiplicity of interlocking threads and pathways which visitors can select.³³

Ambitious and unrealistic as these goals might seem, Oppenheimer, with an extremely resourceful staff of designers and craftsmen, contrived a museum whose exhibits met them exceedingly well. In part by publishing their designs in detail in "cookbook" fashion, the Exploratorium has exercised a wide and stimulating influence on museums in this new mode throughout the world. The democratic and unifying spirit in this vision—in stark contrast to the rigidity of the Deutsches Museum—is political in the best sense of that term. Going often to intuitive phenomena, simple and perceptually surprising, Oppenheimer circumvented the traps of technology and was able to construct a common meeting ground for naive visitors and scientists alike. This sense of wholeness, both in society and in the body of the sciences, may hark back to the universality we identified in Alexandria; at times it becomes for Oppenheimer an invocation of the unifying concept of "nature," once so prized but now, as we have seen, often forgotten in new trends in museums:

The Exploratorium is about nature, and one of the accomplishments of science has been to demonstrate that there is a unity to the diversity of nature. . . . It is hoped that the visitors to the Exploratorium sense this connectedness.³⁴

We may almost recognize an invocation of the Muse in Oppenheimer's suggestion that there is art involved in this process of composition:

A museum can resemble a musical composition, a symphony in which, even though the listeners may not be aware of the structure of the piece, they must sense that it exists because the composer was disciplined in his efforts to achieve the coherence of his composition. Museums, at their best, require their creators to be guided by a similar kind of discipline.³⁵

We may see in the Exploratorium one approach to an answer to the problem of the diaspora. Where wholeness can no longer be achieved in terms of a comprehension of the whole of science, another form of composition takes its place. If we cannot aspire to a whole in common, each person can aspire to an individual composition, can assemble things in a personal and special way. Similarly, the museum is no longer a coherent display of the body of science, but an arrangement of options among which the visitor can design a personal route. Terms and themes run through, and if there is no community of knowledge, there is in this one great hall a bond of common experience, for we are all in the same position; the scientists themselves are, in their way, in the same condition, for they can no more master their separate fields than we.

The Exploratorium, then, symbolizes the new world of dispersed knowing, and may be the mode in which the Muses (themselves no doubt as baffled as we) summon our spirits to deal with it. It does not address directly the social issues we said earlier that no science museum could afford to neglect; yet it is, on the other hand, specifically intended to empower the citizen to come into dialogue with the scientists. It may thus be, indirectly, the very basis on which the responsible democratic criticism of science must rest.

The visitor's experience may be organized around any one of perhaps uncountable "mini-curricula" which weave exhibits in respect of various themes or scientific principles. But simple sightseeing is equally appropriate. Without, I presume, entertaining any such intention, Oppenheimer seems to invoke the image of the sacred grove, saying of his Exploratorium:

It is a place for sightseeing, a woods of natural phenomena through which to wander. Sightseeing is more than just pleasurable; it can build the experiences and the intuitions on which other

opportunities for learning rely; it can arouse curiosity and, in a broad sense, it can help people determine where they are going and where they want to make their home.³⁶

This sense of the aesthetic composition goes beyond the role it plays in the design of the exhibits and their arrangement in the museum, for an explicit invocation of the arts is a parallel and co-equal partner of exhibit design. Artists-in-residence are commissioned to come and work at the Exploratorium where, in close collaboration with the staff, they shape pieces which approach the phenomena of nature from a very different point of view:

Art is not included just to make things pretty. . . . but primarily because artists make different kinds of discoveries about nature than do physicists or biologists. . . . both artists and scientists help us notice and appreciate things in nature that we had learned to ignore or had never been taught to see. Both art and sciences are needed to fully understand nature and its effects on people.³⁷

We sense, again, a breathtaking liberation springing from the spaciousness and generosity of Oppenheimer's vision, breaking the spell of the linear dogmatic or historic exhibits which in an earlier era seemed so inevitable.

One of these commissioned works, the "Sun Painting," well illustrates the way in which the same principles exhibited in the "scientific" experiments appear in different guise, incorporated in works of art. Here, prismatic colors extracted from a sunbeam coming through the roof are arranged to paint ever-changing patterns on a great screen. This confirms our intuitive sense of the beauty of the rainbow; it gives us occasion to contemplate and dwell on this beauty. People will return to the Sun Painting to watch this vibrant pattern, much as we are drawn to gaze at the patterns in a flowing stream. Oppenheimer says that a science museum is a composition, like a symphony. The resulting music, the whole composition, is the central objective of the enterprise. In this easy converse with the Muse, which seemed to come so naturally to Oppenheimer, he not only opens new paths to our wonder and contemplation; he is questioning the limitations of our concept of "science."

It would be difficult to summarize the nature of the exhibits themselves, for they take a great many different forms. Reflecting on what makes a good Exploratorium exhibit work, Oppenheimer likened it at one point to a drama: there is curiosity, or fascination, which builds *tension*: and then, some resolution in which this tension is resolved.

In some ways, an exhibit resembles a play or a musical composition. A tension is built up by something in the exhibit that elicits curiosity, or an interesting task or a lovely effect, then the tension is resolved as the result of an aesthetic or intellectual payoff.³⁸

We recognize here the insight of Aristotle, that all learning begins with *wonder* just as a plot proposes a problem which must be solved dramatically, or a musical composition develops tone relationships which require resolution. Psychologically, it is Gestalt theory which best reflects this sense of the tension of the unsolved problem, and the release in the "Aha!" But Oppenheimer's principles are those of poetics as well, the very arena of the Muses, and at the same time the foundations of teaching and learning. It was better understood in Athens than it is today how these insights belong together, in a single invocation of the liberating power of the Muse. Though he eschewed the term, Oppenheimer's insight into the true concept of the museum goes far toward incorporating the insights we have gathered in the course of this essay.

Oppenheimer was sensitive to nuances of appropriate and inappropriate means to achieve these ends. We may leave this section with a warning too little observed in our contemporary scene, where concepts of marketing and competition are rapidly eroding the spirit of our museums, thereby defeating their purpose:

The creation of tension should not involve flamboyance or the high-signal strength of traditional advertising. It should be a quiet affair. . .³⁹

Many a science center today, incorporating a projection-dome theater and measuring its drawing power against the theme parks of our time, would do well to reflect on this prophetic observation.

The Experiment Gallery of the Science Museum of Minnesota

Many of the exhibits at the Exploratorium engage the visitor in investigations, an exploratory thought-process closely involved with the apparatus. But they do not normally support what we might call true *experimenting*, in which the visitor might alter the components of an exhibit with real freedom, forming hypotheses and putting them to the test along lines of thought which are entirely personal. Perhaps only with such fully subjective intervention could the visitor fully come into relation to science, in the way in which the Exploratorium itself intends. With the commitment to an experimental idea—a hypothesis—and with the real possibility of failure and hope of recovery with a revised hypothesis, the visitor might come close to whatever is meant by the term, “the experimental method.” Such an exhibit would be very nearly impossible to design, however, as it must at the same time be interesting, highly versatile, altogether harmless, and reliably unbreakable!

The design of such exhibits has been an ongoing project at the Experiment Gallery at the Science Museum of Minnesota, and it may be interesting to look at just one product of that effort, a visitor-friendly experimental apparatus which works very much as we might wish. It consists of a large set of modular circuit elements which can be connected very freely in any way one wishes; there is a power supply which meets the criteria of “harmless and unbreakable.” The modules, each containing just one circuit element, are provided with paired magnets at each end which permit any circuit element to be connected to any other simply by contact—they stick magnetically, in a way which is secure and aesthetically pleasing: here is a circuit unencumbered with wires and hence satisfyingly clear to the mind’s eye. The circuit elements range from a solid length of connecting wire or simple light-bulbs to diodes, light-emitting diodes, a motor, and a voltmeter and ammeter. Every component is elegantly mounted on a uniform base and plainly labeled, so there is an open invitation to a mix of thought and experimental play.

Clumsy accounts of scientific method in terms of “making hypotheses” and “refuting” them quickly dissipate here in the experience of actually experimenting—in that middle-ground of ideas which are tested

before they are quite formed, of things which are tried in the absence of any distinct forethought (hypotheses which *follow* the experiment)—all under the guidance of half-shaped mythologies such as that of the “circuit” itself. Unpracticed visitors may make tentative arrangements which seem at first like circuits, but must be rethought and reshaped before they will consent to carry currents, while more demanding distinctions such as that between “series” and “parallel” circuits emerge dramatically out of mists of initial uncertainty. It is much better if friends work together, for then the conversation fetches out insights and the embarrassing stupidities which are the order of the day, in ways which are dramatic and, simply, fun. We speak of this where, in the context of the vicissitudes of experimenting, it is especially appropriate, but we might well have spoken of it in other contexts as well. Wherever thought is meeting challenges, as in science museums generally, it is often best if two people meet them together, for the proposals, perplexities, and answers of conversation—which Socrates calls *dialectic*—are the medium of the mind’s most productive life. Thought proceeds by way of challenge and response; here in the context of the Experiment Gallery, it is two working together, helping to make one another’s thinking explicit, who are likeliest to experience true scientific “experimenting.”

I have been describing an experiment in the Experiment Gallery at the Science Museum of Minnesota, where there are many other experiments as well. It is a very musical space, in which the spirit of inquiry is in some way “in the air.” In its old form, in which I knew it, it was a bit dark; there was a gazebo in the center in which the sound of birds could inexplicably be heard. Many of the experiments are beautiful: water waves, sand waves, sound waves, brilliant mathematical tiling patterns on a computer screen involving geometrical problems of a very unfamiliar sort. Here, I am confident, is the very garden of the modern Muse. When two people, sharing any one of these experiences, burst forth in a simultaneous, hard-won mutual insight, it is perfectly evident that the Muse has full control of the situation.

Young people who perhaps ought to do other things with their lives could easily be seduced into becoming scientists here. But the Muse we meet is really less specific. This “experimenting” escapes the bounds we attempt to place around the sciences; one could as well experiment

with the plot of a story, the development of the theme in a sonata, alternative modes of communication with one's children, or the control of global warming, We cannot package this mode of thought; where does it begin or end? From the "circuits" experiment, one might take away not so much an insight into the laws of physics, as a new and abiding metaphor. This would satisfy the goals of a science museum as well, if not better.

It is only when the sciences are not lively—as in the most conventional museum displays—that they package well. Once the exhibits spring to life, minds begin to click and the intended fences do not hold. The Muses, we have suspected from the beginning, are finally *one*. This, not the orderly packaging, is the true strength of the Museum as the sacred grove. With conversation and far-ranging thought, the Museum can take giant steps toward reassembling the fractured world. "Science" only pretends to be a defined and limiting discipline; it is really simply a new mode of entry into the full range of human critical thought.

The National Museum of American History

A fundamental and lasting transformation has taken place, during the period since World War II, in our approach to the study of history. Rather than the formal narration of what was traditionally thought of—and is still often referred to—as the "facts" of history, a new approach looks more deeply into the social origins and implications of the developments which make up the formal account. It sometimes takes the form of history "from the bottom up" as it views events from the point of view of the people involved and their interests and practices, rather than recording simply the names of the commanding figures and the "historic" events. The word "culture" figures largely in descriptions of the new approach, often characterized as "cultural history."⁴⁰ It is on the whole a welcome development, as it entails an effort to tell the whole story, or to admit that there may be many stories, rather than to supply a single convenient, skeletal, and selective framework. The deep connection between our universities and our museums is evidenced, hearteningly, by the fact that this movement within academia has had its consequences for the museums as well. Once again, it will be helpful to look at this in terms of our Smithsonian Institution as an example, for there, its effects have been dramatic and es-

pecially disturbing. It may be well to remind ourselves that, for American readers, events at the Smithsonian are inevitably of special interest, since as a public trust within our democracy, the Smithsonian not only serves, but is the personal responsibility of every voting citizen.

A new component of the Smithsonian Institution was opened in the period after World War II, as the National Museum of History and Technology. On its scientific side it was an American version of the Deutsches Museum, less disciplined by far, but setting out in an intelligible order the development of fundamental sciences and technologies. In its aspect of a “history” museum, it exhibited various memorabilia from a broad expanse of American history. With the coming of the new cultural history, however, this paradigm seemed limiting and restrictive, and a transformation of the museum took place, reflected in a new name, the National Museum of American History. Science and technology continued to be included, now however to be assimilated as elements of a larger history, inclusive of an astonishing range of cultural artifacts and concerns. A major shift was taking place in the concept of the science museum, from the paradigm of the Deutsches Museum to something far broader and evidently closer to the universality of the museum as we saw it asserted in Alexandria.⁴¹

One example taken from the recent history of the NMAH will exemplify this new approach and the issues it brings with it. For a long while a professional association of scientists, the American Chemical Society— itself an institution of the diaspora of which we have been speaking— had been interested in looking to its own educational role, explicitly taking the Exploratorium as one model, but clearly also with the exhibition of its own science, perhaps in the manner of the Deutsches Museum, in mind as well. It had thought at first in terms of a small science museum within its own headquarters building, but when this proved unfeasible, the Society proposed to carry out its project by way of a contract with the nearby Smithsonian Institution. Accepting a sum which ultimately amounted to \$5.3 million, the Institution undertook to mount an exhibit to be called “Science in American Life.” The title should perhaps have suggested to the Society the broader approach which lay in store. By agreement, the Society appointed an Advisory Committee of twenty scientists and scholars, but ultimate decision was reserved to the Smithsonian, rep-

resented by the exhibit's Curator. An implicit polarization was in store, for the Society wanted a purely "scientific" exhibition which would introduce young people to chemistry in a supportive spirit, while the curatorial staff envisioned a cultural approach to the same science, in a broader and more critical spirit. Yoked by a contract which lawyers agreed could not be broken, they were, it would prove, worlds apart.⁴²

A major supporter of the American Chemical Society is the Du Pont Company, and it was precisely the spirit of Du Pont's legendary claim of "Better Things for Better Living Through Chemistry" which the curators wished to bring into thoughtful question. Exhibits, beyond the interactive science area with which the donors were pleased, addressed, among many other topics, the birth control pill, the public adaptation to the era of the nuclear bomb, and environmental problems including DDT and the ozone layer. To the Advisory Committee, the very fact of raising such questions seemed a negative move, or a thrust *against science*; they fought the curators, but though they achieved some slackening of the label texts, they essentially lost the battle, and their funding was completed in an atmosphere of acute bitterness in which they were joined as well by the American Physical Society, whose delegation to the Secretary of the Smithsonian on the issue is said to have included two recipients of the Nobel prize. The ACS vowed that it would never again fund an exhibit over which it did not retain control, a pronouncement which came at exactly the time in which the Smithsonian was being shifted from federal to private support. A new Secretary, I. Michael Heyman, renowned for the fund-raising abilities he demonstrated as Chancellor of the University of California, has made it clear that he welcomes this challenge, and intends to redouble the Smithsonian's private funding.

When a fundamental issue of this sort arises, between narrow and broad understanding of a science museum's role, the autonomy of the institution is called into question, and in part this *becomes* a matter of funding. Even if, as in this case, those who fund an exhibit do not control its content, this same case makes it clear as well that if donors are not satisfied by the Institution's performance, future funding will not become available.

Secretary Heyman has made clear that the Smithsonian “*bears a huge responsibility to the donor community.*”⁴³ Taken in its apparent sense, this would mean that the donors hold an ultimate veto over the exhibit process; and insofar as the Smithsonian bears the responsibility of formulating science and its history on behalf of the American people, the question can be bluntly but plainly put: “Who owns our history?” In Henry’s understanding, the Smithsonian, as a trust on behalf of mankind, would be absolutely independent of external funding. In the succeeding years, dependence on federal funding became a question of submitting an annual request, and with this, the Institution became frankly national and an instrument of the democratic process: the nation “owned” its history and funded its interpretation. The new era will be different yet, in that individuals, corporations, or groups willing to fund exhibitions will “own” the result; in the long run, the wishes of private donors will control the interpretation of science. The possibility remains that private donors may be found who are willing to respect the autonomy of the Institution, and yield control; but we see that that is not the case with even a respected scientific society.

The concept of obligation to funding sources can take very crude form, the more ominous as large science museum projects require increasing levels of funding and join forces with commercial, civic, or federal development projects. In the case of a very large new science center in nearby Baltimore, even government funding has been characterized as “venture capital,” with the stark assertion in respect of one exhibit function that donors, whether federal or private, are entitled to “*quid pro quo.*”

Two intertwined issues were raised by the “Science in American Life” exhibit: one is that of funding and the principle of a museum’s autonomy; the other is that of the type of exhibit appropriate to a science museum. With respect to the latter, the issue has now been clearly joined between the concept of the “pure” exhibition of science and technology and the broader view of science in its full human context. With the pronouncement of the Chemical Society that it would never again release control of an exhibit it funded, we have seen how ominously these two issues may become identified.⁴⁴

The “Enola Gay” affair

We turn now to the National Air and Space Museum, another component of the Smithsonian Institution, where the issue we have just met has recently taken drastic and more ominous form in the cancellation of an exhibit planned to accompany the display of the “Enola Gay,” the aircraft which launched the first atomic bomb over Hiroshima in 1945. The origin of the National Air and Space Museum was significantly different from that of other divisions of the Smithsonian: it was born, not as an offshoot of any pursuits originating within the Institution, but out of a desire on the part of a retired Air Force officer, General Harold “Hap” Arnold, to preserve certain military aircraft following World War II.⁴¹ The aircraft would memorialize those who had fought in them, though no doubt at the same time nourishing support for the ongoing role of military airpower in the future. Quite independently, during that same period arrangements had been completed to return to the United States the original Wright brothers’ aircraft, the “Flyer.” It, too, was to be memorialized, and other aircraft, including Charles Lindbergh’s “Spirit of St. Louis,” were added to the collection. It fell eventually to the lot of the Smithsonian to host this new function when, with the advent of space exploration further exhibits were provided by NASA and the new museum opened its doors in 1976 under the name, the “National Air and Space Museum.” Only with time would a distinction between those limited *memorial* functions and those of a *museum* come fully to the surface as an open contest of wills.

Initially, under the direction of a retired general expert in aircraft technologies, the display took the form of an uncritical celebration of aeronautical engineering and a depiction of the advance of aircraft technology, in comfortable conformity with the tradition of the Deutsches Museum. Military aircraft, arrayed in linear, developmental sequence, were displayed for appreciation as technical achievements, with no consideration of their essentially lethal mission. With the addition of the famous “moon rocks” and other exhibits from the era of space exploration, the new museum included the work of NASA as well as the Air Force, and thus showcased the products of a large segment of the American military-industrial complex. It was described in a 1981 review as “basically a temple of the glories of aviation,” and by one critic as “largely a great advertisement for air and space technology.”⁴⁶ Primarily as a consequence

of its space exhibits, it has become today the most popular museum in the world, with some seven million visitors annually.

The tide began to turn at the NASM following the appointment of a new Secretary of the Smithsonian Institution, Robert Adams, in 1984; the Re-gents appointed Adams with the intention of raising the academic standards of the Institution, and Adams in turn felt that one of the divisions most in need of attention was the NASM. This opinion was later echoed by the NASM's Advisory Council, which asserted that science literacy must be extended to include cultural interests and meanings.⁴⁷ Dr. Martin Harwit, a new director appointed in 1987, came not from the military or the industry, but from academia, with a background in astrophysics; he had participated at Cornell University in the formation of a program in the history and philosophy of science. He shared the belief that the NASM's mission should extend to consideration of the social effects of the technologies it exhibited: "No longer is it sufficient to display sleek fighters," he said, while making no mention of the "misery of war."

In this, the NASM was following the path of the new concern for "cultural history" which we have already encountered in the case of the Museum of American History. From an unquestioning memorial to the exploits of space exploration and flight, the NASM was being transformed into a true museum, which could not by its nature be uncritical. Under Harwit's direction a variety of projects were initiated, one of them a new mounting of a V-2 rocket exhibit which looked now to the rocket's effects as well as to its technology—an exhibit which, in all those halls of lethal instruments, is said to have included the museum's first image of a corpse. A revealing, broad-ranging study of air power in World War I looked unflinchingly at the extremely short lifespans of the pilots whose heroism was so well known, and at the deadly effects of early aerial bombing in its first use against civilians, as well as its role in combat.

Many supposed that with this new approach the museum was turning altogether away from its earlier role in memorializing flight; but I think we must acknowledge that in truth the two functions converge. Every solemn memorial invites reflection on the foundations upon which it rests, in the very spirit of critical thought which is the hallmark of the serious museum; in a sense, such a memorial is by its nature at the same

time a grove sacred to the Muses. In striving to become a museum in earnest, the NASM was thus in effect only rising to the full measure of its responsibility as custodian of the nation's icons of space and flight. As we shall see, however, this point was not appreciated by some who were already agitating for a return to the simpler ways of an earlier, unquestioning era.

The occasion was approaching in which the nation would put this issue to the test, for the 50th anniversary of the dropping of the world's first nuclear bombs was at hand. The "Enola Gay," the aircraft which had launched the bomb on Hiroshima, had been stored in the possession of the Smithsonian since 1949, but had never been placed on display. It was evident that this anniversary would constitute the occasion on which a section of the plane should be restored and placed on view, and—in a judgment whose wisdom it must be left to the reader to weigh—it seemed evident to the museum as well that with the lapse of a half-century, the time had come to contemplate the reality of nuclear bombing and to reflect on the thinking which had led to the decision to launch the bomb. The NASM thus resolved to mount such an exhibit, incorporating a careful, reflective discussion of the decision to conduct the nuclear bombing as well as the consequences of this decision for the world. Certainly, if ever an historic decision called for critical reflection and study, this was that case; and it would be reasonable to suppose as well that the nation's Smithsonian Institution would be the appropriate host for such a review.

Those responsible for this decision realized full well that this would be a difficult matter, for the American people had been insulated over the years from confrontation with the reality of this holocaust of their own making.⁴⁸ Great care would be taken to introduce the topic to the public gradually, through a series of lectures, panels, and symposia conducted by nationally recognized scholars, and spanning a period of more than a year. The plan for the exhibit itself, and the initial version of the script, would be shared with interested organizations. No preparation, however, could protect the visitor from the experience of confrontation with one element of the exhibit, the "Ground Zero" room. There the visitor would get some sense of the reality on the ground below the Enola Gay, where 100,000 persons, the majority of them women and children, were immolated in an instant. All that would appear would be finely-divided rubble,

with a scattering of items, one of them a child's carbonized lunchbox. Is Ground Zero, we may wonder, a fit abode for the Muses? We know that they are made of stern stuff; through the eyes of Sophocles, for example, the Muse has looked, when comprehension required, upon sheer horror.

During the weeks after the first version of the script had been made public, a wave of criticism and growing outrage swept through the media and found voice in the halls of Congress: both the House and the Senate passed resolutions condemning the exhibit. Veterans' organizations, beginning with the Air Force Association, organized widespread opposition; efforts to work with them in revising the script, culminating in one now infamous session in which the curatorial staff at the museum consented to sit down with representatives of the American Legion to revise a script line-by-line, were of no avail. The same organization which agreed to a revised script one day would continue to condemn the exhibit on the next; it became evident that there was no will on the part of these critics to arrive at agreement on any form the exhibit might take; no form of the exhibit would in fact be acceptable.

Many voices of the political right, which had already embarked upon broad attacks on cultural institutions and the academic "elite," simply seized this occasion to beat their familiar drums. But other voices of the media, including some of the most respectable of the nation's newspapers, joined in the chorus of complaint. The Institution was widely accused of engaging in "revisionist history," of "rewriting history," or simply of "questioning" those things which had long been accepted as unquestionable; there was little evidence of understanding that history by its nature is continually in process of being written, or that new documentation had emerged over the years which threw important light on many of the events and decisions of that time. Ultimately the new Secretary of the Smithsonian, I. Michael Heyman, whom we met earlier in connection with the Science in American Life exhibit and who took office in the midst of these events as well, after first defending the exhibit subsequently cancelled it, leaving only the section of the plane itself and the barest of labels where an exhibit should have been.⁴⁹ Martin Harwit, given the position in which he then found himself, soon resigned his directorship. Even the book which had been announced, which would have preserved the record of the script and images of the exhibit for those interested in

studying it, was cancelled by the Smithsonian Press on the instructions of the Secretary. The conservative Congressional voices which were raised in triumph at this victory demanded a return to “patriotism” and uncritical “commemoration”; since 77% of the funding of the Smithsonian comes from the Congress, and Congress would hold, as we know, a group of seats *ex officio* on the Institution’s own Board of Regents, a heavily conservative Congress from this point forward would hold a tight rein on the Smithsonian’s future.

The Smithsonian Institution had been driven altogether from the field; whether the engagement itself had been ill-advised and foolish, or whether this was a noble defeat in a worthy cause, may be difficult to decide. Many conclude that it was the wrong exhibit, in the wrong place, at the wrong time; others believe that the museum should have done a far better job of estimating and confronting its opposition, or should have been more realistic in moderating the exhibition itself. Few serious critics seem to claim that the script, as it emerged from its first revision, was faulty from a scholarly point of view, or unbalanced in its presentation.⁵⁰ In any case, this defeat of the Smithsonian, as the nation’s museum, and on an issue absolutely vital to the national experience, has dealt a devastating blow to museums in general. As a result, it has given rise to a great deal of reflection on the role of the science museum in our society today.

We should perhaps not be too quick to take the attack on the Enola Gay exhibit as genuine evidence of the voice of the American people, who we must believe would support a balanced and thoughtful exhibit in the proper circumstances—else how could we preserve our faith in the future of our democracy? Two subsequent analyses of the Enola Gay affair give grounds for the belief that strong forces other than those of “veterans” were working against the Smithsonian, and that the American people were not receiving a true account of the exhibit to which they were expressing their opposition.

It is important to know, first, that the Air Force Association, whom even Harwit describes as a “veteran’s organization,” has in fact 199 *corporate sponsors* as well; the pages of its magazine are filled with advertisements for advanced air and space weaponry. The AFA joins with the

aerospace industry in promoting shows of advanced weaponry; it has been characterized as the “air wing” of the “military-industrial complex” against which Dwight Eisenhower once warned the nation. The ties between the Association and the Museum, dating from its founding, had been extremely close until the new administration broke the spell of uncritical celebration of the industry. Since the Air Force Association lobbies the Congress for the restoration of cuts in the military budget, it is understandably concerned that the popular image of the industry remain favorable and unquestioned. Thus the battle in which the Smithsonian found itself engaged with the AFA may not have concerned the Enola Gay exhibit alone, but rather may have constituted a struggle for control of the Air and Space Museum, or even of the Smithsonian Institution itself—a struggle for the soul of the museum, as a place of mere celebration, or of serious and critical reflection. It is a sobering consideration that among the corporate sponsors of the AFA one finds Boeing, Du Pont, Martin Marietta, Northrup Grumman, Rockwell, and Lockheed—clearly names on any list to which Secretary Heyman must go to seek future corporate funding for the Institution.⁵¹

The AFA is long experienced in lobbying, with well-developed ties to the Congress and skillful techniques for dealing with the press—“feeding” the press, in the terms of its own experts. In one case, a mailing of over two thousand pages each was sent to some thousand recipients in the Congress and the press, with guides to call attention to significant passages. It has been shown that the passages selected were taken out of context and misleading, indeed chosen to be as damaging as possible.⁵² But even the normally responsible press accepted such handouts, and repeated and editorially amplified them in such a way that neither the press nor the American public in voicing their opinions was reacting to a realistic account of the exhibit. The public was, in Harwit’s description, denied an exhibit which many might have wanted to see had they known what the options really were.

This affair of the Enola Gay exhibit is not a clear-cut case. Yet, however one is to evaluate it, it stands directly in the path of any inquiry into the fate of the science museum in our time. It has reverberated throughout the museum world and raised well-founded fears for the future choice and design of socially-sensitive exhibits. We have recognized that

the science museum in its essence must be political; not only does its own welfare depend on the health of the political process, but the kind of critical thinking which the museum makes possible is itself essential to the democratic political process. If such thinking can be blocked, as it has been in this case—the exhibit cancelled and the book suppressed—it is not the fate of the museum but through it the fate of the democratic process, which has been crippled. We see in this instance how closely the critical role of museums, large and small, may be bound to the future health of the democratic process.⁵³

The Muse in the white lab coat

The time has come to confront a question which we have touched upon over the course of this essay, but saved for proper consideration until more evidence was before us: Who is this “Muse of Modern Science,” to whom the world has paid such enthusiastic service for so long? In the first instance, she presides over our laboratories and our institutions of research, and she must certainly take credit for a flood of technologies which have delineated the course of progress of the modern world. She enchants us with visions of progress; it is she who spreads before us series of engineering achievements such as those celebrated in the Deutsches Museum, or the triumphs of technology to which the world beats its path at the Air and Space Museum. She inspires the composition of the great theories of fundamental physics and biology, and stirs the ingenuity which devises the experiments which put them to the task. Whatever the family relationship, she is not simply the ancient Urania who charmed Euclid and Ptolemy, for she incites her followers with a *scientific method* to produce objective truths of a new sort, verifiable in the domain of the senses. No one can deny the power and splendor of the works which this, her method, has produced. She is the Muse in the White Lab Coat, and her vestment symbolizes the objectivity and certainty of the knowledge she offers, untainted with personal opinion or the ephemera of dreams and wishes.

Her domain, however, is apparently considerably larger than her garb suggests, for she is not only to be found in the laboratory. It is hard indeed to know where her method begins and ends. Often enough, we

refer to the objective truth of scholarship, not least when the scholarship is that of a curator who has guaranteed the information underlying a museum exhibit. Is it not the case that whenever an historian stands firm upon the facts, or an interpretation is presented as verifiable in the documents and records of an event, these assertions stand as *true* under the authority of our Muse, until they may be refuted by the production of other evidence? Thus the historian, too, and many another scholar of the modern era is using the scientific method, presided over by the same Muse.

Perhaps we are ready for a definition of this broad realm. *Whenever reason searches out evidence, builds theories, forms judgments, and is ready to look again and revise or abandon a position in the face of new evidence or a contrary demonstration, there is science, and there is our Muse at work.* This captures, I suspect, the spirit if not quite the letter of the age of modern science. May we not assert, for example, that the curators of the Air and Space Museum, preparing that exhibit which was destined never to be seen, were working under the spirit of the new Muse, as the composition they were preparing was not one of mere opinions but of reasoned and carefully supported positions, designed to invite the same thoughtful spirit on the part of the American public? If so, it was she who was banished when that exhibit was cancelled. "Critical thinking" is perhaps another name for this same domain, that thinking which we saw being cultivated at the Exploratorium and in the Experiment Gallery. We have remarked on the irony of the situation in the "Science in American Life" exhibit, in which the very adherents of critical thinking, the chemists, flinched when that same reasoning was brought to bear on their own case. Our Muse, then, not only unfolds the achievements of the sciences, but inspires that further stage of thought which brings imagination and evidence to bear upon them, to probe their meaning.

It may be Francis Bacon who first introduced the new Muse to the world in the *New Organon*; and if so, the scope of her realm may be just that to which Bacon intends his work to apply. By this test she is everywhere to be found, for Bacon did not name his work the *new* "Organon" without intending his method to be at least as extensive as Aristotle's *old* one. Like Aristotle's, Bacon's *Organon* covers the range of human affairs, though now in a very new spirit. It is this searching spirit and strict

method of probing inquiry which is new—overturning idols, as Bacon says, questioning assumptions, and putting all things to the test of firm evidence and reasoned judgment. Bacon was no quantifier—he seems not to have had a head for mathematics, he was a man of vivid rhetorical images—so we should be careful not to identify our Muse too closely with number and measure alone. Still, whenever the need arises, the scientific mind is prepared to deal with qualitative information, incomplete data, and probable judgments. It is not the precision and completeness we associate with physics which is essential, but the spirit of reason and investigation whose scope of application is far broader.

Having seen, then, that this Muse deals in her own way with a vast range of human affairs, we must now ask the further question: does she work alone? It is a striking aspect of the Muses as Socrates introduces them that they constitute a company to such an extent that we can understand them best as aspects of a single Muse. Yet for a long while it has been a commonplace of our modern culture to suppose that it is split into one domain of the humanities and another of the sciences, and that the bridge between the two is difficult or impossible to build—which is to say, that our new Muse does not keep company with the others. The argument to the contrary is not only to be found in the spirit of Bacon's work, which does not admit such boundaries, but in the operations of critical reason itself, which follows a question wherever it leads. Further, we know that the white-coated Muse keeps close company with Erato, for scientists above all people are lovers of their work, and the greatest scientists are those who have pursued it with the most unflinching devotion. We who read their writings or follow their theories share the beauty of the argument, and the delight of grasping it. But retribution is close at hand as well. The Enola Gay and the forbidden image of Ground Zero symbolize well enough the awful embrace in which tragedy holds our sciences today—beautiful in themselves, but doomed, tightly harnessed to war, the ugliest of human activities.

One further question may trouble us. If this new Muse is so busy at the forefront of the sciences, why should she be bothered with visits to such old-fashioned places as sacred groves; will she have any real presence in a science museum? Perhaps her case is like that of Calliope, the Muse of epic, who, it is true, is vivid in the mind of Achilles at Troy, but

whose role really begins later, on reflection, when the bard turns these affairs into epic verse. That is, in turn, why Mnemosyne's role is so central, the Muse of history, for it is only in memory that events find the coherence and meaning of song. The sacred grove is that place of reflection whose mystery endows the fleeting and fragmentary with wholeness, timelessness, and meaning. Our new Muse needs such halls of reflection and retreat all the more, as the events in her world unfold with lightning speed and seeming inexorability. Science needs the science museum. The new Muse works in the greater world, but she is at home, and most in converse with her sisters, and Apollo too, in the quieter halls of the science museum. It is here where thought must be freest and most reflective. As other institutions, increasingly including our universities, reconcile themselves to the pace and measures of the commercial world, the science museum, if it endures, may be the crucial remaining host to the sacred grove.

The human mind, whose spirit we represent in the image of the Muses, is ultimately one and whole, however its attention roves the world among the disciplines and the arts. It is that integrity of the human mind—which sings and loves, reasons, or despairs—which is symbolized in the unity of the Muses and discovers itself only in the retreat of the sacred grove. Every-where in the world, where thinking is clear and evidence is respected, our Muse has some involvement, but this is normally scattered and fragmentary; only when the Muse is at home, dwelling with her sisters, will things come together, as they once did for Euclid in Alexandria, into a composition which we can grasp, and by which we can be moved. As we have seen, Frank Oppenheimer seems to have had a remarkable intuition of the meaning of the sacred grove for the science museum; but the task remains to press this concept further, to take the full measure of both the sciences as they present themselves, and of that mode of critical thought as well which is the spirit of the sciences in its application in the wider world. It is thus not only within the walls of the traditional science museum that science and its products are to be studied, or that the critical thinking engendered by science is to be brought into play. Industrial archaeology, for example, performs this magic, converting the original scene of a technology into a museum-like reflection upon itself, in which

it can be understood after the fact in a way it could never have been while the time-clocks were running and the power was still on.

VII. The object becomes subject

Museums without walls: The Slater Mill

There is a magic in viewing historic things; they bear their legends in their very beings, but these texts tend to remain hidden, only waiting to be read. That, of course, is part of the fascination of the historic displays in a traditional museum, very well exemplified by the planes of the Air and Space Museum. As in the case of those aircraft, their stories sleep within them, to become vivid only when they are somehow set in the context in which they once lived. The same is true of historic sites, which become museums in their own way, without walls—and here, too, their stories sleep, awaiting some wake-up call.

We have seen the science museum entering more boldly upon questions of social history and cultural context, and with this transformation the object may become uncomfortable housed in the museum, crying out to be visited in the very place from which its story radiates. One might hope that the object which had slept within the walls of the museum would yield its story as soon as we visited it in its original home, but this is not necessarily the case. An exhibit may sleep as comfortably when restored to its original site as it did enclosed in a museum. What brings an exhibit to life is not a fine display, even on an original site, but some real question. Only when we meet surprise or perplexity, or when an exhibit strikes home with us in some special or personal way, do we become fully attentive, and then begin to hear the story which it has always been prepared to tell. And curiously, such a story may not prove to be about the old days, when the mill was in full operation or the machines were at their best—it may rather be a story of today, which binds past and present in that vital relation which is the life of history.

This is the secret of industrial archaeology, an extension of the science museum which is drawing increasing attention as the social significance of science and technology becomes better understood. Once in

a while now, a covered bridge is rescued in the nick of time, an old mill saved, a railroad line or a canal preserved—typically the achievement of dedicated amateurs with a love of the object or the site, or some memory of the people who had made it or used it.⁵⁴ The rescued item is prized, but there may be little understanding of the kind of significance it may harbor, or the ways to bring this significance to light.

One site especially woven into American legend may illustrate these considerations—the Slater Mill on the Blackstone River in Rhode Island, which on plausible grounds defines itself as the “Birthplace of the American Industrial Revolution.”⁵⁵ Like many another site rescued from an industrial past, it has been tidied up and restored as something of a shrine to an early technology. Surrounded now by a small, tree-shaded park above the river which once powered the mill, it appears the very image of a grove of the Muses; yet we must see whether the Muses will indeed inhabit there. In such a charming setting we might be reminded of the locusts who sang to Socrates and Phaedrus, those Siren voices sent by the Muses to test the souls of men—luring them, if they could, to idleness and sleep. Locust-history is like that, comfortably enclosing the past in a cocoon of unquestioned fable, changing the reassuring music of the theme-park.

Slater’s frame building has been carefully restored, emerging pristine after shedding generations of other uses, as once a manufactory of casket hardware, and then again a testing rink for a local purveyor of bicycles. Inside, today is found Samuel Slater’s machine on which thread could for the first time in America be wound by mechanical means.⁵⁶ There Slater, a good Quaker, launched the era of unskilled labor by giving employment to seven children, four boys and three little girls—not to be thought of as an exploitation, since the work was light and an attractive alternative to farm labor.⁵⁷ Here then is food for thought, assuredly, but not yet a living question: the Slater site is if anything too well interpreted, the story is told and the past left sealed. The very cleanliness of the site makes it fresh and strangely new, and yet by the same token infinitely remote; it is nowhere in time, neither “then” nor “now,” only a textbook vignette.

Around this gem-like park, however, the eye is met in every direction by evidences of a very different kind, vast abandoned mills of brick or stone which not so long ago were still flourishing but are now only shells, haunting in their emptiness, or in the rubble of their decay. Here indeed *is* a question: what has befallen this home of the Industrial Revolution? It is thus not the manicured Slater Site which draws the Muses. We sense that they do indeed haunt this locale, but it is the ghosts who are speaking, ghosts of mills, ghosts of the thousands whose lives were devoured by the descendants of Slater's fate-laden machine.⁵⁸ With all the force of Delphi itself, this place now cries out with a question, "What was that Revolution? What befell it, and what has it left us, today?"

The Slater Site, reproduced as an exhibit, is placed carefully in the *past*-and there it sits. Perversely, the Muses opt for the decaying mills. It is their ghosts who ask the *present* question, for it is *our* time, the new time, which is broken and speaks of loss, while the old time is presented as whole and secure, a mere memorial. Met in tense conjunction with its ruined offspring, however, the old mill breaks its silence and asks a question which bears on us today: "What have we now, what is our case?" In this valley, in the tight space between its beginning and its demise, is embraced the whole intricate history of the Industrial Revolution. This in turn is a question which will strike home for many Americans, for many of our towns today look a little like this one, marred by disturbing symptoms of the same virus. It is our own history, then, which is embraced by this dual vision, of promise and ruin; and with this observation we come to a central realization: this question is *real* precisely because it has *come home*. In this way, all real questions are in some respect personal questions, as all real answers are those in which we have invested something of our own selves.

It happens that we may take our question up-river, where in the same Blackstone Valley, which once teemed with mills built along "the hardest-working river in America," a new museum has sprung up which embraces the question of the fate of the Industrial Revolution. This is the Museum of Work and Culture, devoted to the traditions and the struggling, embattled lives of the thousands of French-Canadian workers once recruited to fill these mills and work the machines—selected as they were for their large families, presumed docility, and linguistic isolation from

agitational elements.⁵⁹ The Museum of Work and Culture is not conceived to encapsulate a statement about the past, but to launch an empowering proclamation concerning the present and the future: of a people, no longer mill-workers, but present, and proud.

The inversion of past and present implicit in the confrontation between Slater's mill and its surroundings becomes explicit here, where the present becomes, in effect, the exhibit's standpoint from which the world is seen. For *past* we here substitute *present*; but further, for *object* we substitute *subject*—for now the workers are not being *spoken of* (though they are exhibited), but *speaking* (for they are the interested exhibitors). Here, then, is a spirit which is living, something of an answer to the oracular cry from below, "What is our case today?" The Museum of Work and Culture replies, "We are here; and this is who we are." With this, one can truly feel the presence of the Muse. But is this our Muse of science? I believe it is, exactly: for the exhibits, and the mills around them, display in full human extension the technology of the Industrial Revolution and its consequences; while this is posed as a real and powerful question which, as much perhaps as the apparatus of the Minnesota Experiment Gallery, invokes the active involvement of the speculative and critical mind. Since the question is a real one for the social and economic future of our society, we see here again that the science museum gravitates as if by its very nature toward the domain of the political, where it may offer a surprising source of strength.

Museology as thaumaturgy

The distinctive power of the Muses is to induce us to activity, to dance or sing, to compose, or above o, to speak. In each case it is a question of inspiring us with love, for it is by love of the beautiful that we are moved to perform as artists in any of the spheres of the Muses. Thus, to refer once again to that Dialogue of Plato's with which we began this exploration, the great turning point arrives—that moment in which we see that the magic of the Muses has, through Socrates' inspired speech, begun to work upon him; when Phaedrus is moved to step out of his easy role as *connoisseur*, as mere listener and the object of others' persuasions, when he begins to speak from his own convictions, in which his own ac-

tive thought is invested. He becomes willing to join in earnest dialogue with Socrates and give voice to thoughts of his own. We tend to think of a museum as a place where things are shown to us, or we are intrigued, entertained or informed: but the Muses have not begun to function fully until we have made the passage Phaedrus made, and the questions become our own. Such was the question prompted by the stark juxtaposition of the end of the Industrial Revolution to its tidy beginning at the Slater Mill.

It goes hand-in-hand with this observation to notice also that Phaedrus is coming to realize that the Dialogue is not about others, but about himself: that the image of which we spoke earlier, of the soul drawn by two disparate horses, is a description of Phaedrus himself, and of the present moment as well. This is deeply disturbing and more than a little frightening; myth is strong medicine, which Socrates is administering with very specific awareness of its powers in this case. The moment is one of magic, *thauma*, and the treatment Phaedrus is receiving is an instance of the Socratic thaumaturgy, or wonder-working. Strangely, we must admit that the museum—whether its exhibits are about life-forms of millions of years ago, or about steam engines, aircraft, or computers—begins to perform its essential role only when we are struck, by way of some thaumaturgy, with the realization that the exhibits are ultimately of ourselves. So it is for any who recognize in the mills of Rhode Island symptoms of their own home-towns. Everywhere, in all truly successful exhibits, the text is one: “*Know thyself!*” As the artful curator—and who is that but Socrates?—well knows, from being the *object* of the curator’s messages, we must be led to become the *subject* who is responding. These subtleties of object and subject, effected in the Dialogue through the many devices of the Socratic thaumaturgy, will help to prepare us for the last, and most mythic, of the museum visits in this essay’s odyssey.

Revolution in anthropology

We have seen how, in the early “collecting” phase of the Smithsonian, the Bureau of Ethnology investigated Native American groups in much the same manner as other specimens from the West were being studied and classified. They were treated as *objects* of observation and collection.

Now, in an impressive upheaval in the museum process, the Smithsonian has come full circle, and has opened the Heye Collection in New York City, the first phase of a new Museum of the American Indian, as a museum in which those who until now had been *objects* of the study now become *subjects*. They take over the exhibiting process, and speak for themselves, with authentic voices. Native Americans both choose the displays and speak for them, as if in the very voice of the display itself. The collected object has taken voice, and becomes with this reversal of the flow of discourse, in a sense its own interpreter.⁶⁰ In the first hall of this new museum we see fascinating artifacts, as we have before, but now in place of the label or the interpretive graphics of the museum designer, we hear voices, very human and yet in some way mythic, speaking gently, firmly, and as if timelessly of the world as it appears from within the culture which they are now exhibiting to us.

The collection itself from which the exhibits are drawn was that of a certain George Gustav Heye, a New York investment banker and a collector in the starkest form of the old mode: over a period of decades he gathered artifacts from Native American communities into what became perhaps the largest collection of such artifacts in the world. The Heye Foundation for many years maintained a small museum in Manhattan, but the greatest part fell into precarious condition in a warehouse in the Bronx. Since 1989, when the collection passed into the hands of the Smithsonian, the warehouse has been repaired, and the new museum in the old Customs House at the Battery in New York City has opened as a branch of the future National Museum of the American Indian, to take its place in the company of Smithsonian buildings on the Mall.

The exhibits to be shown in New York were chosen from that immense collection, not by museum curators in the normal manner, but by Native Americans themselves. To prepare a second hall, "All Roads are Good," twenty-six "selectors" were named, each of whom chose at will a group of artifacts which were in some way appealing, and which the selector wished to display to the world. In a videotape accompanying each exhibit, the same selector speaks quite personally about the special significance of the objects chosen. These voices are distinctive, for not only do they speak authentically for the objects displayed, but as subjective and personal they are remote from the customary objective voice of cu-

ratorial authority. For a visitor who listens with sensitivity to these words, this museum is unlike others: this is not cultural information but personal address. Here is a museum which is a human space. We are reminded, yet again, of that grove in Athens in which our inquiry began, with a most human conversation in an aura of mythic forces. Here are the words of one of the Pueblo voices:

I feel very strongly that Indian people forget—all people forget—those deeper places these objects can remind us of. As a human race we have moments of incredible greatness, not power and control over things, but power to connect with Po-wa-ha, 'water-wind-breath,' the creative energy of the world, the breath that makes the wind blow and the waters flow.⁶¹

The museum has become a sincere and mythic place. It would be easy to conclude, on the other hand, that this is now *not* a "science museum," were it not that the winds spoken of here sound so much like those of the grove on the Ilyssus, as though we were being reminded of something which our own tradition had in some way once known, but forgotten. We need to ask once more, whether the science museum, taken in its serious and root sense as we have tried to do, might properly include the Heye Collection, and even in the future tend to become more like it. Does not the American Indian, after all, at this late date have something to teach us about *science*?

If it belongs to science to study the peoples of the world and to come to know their cultures, as such sciences as anthropology and ethnology, among others, assume, then we cannot be content to know *about* them, objectively, which is as we have seen, not to know them at all. We must know them for what they are, as subjects, not objects, and with points of view very different from our own. They must speak, and we must listen. Only in this way can any true knowing, or science, arise. But finally as well, once this step has been taken, we see that knowing becomes a two-way street. Who is the knower, and who the known? Science, or knowing, is opened to the same symmetry. This is not so surprising; our science has always been telling stories, and is no stranger to myth. Perhaps we in the West have lacked imagination about our own modern science; very likely our Muse has been waiting patiently for us to catch up with her. In the new global society of a world ever more closely in touch with itself, there

is no preferred viewpoint; “we” are all people, we must come to know each other, and to do this authentically—to do this truly scientifically—we must pool our modes of knowing. This is the significance of the Heye Collection for the science museum of the future.

VIII. Conclusion

Toward the science museum of the future

It is hardly given to us to predict what the science museum is apt to be like in the future, but we may draw some conclusions from the excursion we have made among existing instances, and together with rumors we have heard about new developments, draw a picture of the science museum of the future as we might wish to envision it.

It does not seem that great size is advantageous: in fact, the immense requirements for funding of great enterprises tends, as we have seen, to leave them hostage to inherently unfriendly forces. We need to rethink the science museum, to see whether its purposes may not be achievable on a more human and less vulnerable scale. The human feeling, the participatory character and the authentic voices of the Heye collection, suggest one attractive model. Though its own scale is in fact large, it is nonetheless quiet, musical, and thoughtful, and invites translation to a modest, local, or regional level. The places we care most for; and the technologies and industries which most immediately affect our lives are likely to be local. Again, the museum without walls which extended to the entire Blackstone Valley is an interesting paradigm, for we do not need formal temples so much as provocative local sites, about which to think. Indeed, the science museum of the future might well be in anyone’s home town. Great exhibits are less important than they used to be: they put us off, make us dependent on exhibit designs and curatorial authority, and in general lock us into syndromes suggestive of the worst, rather than the best of the traditions we have considered. It must be better to summon the best of local resources, in schools, colleges, libraries, local historical societies, and the dedicated amateur labors of students and willing citizens, than to place ourselves in the hands of remote institutions and external authority. What is important is the process of

informed, dedicated, and critical thought directed to present questions; and that may often best be brewed at home. 62

It is very important, however, on the other side of this ledger, to conceive the science museum as a cosmopolitan meeting place which escapes bounds of habit and prejudice and opens up new worlds. That would seem to work directly against the intimate, local nature of the museum I have just suggested. But there is a new mode of global conviviality available to us now, and here we may meet the answer to many of our conundrums. Increasingly, we will have access to other persons and remote places by way of what is today called the "Internet," and will take on new forms and names as time and technology unfold. This offers the prospect of digital electronic communication with sites-with the great, remote exhibits, or more importantly, perhaps, with persons in communities, individually or in groups-in ways we could not have imagined. The science museum of the future, albeit local and limited in resources, may thrive on this mode of human communication, so open to the personal voice and the inquiring mind. Today the world perceives its new digital technologies in terms of "information"; but we do not love information of which no Muse exists. For the science museum as we have described it, communication is a means to insight, with critical and imaginative thinking. For such a museum, the Internet and its descendants will be modes of conversation, dialectical and transforming in ways fit to delight the Muses.

Against these suggestions must be set the abiding value of the great museums we already know. There, unique exhibits, not to be reproduced on local scales or by lesser means, can be visited; one can wander in Oppenheimer's grove of enchanting devices or play freely in an Experiment Gallery. The challenge becomes that of integrating all of these into one system vibrant with life at all levels. It is too early to spell out what this might be like. But let us hope it will draw upon the best features of the sites we have visited, from Athens to Rhode Island, and that throughout, it will invoke the Muses and rise to the principles we identified first in Alexandria. If so, even the Internet will have contrived to become a sacred space, and there is perhaps no reason why it might not.⁶³



Endnotes

1. Strictly transliterated, this term would be *mouseion*, but we avoid a pitfall of English pronunciation by taking the liberty of substituting *museion*. After all, literal application of the same rule would make Homer's Muse a "mouse"! I owe the suggestion that it would be fruitful to pursue the term "museum" to its source with the Muses to Caryl Marsh, "A Neighborhood Museum that Works," *Museum News*, October, 1968.
2. See *GBWW* 1: 7, 115-41; 11: 6, 115-41
3. There is, of course, a rich literature on Alexander and Alexandria. On Alexander, we may mention first the *Encyclopaedia Britannica* article "Alexander the Great" by Frank W. Wallbank, and Plutarch's *Life of Alexander* (*GBWW* 1: 14, 540-76; 11: 13, 540-76); then Michael Grant, *From Alexander to Cleopatra* (New York: Charles Scribner's Sons, 1982); Agnes Savill, *Alexander the Great and his Time* (New York: Citadel Press, 1966); and the discussions of Alexander's political vision in Stringfellow Barr, *The Mask of Jove* (Philadelphia: J.B. Lippincott, 1966). On Alexandria, there is first E.M. Forster, *Alexandria, a History and Guide* (Gloucester, Mass.: P. Smith, 1968); Jasper Griffin, "The Library of Our Dreams," *American Scholar* vol. 65, December, 1996, p. 59; David T. Runia, "Polis and Megalopolis: Philo and the Founding of Alexandria," *Mnemosyne*, vol. 42, fasc. 3-4, 1989, p. 398; and especially Andre Bernand, *Alexandrie des Ptolemies* (Paris: CNRS Editions 1995). Bernand traces each aspect of Alexander's plan to corresponding passages in Aristotle's *Politics* (*GBWW* 1: 9, 445-548; 11: 8, 445-548). References specifically concerning the museum and library are given in note 4, below.
4. Sources concerning the Library and the Museum abound: Diana Delia, "From Romance to Rhetoric: The Alexandrian Library in Classical and Islamic Traditions," *American Historical Review*, vol. 97, December 1992, p. 1449; Andrew Erskine, "Culture and Power in Ptolemaic Egypt: The Museum and Library of Alexandria," *Greece and Rome*, vol. 42, April 1995, p. 38; Edward Parsons, *Alexandrian Library, Glory of the Hellenic World* (London: Cleaver-Hume Press, 1952); Mostafa El-Abbadi, *The Life and Fate of the Ancient Library of Alexandria* (Paris: UNESCO/UNDP, 1990).
5. As often, Aristotle's words here are a challenge to translate, though the idea is clear and striking, since "to leisure" is an active verb. He seems to say: "We busy ourselves (we un-leisure) in order to carry on leisure (to leisure), as we wage war in order to wage peace," *Nichomachean Ethics*, 1177b4 (*GBWW* 1: 9, 432; 11: 8, 432).
6. On the life of Aristotle, see Lorenzo Minio-Paluello, "Aristotle and Aristotelianism," *Encyclopaedia Britannica*, ed. 15, vol. 14, p. 55; and W.D. Ross, *Aristotle* (London: Methuen, 1945). On the relation of Aristotle and Alexander, see Bernand, *op. cit.*, p. 6. One wonders, if Alexander and Aristotle had both lived, whether Aristotle might not have been invited to become the first Director of this new Lyceum.
7. Historians have long repeated the tradition that the Library at Alexandria burned as an inadvertent consequence of Caesar's attack on Alexandria. In fact it appears to have been only the copying enterprise or publication department, located at the harbor's edge, which burned, with a loss of some 40,000 volumes, a small percentage of the total. See Luciano Canfora, *Vanished Library* (Berkeley: University of California Press, 1987), and Bernand, *op. cit.*, p. 13ff.
8. See Euclid's *Elements* (*GBWW* 1: 11, 1-396; 11: 10, 1-396).
9. See Apotionius' *Conics* (*GBWW* 1: 11, 603-804).
10. See Ptolemy's *Almagest* (*GBWW* 1: 16, 1-478; 11: 15, 1-478).

11. A basic source for the history of the Smithsonian, including an account of the Smithsonian bequest, is Paul H. Oehser, *The Smithsonian Institution* (Washington, D.C.: Praeger Publishers 1970); I have made use of an earlier work by the same author, *Sons of Science* (New York: Henry Schuman, 1949). The Institution's early history is detailed by Joseph Henry himself, in the sequence of his annual Reports and in other documents assembled in a unique volume as *Account of the Smithsonian Institution* (1854) at the Johns Hopkins University Library, and reviewed in his *Ninth Annual Report to the Board of Regents* (Washington, D.C.: Smithsonian Institution, 1855). His writings are collected in Nathan Reingold, ed., *The Papers of Joseph Henry* (Washington, D.C.: Smithsonian Institution Press, 1972). John Quincy Adams' proposals for the new museum are contained in Wilcomb E. Washburn, ed., *The Great Design: Tivo Lectures on the Smithsonian Bequest* by John Quincy Adams (Washington, D.C.: The Smithsonian Institution, 1965).

12. The Regents originally consisted of 15 members: the Vice-President and the Chief Justice of the United States, and the Mayor of Washington, *ex officio*, three members of the Senate appointed by the President of the Senate, and three members of the House of Representatives, appointed by the Speaker of the House, and six citizen members, appointed by joint resolution of the Senate and the House.

13. Accounts of Joseph Henry are to be found in the works by Oehser cited in note 11 (*Sons of Science*, pp. 26 ff; *Smithsonian*, pp. 26 ff); and the article by Spencer F. Baird, in the 11th edition of the *Encyclopaedia Britannica*. See also Arthur P. Molella, Nathan Reingold, et al., eds, *A Scientist in American Life: Essays and Lectures of Joseph Henry* (Washington, D.C.: Smithsonian Institution Press, 1980), and the historical notes throughout *The Papers of Joseph Henry*, cited above.

14. It would not be out of line with my understanding, if it were true that he was influenced by the charter of the Royal Institution (founded, interestingly, by the American, Benjamin Thompson, Count Rumford), for "the general diffusion of knowledge," which in turn is likened to the phrase in George Washington's Farewell Address, urging the founding of institutions for the diffusion of knowledge. This is suggested by Oehser, *Smithsonian*, p. 13.

15. Henry's "Plan" is reproduced in Oehser, *Smithsonian*, p. 256.

16. Many documents testifying to its solemn role, including a copy of the New Testament, were deposited in the cornerstone. Unfortunately, as Oehser points out, no one thought to mention where this is located, and the Institution, custodian over the years of the nation's collections of record, had never, at least at the time of Oehser's account, been able to find its own cornerstone! (Oehser, *Smithsonian*, p. 186)

17. On the Weather Bureau, see Oehser, *Smithsonian*, p. 35. Other functions were incubated and later spun off, among them what was to become the Fish and Wildlife Service (*ibid.*, p. 41).

18. On the Bureau of American Ethnology, see Oehser, *op. cit.*, p. 63, and *Sons*, pp. 81 ff.

19. The episode was related by the president of the Royal Society in an address shortly after Smithson's death (Oehser, *Sons*, p. 6).

20. Oehser, *Smithsonian*, p. 40.

21. On Baird, see Oehser, *Sons*, pp. 60 ff.

22. Pere Alberch, Director of the Museo Nacional de Ciencias Naturales in Madrid, "The Identity Crisis of Natural History Museums at the End of the Twentieth Century," in Roger Miles, Lauro Zavala, *Towards the Museum of the Future* (London: Routledge, 1994), p. 196.

23. On the "Bairdians": Oehser, *Sons*, p. 106.

24. On the founding of the National Museum of Natural History, Oehser, *Smithsonian*, pp. 96 ff. An interesting review written from the same point of view is the article "Museums of Science," by William Holland, in the 11th edition of the *Encyclopaedia Britannica*. See *The Origins of Natural Science in America*, Sally Gregory Kohlstedt, ed., and George Goode (Washington: Smithsonian Institution Press, 1991).
25. Oehser, *Sons*, pp. 140 ff.
26. The Museum is currently at work updating the classic Planetarium, another category of natural history display, whose once awesome effect many readers will have known.
27. Galen, *On the Natural Faculties* 1, xiii; 39 (GBWW 1: 10, 173-77; 11: 9, 173-77).
28. On the emergence of the "idea-driven museum," see the Introduction by Amy Henderson and Adrienne L. Kaeppler, eds., to *Exhibiting Dilemmas: Issues of Representation at the Smithsonian* (Washington, D.C.: Smithsonian Institution Press, 1997). Much of the thought "deconstructing" traditional museum concepts derives from the seminal work of Michel Foucault, *The Order of Things* (New York: Vintage Books, 1973); Eilean Hooper-Greenhill applies this systematically to museums in *Museums and the Shaping of Knowledge* (London: Routledge, 1992); see also "Museums and Communication: An Introductory Essay," in Hooper-Greenhill, ed., *Museum, Media, Message* (London: Routledge, 1995). A provocative discussion prompted by this issue as it arose at the Field Museum in Chicago is reported in William H. Honan, "Say Goodbye to the Stuffed Animals," *New York Times Magazine*, January 14, 1990, p. 35.
29. On the Deutsches Museum, see Wolfhard Weber, "The Political History of Museums of Technology in Germany Since the Nineteenth Century," pp. 13 ff.; Svante Linqvist, "An Olympic Stadium of Technology: Deutsches Museum and Sweden's Tekniska Museet," both in B. Schroeder-Gudehus, *Industrial Society and its Museums* (Chur, Switzerland: Harwood Academic Publishers, 1993), and from a recent perspective, Melanie Quin, "Aims, Strengths and Weaknesses of the European Science Centre Movement," in Mills and Zavala, op. cit., pp. 39 ff.
30. Kenneth Hudson, *Museums of Influence* (Cambridge: Cambridge University Press, 1987), p. 100.
31. See Joseph Henry's address as outgoing president of the American Association for the Advancement of Science in 1850, in Arthur P. Molella et al., eds, *A Scientist in American Life: Essays and Lectures of Joseph Henry* (Washington, D.C.: Smithsonian Institution Press, 1980), p. 35.
32. Sally Duensing, "Science centres and exploratories: a look at active participation," in David Evered and Maeve O'Connor, eds, *Communicating Science to the Public* (New York: John Wiley, 1987), p. 13 1.
33. Frank Oppenheimer, *Exhibit Planning* (occasional document, March 12, 1971, kindly supplied by Sally Duensing.)
34. Frank Oppenheimer, "Exhibit Conception and Design," in Oppenheimer and the Exploratorium Staff, *Working Prototypes: Exhibit Design at the Exploratorium* (Washington, D.C.: Association of Science-Technology Centers, 1986), p. 5.
35. Loc. cit.
36. *Ibid.*, p. 6.
37. *Ibid.*, p. 9.
38. *Ibid.*, p. 12.

39. Loc. cit.

40. See Bernard S. Finn, "Exhibit Reviews-Twenty Years After," *Technology and Culture*, vol. 30, 4 October 1989, p. 993; Amy Henderson and Adrienne L. Kaeppler, eds., *Exhibiting Dilemmas* (Washington, D.C.: Smithsonian Institution Press, 1997), especially their Introduction to this volume; Michael Wallace, "The Politics of Public History," in Jo Blatti, ed., *Past Meets Present* (Washington, D.C.: Smithsonian Institution Press, 1987) p. 37.

41. Oehser, *Smithsonian* p. 96; Steven Lubar, "Public History in a Federal Museum: The Smithsonian's National Museum of American History," in Barabara J. Howe and Emory L. Kemp, eds., *Public History: An Introduction* (Malabar, Florida: Robert F. Krieger Publishing Co., 1986), p. 218.

42. Faye Flam, "Privately Funded Exhibit Raises Scientists' Ire," *Science*, vol. 265, no. 5173, August 5, 1994, p. 729; Robert Adams, "Smithsonian Horizons," *Smithsonian*, vol. 25, no. 3, June 1994, p. 8; Sasha Memecek, "Out of the Lab and into the Fire," *Scientific American*, vol. 272, no. 2, February, 1995, p. 21.

43. 1. Michael Heyman, "Smithsonian Perspectives," *Smithsonian*, vol. 25, no. 9, December, 1994, p. 12.

44. Steve Olson, "Baltimore's Newest Tourist Attraction-Scientists," *Science*, vol. 275, no. 5308, March 28, 1997, p. 1874.

45. Oehser, *Smithsonian*, op. cit. Alex Roland, "Celebration or Education: The Goals of the National Air and Space Museum," in Schroeder-Gudehus, op. cit., p. 77.

46. Samuel A. Batzli, "From Heroes to Hiroshima: The National Air and Space Museum Adjusts its Point of View," *Technology and Culture*, vol. 31, no. 1, January, 1990, p. 830; Michael Wallace, "The Battle of the Enola Gay," in his *Mickey Mouse History and Other Essays on American Memory* (Philadelphia: Temple University Press, 1996), p. 270. The story of the Enola Gay affair is told by Martin Harwit, the museum's director, himself, in *An Exhibit Denied: Lobbying the History of the Enola Gay* (New York: Copernicus, 1996), and in Philip Nobile, ed., *Judgment at the Smithsonian* (New York: Marlowe & Co., 1995), a volume which includes an unauthorized printing of the original script, "The Crossroads: The End of World War 11, the Atomic Bomb and the Origins of the Cold War." See especially the careful study by Barton J. Bernstein, "The Struggle Over History: Defining the Hiroshima Narrative," in that volume, p. 127.

47. Batzli, op. cit., p. 824.

48. The systematic suppression of images of the actual effects of the atomic bomb-ings is traced by Gary Mitchell, "A Hole in History: America Suppresses the Truth About Hiroshima," *Progressive*, vol. 59, no. 8, August, 1995, p. 22.

49. Before the weight of opposition led him to change his position, Heyman had originally stated, "The Smithsonian, as a meaningful and responsible public educational institution, should seek to present matters in their full dimension. At the same time, we should do our level best to be balanced. . . . This is what we are trying to do with the Enola Gay exhibition. I believe that our final product, to go on display in May, will properly present the record of what happened. . . ." *Smithsonian* vol. 25, no. 8, November, 1994, p. 10.

50. In mid-January, Heyman was still able to write: "I believe the script . . . now strikes the appropriate balance. . . . The development of this script has served as a catalyst for a national discussion about the legacy of the *Enola Gay*, and the atomic bombings. Next May we will open an exhibition that I believe will make a positive and thoughtful contribution to this dialogue." Harwit, op. cit., p. 360.

51. Wallace, "Battle of the Enola Gay," p. 286.

52. On the Air Force Association's management of the press, see Harwit, *op. cit.*, p. 320. A very careful critique of the distortion of the public discussion is formulated by Tom Capaccio and Uday Mohan, "Missing the Target: How the Media Mishandled the Smithsonian Enola Gay Controversy," *American Journalism Review*, July-August, 1995, p. 19.

53. The implications of the Enola Gay affair for museums generally have been widely discussed. See for example Lonnie G. Bunch, "Fighting the Good Fight: Museums in an Age of Uncertainty," *Museum News*, March-April, 1995, p. 32; Edward T. Linenthal, "Can Museums Achieve a Balance Between Memory and History?" *The Chronicle of Higher Education*, February 10, 1995; Barton J. Bernstein, "Misconceived patriotism," *Bulletin of the Atomic Scientists*, vol. 51, no. 3, May-June 1995, p. 4. It is perhaps unnecessary to remark that the issue of the use of nuclear weapons is one confined neither to museums, nor to the past; the failure of the Smithsonian in hosting thought about what this means is thus a blow to the present thinking of society generally. One large modern weapon is equivalent to some 1,000 Hiroshima bombs, while the world is presently equipped with some 35,000 nuclear weapons: a situation neither well understood, nor under stable control. See Jonathan Shell, "The Gift of Time," *The Nation*, vol. 266, no. 4, February 2/9, 1998, p. 9.

54. Kenneth Hudson, *World Industrial Archaeology*, (London: Cambridge University Press, 1979); Emory L. Kemp, "A Perspective on Our Industrial Past Through Industrial Archaeology," in Barbara J. Howe and Emory L. Kemp, *op. cit.*, p. 174.

55. Theodore Z. Penn, "The Slater Mill Historic Site and the Wilkinson Mill Machine Shop Exhibit," *Technology and Culture* 21 (January 1980), p. 64. The Slater site is described in a National Park Service National Heritage Service brochure, *Blackstone River Valley*, while a number of other sites in the same region are interestingly interpreted in other brochures published by Blackstone River Valley National Heritage Corridor Commission, One Depot Square, Woonsocket, Rhode Island, 02895; see also Paul Rivard, *Samuel Slater, Father of American Manufactures* (Pawtucket, Rhode Island: Slater Mill Historic Site, 1974); Steve Dunwell, *The Run of the Mill* (Boston: David R. Godine, 1978), p. 14; and Gary Kulik and Julia C. Bonham, *Rhode Island: An Inventory of Historic Engineering and Industrial Sites* (Washington, D.C.: Historic American Engineering Record, 1978), p. 143. Regions analogous to the Blackstone Valley are discussed in Brian O'Donnell, S.J., "Memory and Hope: Four Local Museums in the Mill Towns of the Industrial Northeast," *Technology and Culture*, vol. 37, no. 4, October, 1996, p. 817; "deindustrialization" is discussed by Mike Wallace in "Industrial Museums and the History of Deindustrialization," in his book, *Mickey Mouse History* cited earlier.

56. The original Slater machine is not at the site, but exhibited in the National Museum of American History in Washington, in the very different context of the interesting exhibit, "Engines of Change."

57. Rivard, *op. cit.*, (unpaginated) p. [25]; Ruth Macaulay, *Dull Dejection in the Countenances of them All: Children at Work in the Rhode Island Textile Industry* (Pawtucket, Rhode Island: Slater Mill Historic Site, 1987).

58. The problem of the manicured exhibit is well discussed by Kath Davies in "Cleaning up the Coal Face and Doing Out the Kitchen: The Interpretation of Work and Workers in Wales," in Gaynor Kavanagh, ed., *Making Histories in Museums* (London: Leicester University Press, 1996), p. 105.

59. Announcement of "The Museum of Work and Culture," Woonsocket, Rhode Island, 02895; the museum has taken shape under the guidance of Dr. Scott Molloy of the University of Rhode Island's Labor Research Center. On the experience of French-Canadian workers in

the mills, see Gerald J. Brault, *The French-Canadian Heritage in New England* (Hanover, New Hampshire: University Press of New England, 1986).

60. Ian Fitzgerald, "America's Indian Renaissance," *History Today*, vol. 44, no. 11 (November, 1994), p. 4; Joseph Bruchac, "The Heye Center Opens in Manhattan," *Smithsonian*, vol. 25, no. 7, October, 1994, p. 40.

61. Bruchac, op. cit., p. 47.

62. The Anacostia Museum, in southeast Washington, D.C., has long been a paradigm of the local neighborhood museum. See Caryl Marsh, "A View from the Anacostia Museum Board," *Curator* June, 1996, p. 86; and her article cited in note 1, above.

63. My own further thoughts concerning computers in museums are expressed in "The Vision Machine," in Natalie Rusk and Anna Slafer, guest editors, "Digital Media in Museums: Preparing for the Post-Hype Era," *Journal of Museum Education*, vol. 22, no. 1, Winter, 1997, p. 7.