REPORT ON

# Places of Invention: *The First Lemelson Institute*

*Organized by the Jerome and Dorothy Lemelson Center for the Study of Invention and Innovation*

LEMELSON ARCHIVES

Incline Village, Nevada • August 16–18, 2007

The Lemelson Center
for the Study of Invention & Innovation

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# *The Lemelson Institute*

## FROM THE DIRECTOR

It is a distinct pleasure to present these findings of our first Lemelson Institute, held at Incline Village, Nevada, August 16–18, 2007. Overlooking the northern shores of Lake Tahoe, the newly erected Lemelson Archives provided a magnificent setting for this inaugural event. Jerome Lemelson's papers, which are being gathered at the archives, supplied the inspiration for our exploration of the theme, "Places of Invention." For this period, the Archives itself became a place of invention in its own right and the institute participants, the inventors. It is my hope that this joint creation—the Lemelson Institute—will continue in future years on a periodic basis, forging a new tradition—not just as another think tank but as an agent to transform our understanding of inventors and the process of invention in the United States and around the world. I also hope that the report that follows conveys some of the intellectual challenges, excitement, and sheer fun involved in launching such a new and promising institutional endeavor.

ARTHUR MOLELLA
*Jerome and Dorothy Lemelson Director*

# *Executive summary*

In August 2007, an interdisciplinary group of scholars and practitioners met at the Lemelson Archives on the shore of Lake Tahoe to examine the relationship between physical spaces and creativity. What is it about a particular place that excites a creative mind and makes it a "place of invention?" How do creative people shape the spaces in which they work? What combinations of elements make one place a hotbed of innovation while a similar place may founder? These questions and many more were discussed at the first Lemelson Institute through case studies of creative people, new and existing spaces, and innovative regions.

*The goals of the Institute:*

- Engage scholars and practitioners in an interdisciplinary examination of the relationship among inventive spaces, inventors, and creative activity
- Offer participants new perspectives on the subject, based on their interaction with those from other disciplines
- Produce a written report of the Institute's findings and seek to publish the findings in an influential journal or magazine
- Inform the Lemelson Center's exhibition and documentation efforts on the topic of "Places of Invention"

The findings of the Institute offer insight into the qualities of physical space that are conducive to innovation; the ways that creative people shape the spaces in which they work; and common creative features among places ranging from the garages and basements of independent inventors to academic or government laboratories to regions and cyberspace.

*Summary of findings:*

- Places of invention that "work" share some common features, including flexibility, understated leadership, good communication, and a balance between individual and collaborative work.
- Similarly, individuals working in creative spaces exhibit some common desires and tensions. Freedom in work style and the personal control of space, including how it is arranged and how it is planned and unplanned, are important to creative people. An element of chaos is a good thing.
- Communities, whether large or small, play an important role in shaping places of invention. Even the quintessential "lone inventor" is part of one or more groups and communities. Conversely, most creative groups have a leader, that charismatic person around whom teams form. Inventors and the many communities of which they are a part are affected by their social and intellectual networks, by changing forms of communication, and by the patent system. But trying to create a new community of invention by replicating a successful model seldom succeeds.
- The idea of "flow" or continuity is an actor throughout the history of invention. One of the most striking examples of this is the fact that places of invention, whether they are institutions or regions, have a documented lifespan. The prevalent use of analogy by inventors to link ideas across disciplines also highlights the importance of flow to an inventor's work.

# *Mission and goals of the Institute*

Innovation has become a universal watchword. Yet, despite its popularity, the process of innovation and its global effects require deeper understanding. Questions about the social and cultural implications of invention and innovation remain underexplored by academic, industrial, governmental, and nongovernmental organizations. The Lemelson Institute is designed to fill this critical gap in scholarly and public thinking. Through small, interdisciplinary seminars centered on issues of invention, innovation, and society, we aim to raise the profile of invention and innovation and to open new channels of communication between the various disciplines and sectors of society concerned with technological innovation.

Sponsored by Dorothy Lemelson, the Lemelson Institute is organized by the Jerome and Dorothy Lemelson Center for the Study of Invention and Innovation, part of the National Museum of American History, Smithsonian Institution. The mission of the Lemelson Center, founded in 1995 through a generous gift from the Lemelson Foundation, is to document, interpret, and disseminate information about invention and innovation; to encourage inventive creativity in young people; and to foster an appreciation for the central role that invention and innovation play in the history of the United States.

Honoring the memory and ideas of Jerome Lemelson (1923–1997), the eminent American inventor and philanthropist, the Lemelson Institute brings together scholars and practitioners, including historians, archivists, inventors, scientists, artists, policy makers, leaders of nonprofit and philanthropic organizations, and others with an interest in innovation, to discuss issues of invention, innovation, and society. This first Lemelson Institute examined the theme of "Places of Invention" to begin to understand and define the relationship between physical spaces and creativity.

*The Institute conveners identified the following goals for the meeting:*

- Engage scholars and practitioners in an interdisciplinary examination of the relationship among inventive spaces, inventors, and creative activity
- Offer participants new perspectives on the subject, based on their interaction with those from other disciplines
- Produce a written report of the Institute's findings and seek to publish the findings in an influential journal or magazine
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# *Setting the Stage*

## THE LEGACY OF JEROME LEMELSON

Jerome Lemelson, known to his family and friends as "Jerry," lived the quintessential American dream. The holder of more than 600 patents, Lemelson and his remarkably creative intellect touched almost every facet of our everyday lives. One of the 20th century's most prolific inventors, Lemelson received an average of one patent a month for more than 40 years—all on his own, without support from established research institutions or corporate research and development departments.

Automated manufacturing systems and bar code readers, automatic teller machines and cordless phones, cassette players and camcorders, fax machines and personal computers—even crying baby dolls derived from Lemelson's innovations. A universal robot that could measure, weld, rivet, transport, and even inspect for quality control utilized a new technology: machine vision. This was his breakthrough invention and the one of which he was most proud, despite the hundreds of others he produced during his 45-year career.

In his philanthropy, as in his professional work, Lemelson was devoted to invention. In the 1990s he and his wife Dorothy established the Lemelson Foundation, which began funding new programs that promote invention and entrepreneurship. One of these is the Lemelson Center for the Study of Invention and Innovation, which was created through a $10 million gift to the Smithsonian Institution's National Museum of American History.

A gifted and versatile inventor, Jerome Lemelson always stood by his belief that people who worked hard and believed in themselves would triumph. He devoted much of his life to championing the rights of the independent inventor, because above all he wanted to ensure that the United States thrived in a high-tech, global marketplace.

Lemelson passed away on October 1, 1997, at the age of 74.[1] We dedicate this first Lemelson Institute to his memory.

*. . . his remarkably creative intellect touched almost every facet of our lives . . .*

1 Abridged from the Lemelson Foundation Web site at http://www.lemelson.org/about/bio_jerry.php

## THE ROLE OF AN INVENTOR'S STYLE ON PLACES OF INVENTION

Not all inventors are as driven and productive as Jerry Lemelson was, but some general characteristics can be traced through most inventors' careers. One of these is a signature "style" of invention, about which Thomas Parke Hughes, a noted historian of technology, has written extensively.[2] By this he refers to the common methodology that an inventor uses throughout his or her career to foster invention and creative thought. For example, he notes that Thomas Edison's style of invention included "a rational and artful combination of scientific law, economic principles and facts, endless calculation, and tireless experimentation."[3] For this method to succeed, however, Edison also had to create the proper place to nurture these activities, surrounding himself with rich resources in terms of people, up-to-date information, physical plant, and financing in what he dubbed his "invention factory."

Participants in the Lemelson Institute offered many examples of how inventors' styles both inform and are shaped by their "places of invention." Dorothy Lemelson's description of how Jerry worked was particularly helpful as a reminder to the group that the mind is perhaps the ultimate place of invention. Regardless of where they lived, Dorothy told the group, Jerry set up his work space in a consistent pattern, fashioning for himself what she described as an "inventor's studio":

*He always had a lot of papers. He always put papers in boxes; no matter what situation he was in, he always had boxes of papers underneath his desk. . . . He did not file them, but he knew where each subject matter was in a drawer, so he could access it. And he always had to have someplace where he could be almost prone—his back would be up against something, his feet would be up, and he'd sit and write. And he had a desk and a drawing board. . . . That is the way Jerry worked. . . . The children never bothered him. He would listen, perhaps, to some music. He just lived within his mind, without any outside interference.*[4]

Art Molella also shared his experience with Jerry's inventive process. Jerry told him that he would look at things and see something missing in them, and he would think about how to improve them. That was where invention began, with solving a problem.

*(continued)*

2 See, for example, *Elmer Sperry: Inventor and Engineer* (Johns Hopkins Press, 1971); *American Genesis: A Century of Invention and Technological Enthusiasm, 1870–1970* (Viking, 1989); and *Rescuing Prometheus* (Pantheon Books, 1998).

3 Thomas Parke Hughes, *Thomas Edison: Professional Inventor* (London: Science Museum, 1976), p. 24.

4 In *Einstein: His Life and Universe* (Simon & Schuster, 2007), Walter Isaacson noted similar characteristics in Albert Einstein: "One of his strengths as a thinker, if not as a parent, was that he had the ability, and the inclination, to tune out all distractions, a category that to him sometimes included his children and family. 'Even the loudest baby-crying didn't seem to disturb Father,' Hans Albert said. 'He could go on with his work completely impervious to noise.'" (p. 161)

Similarly, independent inventor Saul Griffith, a participant in the Institute, talked about creating Squid Labs—his place of invention—and how the physical space corresponds to his invention "style." Griffith and his colleagues work in the control tower at the former Alameda, California, naval base airfield. The lab is characterized by a combination of sophisticated computer systems, hand tools, and music and art. Griffith stressed the importance of a healthy dose of chaos in a place of invention and of having resources on hand since, as he said, "You don't know what you will invent tomorrow."

From the impromptu to the planned, spaces are an important element in human creativity. Bodies of scholarship exist about the relationship of artists to their studios, or of scientists to their laboratories. However, inventors' intimate relationships with their spaces have attracted little attention, perhaps because of the obscurity of the vast majority of inventors.

## *Getting the inventive juices flowing*

In order to awaken the inventor in all of the participants from the Institute's outset, the group split into teams at their opening dinner for an exercise in "grab bag inventing." For this lighthearted yet purposeful activity, each team received a brown paper bag containing miscellaneous items—for example, pipe cleaners, balloons, tape, string, etc.—a time limit for the exercise, and a problem-based scenario to guide its work:

Scenario 1: You are an independent inventor working in your garage. You have a job outside your home, but enjoy tinkering and inventing during your free time. You are currently working on something that will address a household need.

Scenario 2: You are an inventor working in the developing world. You work with local residents to identify and help solve their most pressing problems. You are currently working with a group of farmers to invent something that will help them increase their crop yield.

Scenario 3: You are an inventor in a research lab in a large corporation. You are currently working to create an antigravity device using only the materials that you already have in your lab.

Later in the weekend, the teams reported on their process, their inventions, and on how place (in this case, a table in the hotel dining room) affected their work. One team took a humorous approach to Scenario 1 by defining the "household need" as encouraging unwanted houseguests to leave and created an escalating set of annoyances to accomplish the task. Another team addressed Scenario 2 by conceiving of a omnidirectional windmill that would power a well pump, providing a constant source of water for crop irrigation. A third team, comprised of academics and museum professionals, tackled Scenario 3 by incorporating scholarly knowledge into an invention that was easy to explain and understand visually; they stated that their balloon was filled with negative mass, making it defy gravity. On the overall experience, members of the teams commented on the pressure created by the limitations on time, materials, and work space, and on the joy and freedom that they felt in using their imaginations to think about both plausible and fanciful solutions to the scenarios.

# Framing the task

DISCUSSION LEADER: ART MOLELLA

Art Molella opened the proceedings of the Institute with some framing questions for the discussion. He asked the participants to consider what, if anything, makes a place designed for and devoted to invention different from other creative spaces? Are there specific features that are common to inventive places, whether they are individual workshops or geographic regions? How do creative people shape and interact with their spaces? In what ways do communities, cities, and regions support and/or constrain invention? How have these factors affecting inventive places changed over time?

Similarly, why are some places seemingly more fertile for invention than others? What is it about common, everyday places like kitchens, garages, and farms that inspire the inventive spirit? When does a workplace become a wellspring of invention? Can regions eager to foster invention and its economic benefits successfully emulate places like Silicon Valley?

The interdisciplinary group participating in the Lemelson Institute was brought together to ponder these questions and to inform the Lemelson Center's future activities on the subject of places of invention, including publications, exhibitions, and documentation of contemporary inventors.

# Overview of research on places of invention

DISCUSSION LEADER: JENNIFER LIGHT

Jennifer Light, Northwestern University, oriented the group to current thinking, across disciplines, about the connections between place and invention. She presented a review of recent research in the form of a syllabus for a new course she would teach, aptly named "Places of Invention."[5]

She began by asking three fundamental questions, each targeted to examine assumptions about invention and place and to study their intersections:

- What is invention?
- How does place matter?
- Why take a historical approach?

## *What is invention?*

Invention, she paraphrased, is like pornography—scholars seem to know what it is, but they typically do not define it. She noted that while there is a growing literature across disciplines on inventiveness and innovation, frequently authors fail to explain their terms. As the group discussed this, they differentiated between scientific discovery and technological invention. The first consists of phenomena that existed but were previously unknown to humankind, while the second involves the creation of something that never existed before, particularly something having utility. The question of artistic invention was also raised, but was seen as a less useful concept than artistic creativity. An important point of agreement was that invention often results from cross-fertilization of ideas from different fields brought together to answer new questions. Members of the group offered illustrations of biomimicry (for example, studying the shape of a kingfisher's beak in order to streamline the design of Japanese high speed trains); the transfer of knowledge (such as using the experience gained from steam engines to inform the field of thermodynamics); or fusing disciplines (for example, Howard Becker's merging of art history and sociology in his book, *Art Worlds*).

*(continued)*

5 The syllabus is available for download at http://invention.smithsonian.org/downloads/LemInst_Light_syllabus.pdf

*What is it about a particular place that excites a creative mind?*

### *How does place matter?*

Light presented an overview of scholarship in several fields, noting three points that scholars have made in their assessments of the relationship between place and innovation. First, scholars have observed that individual leaders play a crucial role in fostering creative spaces. Architects for example, design work spaces that they believe will enhance communication and cross-disciplinary collaboration. Managers can contribute by "participating in idea generation rather than remaining on the sidelines, focusing more on the structure, timing, and objectives of projects than on the specific conduct of the work, allowing workers freedom and flexibility in how they go about accomplishing their mission, and developing the social skills to facilitate coordination among collaborators with different backgrounds and forms of expertise."

In addition, social scientists in sociology, economics, and other fields have shown the importance of social and collaborative networks. Invention is often a process that spans disciplines, but even self-styled independent inventors have social networks that support and enhance their work. The group discussed what they perceived as an increase in access to multiple networks, facilitated by new and faster means of communication. This in turn increased exposure to ideas and techniques from multiple disciplines.

The third factor in the relationship between innovation and place, illustrated by scholarship in legal and policy studies, emphasizes the importance of community codes. Government regulatory policies, for example, designed to foster invention and innovation, may in fact constrain them as well. The U.S. patent system illustrates this tension. Applying for and defending patents take time away from inventive work, yet a patent has both tangible and intangible value, protecting an inventor's work and conferring a cachet of genius. Evidence exists that the lack of a robust patent system hinders invention in developing nations.

### *Why take a historical approach?*

Light reported that scholars have identified changes in the inventive process from the late 19th through the 20th centuries, suggesting the value of taking a historical approach to assess even contemporary innovation practices. These included moving from producer-defined processes to ones incorporating the response of consumers; from discreet to continuous activities; and from field-specific to multidisciplinary work. One specific departure in the late 20th century from traditional places of invention is the use of cyberspace for collaborative and distributed work. But surprisingly, scholars have not found that inventive activities conducted in cyberspace differ significantly from those in more traditional locations. "While cyberspace has diversified the venues in which participants in the innovative process can meet," Light noted, research interpretations make the case that "there is as much continuity as change in the era of the Internet."

Light's overview of research in the field led her to propose two areas requiring further study. First, creating and sustaining places of invention are related but separate endeavors; places that first succeed as places of invention can fail in the long term. However, most scholarship considers only the creation of a place of invention. Second, existing studies of inventive spaces typically focus on the generation, not the reception, of ideas, but the latter is a critical phase of the inventive process. She noted there is an entire field of research on the diffusion of innovation that might be tapped for ideas.

# *Examining places of invention*



## CREATIVE PEOPLE: THE PEOPLE/PLACE NEXUS

Lillian Hoddeson, University of Illinois, outlined her work on a number of research organizations that have produced significant inventions, including Bell Laboratories, Fermilab, and Energy Conversion Devices. She noted several characteristics common to highly creative places: a clear mission that is supported by both leadership and researchers; minimal bureaucracy; research freedom; interdisciplinary (and in some cases cross-disciplinary) collaboration; adequate funding and other resources supportive of invention; a favorable balance between isolation from and interaction with the outside; and good morale.

This list of elements raised an immediate question for the group: are these points unique to invention, or are they universal for creative teamwork more generally? It did indeed appear that many types of creative places share these traits. Whether places of invention exhibit unique characteristics beyond the ones discussed here could not be answered in the discussion, although the group agreed that having a dramatic goal—winning a war, landing a man on the moon, or defeating polio—enhances the ability of a mission to drive inventive individuals and organizations. Effective managers, who go beyond leading with a soft touch to demonstrating a tolerance for failure and "creative anarchy," appear to be essential to the inventive process. Often such managers become partners with researchers and inventors in successful places of invention.

Using the power of individual personalities to put a human face on invention, even when those individuals work within large organizations, is another feature of many inventive places. The "lone inventor" remains a cultural icon, thanks, in part, to the affirming value of prizes and patents awarded to individuals and the convenience this myth offers for helping the external world understand what inventors do.

One of the more curious characteristics of places of invention identified by the group, however, is their temporary nature. Places that experience periods of great inventiveness often later undergo creative decline, sometimes followed by a period of inventive rebirth. In general, the phases of inventiveness last about 20 years. Some causes of this "half life for creativity" were postulated. After roughly two decades, bureaucracy and hierarchy tend to solidify, which does not typically enhance inventiveness. Similarly, the reputation of a successful place of invention can come to overshadow the individuals who populate it. In short, some of the very features that make an organization successful at innovation can eventually impede its continued success.

The participants also stated a goal for current and future sites of invention. Concerned that the majority of actors in the places of invention discussed were white males, the group stressed the importance of working toward enhancing diversity in spaces of invention. Various incentives to recruiting and keeping women and minorities in the invention workforce were discussed. One promising trend for young people in start-up cultures is that their tendency to hold a succession of jobs in a short time period is no longer seen as a disadvantage. Rather, the implication is that the worker has seen failures in other companies and can bring that knowledge to bear in the current culture. ❋

*. . . flexible spaces, minimal bureaucracy, and an element of chaos are important . . .*

## CREATIVE PLACES: THE PEOPLE/PLACE NEXUS

Fred H. Gage, Salk Institute, described his research into the plasticity of the brain and the fairly recent discovery that certain locations in the brain continue to grow functioning new cells throughout a person's life. The striking part of this is that the birth and maturation of new cells into new neurons is regulated by experience. Experiments with animals show that enriched environments result in the production of more cells and those cells divide more readily and survive better when the animals experience complex environments. Furthermore, there is a relationship between learning and physical exercise in the creation of new cells: exercise enhances the proliferation of cells, while complex learning experiences aid the cells' survival.

These results indicate that the brain continuously adapts to environments throughout a person's lifetime, raising the question for the group: can architecture affect the structure of the brain? Since experience can change the structure of our brains, and architecture changes our experience, Gage offered the provocative hypothesis that buildings can change our brains by virtue of changes in spatial experience. Gage and his colleagues are currently involved in a study of workers in Washington, D.C., who are moving their work spaces to new buildings, but more research is needed on the effect of architecture on the structure of brain to show if any particular design is better than another to enhance creativity.

However, Gage offered two examples of highly creative spaces as case studies. The first was architect Frank Gehry's personal creative space—a spacious, hangar-like building—that Gage described as seemingly chaotic on the surface, with multiple projects in various states of completion, but clearly productive and creative. He then discussed the well-planned architecture of his home institution, the Salk Institute. Originally designed to include three towers, the plan was modified before construction to two towers and a central courtyard to facilitate communication and interaction among the staff. Inside the buildings, concealed trusses allow unobstructed lab space, and, though the towers are each six stories high, there are only three lab floors. Between each of these floors is an interstitial space containing all the water, electricity, ducting, etc. Any of these utilities may be dropped from the ceiling, permitting multiple configurations of the space to match the work at hand. "So," Gage reported, "periodically, and more often than you would think, we tear out whole sections of the soft wall spaces and just redesign it." The common and essential characteristic of the two spaces, Gehry's studio and the Salk Institute, is flexibility.

The group broadened the concept of flexible space and postulated that having the freedom to actually transform a space and make it one's own might be a key to opening the doors of one's creativity, doors that would remain closed if one were living in someone else's space.

## CREATING "PLACES OF INVENTION": REGIONS AND NEW SPACES

Stuart W. Leslie and Robert Kargon, both of Johns Hopkins University, compared and contrasted the role of formal planning for inventive regions and institutions. Leslie began with an overview of the literature on invention, business, and regions. He explained that for many years the predominant interpretation of the intersection of business and innovation ignored geography and instead concentrated on the firm, the entrepreneur, or the industry. The leading proponent of this approach was Alfred Chandler, whose ground-breaking studies examined where research and development happened within a corporation, but were not concerned with where the corporation was based.[6] This began to change with the work of Charles Sabel and Michael Piore,[7] who looked at individual regions of flexible production in several countries as an alternative to the methods of multinational corporations, and AnnaLee Saxenian,[8] who compared the relative success and failure of Silicon Valley and Boston's Route 128 corridor in terms of the interaction of firms within a region.

Historically defined by maps and physical geography, regions today could effectively be mapped according to the flow of capital and skilled workers. Understanding regions in this way helps to explain why some fail. A successful region combines talented workers, venture capital, and production. But regions may also fail because of regulatory antitrust policies designed, ironically, to protect competition. A third factor identified in the failure of regions is the often-tried exercise of replicating a successful model in an unsuitable new location. To succeed, institutions need to grow organically within their regional settings.

Successful regions, like successful research laboratories, often have a strong, mentoring personality guiding their development. Frederick Terman is widely seen as having played this role for Silicon Valley. Similarly, William Shockley receives credit for starting the semiconductor industry in California. A charismatic figure attracts talent and investors. Other models of course exist; for example, the creation of government-mandated economic regions in Germany offers a contrasting view.

The idea of lifespan applies to regions as well as to research organizations, though the productive period of regions is typically longer than the twenty-year average ascribed to laboratories. Lowell, Massachusetts, for example, remained at the forefront of the textile industry for roughly a century. However, the cycle is similar, and the group postulated that this may be a natural component of capitalism. New firms with new ideas control for a while, but once competition sets in, resources are not as plentiful. The places that survive the longest are the ones that are responsive to changes in society and technology as a whole and are therefore able to grow into new entities, sometimes bearing only a slight resemblance to their founding companies.

What kind of planning, then, would be most effective in building regions and institutions in which creative people may do what they want to do? There are a number of elements to consider. Removing legal, organizational, and financial barriers is essential. Tolerating controlled chaos, minimizing bureaucracy, and keeping spaces flexible are also important. One interesting idea discussed was the effect of temporary structures on creative work. Does planning for a near horizon, not for the long term, result in a more creative space? Does minimal planning actually deliver the desired results?

The Manhattan Project at Los Alamos and the Massachusetts Institute of Technology Radiation Laboratory were examined as exemplars of creative places that were meant to be temporary and therefore not thoroughly planned. The atmosphere of flexibility and impermanence that produced so much creative work indicated to the group that designers of places of invention might do well to begin the planning process with a test phase to see what does and does not work. Planning from the outset to build a permanent place of invention may mean that the seeds of ultimate failure are present from the start.

6 Chandler's most influential book is *The Visible Hand : The Managerial Revolution in American Business* (Cambridge, Mass.: Belknap Press, 1977).

7 Charles Sabel and Michael Piore, *The Second Industrial Divide: Possibilities for Prosperity,* (New York: Basic Books, 1984)

8 AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass.: Harvard University Press, 1994)

## CREATING "PLACES OF INVENTION": ADAPTING EXISTING SPACES

Merton Flemings, Massachusetts Institute of Technology, shared his experiences over 60 years at one of the foremost places of invention. MIT embodies many of the characteristics already identified as essential to creative places. It has a clearly stated and supported mission, leadership "with a light touch," a strong commitment to interdisciplinary teaching and research, academic independence within research groups and among faculty, and tolerance for the sometimes chaotic and organizationally "messy" conditions that promote creativity.

MIT, however, adds other features to the mix. The Institute's culture is intense, diverse, self-sufficient, a bit cocky in terms of expectations of success, and dedicated to hands-on experiences. This culture is nurtured in part by crowded work spaces and buildings connected by the "infinite corridor," both of which promote interchange between and among faculty and students and facilitate not only unexpected but effective encounters. In addition, MIT's tenure process promotes technological creativity and inventiveness through its emphasis on an individual's ability to affect his or her field, either through publications that have influenced the work of others or through products created, including inventions.

Flemings's observations on life at MIT suggested three factors that echo those identified earlier as necessary for creating successful places of invention. The first of these is, once again, flexibility and its corollary, impermanence. Flemings commented that, long after their expected lifespan was over, the buildings that had housed the Radiation Laboratory were still seen as desirable places to work. "Even later," he said, "when other buildings began to go up around MIT, people still loved that lab. And not just from memory, they loved to work in it! . . . If they didn't like a wall, they could knock it out! It didn't take much more than sticking a foot through it."

The interdisciplinary nature of MIT is indicative of a change throughout the university system in the United States. As institutions move away from an emphasis on core disciplines with their own methods—mathematics, history, physics, etc.—to embrace critical problems that transcend and demand the cooperation of many, "hybrid" disciplines (e.g., biochemistry) as well as multidisciplinary practices (e.g., public health, material science) are born. This combining of disciplines is also common in many successful places of invention.

Finally, proximity, with its implied tension between seclusion and inclusion, also factors into MIT's creative life. The idea of the "infinite corridor" is not unique to MIT. The architecture of Bell Labs, the RAND Corporation, and General Atomic, to name only three, were all planned to maximize contact among the buildings' inhabitants. However, individuals and their work styles differ and there is a strong need to balance the desire for privacy with ease of collaboration to the extent possible for the success of the work. But what does proximity mean in the Internet age? Is physical proximity still relevant and necessary, especially as more research is carried out by virtual teams working in disparate locations? The group did not arrive at a conclusive answer to this question, but pointed instead to companies that exist because of and for the Internet, like Google, but still have extensive physical campuses. Perhaps proximity is becoming less about communication and more about the inspiration that place provides. ❀

*. . . creative places make it easy for people to discuss, share, and argue ideas . . .*

## MAKING IDEAS CONCRETE: PUBLIC DISSEMINATION

Peter Friess, The Tech Museum of Innovation, and Art Molella, Lemelson Center, led the final discussion. Molella explained that the group would be asked to brainstorm and comment on two separate but related exhibition concepts. The first is *Places of Invention,* scheduled to open in the Lemelson Hall of Invention at the National Museum of American History in 2011. The other exhibition, *Spirit of Silicon Valley,* will be installed at The Tech Museum.[9] The target audience for *Places of Invention* is families with children aged 6 to 12, with special efforts made to bring in local families from the metropolitan Washington, D.C., area. *Spirit of Silicon Valley* is aimed at increasing tourist visitation to The Tech. The goal of both exhibitions is to develop a model for ways in which distant and organizationally separate institutions may work collaboratively and effectively on a major exhibition project.

*Molella highlighted the objectives of the Smithsonian's exhibition:*

- Explore the rich relationship among individuals, communities, and environments that foster inventive activity
- Investigate the role of invention in shaping places and communities, including those that support sustainable lifestyles and positive social outcomes
- Consider inventions within their social and historical context
- Inspire people not only to learn about invention, but to consider how their choices affect the larger world and to see themselves as potential inventors

*Some of the elements that will be used to meet these objectives include:*

- Case studies of famous and also lesser-known inventors of diverse backgrounds and experiences who work in a variety of places across the United States, e.g., large laboratories, small businesses, homes, cities, rural areas, and communities
- Multidisciplinary perspectives including engineering, arts, science, and design
- Documentation of the process of invention, particularly the collaborative nature of the creative process

Friess then provided background on The Tech Museum of Innovation, whose core mission is, "Inspire the innovator in everyone." He explained that currently the museum has no collections and is in the process of redoing all of its galleries, comprising roughly 40,000 square feet. He has established a new department to develop content for the outdated galleries, with the overall goal to make the museum relevant to Silicon Valley residents and tourists. Over the next five years, the museum will develop exhibitions and experiment-centered presentations on Silicon Valley and its industries. Currently, *Spirit of Silicon Valley* is focused on three themes that relate to places of invention in general and Silicon Valley more specifically: the Valley itself, the people/teams behind the inventions created there, and the inventions/products themselves.

9 Exhibition titles are tentative.

*The discussion turned to suggestions from the group on people, places, and techniques that might be included in the exhibitions.*

- Feature a Shaker community as a case study in innovation, design, and collective imagination in the context of agriculture and manufacturing.
- Feature a historical community from the Southwest (e.g., the Anasazi) to illustrate farming techniques and the notion of collective invention; communal societies share characteristics with places of invention.
- Include situations in people's lives that lead them to invent or solve a problem in some way.
- Use period rooms to evoke a sense of place. They are popular with museum visitors. Perhaps GIS can be used to create a period room of a region.
- Include an introductory film to define the exhibits' objectives to visitors. Have fun with it; look at "The Simpsons" episode about Edison for ideas.
- Use "exploded objects" to discuss regions and to show how many places had a hand in producing the object. Include labor history, environmental impact, defense components, negative consequences.
- Include user communities in the stories told.
- Pull visitors quickly from the familiar into the unfamiliar areas in which place has shaped invention and in which invention has shaped place; use objects, photographs, and graphic materials to do this.
- Keep the main focus on individuals; museum visitors relate to stories of individuals.
- Include something about the changing ethnic and economic demography of Silicon Valley.
- Tap into people's personal interests in hobbies and where they participate in those (e.g., garages, sewing rooms, small studios).
- Challenge and expand the mythological stories of the garage inventor, or the basement inventor.

*The group also offered comments on the objectives of the exhibits:*

- Be clear that there is a difference between solving a problem and inventing something. An invention is something new. Solving a problem, on the other hand, is a means to completing a specific task.
- Be careful not to be too general when explaining what invention is and who is an inventor; do not let "invention" mean everything.
- Take people back to the historical point where key inventions happened. Most people do not think about the fact that everything in their lives was invented.

*Finally, the group provided some general advice:*

- Do audience testing early on; find out if the target audiences are as interested in the topic as this group is.
- Do not avoid controversy, but put criticism in the voice of the participants, not the curators; incorporating first-person accounts is a useful technique.
- Be sure to deal with failure.
- Prototype!
- Give the visitor some sense that there was an early understanding in the Constitution that people were going to be encouraged to be creative and to patent inventions.

# *Findings*

The findings of the Institute offer insight into the qualities of physical space that are conducive to innovation; the ways that creative people shape the spaces in which they work; and common creative features among places ranging from the garages and basements of independent inventors to academic or government laboratories to regions and cyberspace.

*Places of invention that "work" share some common features.*

- **Flexibility.** Truly creative spaces are flexible. They are easily reconfigured, modular, and responsive to the needs of different people and different projects. It can be shown that as buildings and spaces become more solid and permanent, so do their occupants, often with a resulting waning of creativity.
- **Leadership.** Places of invention are characterized by managers who articulate and promote a clear mission, support individuals' research freedom in pursuit of that mission, encourage interdisciplinary teams, and manage with a "soft touch" characterized by minimal hierarchy and bureaucracy. Often, an influential mentor is responsible for originally bringing a group of creative people together.
- **Communication.** Creative places make it easy for people to discuss, share, and argue ideas, whether in the laboratory or the cafeteria. By maximizing both formal and informal contact between individuals, such spaces encourage cross-fertilization of thinking.
- **Balance between inclusion and seclusion.** In order to succeed, inhabitants need to balance their need for solitude with their need for interaction with others. Essential to achieving this balance is giving the individual private, personal work space, while at the same time offering inviting communal spaces, especially those that foster interdisciplinary and multigenerational interaction. A space that is dictated and inflexible is unlikely to succeed as a creative space.

*Similarly, individuals working in creative spaces exhibit some common desires and tensions.*

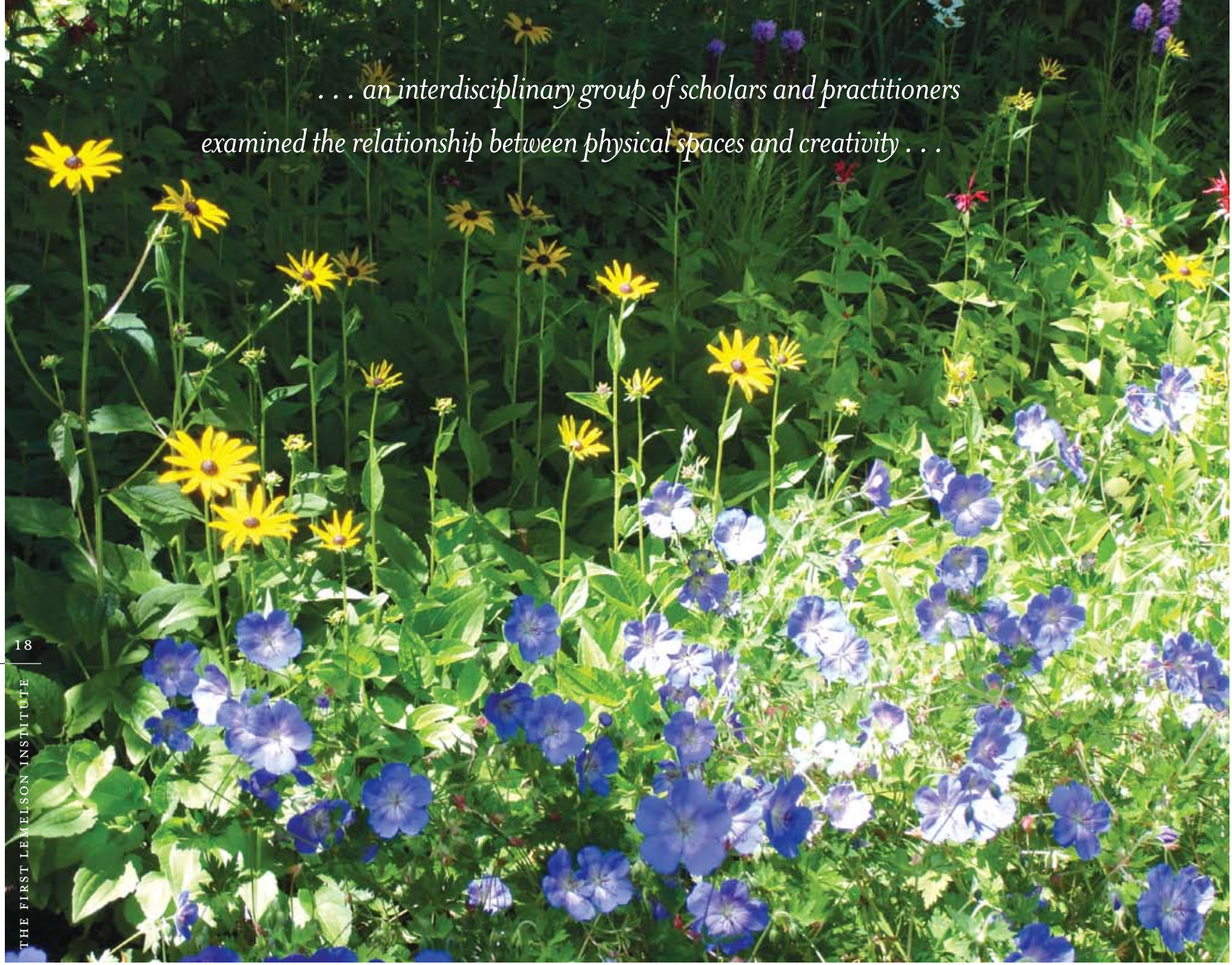
- **Arrangement of the space.** Creative individuals want to arrange, modify, and adapt their personal work spaces to meet their own needs and whimsy. It is almost a cliché that creative people have messy spaces and espouse a hands-on mentality.
- **Control and lack of control.** Chaos and lack of control are vital to creative people. It is crucial to remove them from normal, predictable surroundings, and to give them the freedom to do what they want if they gather the resources needed.
- **Tension between planned and unplanned spaces.** Is it possible to "plan" for spontaneity? Probably not. Planning creative spaces seems to work best if done in stages, with evaluation and adjustment along the way.

*Communities, whether large or small, play an important role in shaping places of invention.*

- **The individual and the group.** While the idea of the "lone inventor" has been dismissed as a myth used to explain the work of inventors to the world, it is still true that most teams have a leader, that a charismatic person is often the reason teams form, and that in spite of the move towards building consortia and other types of groups, individual fiefdoms of invention persist. Why? Part of the answer lies in a continuing bias for the individual that is supported by the prize system and the patent process.
- **Replicating successful models.** With few exceptions, spin-off institutions and replicated regions have not been successful.
- **Changing forms of communication and interaction.** Social networking and forms of distributed knowledge are changing the ways in which inventors work (for example, by creating "virtual" teams of colleagues in disparate places).
- **The role of patents.** The patent system still acts as a constraint and a benefit to invention. While inventors point to the time that the process, and possible ensuing litigation, take away from creative work, inventors who live in countries with a weak or nonexistent patent system see that as a disincentive to invention.

*The idea of "flow" or continuity is an actor throughout the history of invention.*

- **Science v. technology.** While definitions of "science" and "technology" abound, it is more useful to see science, technology, application, invention, and art as part of the continuum of creativity. This viewpoint is useful in understanding the changing nature of the inventive process from the late 19th to the 21st century.
- **Temporal nature of creative spaces.** Creative institutions have life spans. On average, research laboratories, for example, are productive for about 20 years. It is important to examine how the factors that make a creative place successful in the beginning may come to stifle it later on. Creative regions exhibit a similar, though longer-term, pattern. Questioning what resources exist, how long they last, what the competition for them is, and given those factors, how long the institution's way of operating can be sustained, will begin to explain this phenomenon.
- **Encouraging interdisciplinary, multidisciplinary interests.** Invention brings together knowledge from different disciplines to create something new and exhibits a long history of mapping ideas from one field onto another.
- **Connections across time and topic.** Linkages are important to understanding the history of invention. One of the inventor's most powerful tools is his or her ability to create analogies. The act of "transgressive cognition," or the ability to leap over intellectual barriers, is a constant.


. . . an interdisciplinary group of scholars and practitioners
examined the relationship between physical spaces and creativity . . .

# Participants

**MERTON C. FLEMINGS** Lemelson-MIT Program, Massachusetts Institute of Technology, Cambridge, Mass.

Merton Flemings is professor of materials processing and faculty director of the Lemelson-MIT Program in invention and innovation at the Massachusetts Institute of Technology. He has been a member of the MIT faculty since 1956. In addition to teaching and research, he has served as founder and first director of the Materials Processing Center at MIT, as head of the Department of Materials Science and Engineering, and as MIT Director of the Singapore-MIT Alliance. He is co-inventor, with students and co-workers, of 31 U.S. patents in the areas of processing and manufacturing. He is a member of the National Academy of Engineering and the American Academy of Arts and Sciences.

**PETER FRIESS** Tech Museum of Innovation, San Jose, Calif.

Peter Friess, president of The Tech Museum of Innovation since 2006, is charged with driving the content, programs, and Silicon Valley business and education partnerships essential to "inspiring the innovator in everyone." He has extensive museum experience, having helped create and then direct the Deutsches Museum Bonn, and having run projects for the J. Paul Getty Museum, the Smithsonian Institution, and the Bavarian National Museum. Friess, a master clockmaker, received his Ph.D. in 1992 from the Ludwig-Maximilians-University Munich with a dissertation on art and technology. In 2001, Bavaria's State Chancellor asked Friess to build up the Agency for Media and Communication Technology in Germany, California, and India in order to attract foreign businesses to Bavaria, Germany. Since 2003, Friess has been Secretary General of the Fondazione Parmenides of Elba, Italy.

**FRED H. GAGE** Laboratory of Genetics, Salk Institute for Biological Studies, La Jolla, Calif.

Fred H. Gage, Adler Professor in the Laboratory of Genetics, joined the Salk Institute in 1995. He received his Ph.D. in 1976 from Johns Hopkins University. Gage's work concentrates on the adult central nervous system and its unexpected plasticity and adaptability to environmental stimulation. In addition, his studies focus on the cellular, molecular, and environmental influences that regulate neurogenesis in the adult brain and spinal cord. Prior to joining Salk, Gage was professor of neuroscience at the University of California, San Diego. He is a fellow of the American Association for the Advancement of Science, a member of the National Academy of Sciences and the Institute of Medicine, and a member of the American Academy of Arts and Sciences. Gage also served as president of the Society for Neuroscience in 2002 and has been the recipient of prestigious awards, among them the 1993 Charles A. Dana Award for Pioneering Achievements in Health and Education, the Christopher Reeve Research Medal in 1997, the 1999 Max Planck Research Prize, and the MetLife Award in 2002.

**SAUL T. GRIFFITH** Makani Power Inc., Alameda, Calif.

Saul Griffith is an MIT alumnus with multiple degrees in materials engineering and mechanical engineering. He completed his Ph.D. at the MIT Media Laboratory in 2004 on self-replicating hardware and the role and limits of information and state in the self-assembly of complex structures. While at MIT Griffith cofounded Low Cost Eyeglasses, a company using two novel technologies to provide prescription eye care at low cost for rural and developing communities. With Joost Bonsen and Nick Dragotta, he also started *Howtoons*, an alternative curriculum for hands-on-science and engineering illustrated in playful cartoons. A deep interest in the use of social networks for engineering and design led Griffith to cofound Thinkcycle and Instructables, experimental platforms for enabling open-source approaches to developing physical objects. Griffith's principal research focus is in new multifunctional materials and in minimum and constrained energy surfaces for novel manufacturing techniques. His seemingly broad array of interests stems from the past 40 years of developments in logic theory, software, and documentation that enable new ways to look at the way we build and manufacture things.

**LILLIAN HODDESON** Department of History, University of Illinois, Urbana, Ill.

Lillian Hoddeson is professor of history at the University of Illinois. The author or editor of eight books and many articles, she teaches courses on the history of science and technology, oral history, and memory. Her books (most of them with collaborators) include a history of the transistor *(Crystal Fire)*, a biography of John Bardeen *(True Genius)*, and a history of the atomic bomb *(Critical Assembly)*. A new book (in press) treats "megascience" as it evolved at Fermilab. Presently she is at work on a biography of Stanford Ovshinsky, an independent American inventor of alternative energy technologies; a monograph on oral history and human memory; and a history of the Superconducting Super Collider Laboratory. Hoddeson is a fellow of the American Physical Society, the Center for Advanced Study at Illinois, and the John Simon Guggenheim Memorial Foundation.

**ROBERT KARGON** Department of History of Science and Technology, Johns Hopkins University, Baltimore, Md.

Robert Kargon is the Willard K. Shepard Professor of the history of science at Johns Hopkins University, and a co-organizer of the Lemelson Institute. Trained at Duke, Yale, and Cornell, he is the author and editor of *Science in Victorian Manchester, The Rise of Robert Millikan,* and *Atomism in England from Hariot to Newton,* and has recently completed (with Arthur Molella) *Invented Edens: Techno-Cities of the 20th Century* (in press). In recent years he has been examining "knowledge for use," especially in science regions such as Silicon Valley and Route 128, Boston; science and technology in cities; and science in institutions of higher learning.

**STUART W. LESLIE** Department of History of Science and Technology, Johns Hopkins University, Baltimore, Md.

Stuart W. Leslie has taught the history of technology at Johns Hopkins University since 1981. His publications include a biography of inventor and automotive engineer Charles "Boss" Kettering and a study of American science and engineering education in the cold war. He has also written a series of articles (many coauthored with Robert Kargon) on the geography of innovation. His most recent work includes studies of laboratory design and architecture, including projects by Eero Saarinen, I. M. Pei, and Louis Kahn, intended to culminate in a book about "How Laboratories Learn," and a road book about American industrial and deindustrial history focusing on ten towns from Lowell to San Jose, titled "We Can't Make It Here Anymore: A Road Trip through Deindustrial America."

**JENNIFER S. LIGHT** School of Communication, Northwestern University, Evanston, Ill.

Jennifer S. Light is associate professor of communication studies, history, and sociology, and faculty associate at the Institute for Policy Research at Northwestern University. She received an A.B. in history and literature and Ph.D. in history of science from Harvard University, and also holds an M.Phil. in history and philosophy of science from Cambridge University, where she was the Lionel de Jersey Harvard Scholar. Light works on historical and contemporary issues raised by the intersection of new technologies and urban life. She is the author of *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America* (2003, 2005), and journal articles in publications including *Journal of the American Planning Association, International Journal of Urban and Regional Research, New Media and Society*, and *Technology and Culture.* Light's recent research has been awarded grants from the Andrew W. Mellon Foundation and the Graham Foundation for Advanced Studies in the Fine Arts. She will spend 2007–2008 at the School of Architecture and Planning at MIT.

**MARC J. PACHTER** National Portrait Gallery, Smithsonian Institution, Washington, D.C.

Marc Pachter is a cultural historian with a particular interest in biography. As the director of the Smithsonian's National Portrait Gallery until 2008, Pachter was responsible for a $30 million fundraising campaign that ensures that Gilbert Stuart's "Lansdowne" portrait of George Washington remains on permanent display; the creation of the first national portrait competition; and the restoration of the National Portrait Gallery's magnificent National Historic Landmark building. From 1990 to 1994, Pachter was the Smithsonian's deputy assistant secretary for external affairs, overseeing *Smithsonian* magazine, Smithsonian Institution Press, and membership and development programs. Later, he was appointed counselor to the Secretary of the Smithsonian, overseeing electronic media issues, chairing the Institution's 150th anniversary, and facilitating key international partnerships. In 1999, he was awarded the Secretary's Gold Medal for Distinguished Service. From November 2001 until January 2003, he also directed the National Museum of American History. Pachter has been a frequent commentator for CBS *Nightwatch,* the Voice of America, and C-SPAN, and has authored or edited a number of books, including *Abroad in America: Visitors to the New Nation; Champions of American Sport; Documentary History of the Supreme Court;* and *Telling Lives: The Biographer's Art.*

*Discussants:*

**BIRGIT BINNER** thema gestaltung, San Jose, Calif.

Graphic designer Birgit Binner studied at the Hochschule für Gestaltung Schwäbisch Gmünd in Germany, a school that builds on the traditions of the Bauhaus, and received her diploma in design in 1990. In 1993 Binner opened her own design firm in Munich, called "thema gestaltung." She focuses on cultural projects related to industry, museums, and foundations. Her clients have included Bayer AG, the Deutsches Museum Bonn, and the Smithsonian's Lemelson Center, for which she designed the exhibition, *Nobel Voices: One Hundred Years of the Nobel Prize.* This traveling exhibition has been seen across the United States and in Europe, India, and Mexico. In 2006 thema gestaltung moved from Germany to Silicon Valley to unite Binner's interests in good design and new technologies. She also teaches at the university level to share her knowledge with the next generation of graphic designers.

**BRENT GLASS** National Museum of American History, Smithsonian Institution, Washington, D.C.

Brent D. Glass joined the Smithsonian Institution as director of the National Museum of American History, Behring Center in December 2002. A leading public historian, Glass received a Ph.D. in history from the University of North Carolina-Chapel Hill. Glass served as executive director of the North Carolina Humanities Council (1983–1987) and as executive director of the Pennsylvania Historical and Museum Commission (1987–2002), the largest public history program in the nation. He has served on the U.S. National Historical Publications and Records Commission and on the council of the American Association for State and Local History. He is a member of the Flight 93 Memorial Commission. His research interests include architectural and urban history; the history of industry and technology; and the history of memorials, museums, and historic sites.

**JOSEPH N. TATAREWICZ** Department of History, University of Maryland, Baltimore County, Baltimore, Md.

Joseph Tatarewicz is associate professor of history at the University of Maryland, Baltimore County, and director of its Human Context of Science and Technology program. He holds an M.A. degree in philosophy from Catholic University and an M.A. and Ph.D. in history and philosophy of science from Indiana University. He is the author of *Space Technology and Planetary Astronomy* (1990) and *Exploring the Solar System: The Planetary Sciences Since Galileo* (forthcoming), as well as articles and reviews for professional journals and publications in the history of science, technology, and policy. He is a contributor to *The Space Telescope: A Study of NASA, Science, Technology, and Politics* (1989, 1993).

**PHIL WEILERSTEIN** National Collegiate Inventors and Innovators Alliance, Hadley, Mass.

Phil Weilerstein, executive director of the National Collegiate Inventors and Innovators Alliance, began his career as an entrepreneur while still a graduate student at the University of Massachusetts. Along with classmates and an advisor, he launched a start-up biotech company that eventually went public. This experience, followed by several other entrepreneurial ventures, instilled in him a lifelong passion for entrepreneurship, which he has lived out through his work with the National Collegiate Inventors and Innovators Alliance. As an entrepreneur in a nonprofit organization, he has grown the NCIIA from a grassroots group of enthusiastic faculty to a nationally known and in-demand knowledge base and resource center.

## *Jerome and Dorothy Lemelson Center for the Study of Invention and Innovation, National Museum of American History, Smithsonian Institution, Washington, D.C.:*

**JOYCE BEDI** senior historian

Joyce Bedi has served as the Lemelson Center's senior historian and webmaster since 1995. She is the coeditor, with Arthur Molella, of *Inventing for the Environment* (2003), and has authored publications and exhibits on the work of Harold Edgerton in stroboscopic photography. Before coming to the Smithsonian, Bedi held research and curatorial positions at the MIT Museum, the IEEE History Center, the Edison National Historic Site, and the Museum of Applied Arts and Sciences (now the Powerhouse Museum) in Sydney, Australia. She is an adjunct faculty member in history at the University of Maryland, Baltimore County.

**BENJAMIN BLOOM** new media specialist

Benjamin Bloom, now at the National Portrait Gallery, produced Web sites and the podcast series "Prototype Online: Inventive Voices," for the Lemelson Center. His past work includes online exhibitions and educational Web sites for the National Museum of American History and the Minnesota Historical Society.

**CLAUDINE KLOSE** deputy director

Claudine Klose, now retired, was with the Lemelson Center since its inception in 1995 and at the Smithsonian for more than twenty-five years. She was responsible for finance, personnel, and day-to-day operations, overseeing development of two traveling exhibitions and a dynamic series of programs and educational initiatives. Prior to her work with the Center, she was project manager for *Science in American Life* and *Information Age*, two multimillion dollar long-term exhibitions at the National Museum of American History, and has held positions on many smaller exhibition projects at the Museum.

**ARTHUR MOLELLA** Jerome and Dorothy Lemelson director

Arthur Molella received his Ph.D. in the history of science from Cornell University and was awarded an Honorary Doctor of Science from Westminster University, London. He served as head curator of the Smithsonian's *Science in American Life* exhibition and co-curator of the international exhibition, *Nobel Voices.* He has written widely on the relation of science, technology, and culture and on the politics of science museums and displays. He has recently completed a book, *Invented Edens: Techno-Cities of the 20th Century*, written with Robert Kargon, to be published by MIT Press in 2008.

*The Lemelson Foundation:*

### DOROTHY GINSBERG LEMELSON chair

Dorothy Lemelson founded the Lemelson Foundation with her husband, Jerry, one of the world's most prolific inventors. Today, Dorothy Lemelson is fostering the couple's dream of encouraging and supporting America's next generation of inventors, innovators, and entrepreneurs. In addition to her work with the Lemelson Foundation, Dorothy also heads the Lemelson Education and Assistance Program (LEAP). From her residence in Incline Village, Nevada, she both funds and directs this program that was originally intended as a catalyst to improve public education in her community. LEAP has since expanded its outreach to include scholarships, grants to individual schools, and special programs designed to help provide opportunities for at-risk students to thrive and learn. Prior to pursuing her philanthropic interests, Dorothy was a successful interior designer and owner of Dorothy Ginsberg Associates in New Jersey.

### ERIC LEMELSON co-vice president and treasurer

Winemaker Eric Lemelson has always followed in the creative and entrepreneurial spirit of his family. During a year off from law school, he followed his intuition and purchased a small farm bordering the wine-growing region in Yamhill County, Oregon. One afternoon, he met noted winemaker Dick Ponzi, who offered to buy grapes if Eric would plant a vineyard on his property. He spent the spring and summer of 1995 tending his two-acre vineyard and loving the work. By the next summer, he was out in the fields preparing to plant another thirty acres of pinot noir, and Lemelson Vineyards was on its way. Prior to attending law school, Lemelson worked as a campaign staffer on local, state, and national political campaigns, and as a legislative aide. He received his J.D. in environmental and natural resources law from Northwestern School of Law of Lewis and Clark College, with a special focus on Western water law. Following law school, he directed a research center focused on Pacific Northwest water policy and aquatic biodiversity issues. He is also a board member of several Pacific Northwest environmental organizations.

### JENNIFER BRUML LEMELSON member, Board of Directors

Jennifer Lemelson received her B.A. in art history from Boston University and continues to pursue her artistic passions as a potter. Lemelson Vineyards keeps her busy with ongoing special events, and her commitment to the rural community in which she lives is partially fulfilled with her position as a board member of CASA, a nonprofit organization committed to the welfare of children in the area.

### ROBERT LEMELSON co-vice president and secretary

Rob Lemelson is an anthropologist who received his M.A. from the University of Chicago and Ph.D. from the Department of Anthropology, UCLA. He is currently a lecturer in anthropology and psychology at UCLA. He was a Fulbright scholar in Indonesia in 1996-1997, has conducted research for the World Health Organization, and is additionally trained as a clinical psychologist. His area of specialty is Southeast Asian studies, psychological anthropology, and transcultural psychiatry. He is also the president and founder of the Foundation for Psychocultural Research, a nonprofit research foundation supporting research and training in the neurosciences and social sciences.

### SUSAN MORSE member, Board of Directors

Susan Morse is an architect and painter who received her M.A. from the Division of Social Sciences, University of Chicago, with a focus on public policy. She worked in the field of educational policy before turning to architecture. She earned her masters in architecture (M.Arch.) from the Southern California Institute of Architecture (SCI-ARC) and is currently the design principal of SML Design Studio.

### JULIA NOVY-HILDESLEY executive director

With a team of advisors and staff, Julia Novy-Hildesley develops and implements the Foundation's domestic and international programs and oversees Foundation operations. She has previously served as the director of the World Wildlife Fund's California office, conducted research on economic alternatives to slash-and-burn agriculture in Madagascar as a Fulbright Scholar, held positions with USAID and the World Bank, and has worked with government agencies and nongovernmental organizations in Tanzania, Bolivia, and French Polynesia. Novy-Hildesley earned a master of philosophy in international development from the Institute for Development Studies at Sussex University in the United Kingdom, and a bachelor's degree in human biology with a minor in African studies from Stanford University, where she was named Phi Beta Kappa. Novy-Hildesley serves on the John F. Kennedy School of Government Women's Leadership Board and is a fellow of the Donella Meadows Leadership Fellows Program.

## The power of place

While the Lemelson Institute focused on places designed for invention, the location of the meeting lent its own aura of inspiration to the discussions. Designed by architect Roderick Ashley, the Lemelson Archives is the physical embodiment of Dorothy Lemelson's creative sensibilities.

Nestled above majestic Lake Tahoe, the Lemelson Archives overlooks the lake and the Sierra Nevada mountain range beyond. The immediate pine forest and dense undergrowth provide a serene environment where visitors can review the work of Jerome Lemelson, while also engaging in creative discussion about the act of inventing.

The archives design is a simple architectural composition embodying subtle relationships between materials and environment that are unveiled as a person moves through the site. The project is composed of two pavilions—the archives and conference center and a guest residence—mirroring one another and connected via a raised wood boardwalk threaded through a gravel sculpture garden. This simple walkway acts as both a visual and physical connector between the buildings, bordered on the public side by a double allée of aspen trees and open to the garden and spectacular views on the other. The two buildings appear as bookends in a composition that is meant to both engage the surrounding landscape and contain the immediate gravel garden. These carefully crafted buildings are purposefully understated so that attention is directed to the exquisite natural and landscaped surroundings.

The Institute marked the installation of the first exhibit of Jerry Lemelson's papers in the new Lemelson Archives space. To illustrate the breadth of Lemelson's inventions, exhibit curator Joyce Bedi, Lemelson Center, selected materials that featured Lemelson's industrial inventions in one case, and toy inventions in a second case. The notebooks, sketches, correspondence, and patent materials displayed highlighted the path of Lemelson's invention process, showing the connections among the various ways in which he developed his inventions.

Brent Glass, director of the Smithsonian's National Museum of American History, commented that Jerry Lemelson embodied the American dream in the way he continually overcame barriers, believed in progress, and created opportunities for his inventive spirit. Glass commended Mrs. Lemelson for building the Lemelson Archives as a testament to her commitment not only to Jerry's legacy but to future generations as well.

# Acknowledgments

Organizing an intellectually stimulating yet socially enjoyable event like the Lemelson Institute required the dedication and hard work of many people. We thank Claudine Klose, Leslie Casaya, and Maggie Dennis of the Lemelson Center for their untiring efforts with planning and logistics for the meeting. The expert assistance of Caryn Swobe and Susan McLelland ensured that the Institute's preparations and proceedings went smoothly in Incline Village. Joyce Bedi was responsible for the preparation of this report, while Benjamin Bloom handled the audiovisual requirements for the meeting and, with Art Molella, served as the Institute's photographer. Colleagues Robert Kargon and Julia Novy-Hildesley helped us shape the content of the Institute and offered many suggestions for participants. Joseph Tatarewicz lent his expertise in astronomy to a guided tour of the night sky over Lake Tahoe that none of the participants will soon forget.[10] Finally, we especially thank Dorothy Lemelson for her hospitality, generosity, and contributions to the discussions. Her passion for places of invention and her personal grace set the tone of the Institute.

## ABOUT THE LEMELSON CENTER

The Lemelson Center was established at the National Museum of American History in 1995 through a gift from the Lemelson Foundation. Jerome Lemelson (1923–1997) was an independent inventor who earned more than 600 patents, representing one of the largest patent portfolios in the nation's history.

The Center's mission is to document, interpret, and disseminate information about invention and innovation, to encourage inventive creativity in young people, and to foster an appreciation for the central role invention and innovation play in the history of the United States.

## ABOUT THE NATIONAL MUSEUM OF AMERICAN HISTORY, SMITHSONIAN INSTITUTION

The National Museum of American History collects, preserves and displays American heritage in the areas of social, political, cultural, scientific and military history. Documenting the American experience from colonial times to the present, the Museum looks at growth and change in the United States.

*. . . invention brings together knowledge from different disciplines to create something new . . .*



10 "Astronomical Places of Invention" is available for download at http://invention.smithsonian.org/downloads/LemInst_JNT_astro.pdf

## PHOTO CREDITS

Cover: Selections from the Lemelson Archives on display for the Lemelson Institute *(left, Ben Bloom photo)*, and Lemelson Archives conference room *(right, Stephen Cridland photo)*.
p. 3: Dorothy Lemelson *(center)* welcomed the Institute participants *(Art Molella photo)*.
p. 4: Jerome Lemelson, around 1986 *(Lemelson Family collection)*.
p. 6: Lillian Hoddeson and Robert Kargon at work on their "grab bag" invention *(Ben Bloom photo)*.
p. 8: Boats on Lake Tahoe *(Joyce Bedi photo)*.
p. 11: Fred H. Gage *(Ben Bloom photo)*.
p. 13: Lake Tahoe *(Art Molella photo)*.
p. 18: Lemelson garden *(Joyce Bedi photo)*.
p. 23: The guest residence *(top left)*, Lemelson Archives building exterior *(bottom left)* and archives conference room *(Stephen Cridland photos)*.
Inside back cover: The moon, photographed through the telescope during the star gazing session *(Art Molella photo)*.

# The Lemelson Center

## for the Study of Invention & Innovation

*Jerome and Dorothy Lemelson Center for the Study of Invention and Innovation*

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