GENERAL ARTICLE

BRIDGES I: Interdisciplinary Collaboration as Practice

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ABSTRACT

Today, a worldwide community of innovators is engaged in the convergence of art, technology and science, as are a number of vital and active organizations, yet there seems to be very little discourse about the *process* of doing interdisciplinary work. The BRIDGES Consortium seeks to create a collaborative forum for the study and development of interdisciplinary collaboration as a practice. At the first Bridges Summit, held in June 2001, participants discussed a broad range of topics, including: preceding historical developments, the role of language, institutional hurdles to collaboration and the value of art/technology-based research. The event concluded with recommendations for aggregating, validating and strengthening the interdisciplinary community through the creation of a new form of collaborative organization.

The increasing complexity of technology requires both deeper levels of specialization and greater levels of collaboration between disciplines. Differences in work and communication styles, priorities, educational principles, institutional frameworks, funding models, temperaments and even fundamental values have the potential to become either obstacles or stimulants to effective collaboration. The greatest challenge for those involved in the communication revolution is not technology, but communication between people.

The BRIDGES Consortium was formed in 2001 to create a network for the development and dissemination of strategies to improve and support the practice of interdisciplinary collaboration in the arts, sciences, culture and technology [1]. The consortium, initiated jointly by the Annenberg Center for Communication of the University of Southern California (USC) in Los Angeles, California, and the Banff Centre New Media Institute (BNMI), in Banff, Alberta, Canada, seeks to create an international forum and think tank to study and enhance the process of interdisciplinary collaboration in the arts, sciences and technology.

The BRIDGES Consortium think tank brings together top experts from educational, research and funding institutions; the private sector; and independent artists, technologists and scientists—experts with a known track record in this area—to explore art-and-technology collaboration, with its own unique set of issues, challenges, opportunities and skills. BRIDGES pinpoints collaboration itself as a skill to be identified, studied and learned, and proposes practical strategies for including collaboration as a vital component in education, creation and research.

The BRIDGES Consortium is structured around an annual summit. The first of these was held 31 May through 1 June 2001 at the USC Annenberg Center for Communication. The second, held the first weekend of October 2002 at the Banff Centre, expanded to include social science and humanities research.

The BRIDGES web site provides the general public with access to the work of the consortium, including on-line proceedings for each event and a publication. The web site also serves to encourage ongoing dialogue, networking and support, and the opportunity to form new collaborative partnerships. Our goal is to aggregate international efforts and make them accessible to anyone interested in this area.

This report is a summary of the results of the first BRIDGES summit. A full-length report as well as full on-line proceedings is now available at the BRIDGES web site at <www.annenberg.edu/BRIDGES>.

INTRODUCTORY REMARKS

The BRIDGES Consortium was formed out of a need we saw in our day-to-day activities in the field of cross-, inter- and trans-disciplinary collaboration. The field presents special challenges, largely owing to the fact that we are, in a very essential way, breaking down traditional boundaries, which are not only practical, but also culturally encoded. In Western culture, art and science have come to be largely divided. The historical context of the computer and the shift to a science-and-technology-driven culture has magnified this dichotomy. Both technical and creative expertise, as well as humanism, have come to be recognized as essential to the successful integration of technology into culture. New forms of trans-disciplinary discourse have emerged. Since the 1960s, artists and technologists have joined forces to create new forms of understanding and expression. Today, there is a worldwide community of innovators engaged in the convergence of art, technology and science, and a number of vital and active organizations are engaged in this work; yet there seems to be very little discourse about the *process* of doing interdisciplinary work. We feel that interdisciplinary collaboration is a discipline in and of itself. The BRIDGES Consortium seeks to create a collaborative forum for the study and development of interdisciplinary collaboration as a practice.

The Banff Centre joined forces with USC in the creation of the BRIDGES initiative to bring together overlapping and separate networks in the areas of arts, culture, science and engineering collaboration. The hope was to evaluate the key frameworks, questions, projects and methods that have structured and defined the practice of culture-and-technology research and creation and to analyze this work more deeply. We wanted to approach this area critically and from a variety of

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perspectives and methods—playful, analytic, collaborative. We wanted to step back from assumptions that all arts-and-science collaboration is beneficial, or good, and instead assume that we need to state why we work, how we work and where we want to move to next. We also wanted to evaluate outcomes in this field in order to better understand and optimize the collective impact of such work.

We hoped to come away from the first summit with a set of methodologies that could facilitate, at the 2002 summit, the inclusion of social science and humanities researchers as well as projects that combined a wider set of disciplines. We wanted to test the waters for ongoing communication and projects, without intensifying the workload. We wanted to kick-start a more focused and ideologically clear set of collaborations and discussions in this field. Attendees at the first summit included Canadians, Americans, Europeans and Latin Americans as well as participants from the Pacific Rim.

Creating Context: Historical Overviews

The first day of the summit focused on creating a cultural and historical context for art-and-technology collaboration. A round table of brief introductions by participants launched the conference and immediately highlighted a prominent issue: most people could not describe themselves in a sentence, since the participants were, to various degrees, interdisciplinary. BRIDGES conference attendees then laid a foundation for discussion by providing historical overviews. Early projects of the 1970s, including University of Illinois at Chicago's Electronic Visualization Laboratory (EVL), emerged at a moment when visualization technologies were on the upswing and provided a basis for common goals. EVL Director Dan Sandin pointed out that artists offered their knowledge, communication-design and project-management skills. Scientists provided the content and design challenge and the means to raise money to give artists access to high-end technologies. The CAVE Automatic Virtual Environment, a now-standard immersion display environment for virtual reality, is an invention born of this art-and-technology collaboration, the direct result of a transdisciplinary approach to problem solving. As a result of these collaborations, the "interdiscipline" of scientific visualization was born.

Randall Packer and Ken Jordan synthesized a number of the key ideological and practical threads from their book, *Multimedia: From Wagner to Virtual Reality* [2], in particular a historical mirroring in concepts that evolved more or less simultaneously in the fields of art, science and engineering at the end of the Second World War.

Independent artists Kit Galloway and Sherrie Rabinowitz, co-founders of Electronic Cafe International, discussed their strategic collaborations with NASA (the National Aeronautics and Space Administration). They described their practice, dating back to multi-site dance performances using NASA satellites in 1977, as one of experimentation and creation of context for collaboration. Their pre-Internet experimentation with issues such as mediated presence and the aesthetics of latency provided valuable insight into the sociology of current communications patterns.

A number of BRIDGES participants expressed a strong interest in challenging the utopian vision of science and what they referred to as "the first-person approach in science." Mara Beller discusses this in a book called *Quantum Dialogue* [3], in which she charts the internal battle of the quantum physicist. A key premise of the book highlights the role of *dialogue* as the process used by scientists to reach their conclusions. Dialogue is key to understanding how stories in the histories of science are constructed.

Randall Packer, Director of Zakros InterArts, recalled a radical suggestion by Billy Klüver, pioneering co-founder of Experiments in Art & Technology (EAT): "The idea of putting the engineer at the service of the artist in order to subject him to the artist's concern for the integration of technology and the context of cultural issues" [4].

Computer scientist Dan Sandin disagreed: "I'm just a little bit surprised that artists put themselves in the roles of critics of science activity, because I don't really think the artists have traditionally been critical of their [own] participation in society [any] more than scientists."

Related to this discussion is the "contained" motivation scientists often have when collaborating with artists in serious research. Scientists may think that the contribution of artists is not valuable, perhaps because the methodologies and practices of the two are so different. Or the problem may be a communication issue. One tension that arose at the summit involved U.S. military interest in artist-led research and development. The USC Institute for Creative Technologies, represented by Jacqueline Morie, applies entertainment industry production value and story craft, provoking emotional experiences in military-based training and simulation. Many artists question the merit of these kinds of exercises and their potential for unintended consequences. The subversion of military funding for art projects under the auspices of research is nothing new, not to mention the many military-funded research initiatives that result in great benefits to civilians, the Internet being perhaps the most obvious example.

The conclusion on the role of art/science collaboration as a practice seemed to return to the complementary roles of artists and scientists, with artists seen as (1) providing lateral thinking about technology and science, (2) socializing and humanizing technologies, (3) challenging dominant structures in this process and (4) engaging in actual invention. Warnings were also sounded about artists naturalizing technologies; undertaking naïve, dangerous or opportunist collaborations; or sidestepping social and humanist analysis. At the same time, there was a sense that the artists were capable of deep intervention into actual invention as well as critique of technology or science. Sherrie Rabinowitz reminded us that scientists have aesthetics, too: "They'll tell you that this is a really beautiful equation, and you'll understand their enthusiasm about the beauty of the way these numbers work together."

Inter-Communications: Language Experiments

Looking at issues of interdisciplinary collaboration made it apparent that language was a fundamental issue. It has been well argued that language has material effects. Language embodies our view of the world—how we understand others and ourselves, as well as social, natural and cultural forces. Fundamental to language is a struggle for precision, the need to express nuance, the capacity to communicate. Yet language is also a tool for metaphor, for abstraction, for movement. Language is a means of excluding and including. It is used to mark boundaries, to separate categories. Language designates change, integration and flow. Interdisciplinary communication can reduce the complexity within a discipline in ways that undermine deep research, or it can underline the ability to create new, hybrid understandings.

Sara Diamond and several others led a language workshop to explore the way language both connects and separates. (A full-length transcript can be found on the BRIDGES web site.)

The first phase, a question-and-answer exercise, involved half of the participants

writing a question using the term "surface tension" and the other half writing an answer using the words "Because the artist . . . " These were then mixed up and read in randomly generated pairs. This Surrealist language game was valuable for a number of reasons. The game arranged thought in lateral compositions, highlighting the ambiguities of language. It also highlighted various biases and cultural coding that exist within language.

The second phase was an exercise in definitions. All of us had spent hours in meetings, discussions and creative and technical design processes where radically different assumptions were often made about what a word meant. Volunteers were asked to define the word "primitive." Comparisons of the definitions revealed conceptual links between social science, anthropology and computer graphics as well as cultural biases regarding primitive or pre-literate cultures. In discussion, the group voted to sustain the tension between the definitions, considering that words are generally defined by context.

In the third phase, we broke into groups to negotiate and explore definitions of words we saw as conceptual watersheds. The final words selected for the exercise were: *performance, interdisciplinary, artifact, collaboration, model* and *representation*. Each group explored a collective set of meanings and implications for one of the selected words. We then shared our results. The discussions moved between finding a precise, narrow definition or an inclusive definition. An example:

Artifact: We compared computer-graphics definitions (artifacting) with cultural definitions to find a value scale. The term can be seen as negative or positive, in either case having a relationship to ideas about authenticity. Can one make an artifact deliberately, or just identify its presence? An artifact is a record of time passing, it carries information and its value depends on who is looking at it. An artifact is a trace element; unintentional artifacts can become desirable in a range of contexts; artifacts have to be unpacked, traced back; they serve as forensic evidence of past events. Two new words, *artifactonic* (describing the relationships of artifacts to time) and *artifacture* (to forge antiquities) emerged from the discussion.

The insights uncovered through this playful and immersive process were surprising and delightful, bringing to everyone's attention the vital need for ongoing linguistic analysis.

SUMMARY OF DISCUSSIONS

In the provocative discussions that occurred throughout the 2-day BRIDGES conference, many major themes arose that deserve further attention, including the following.

Interdisciplinarity: To Be or Not To Be

Not enough scientists present. The number-one issue was an under-representation of scientists and technologists. Those who did attend were enormously helpful in identifying some of the reasons behind this. One was a concern that scientists had not been involved in the initial planning for the event. Another is that the reward structures for science and technology do not support participation in this type of activity. Next time, each artist will bring a scientist; perhaps each scientist should bring an artist.

Disciplinarity itself an issue. People felt that the notion of discipline-as-identity and -as-boundary-condition only reinforced some of the problems, including counterproductive stereotypes. BRIDGES participants, by definition, are people who question and break boundaries, as well as embody the breaking of those boundaries. Perhaps being interdisciplinary is itself a meta-discipline of seeking to form connections rather than boundaries between things. It is through this crossing of boundaries that we have given birth to new "interdisciplines," such as scientific visualization.

Break down boundaries/map skills. We need to find a way to break down boundaries and avoid language and frameworks that support differentiation. One suggestion was to create a visualization tool that would allow us to map skills constellations, rather than defining individuals by their skills. In this way, we could use visualization to diagram our own practice.

Art & Technology Practice Is Both "Hot" and Marginalized

Finding the tipping point. While many agreed that "collaboration" and "interdisciplinarity" were both emerging as trendy clichés and catchphrases, especially at the institutional level, it seems clear that this type of work has been marginalized in a variety of ways. Institutional, economic, educational and social structures in the fields of art and science/technology shun aspects of the other. Reward systems are structured to support narrow expertise. Furthermore, the current state of "the arts," particularly in the U.S.A. but elsewhere as well, continues to be built on the framework of art-as-commodity. The value of such art is often identified with that of the individual artist. This can create challenges for collaborative teams that struggle to give credit to all the team members in a traditional art exhibition. This is especially true when not all the collaborators are artists. Scientists do not get tenure points for being in art exhibits any more than artists gain value by working on scientific research. In the United States, art-and-technology works are more often seen in children's science centers than in art museums. Other possible opportunities for exposure include international exhibition centers and specialized venues, art festivals, computer science or technology conferences and grass-roots artists' collectives. BRIDGES could seek new audiences and new contexts for this type of work, as well as help it to find a way into traditional contexts.

On the verge. There is no question that the field is on the verge of reaching critical mass. Two large museum shows in New York and San Francisco have embraced art-and-technology. But many BRIDGES participants agreed that these shows sidestepped the existing art-and-technology community in favor of a more object-centric, museum-curator– and collector-friendly approach. Another sign of the acceptance of art-and-technology collaboration is the explosion of interdisciplinary initiatives in academia and the emergence of important work entering popular culture. Machiko Kusahara of Kobe University said, "What artists do almost immediately influences the culture through designers . . . and eventually influences the whole world of art and technology and science."

The Role of Research: aRt&D

aRt&D. Anne Nigten, of V2 Lab and Encart, coined the term aRt&D to highlight the contrast between art-and-technology research and traditional R&D. aRt&D uses different processes, methodologies and objectives than pure science or technological research. Also, many art-based projects have a performative or production strand that demands quite a different way for research teams to work together.

Art as speculative research. aRt&D is intrinsically more human-centered than traditional R&D. Diana Domingues, of University of Caxias Do Sul, Brazil, noted: "I think that what we are experiencing now is an anthropological evolution, and not a technological evolution, because we have new forms of life, new behaviors that we didn't have before. That's the part that for me is most exciting." As Dan

Sandin said, "Artist-organized projects helped visualize data and create media mechanisms; not just the content, but the mechanism for delivering the data. . . . Interactive art I view as a kind of speculative research in the human-computer interface."

Value of art/technology based research. Art research veteran Michael Naimark, formerly of Interval Research, laid out a value proposition for aRt&D projects:

1. They provide stimulation and provocation to the research community, adding meaning, entertainment and emotional resonance.
2. These projects often act as magnets to bring together unconventional combinations of skills and talents.
3. They can provide content to test tools and sometimes even tools to test content.
4. They are means for collecting data, both through explicit querying and through observation.
5. They may lead researchers down unforeseen paths and result in new discoveries and intellectual property.
6. External deadlines and public scrutiny serve as a forcing function for decision-making rigor and completion. They keep projects street-smart. Putting on a show allows researchers to test new ideas in a simulation of the real world.

Creating a Critical Mass

We need a community. The general sense was that we need a way to codify our community; to aggregate our organizations, knowledge, skills and resources; and to create a critical mass of people and ideas. All agreed that BRIDGES was uniquely positioned to build such a community in order that the interdisciplinary community can have greater control over how such work is funded, created and disseminated.

The importance of strong communicators. The interdisciplinary community needs strong communicators who can articulate the value of foundational work in this field to diverse constituencies, including governments, corporations, museums and foundations. Bronac Ferran of the Arts Council of England noted that "unless the arts get involved with these other sectors and try to make a difference, then it's really underplaying the potential of what artists are actually doing themselves. Let's develop initiatives . . . [I]t will allow us to actually influence policy in our own countries."

Network, Knowledge and Resource Aggregation

Aggregate and distribute existing research, resources and knowledge. BRIDGES could serve as a means to aggregate existing knowledge, research and resources and create means for better communication and knowledge sharing. This could include doing joint projects with community members engaged in similar efforts or creating portals on the web site to events, resources, information, etc. There was general agreement on a network-based aggregation of resources for: (1) connecting dialogues that are already going on, (2) exploring existing tools and resources that support networked collaboration and (3) joint presentations to potential funders.

Resource bartering. A proposal was made to create a system for resource bartering, which lets people use systems during downtime, such as summers or evenings. Students and equipment could be shared, as could software, space, tools and other resources.

Validation/credibility. BRIDGES could also play an important role in validating arts/science research. A great first step in this regard could be the creation of a map of the network represented by BRIDGES participants. Another avenue might be joint funding proposals.

Provisional Organizational Structures: Sustainability through Temporality

Should BRIDGES become an organization? We discussed pros and cons of making BRIDGES into a formal organization. Should we look at BRIDGES in the context of a provisional organizational structure that serves as an aggregator of existing organizations rather than an entity unto itself?

Economies of scale. Sara Diamond put forth the following questions, which can form important lines of future investigation:

> Is it more effective to have a number of organizations networked in a permanent way and to work together, and is there an economy of scale there? When is the network too big and not efficient? Do dedicated focus networks sometimes make the most sense? What should stay local and what is better networked?

Sustainability and provisional networks. An underlying aspiration is simply sustainability. The interests within an interdisciplinary field are by their very nature diverse. Ironically, sustainability may be best achieved through creating a network of temporary or provisional constructs or "process hubs." These are defined by business analyst Gary Bolles as "a central platform through which problems can be solved dynamically and the efforts of individuals and groups who can produce the parts of work necessary to accomplish the goals or vision of an organization will interact through that hub" [5]. These hubs might be associations of people and institutions, which fulfill individually defined goals, yet achieve some higher-level objective. They might be projects, collaborations or frameworks undertaken with an implicit understanding that they will eventually conclude.

Concerns about volunteerism. A concern was raised about the volunteer nature of the consortium: How can we make sure that people are able to follow through on whatever level of commitment they are willing to make?

Issues of Practice

Best-practices research and workshops. There seemed to be a real need to aggregate best practices by capturing past work through case studies and other means and finding a way to document what has been done thus far. A suggestion was made to co-produce with members and member organizations a series of skills workshops in areas such as communication/language, collaboration, tools, groupware and project management.

Language is fundamental. The friction and fission of language across disciplines was an area that all agreed warranted further investigation. The experiential approach used in the language exercises led to a number of discussions on this topic. We talked at some length about poetics and the ambiguity of language versus the importance of functional definitions that could move a process forward through precision. We discussed the capacity of definitions to shift and the value of this, as well as the value of understanding epistemology, or the evolution of language. Even natural-language research with computers drifts towards ambiguity within a short period of time. We talked about competition around the creation of new words or definitions, how terms could draw boundaries that included or excluded, and how technocratic cultures absorb terms that artists develop. All agreed that discipline-specific language should not be watered down for mass consumption, but that conversely, cross-disciplinary collaborators needed to learn techniques for clarifying their meanings.

Education and student involvement. Many felt that we needed to come up with strategies for integrating students into the process, both using them as a resource and availing them of our collective knowledge.

Format for the Next BRIDGES Summit

Organizers' authority (happily) usurped. The organizers were very pleased that members handily usurped their authority and proposed an expanded and improved format for the second summit. One group in particular focused on this, but others supported and agreed with their approach.

Rethink BRIDGES summit format. The next event should consist of small topical workshops derived from position papers submitted in advance, larger group sessions to share results of workshops, open time for individual networking, and some type of framework borrowed from the science world, such as poster sessions or technical sketches, which could be used to present works in progress for group critique. Results: each workshop group would produce a paper documenting the results of their session(s).

Regional events. Also suggested was the possibility of having smaller, more regional events, perhaps even a chapter format of some kind.

Funding Is Art, Not Science

The funding environment. The funding environment is a complex, tiered, overlapping, conflicting and archaic process for anyone involved in the field. There are very few resources to draw from, and thus many start from scratch. Even when an appropriate source is found, the competition for funds is intense. Conversely, some funds are underutilized, and organizations complain of a lack of quality applicants. In the U.S.A. there are interesting mutant adaptations, such as hybrid art projects seeking science and military funding, and various forms of corporate sponsorship, including industrial R&D departments that function as art-and-technology incubators.

Corporate marketing strategies. It was suggested that we could work with companies through creative marketing, advertising, commercial, sponsorship scenarios. For example, we could engage software companies to sponsor webcasts ("Webcast brought to you by . . . ") by donating software, money, etc. If we are viewed as the expert "source," this could be advantageous for them.

Commercial research. The conflict many artists grapple with in seeking financial support from commercial sources is typified by Naimark's remark on his Interval Research experience: "Our obligation was to protect what we did, but not necessarily market that. . . . In a very real way, it was to see if anything useful could come out of this in terms of intellectual property, while dealing with content that we felt was personally meaningful." This approach represents at least some basic ethical compromise that many of us can subscribe to in aRt&D.

Industry as a strategic partner. The interdisciplinary community should look at industry as a strategic partner with eyes wide open. Industry could look at such collaboration as a tool for recruiting and as a way to test and promote their products.

PROJECT INITIATIVES/ WORKING GROUPS

As a group, BRIDGES attendees developed a collective direction for the consortium, as well as seven concrete initiatives/working groups to make this vision tangible. In spite of our diversity, our community shares common concerns, passions and challenges. The following is a description of the Working Group initiatives that arose out of the final full-group discussion. A full description of the individual group results can be found on the BRIDGES web site.

Collaboration/ Best Practices Initiative

This group will focus on the practice of collaboration as a discipline using the following and yet-to-be-developed methods:

- Collaboration, communication and project management workshops
- Document and formalize practices/create a best-practices initiative:
  a. Publish case studies, including projects of historical significance, to look at past processes that have led to success, as well as failure
  b. Create a framework for disseminating best practices in inter-disciplinary collaboration
- Prototype Project: develop a group project whose process can be documented as a model for best practices
- Develop a best-practices network:
  a. Aggregate current research
  b. Connect dialogues that are already going on
  c. Explore tools and techniques that support proximal and remote collaboration
  d. Present our results to potential funders.

Event Planning Initiative

This group will focus on planning for future BRIDGES events, including:

- Develop new framework for next summit:
  a. Submission of topic proposals/ position papers
  b. Working group format with large group reporting
  c. Unstructured time to allow for informal interactions
  d. Explore formats that incorporate both art and science frameworks, such as technical sketches or poster sessions.
- Explore distributed model:
  a. Create regional "chapters"
  b. Sponsor regional meetings, workshops and events.

Festival/Prototype Initiative

- Create international festival of art/tech projects, tied in with BRIDGES summit; possibly via the Web and/or multiple BRIDGES locations
- Create prototype project that can be presented as part of festival (may overlap with best-practices group).

Visualization Methodology and Database Resource Initiative

- Explore methods for visualizing and mapping interdisciplinary practice in a variety of contexts
- Borrow from other areas outside our own
- Come up with a variety of strategies for visualizing a database of the interdisciplinary community
- Explore new ways to think about organizing specializations that take into account that individuals and institutions are also interdisciplinary.

Collaborative Networks/ Resources Initiative

- Develop a database of resources
- Create a collaborative network that we can all work within
- Note that this group may have some overlap with the Network Aggregation group.

Network Aggregation Initiative

- Build the BRIDGES community and aggregate the arts/technology network
- Position BRIDGES as central to the arts-and-technology world, using it as a way to lend power and caché to

projects and as a rallying point for the formation of an international community
- Find ways to bring all our resources and communities together for knowledge sharing.

Evaluate Collaborative Tools

- This group will serve an ongoing function of creating a system for evaluating tools for remote and other types of collaboration
- Group may evaluate tools themselves, interview users, or set up a system whereby members can report their own experience with various tools
- Suggestion: create an automated system with a set of established criteria for user tool review.

NEXT STEPS

BRIDGES Summit 2, held during October 2002 at the Banff Centre in Alberta, Canada, will bring together the existing network, with the addition of international scientists, engineers, social scientists and humanists engaged in collaborative research between culture and technology.

For further information and regular updates on BRIDGES and its activities, please visit the web site at <www.annenberg.edu/bridges>.

APPENDIX A: THE ORGANIZATIONS

The USC Annenberg Center for Communication

Created in 1993 through a grant from Ambassador Walter H. Annenberg to the University of Southern California, the USC Annenberg Center for Communication supports active research that addresses practical problems in the convergence of content and digital technology. Directed by a team of respected leaders from arts and entertainment as well as science and technology, who embrace the cross-disciplinary ideas of its projects, the center identifies and explores ways in which communication technology affects education, law, science, engineering, healthcare, arts, entertainment and politics. Web: <www.annenberg.edu>.

The Banff Centre New Media Institute

The Banff New Media Institute (BNMI) was founded in 1995 to stimulate dialogue and creative innovation in the exploding and ever-shifting field of new and converging media. Talented individuals and companies from around the world come to BNMI to network, train, converge and collide. BNMI collaborates on and co-produces projects in a wide scope of new media areas, including creative content development and production methods, art and virtual environments, social and cultural analysis, implications of culture and technology, cultural difference, 3D web development, artist/engineer and computer science collaboration, user-driven technologies, policy analysis, and development and accessibility. Web: <www.banffcentre.ab.ca/nmi>.

References and Notes

1. BRIDGES was co-founded by Celia Pearce and Sara Diamond. Phase 1 of the project was made possible through financial and administrative support from the Annenberg Center and administrative support from the Banff Centre.

2. Randall Packer and Ken Jordan, *Multimedia: From Wagner to Virtual Reality* (New York: Norton, 2001).

3. Mara Beller, *Quantum Dialogue: The Making of a Revolution* (Chicago: University of Chicago Press, 1999). Part of the Science and Its Conceptual Foundations series.

4. Billy Klüver, "The Great Northeastern Power Failure," reprinted in Packer and Jordan [2] p. 35.

5. Gary Bolles, "Death of the Corporation, Birth of the Process Hub," in *EMERGEncy,* Creative Disturbance Newsletter (17 November 2000); web site: <www.creativedisturbance.com>.

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Mark Beam has had leading roles for a wide range of organizations, from senior Wall Street executive and investment banker to executive producer and entrepreneur. Beam is a cofounder of Creative Disturbance, a global aRt&D network; Collective Intelligence, a network for increasing social capital investment; New Minds, a lecture series on social technology; and beaming, llc., a new media venture consulting firm in San Francisco. Prior to that, Beam was a senior executive and portfolio manager for three of the largest banks in the world in Chicago, Los Angeles and New York. Beam is a member of the Board of Directors of Leonardo and an advisor to the Department of Media Arts at the San Francisco Museum of Modern Art. Web: <www.beaming.com>.