

Critical Science Literacy: Identifying Inscription in Lives of Resistance

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Responses

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This paper seeks to outline a vision of scientific literacy by trying to articulate science to lives of protest and resistance. This is an initial expression and working through of what this rearticulation means and, more important in this first moment, “who” it means: who is the critical science literate.

All scientific literacy discussions are inherently articulations about the nature of the relationship between a credentialed, professional technoscientific class and its dependents, and the development of that dependency. In the current reform movements science literacy is presented as the skills developed within the cultures of enterprise science, e.g., observing, measuring, etc. (DeBoer, 1991; Weinstein, 2004a). The scientific literate in this model is one that enters partially and systematically into a highly idealized subjectivity of a scientist. Not just absorbing a scientist's vocabulary, the new science literate is imagined as having the same cognitive (conceptual) structure as a scientist and is dispositionally and practically capable of settling matters through a rational, impersonal, empirical process, i.e., “inquiry.” Appropriating an equity discourse (“Science for all students”), the standards homogenize the “all,” imagining a standardized (i.e., mechanically replicated) reproduction of the scientist's habitus through the possession of the student body as a whole. Of course, the scientific literates won't actually have access to a lab, to data, to the ability to make counter claims on science's own turf; as Latour points out, doing so is a very expensive undertaking (Latour, 1987). This means that the “standards based” scientific literate is ultimately in a position of extreme dependence and obedience to the scientific professional class (for an argument for exactly this dependency, see Shamos, 1995).

Ironically scientific literacy was initially formulated by Paul Hurd in the late 1950s as the alternative to science education curricula that interpellated (positioned) students within an ideology of science qua science (DeBoer, 1991). In this original and now minoritarian definition, science literacy was linked to science for usefulness, science for citizenship, and science technology and science (STS, Aikenhead, 1994). These science literacies have long drawn from challenges to the political economy, epistemology, and even ontology of enterprise science (Hodson, 2002). At present this tradition is most eloquently developed in the work of Roth and Barton (2004), who argue for the community based science, knowledge, and practice. They offer a fully social and political view of knowledge, learning, and ultimately science.

My work here is part of this non-disciplinary tradition, i.e., science as more than the reproduction of professional science. Given the recent appropriation of the term by the standards movement for something decidedly intradisciplinary, I call my counter model a critical science literacy; the word critical here indexing an indebtedness to a certain scholarly and activist tradition rooted in dialogues between Marxism, Antiracism, Feminism, Queer Politics, Liberation Theology, and anti-colonialism—for starters—but also to a prior tradition both within science communities as well as “lay” spheres challenging science's embeddedness within the militarism and capitalism (Haraway & Goodeve, 2000; Levidow, 1986; Moore, 2008; Rouse, 1993) including early work in environmental education and STS. Thus I am indexing something in dramatic distinction to the use of the term literacy within texts like the National Science Education Standards (NRC, 1996).

One central problem with the idea of literacy in the “standard model” is that it is largely propositional: formal statements of what people should know about the content, practice, and history of science. There is no sense of the context in which that knowledge is employed, of how it is used, of the types of agency that such literate practices connects to. Roth & Barton (2004) have done much to reconceptualize scientific literacy by emphasizing its collective, political, and situated contexts. Their emphasis is on “out of school” situations, where practice is tightly connected to community (at very different scopes) practice. My purpose here is to extend their work in two directions; directions that blur boundaries of research and pedagogical/curricular practice. On the one hand I want to closely explore exemplars of critical scientific literacy to trace the kinds of practices involved in its enactment; but I also want these exemplars to serve as models—alternatives or companions to the ubiquitous Einstein ikons that supervise science classrooms. These ikons are deeply pedagogical (and ideological), concrete objects for introjection, for becomings, targets for seeking deeply mythologized ways of life. In this sense I want to emphasize and (re)value the role of the imagination and fantasy in education as it occurs in schools (though elsewhere I have noticed the cultural barriers of fantasy in preservice science teachers, Weinstein, 2004b). I am not so ready to abandon institutional schooling as Barton and Ross seem, to do so feels to me to desert the millions of children subject to its practices. At the same time, my point is not to start in the classroom, but in moments of radical (critical) science literacy that reveal how and why contestations over science occur. What is science literacy for these disruptive communities?

So one of the primary problem of this study is one of inclusion and exclusion criteria: who gets to be counted as the critical scientific literati?

First, I have tried to find people who are “science writers.” Following Latour (1987), I take inscription by both machines and people very seriously. Science literacy in a cyborg or actor-network sense (where not all the actors are human) is centrally about forms of inscription. Science for Latour is about arguing over writings, charts, machine generated diagrams. My search was for specific kinds of writings: public engagements with themes recognizable as constitutive of science: nature, ecology, food, physics, health domains where the technical details counted (Norris & Phillips, 2003).

Second, I have sought writings that in very foundational ways are confrontational to power. If literacy is writing, then critical involves this other aspect, this sense of writing against from dangerous and often marginal positions. To find these voices I have scoured zine¹ archives, blogs, small press productions and other forms of public speech in order to find examples of critical science writings. My understanding of these texts is anthropological: identifying such writings becomes the lead to finding communities of practices to which these writings are expressions. As Barton and Roth note science literacy is a collective act: it is contextualized in communities of practice (Roth & Barton, 2004). Critical science writings in this sense are standpoint knowledges (Harding, 1986, 1991): they emerge out of collective, historically/geographically/culturally specific social struggles. These writings index networks that are actively oppositional to given oppressive orders, power sensitive, and productive of their own media in order to assert counter cosmologies of politics and nature (on the limits to zine politics, see Duncombe, 1997).

Finally, I have to own up to an aesthetic, to affective criteria that is best summed up by the anarchist motto of “love and rage.” In the course of this project I have found wonderful and notable models of science literacy based on love or on rage separately. For example, my searches have crossed the writings of passionate herpetologists who share vital data on their favorite species of chameleons (Anderson, Descamps, Gagliardi, & Snow, 2006). Or the writings of the “Nerdlings” a creative group of physics majors

¹ Zines are independently produced magazines, generally reflecting a distinct point of view of their writer or editor, independently distributed through small bookstores and comic shops or online. Enabled by the ubiquitous presence of copy shops like Kinkos (as well as easy availability of copiers in most work places), zines reached their peak in terms of variety and quantity just prior to the popular emergence of the world wide web. To a very large extent, blogs and e-zines (pdf or blog like publishing) have replaced the niche of zines with dramatic aesthetic consequences: the distinct collage style of many zines is difficult to reproduce in the new media. This has deeply lessened the impact of at least one of my cases: *Guinea Pig Zero* used the grotesque as a key part of its politics, a quality not gone from its website.

whose writings cross and interweave “high science” and popular cultures (nerdling.zine, 2007) including stories that carry on a folk tradition of “myth-busting” by engaging in often frightening self-experimentation to challenge folklore and common sense. These are clearly examples of scientific literacy; and in no way is this meant to disparage such projects. But in a world of high stakes life and death (Farmer, 2003), of sharp divides between have and have nots, these do not represent the critical literacy that I am trying to identify here.

On the other side of the coin are those engaged in mere rage. For me this is the positioning of oneself completely as exterior to the networks of science with no sense of the author’s their own implication within technoscientific practices. If the examples of love unproblematically placed themselves within the network, these authors see themselves as unproblematically excluded from it. Seeking to raze science rather than challenge science, these are fundamentalist positions: religious, environmental or otherwise.

The position of critical science literacy is precisely that problematic location that involves simultaneously love and rage; insider/outsider or outsider/insider statuses within modernity and science. In the words of Paul Gilmore reflecting on the Black Atlantic, these may be writers in but not of the West (Gilroy, 1993). People actively negotiating marginality without easy recourse to fundamentalist or hyper-critical positions. The models I want to offer students, especially those not likely to be in the ruling classes, towards this delicate, complex negotiation.

Certainly the zines of professional human subjects who I have been writing about for the last decade represent one clear example of such a location and literacy. Professional guinea pigs cross anarchist critiques of capitalism and corporate bioethics with discussions of trial phases, experimental design, lidocaine and its proper use, gene therapies, and sleep science (Helms, 2002). The writings of “professional” human subjects in the zine *Guinea Pig Zero* remain for me the most clear-cut example of critical science literacy. I have written a lot about GPZ, and hope that this paper, while touching on its discourse also broadens the spectrum of critical science literacies (Weinstein, 2001, 2004a, 2006a, 2006b).

So in addition to the professional guinea pigs I want to consider two other models of critical science literacy. The first is the websites, blogs, and zines of street health workers who provide medical care for anti-war and anti-globalization demonstrators. Organized through collectives and affinity groups in different cities across the U.S., these medics see themselves as carrying on a bare-foot doctor tradition. Finally, I want to examine people writing from the nexus of disease, environment and political economy. Primarily I will focus on the ecological writings Wilmette Brown’s *Black Ghetto Ecology*, because she so clearly places environmentalism in the context of the body and politics, and environmentalism is the source of most critical science education projects. I, will however also connect her writings to recent attempts by social movements to link disease and environment in the form of the Toxic Links Coalition in the Bay Area. In all these cases the ambivalence I am trying to value is apparent.

Case 1: Medicine for the rioting body

“Fight the power, do no harm” –Motto of Black Cross Health Collective

My first exemplar of critical science literacy comes from the fringes of the EMT profession. In major cities across North America (Boston, Washington D.C., Montreal, New York City, Chicago, Portland, and the San Francisco Bay Area) medical workers have organized themselves into collectives and affinity groups to deal with medical treatment during demonstrations. While one of these collectives traces its roots to medical support for civil rights demonstrators in the 1960s (BAHRC), all of these cells locate their immediate origins in the 21st century, in support the either World Trade Organization protests, the protests against the Republican National Conference in 2004 in New York City, or anti-militarization protests. Given a code of ethics that prioritizes in the street, direct action oriented struggle as vital for meaningful living, these medical units enable such resistance through providing in the street health care for their comrades.

Literacy takes many forms for the street medics. These include production of medical guidelines and procedures, frameworks for coordination of care in demonstrations, training materials, websites to support the distribution of these materials, as well as a medium for these materials, “zines” (irregularly released, underground, informally produced and circulated magazine) with health information, and as I will discuss later research protocols.

What is critical to understand for reconceptualizing scientific literacy is that these groups do not merely provide what they identify variously as “corporate” or “allopathic” (what is commonly thought of as Western Medicine—a very problematic term) care to the communities they serve. These groups are reconceptualizing the practice of medicine in ways that are congruent with the heteroglossic and heterodox spirits of their communities. Heteroglossia literally means “different tongues” and comes from Bakhtin’s analysis of the novel (1990). In it he celebrates the novel as bringing together different voices, accents, registers, and whole languages. The street medics, by analogy, embrace the speaking of multiple medical discourses. This is laid out explicitly in the code forged out of a 2001 gathering of “street medics” in Athens, Greece in 2001—known as the Athens Manifesto, which guides coordination and cooperation between such medics. Here, under the heading of “Rights” it is declaimed “All disciplines (Herbalists, Witches, Allopathic, Homeopathic, Naturopathic, etc.) must be honored and respected.” The next several bullets shape this one, guaranteeing a right to respectfully disagree and to verify references. (Athens Manifesto, 2001).

The Athens Manifesto also brings to the fore issues of power, authority and arrogance that structure “corporate” medical practice. The first bullet of the manifesto states.

Oppressive behavior has happened in trainings and on the streets and in the clinics coming from action medical/1st Aid people. We want to prevent it from happening again. You can be a neurosurgeon or the most experienced trainer around, but if you don't know how to facilitate or are oppressive in your behavior, you are doing more harm than good.

Medical institutions are seen as extensions of other forms of domination in the culture of the radical medical practitioners. Black Cross Health Collective’s website (in Portland, OR), for instance, declares:

We believe that health care is political. The kind of care we do or don’t receive, where and how we receive that care, who provides that care, who has access to training to provide care, and what kinds of trainings are smiled or frowned upon, all involve inherently political issues. We believe the system needs to be changed... the health care system right along with all the others. (Black Cross Health Collective, 2003a)

While eclectic, and critical of institutional medicine, the practices in the field reflect standard practices including “do no harm” and triage (Dominick, ND).

Most remarkably, the Black Cross collective, decided to run its own “clinical trials” to produce “evidence based medicine” for treatments for tear gas and pepper spray. In their protocol, published on their website, they describe blinding (not double) of the treatments, and procedures used to control application and treatment of both skin and eye exposures to these chemical weapons (Black Cross Health Collective, 2003b).

Critical scientific literacy in this first instance echoes the appeals to data, experimentation, rational discourse, and objectivity as depersonalization of the standardized model. At the same time, scientific literacy seems utterly turned on its head as the boundaries between science and non-science as policed by the National Research Council and similar organizations, e.g., CSI (The Committee for Skeptical Inquiry), are explicitly transgressed (on boundary work see, Gieryn, 1983; Hess, 1993). Scientific literacy involves the capacities to work in and navigate extremely heterodox and heterogeneous medical systems (witchcraft, Chinese medicine, and allopathic medicine, etc.), and strong commitments to democratic practice, a skill incongruent to the authoritative and extrinsically defined view of science in the U.S.’s National Science Education Standards (NSES).

It should be clear that the position of the medics is closer to that of scientists than the following two exemplars, which is why they could consider their own evidence-based practices. They work within an expert gaze even if that expertise includes heterodox practices such as naturopathy. In this sense they provide a much narrower subject position, i.e., one that fewer of us can occupy, than those offered by those I describe next. Nevertheless, the street medics offer one vision of a critical science literacy.

Case 2: Challenging the natural

Perhaps some of the most powerful critical science literacy voices come from “the sick,” for whom writing is part of a larger politics as they struggle for care. It should be clear that the sick are not a unitary body; there are multiple populations writing out of sickness. There are those with diseases that are massively diagnosed and treated by complex and sophisticated technical networks like cancer and AIDS but whose treatment, diagnosis, or even etiology, for a variety of reasons, remains problematic. There are also “diseases that people have to fight to get” (Dumit, 2006a) because they are unrecognized by the insurance and medical community, diseases like MCS and chronic fatigue. Both communities of disease have developed critical scientific literacies.

Here I want to focus on the first community and a pamphlet authored by civil rights organizer Wilmette Brown (1986) titled *Roots: Black Ghetto Ecology*, a tract linking cancer to holistic health care, to global struggles for freedom, to racism, sexism, homophobia, militarism and environmental degradation. It clearly was inspired by the thinking of Audre Lorde (1997) in her cancer journals and seems at least to have indirectly influenced Jackie Stacy in her cultural study of her own cancer, *Teratologies* (Stacey, 1997). Published a year before ACT-UP emerged, her political analysis of disease and health care probably influenced their activism as well or at least anticipated it.

Brown articulates a complex portrait of the sick using feminist materialist framework. Relations of gender and wages in a variety of forms is one thread of the text: the unpaid labor of women in family health, the underpaid labor of women in medical systems, the welfare system as product of struggle by Black women in the face of a sexist civil rights movement. Even sickness involves unpaid labor in Brown’s reading.

Convincing meant doing a lot of physical and emotional housework for myself too—relearning basic bodily functions and developing patience. In the social and physical weakness and dependence of illness, I experienced the power relations of childhood, disablement and ageing all at once.

I also did emotional housework for my friends: putting on a brave face to cushion the shock, and terror, and sadness of cancer; and political work too, struggling not to let physical weakness make me abdicate responsibility for my own decisions. (p. 5)

In an analysis similar to Foucault’s analysis of biopower, and Dumit (2006b) and Rajan’s (2006) analyses of health for health’s sake, Brown, drawing on earlier work, ties health to the production of labor.

The NHS [National Health Service] is not a service that the ruling class has granted to us, but a service which hospital workers provide for the ruling class in providing mentally and physically “fit” workers. (Power of Women Collective, cited in Brown, p. 6)

But ultimately critical science literacy in Brown’s labor is a burrowing into if not demolishing categories of the natural. Brown is well girded for this battle, since “nature” has been deployed continuously as a weapon against the identity categories of woman, homosexual, and Black, categories that shape her being.

We refuse to accept as “natural” any traditions that enslave us... or to accept the notion that the “natural” place in the [Black Power] movement was prone... We had decided that forced heterosexuality was no more “natural” than racism or sexism. (p. 11)

There is a broader sense of reworking nature here: the naturalness of disease, of health care, of “naturopathy.” All are re-read through the eyes of someone historically conscious of her position as queer, as Black, and as woman.

Finally, like the medics, Brown embraces a diverse and heterodox set of medical practices. However, she chastises the new age medical movements for not recognizing the Black roots of and contributions to such practices, but it is clear that medical self help is an important element in the struggle over a better medical and environmental practice.

Finally, if for Brown, critical science literacy involves unwriting and rewriting nature, this rewriting is accomplished through autobiography. It is a reading of her experiences that give the account power: autobiography in her analysis of welfare rights, autobiography as a patient, autobiography as a survivor.

Brown’s struggle to locate disease in political economy and ecology is carried on by a wide variety of organizations and environmental cum anti-racist social movements. I want to point to one of them here: the Toxic Links Coalition (TLC). The TLC brought together 36 organizations involved in environmental, and healthcare reforms. It was most infamous for its challenges to the corporate logics behind National Breast Cancer Awareness Month (NBCAM, sponsored by Zeneca which both produces carcinogenic materials as well as chemotherapies for cancer; on the TLC and NBCAM, see Klawiter, 1999) and “Cancer Industry Awareness Tours... “a walking tour and protest through the heart of San Francisco's Financial District, where tour stops include the corporate offices of some of the world's worst polluters” (Toxic Links Coalition, 2006).

TLC radically rearticulated cancer in its activism, bringing to life critical pieces of Brown’s analysis. Disease is not “natural” (in the sense of separate from human activity or political interest) in this analysis. It is part of a profit system that simultaneously produces the conditions for the disease and the expensive treatments of it. Shadowing Brown, they also link cancer demographics to issues of race (though less so to gender and sexuality):

The Toxic Links Coalition believes we all have a right to health and environmental justice; views cancer and other environmentally linked diseases and disorders as human rights abuses, not as individual medical problems; targets companies that perpetrate irresponsible production, use, and disposal of carcinogenic and toxic wastes and products; demands accountability from corporate and agricultural polluters; works against environmental racism, and recognizes that people of color, immigrants, and workers bear a disproportionately high toxic burden. (Toxic Links Coalition, 2006)

Finally, like Brown, they kept alive an analysis and critique of the very “natural” and “scientific” course of treatment for cancer currently entrenched in “best practice” through their challenges to NBCAM renaming it Cancer Industry Awareness Month:

TLC educates the public about companies with questionable ethical and environmental track records who hold a vested financial interest in maintaining the current cancer research, treatment, and prevention strategy standards. (Toxic Links Coalition, 2006)

Here the methods of treatment are themselves denaturalized as cancer is writ large.

In un-writing and re-writing the natural, these science literates draw most heavily on political economy. Science is an unfaithful ally here, tied to industry and state interests, which depart from and even oppose those of the marginal subject. It is not that evidence is unimportant, but that evidence comes from a complex of the personal and sociological rather than the experimental.

Case 3: Science and Guinea Pig Standpoints

While the sick are clearly the objects of medical surveillance, it should be clear that they are not alone. The healthy increasingly are subject to this same objectification. In the mid 1990s, anarchist, IWW

(Industrial Workers of the World) organizer Bob Helms created *Guinea Pig Zero*, a zine for professional human subjects. *GPZ* provided a venue where regular, healthy human subjects could submit stories of their experiences with different research units and evaluate care on Guinea Pig terms including pay, respect for privacy, bureaucratic hassle, follow through, and quality of informed consent (*GPZ*, v1 n 2, 1996, p. 2). This was one of a few publications that emerged from the changes in the political economy of biomedical research that followed the National Research Act (1975) which emphasized the voluntariness of research in the U.S. (for another exemplar publication, see Hogshire, 1992).

Guinea Pig Zero first appeared in 1995 and was immediately identified as important within the zine counter culture, receiving immediate recognition by such arbiters as *Fact Zine 5*. It was also immediately seen as an important voice in the research community; researchers comprised the majority of subscribers according to Helms (1999, March 29); and for a while Helms even served as a resource to official organs such as the OHRP (Office of Human Research Protections). By 2000, Helms was focusing on other enterprises than human subjection, and *GPZ* has become an occasionally updated website.

GPZ sought to produce a guinea pig consciousness through the production of a public culture or discourse on human objectification. Helms, a classicist by training, called *GPZ* an anthropological project (Helms, 1999, March 29). The content of the zine was extremely diverse including first person accounts, report cards, lengthy historical analyses, book reviews, fiction, and news coverage and investigative journalism of deaths of human subjects, e.g., the those of Hoiyan Nicole Wan and Jesse Gelsingier.

It is hard to understate the enormous emblematic importance that *Guinea Pig Zero* has as a model of critical scientific literacy. *GPZ* was a radical attempt at producing justice and community for those who are science's raw material. In this way *GPZ* reflects a social and critical standpoint with all of the problems that such project entails, e.g., problems in being representative of a complex and heterogeneous body (Butler, 1992). *GPZ* was not merely reflective of social movements, which it clearly was, but it is also seeking to produce such a movement. Literacy actively weaves writers and readers together into a collectivity. This reinforces a point made repeatedly by Roth and Barton that the technical science literacy is part of a complex of discourses and disciplines in its critical form. In *GPZ* this included historical analysis, ethical analysis, the ability to produce narrative, social theory, social movement strategy, as well as the ability to make critical judgments about medical procedures.

But Helms argues that the essential literacy needed to protect human subjects is not science, but journalism.

You get no results [from the law], but the venue for protecting the rights of guinea pigs is going to be in scandals, exposing abuses, and uhm I've been constantly saying since couple of years now, investigative journalists have done more to protect human subjects by far, universes beyond what the government's done and that's the way it's always been. It's a scandal driven history. (Helms, 1999, March 29)

There's a second piece to this scandal driven history, which is tied to social movements. Helms attributes the passage of the U.S. National Research Act not just to the scandals created by the journalism around the Tuskegee Syphilis Study but also to the social movements that made the inhuman treatment of the study's victims intolerable:

Public scandal, they were violating the Nuremberg code of ethics which had been written in 1948. Oh, yeah, well that code, yeah, we forgot. They had completely ignored it from the beginning. The Nazis on trial would say, oh well we got this idea from you [i.e., the U.S.]. And see these articles we have here, they're all written by American doctors. And they're all using prisoners, what do you think of that. And they'd say, no excuses, we're going to hang you anyway. But they wrote the Nuremberg code and they flatly ignored it. and uh, it was public scandals. It was the civil rights movement. If there was no civil rights movement the scandal would have never gotten any teeth, but they were, the government was afraid of major riots, so they changed what they were doing. They told the doctors to stop playing

around. I mean there were major riots already happening so they didn't need any more... (Helms, 1999, March 29)

So the power to "rewrite science," i.e., to transform the very modes of gathering subjects was linked to mass movements, organizing, and networks supporting social justice.

This is not to say that there is not a technical side to this literacy. When things go wrong, Helms or others bring to bear a "scientific" reading on the situation. With the death of Hoiyan Nicole Wan, for instance, Helms gave me this analysis:

So, with Nicole wan it worked the same way. They wanted//please don't talk about the fact that lidocaine has been on the market since World War II, so please don't point out the simple obvious fact that any doctor could tell you that taking a lung biopsy is a routine, old procedure that's been happening for 100 years, or that the bronchoscopes; the only change in the technology has been to make it flexible, and they've been around since I don't know 1897 or something, but it's very long [time] ago. So the reason that they're saying it's an experiment when it's not an experiment is because they can say it was an unforeseeable event that she died, that's not true either. They gave her four times the safe amount. And she was probably—I've asked doctors—to say that lidocaine has a slight, a rare—it's statistically rare but it happens with like a half of one percent of the population has this hypersensitivity, they hit the wrong person with four times the safe amount, and she probably wouldn't have died if she was like not hypersensitive, but still four times the amount that's in the book for safe is wrong. (Helms, 1999, March 29)

Notice the mix of the technical (lidocane, bronchoscope, biopsy) with the historical, with critiques of the enterprise of science (the manner in which botched medicine can be covered up through evoking an experimental aura). Certainly a part of this looks like standardized science literacy including the kinds of turns to authority that Shamos (1995) calls for, but it also challenges that model: there is no detached reference to empirical evidence—evidence is almost always presented in very personal terms in GPZ, even in the report cards evaluating research units. There is no endorsement of science as self regulating and governed by Mertonian norms (Kelly, Carlsen, & Cunningham, 1993). History of medicine, sociology of science, and an awareness of institutional politics are the literacy skills needed to read the corpse of Nicole Wan.

It should be clear that while the guinea pigs associated with GPZ share a very different political philosophy than the researchers they engage with, they in fact do share a strikingly similar (anti)metaphysics. Helms and the other contributors and their researchers embrace a material view of the body; one that is shockingly comfortable with exposed interiors, blood, and other transgressions of the skin—in fact the guinea pigs have a kind of machismo about their experimental participation. In this way they share with doctors a kind of boundary work between science and all other traditions (Gieryn, 1983, 1999). Only when discussing homebrew recipes to mask drug use do homeopathic and herbal remedies get discussed. The research on the body, however, is taken unproblematically in most of the guinea pig narratives.

Obviously sick and healthy objects of medical probes share many experiences, and not surprisingly many similar critical literacy skills. In fact the boundary between healthy and unhealthy subjects of medical and scientific gaze is porous (Dumit, 2006b). Brown brings to bear many of the same technologies of self and other that GPZ employs: the subjective, the historical, the sociological. Both of them also embrace realism, deploy statistics, historical reports, and other forms of modernist accounting. In this way they are both embracing and critiquing science simultaneously. However, it is also not surprising the Brown is more open to practices outside of allopathic medicine, given the high stakes struggle she is finds herself facing with cancer.

Finally, I would like to claim that the guinea pigs' engagements with medicine offer the most encompassing of standpoint knowledges and critical science literacies. We are all at some time or other objects of the scientific gaze. Children, in the regimes of RTI (Response to intervention), evidence based

practice, Diebels Tests, IQ testing, and standardized sorting and re-sorting, are made familiar with this positioning vis-a-vis science very young and through schooling. More than ecology or other socioscientific issues, the politics of objectification is central to a critical scientific literacy, and the guinea pigs of GPZ provide the most eloquent political and situated discourse on what that means “today” (though for discussion of radical changes in guinea pigging due to globalization, see Petryna, 2005; Petryna, Lakoff, & Kleinman, 2006; Rajan, 2007).

Critical Science Literacy

Roth and Barton (2004) argue that science literacy emerges in situated and specific struggles over socioscientific issues. In doing so they argue against the decontextualized and self-referential knowledge that schools provide. Certainly in our cases, scientific literacy is very specific, especially when contrasting the work of guinea pigs and patients (GPZ, Brown, TLC) with that of the street medics.

At the same time, each of these actors brought to bear significant social and political theory in confronting and rewriting science and nature. In this way a place for schools is recouped from this analysis. The green screen of schools, schools as non-places, has value precisely because it can simulate so many instances, and be the place where agency is performatively and tentatively explored. Granted, there are many forces working against such re-use of schools, including the standardization of education, and in this sense, Barton and Ross are correct: informal education offers easier settings for situated, authentic engagements, ones that can provide less constrained stages on which to rewrite science and nature. But it should be clear that theory, abstraction, theater, and other projective generalized spheres shape the authentic as much as vice versa, and this is the thread that connects all of my critical science literacy moments: no one is prepared to rewrite science and nature unless they have models and rehearsals of lives which “denaturalize” the extant technoscientific world order.

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