Creating New Spaces for Science

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In the "Marxist Critique of Capitalist Science," Gary Werskey details the history of both the left science of the 1930s and the radical science of the 1960s and 70s. His focus on the British scientific establishment explores how both movements sought to challenge the rational of science created in the interest of capital. However, neither movement succeeded in transforming the institutions of science knowledge creation or the capitalist society in which they resided. Werskey's hope for the future is that a new generation of activists and critical scientists will create the new institutions that will lead to a more just and equitable society.

The challenge put forth then is "how do we then create new spaces for the creation of scientific knowledge that recapture the concerns of the radical science movement?" How do we build scientific knowledge creation practices that:

- address issues of power
- understand that science is not neutral
- critique science contexts (social, political, and psychological)

By brining in critiques of these movements (Martin, 1993; Rose; 1994) as well as insights from feminist epistemologies of science (Harding, 1991; Rose, 1994), can we also create environments that:

- bridge between theory and practice
- connect academic researchers and communities (especially communities that are poor, marginalized and oppressed by the dominant culture)
- allows knowledge to be driven and informed by the experiences of these communities

Can these new spaces for science be created within the context of capitalism? Or, are any new endeavors destined to share the fates of the left and radical science movements? Can we learn from past examples? For instance, Margaret Rossiter (1994) indicates that female scientists in the Post World War II era were able to create opportunities for themselves when locked out, undervalued, or exploited in traditional research environments. By entering alternative settings, such as nonprofits or through independent work via self-employment, they were able to make gains in terms of autonomy, control (resources and personnel), prestige (titles and positions), and even at times financial reward. What are the alternative spaces that can be created for a new science?

One specific technological environment that may provide some insights into the possibilities for alternatives is how a small communication network, ARPANet, became the global information network known as the Internet. The Internet has reworked and challenged many traditional institutions and shifted power relations in dramatic ways. Can learning about this transformation provide us with a blueprint on how new spaces for science might be configured? The chart that follows details the contours of these two iterations of the technology.

	ARPAnet *Advanced Research Project Agency Network*	**The Internet**
Definition	The ARPANET was designed in the 1960s for the US Defense Department. It was developed as a new bombproof, distributed packet-switching network technology that would ensure communication systems would withstand a nuclear attack.	The Internet is a communications network with a global reach comprised of diverse computers platforms which connects users to one another allowing them to share information along multiple channels.
Reach	Boston, NYC, Pittsburgh, IL, Southern California in the continental US	Global reach on every continent.
Users	Initially served military contractors (i.e. RAND, Lincoln Labortories), defense department personnel and researchers at major academic institutions (i.e. MIT, UCLA, Standard)	Diverse populations across cultures, age groups, income levels, educational levels. Those with limited literacy, some physical barriers, remote geographic areas, and in extreme poverty still excluded to some degree.
Purpose	Strategic development to ensure that military complex would be able to communicate with key players in the event of a thermonuclear attach on the US	Multiple purposes from personal communication, commerce, education, community-building, creative expression, etc.

So how did a technology designed for one purpose, evolve into something quite different from its initial formation? One can look to key design elements present from the very beginning of ARPAnet:

- **open** – the technical architecture was designed to allow any type of computer program, running any type of operating system software to connect to the network. The system did not preference one type of content over another. A standard set of protocols eased this process.
- **decentralized** – the system was intentionally self-organizing with new method of sending information called packet-switching. This ensured that no one computer acted as the central traffic cop on the network, making the system expandable and flexible.
- **connected** – the system allowed any node to communicate with any other node without centralized control or moderation.

These initial design features were amplified as other academic institutions joined the network and subsequently began sharing access to the network with their communities. These additional elements of accessibility were soon to follow:

- **usability** – the creation of a graphical user interface (e.g. browser software) transformed the ease with which individuals could approach and access resources on computer connected on the Internet.
- **cost** – competitive market forces entered in driving the cost of connectivity down dramatically. Combined with increasingly low-cost personal computers, this allowed more and more

individuals to get connected.

- **knowledge** – the information network make the transfer of knowledge much easier and online communities were willing to support the learning curves of "newbies." Affordable commercial options (i.e. books, workshops, classes) and computer learning centers expanded the

These six features of ARPAnet allowed it to be culturally reconfigured to the Internet. David Hess (1995) explains that once a science or technology is distributed to mass publics these publics bring their own knowledge systems and cultural contexts to the table and shape new meanings. By its very openness and reach, the ARPAnet technology created the context which would allow it to be molded and reshaped.

So in thinking about new spaces for science, consciously incorporating the features that transformed ARPAnet into the Internet might be a good first step. By promoting openness, decentralization, connectedness, usability, affordability, and learning networks, new communities of learners and practitioners from a variety of backgrounds with differing experiences can be brought into scientific research. These new perspectives may bring the "strong objectivity" espoused by Harding (1991) to a new cultural reconstruction (Hess,1995) of science that may begin to reconfigure the institutional pressures that thwarted the left and radical science movements.

The markers of a new science space would include:

- making the vast knowledge capacities of scientific communities available to all through open journals and open courseware.
- providing access to the tools, materials, and techniques of science to more people and communities through open data projects, shared computing power, and linkages with working scientists.
- building up the capacities of local communities to engage in their own scientific research thorough improved science education, community-based learning opportunities, and participatory science research which allow these communities to discover new processes and knowledge in the process.
- creating networking opportunities between scientists and non-scientists through conferences, online forums, and workshops.

So given these conditions, what would a new science space look like? A scenario might look something like this:

> In the center of downtown Lowell, MA, one finds Science for Humanity (SFH). Housed in the newly redeveloped and green Hamilton Mill complex, the space is bright, open and inviting. It has the openness of contemporary design, but still hints at the city's industrial past. Images and languages representing all of Lowell's diverse communities (i.e. Cambodian, Dominican, Brazilian, Greek, Portuguese, etc) are incorporated into the building's design along with references to science and technology achievements representative of a world culture. In fact, as one enters the light-filled lobby, the images of a global scientific community are promoted on the walls with all ages, genders and nationalities represented.
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> SFH was created through a combined effort of local community groups (i.e. Cambodian Mutual Assistance Association, United Teen Equality Center, Girls, Inc., Massachusetts Alliance of

Portuguese Speakers, etc.), city leaders and key academic partners from the University of Massachusetts Lowell and Middlesex Community College. Several high tech firms were also involved in the project. However, the key impetus for the creation and development of this space came from the community, especially from those involved in environmental projects (i.e. Brownfield cleanup, river reclamation, sustainable framing), community health, and worker safety endeavors.

Many of founders are young leaders who attended the local university, benefited from community service learning projects, and grew up in Lowell's immigrant communities primarily from Cambodia, Central America and Brazil. They understood how necessary a space like this was in moving Lowell towards a more sustainable future that provided jobs and skills to a re-tooling population. These young activists were also acutely aware of how previous technology pushes from the 1800s onward had served the interests of an elite owner class while exploiting generations of workers. They were intent on bringing the values of their traditions, the needs of their communities, and the hopes for a more green and sustainable future to the SFH project.

One of the innovative ideas for SFH was a concept of an open organization. SFH would provide the space, tools, and facilitate the knowledge and skill building of Lowell's communities in the sciences. The organization views itself as a knowledge facilitator and works with local groups and individuals around projects and research of interest to members of the community. They have no specific research agenda other than a mission to educate and support diverse scientific research that is driven and lead by the community for primarily non-commercial purposes. It also views itself as a space for the critical exploration of contemporary science research such as genetic modification, reproductive technologies, advancements in physics, and other emerging fields such as nanotechnology.

SFH's programs and resources are as diverse as its people and it works to make the production of science knowledge a transparent and accessible endeavor. SFH's supports a number of after school programs with community partners including an all-girl space lead by Girls, Inc. SFH also helps link Greater Boston's large scientific community to the local public and private school systems. The organization has an extensive resource room where scientific journals (many provided through the Directory of Open Access Journals), courseware and self-paced tutorials in scientific topics (with the help of the Open Courseware project), data sources (including from the Open Data Consortium) as well as a number of volunteer staffers supplied via a service learning program at the University of Massachusetts Lowell and are supervised by a full-time staffer. A series of regular workshops in basic scientific techniques and methods are also made available and community researchers make presentations and share new techniques and research they are engaged in.

In addition to the resource room, SFH has two fully equipped labs with the necessary equipment for basic biological and chemical testing and experimentation. Strong partnerships with the University of Massachusetts Lowell, Middlesex Community College, Lowell General Hospital, Saints Memorial Hospital, and other research laboratories make additional tools and testing equipment available on a regular basis to a variety of projects often for free or low cost. A high-end computer lab which allows for data processing, computer modeling and computation is also available. These three labs are supported by-year long research interns from local universities supervised by a full time staffer.

SFH also acts as a clearinghouse for community researchers to connect into larger scale research projects, other community research centers, as well as experts in the field. A number of research projects initiated by Lowell community researchers have found support through this network including an urban fish farming project started by the Cambodian Mutual Assistance Association, improvements to small scale food production supported by the United Teen Equality Center's Fresh Roots program, and an exploratory committee looking into rebuilding the city's canal-powered turbine system as means to generate renewable energy. This last endeavor is being explored by a local conservation group, city planners, and a citizen coalition of for green energy. The SFH has provide the space, resources and support to help all of these diverse endeavors take off and assists community researchers with mechanism for making their finding public and creating public data stores of vital research findings.

Given the large number of volunteer and service learning personnel engaged in supporting SFH programs, the organization has a relatively small staff of five full timers. As community members gain skills they are encouraged to share and contribute back into the community to build on local knowledge by running workshops, supporting other research projects and volunteering. The organization is very picky about its funding sources and works to maintain its independent focus as much as possible. While they accept grants from government, private foundations, and corporate entities, the organization is constantly battling attempts to either exploit local research for other purposes or direct specific research agendas. The organization turned down a half million dollar grant for this very reason last year. The organization also diversifies its funding base by ensuring that at least a third to half of its funding comes from local individuals and program use fees. Program user fees are charged on a sliding scale.

SFH has a governance structure that ensure that a majority of its board members are from the community and have been involved in at least one SFH supported project. The by-laws ensure that gender, age, race and ethnic diversity as well as income diversity are maintained in these leadership positions. The remaining board positions are often held by important partner organizations working with SFH.

The SFH space is a model of scientific research conducted by and for a community can happen. It demonstrates that power of partnerships while supporting ways for new perspectives and insights to enter into the research process. It respects community power and understands that building important linkages between marginalized communities and a world of scientific resources and expertise are important.

Resources to Explore

Community Research Network - http://www.loka.org/crnpublicationslist.html
The CRN held six conferences with worldwide attendance from 1998 – 2003, and Loka has published several landmark studies on CBR. CBR is a platform for challenging and transforming the entire mainstream research and development system, and can be used as a tool for policy development in arenas such as nanotechnology design and use. The project is inactive, but a number of useful publications are available.

Community Science Action Guides - http://fi.edu/guide/index.html
Community Science Action Guides offer resources for teachers at any level. The collected "Guides" offer a wide variety of resources and approaches. Some of the resources provide background information while others offer tips for conducting community action projects related to water, energy and life science.

Community Science Workshops - http://www.scienceworkshops.org
To Expand Knowledge, Thinking, and Imagination with Tools of Discovery and Things to Discover." The Community Science Workshops create a safe, informal, and fun space for kids to learn through hands-on activities. Outside of the pressures of the formal classroom, students are free to explore and discover the wonders of the natural world in their own community.

Directory of Open Access Journals - http://www.doaj.org/
The Directory of Open Access Journals covers free, full text, quality controlled scientific and scholarly journals.

Living Knowledge: The International Science Shop Network - http://www.scienceshops.org/
Science Shops are small entities that carry out scientific research in a wide range of disciplines – usually free of charge and – on behalf of citizens and local civil society. Science shops respond to civil society's needs for expertise and knowledge and are often, but not always, linked to universities, where students conduct the research as part of their curriculum.

Open Conferences / Workshops
Environments were the opportunity to learn and network is open to a scientists and non-scientists alike.
Open Workshop - http://psb09openscience.wordpress.com/about/
SciBarCamp - http://www.scibarcamp.org/
BioBarCamp - http://www.barcamp.org/BioBarCamp

Open Courseware Consortium - http://www.ocwconsortium.org/
An OpenCourseWare is a free and open digital publication of high quality educational materials, organized as courses. The OpenCourseWare Consortium is a collaboration of more than 200 higher education institutions and associated organizations from around the world creating a broad and deep body of open educational content using a shared model. The mission of the OpenCourseWare Consortium is to advance education and empower people worldwide through opencourseware.

Open Data Consortium - http://www.opendatacommons.org/
Legal tools for sharing and providing data in an open manner.

The Open Science Directory - http://www.opensciencedirectory.net/
Access to scientific literature is very important for the scientific work in developing countries . As a result of different projects a large collection of e-journals is now available for researchers in developing countries.

Open Science Grid - http://www.opensciencegrid.org/
A national distributed computing grid for data intensive research. Allows research communities to pool together resources. Also check out the world community grid - http://www.worldcommunitygrid.org.

Open Science Notebook - http://en.wikipedia.org/wiki/Open_Notebook_Science
Open Notebook Science is the practice of making the entire primary record of a research project publicly available online as it is recorded. This involves placing the personal, or laboratory, notebook of the researcher online along with all raw and processed data, and any associated material, as this material is generated. An example is here - http://onschallenge.wikispaces.com/list+of+experiments

Open Wetware - http://blog.openwetware.org
Created to support open research, education, publication, and discussion in biological sciences and engineering

Science Commons - http://sciencecommons.org
Works to pull research data in to a shareable commons.

Sciences Linkages in the Community - http://www.aaas.org/programs/education/slic/
The primary goal of SLIC is to enhance the effectiveness of community-based organizations and schools in providing science, mathematics and technology (SMT) activities.

The Open Science Project - http://www.openscience.org/blog/
A group of scientists, mathematicians and engineers who want to encourage a collaborative environment in which science can be pursued by anyone who is inspired to discover something new about the natural world.

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