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Troubling “Environments”

Postgenomics, Bajan Wheezing, and Lévi-Strauss

Postgenomics is intended to move beyond the search for genes to explore disease as a result of genes interacting with their environment, revealing how they have relevance for health. This addition of environment confers genomic research with new cultural life, making it relevant to public health discourse, government interventions, and health disparities. Drawing on ethnographic research following an American genetics of asthma study conducted in Barbados, I explore the ways environment gets construed by the multiple communities involved—U.S. researchers, Bajan officials, medical practitioners, and patient participants. I draw on Lévi-Strauss to argue that plural competing environments give mana to the American postgenomic project as intervention on racial injustice, household practices, pollution, and other aspects of asthma. [postgenomics, mana, race, Caribbean]

In current bioscience rhetoric, studies that search for genes for common diseases are missing something. The search for genes for autism, asthma, or diabetes has had dismal results because the genome alone is insufficient: Such a search needs to be supplemented with the interaction of the genome with its environs (see Arribas-Ayllon et al. 2010; Shostak 2003). This shift includes gene–environment studies, which mean to move away from the search for correlations between a gene or set of genes and some disease and move toward exploring disease as a result of genome interacting with its context to reveal its relevance to health.

Recent social science literature has explored the potentials and pitfalls of gene–environment research. As Lock (2005) and Shostak (2003) argue, such research has the potential to emphasize the location of particular populations and differential exposure to airborne pollutants, hazardous waste, and other deleterious toxins. This potential brings genetics into public health discourses. In the meantime, the “environment” in postgenomic research must be restricted to particular materials that measurably interact with genes. This essay examines how this “environment” confers significance on genomic research. The void at the center of pure genetic research—its lack of application to health and illness—is a felt absence, creating a need to give such research significance. This lack is generated by the accrual (rather than dearth) of genetic studies, as Lock et al. point out (2007).¹ The “environment” in gene–environment fills in for this lack.

Today, various etiologies of illness are increasingly considered to occur through gene–environment interactions (for a critical review, see Shostak 2003). This has accompanied the shift from genetic diseases to genetic susceptibility to disease (on the plural ways patients make such susceptibility meaningful, see Gibbon 2007; Lock et al. 2007; Rapp 1999; Raspberry and Skinner 2007). The emphasis on predispositions found in BRCA mutations or the ApoE Alzheimer’s variant gives a valence of fate to this

susceptibility. Although necessarily implying some environmental interaction, this contribution is masked in the emphasis on the likelihood of a particular fate being realized—the environment in these diagnostic contexts is supplementary (see Lock 2005).

In postgenomics, the genome only has relevance at the moment of its interaction with some nongenome—whether proteins, toxins, or some other environment.² Here I explore the strangeness of this figure. Anthropology since Lévi-Strauss has revealed that interpretations of the natural (like the genome) and the social (like environment) are relational, making each side, and their interaction, culturally particular. By attending to the use of environment as an object forged in relation to genomes, I explore some of the peculiar characters that makes up this postgenomic environment.

I draw on Claude Lévi-Strauss to argue that the environment in this science is a mediator between the naturalized world of the genome and the social world of illness and inequalities. As a mediator, the addition of environment allows the genome to enter new exchanges, now relevant to public health, government interventions, and health disparities. The environment, then, confers *mana* on the genome: It operates as an open signifier, an object shaped by its relationship to the genome, which then gives the genome new life as significant to the social world of public health.

Something called environment has long been an object of scientific and medical science, with different meanings given by epidemiologists, public health experts, and toxicologists (see Shostak 2005). My point here is not to contrast the postgenomic environment with some imagined whole environment, some potential science properly attentive to the political, social, economic, and geographic factors that cause illness. Following through on Lévi-Strauss, any environment is culturally specific, partial, and mediated. I instead evoke as contrastive figure the environment proffered by families and medical practitioners who participate in postgenomic research.

Comparing these “environments” and their intersection is meant to both enact the defamiliarization of a scientific object (a standard anthropological move) and suggest the institutional practices by which such an object relies on contradiction to give shape to an illness subject (another standard anthropological move). In the following pages, I suggest the plural competing “environments” that give an American postgenomic project such power as intervention on racial injustice, household practices, pollution, and other aspects of that quintessential environmental condition, asthma.

I explore this *mana* through one gene–environment study of asthma, a Johns Hopkins University asthma study conducted in the Caribbean country of Barbados. Drawing on ethnographic research following this study, I follow the ways “environment” gets construed by the multiple communities involved—the American researchers, Barbadian officials, patient participants, and medical practitioners.

As in other anthropological accounts of participation in genetic research, reciprocal interpretations within such encounters keep their significance open ended. Rayna Rapp (2003) and Karen-Sue Taussig and colleagues (2003) have explored the ways patient groups become involved in and make genetic research on disorders significant. Margaret Lock (2002 [2001]) examines how new market practices become a part of participant evaluation of genomic research. For examples of research on participants in biomedical clinical trials, see Epstein (1996), Lowy (2000), and Good (2001).

In this article, I contrast the environment in American postgenomic research with the environment among Bajan families that participate in such science. This juxtaposition is not meant to oppose some “traditional” meanings with scientific ones. As Altman et al. (2008) argue, such familial meanings of the poisons in the environment draw on multiple sources—including the scientific. The juxtaposition instead reveals the peculiarities of environment, always construed by contrast, and the particular significance it confers for understanding race, health, and modernization. Through the study, environment is stabilized into a set of practices in the home that interacts with a racial biological predisposition. This science interacts with Barbadian medical and familial concepts of environment as a poisonous modernization of the air and food. I argue that this creates a science in which genotyping technologies make the familiar pollutants and wheezing for Bajan doctors and families into a strange figure called “home environment” that relies on U.S. expertise and technologies to know. In the encounters comprised by the study, conflicting conceptualizations of “environment” make for a contradictory public health genetics. I claim that the mana conferred on the genome by this “environment” claims American genomic research as newly relevant to racial inequalities and burgeoning illness, while estranging the environment into a postgenomic figure.

Methods

This article is based on ethnographic fieldwork tracking the Johns Hopkins genetics of asthma study conducted in Barbados and its wider significance from 2002 to 2008 (with the most intensive fieldwork conducted from 2003 to 2004). This was part of a larger project on the intersection in Barbados of American science, multinational pharmaceutical companies, and the state and families around asthma. This article reports on the fieldwork on the Johns Hopkins asthma genetics study, working among the genetics team and Barbadian nurses and physicians who facilitated the project.

The genetic research was conducted through home visits in which study facilitators took blood samples, administered an asthma questionnaire, collected dust samples, and conducted spirometry (measuring lung function with an instrument into which patients exhale and inhale). I conducted participant observations during approximately 20 of these home visits and at meetings between the genetics team and Barbadian physicians/researchers involved in the studies. I asked families I had met while observing these home visits about interviewing them as well as others they knew who were involved in the research. I interviewed approximately 22 families who participated in the research through multiple formal and informal interactions in their homes and at social events. Through this exploration, I examined the ways the Barbadian asthma experience is translated into a genetics of asthma and race, relying on the plurality of asthma, ethnic identities, and other cultural categories.

But my intention was not to conduct a study of a scientific team.³ Instead, I explored medical, governmental, and familial practices and interpretations that interact with this science and are integral to its production. This led me to interviews with various groups involved in interpreting and acting on asthma in the country: public and private doctors, pharmacists, nurses, government health officials, and families of asthmatics. Through these interactions, I explored the desires and evaluations by which this science is

created and has a cultural life, making new medical meanings, national positioning, and patient identities.

Modern Dust

Barbados has become a center of international genetics of disease research, despite having a population of only 269,000. American and British genetics teams have conducted studies searching for genetic propensity for cancers, asthma, acute lung injury, obstructive sleep apnea, diabetes, obesity, glaucoma, hypertension, and dengue fever. All of this research is premised on race: In these studies, Barbadians are considered Afro-Caribbean, equivalent to African Americans and black people in the United Kingdom, and the teams come to search for racial predispositions to disease. Barbados was specifically chosen for this science of race and disease because of its particular position in the Caribbean as a country with a relatively robust national health care system, the institutional home of the multinational pharmaceutical industry in the Caribbean, and a tourist haven.

I have argued elsewhere that each of these attributed characteristics play off each other to constitute Barbados as a biomedical center in the Caribbean (Whitmarsh 2009b). To summarize, the health care system provides doctors and nurses who facilitate the studies through patient recruitment and administering the protocols. A national drug formulary that is taken as a model by the World Health Organization makes the country the center of the pharmaceutical industry presence in the English-speaking Caribbean, a source of international lectures, information about diseases, and continuing medical education. And the multitude of international lectures, conferences, and research would not occur without the claimed pleasures of a tourist economy.

In this intersection, the Ministry of Health works (successfully) to attract American and British research on race and disease. Each of the genetic studies is conducted through collaborations between a foreign team and the Ministry of Health. The Barbadian government thereby incorporates a biology of race and disease as a kind of public health intervention. The Johns Hopkins Barbados Asthma Genetics Study is one of these research projects.

The Barbados Asthma Genetics Study began in 1993. The study has received the great majority of its funding from the National Heart Lung and Blood Institute and some additional funding from a multinational pharmaceutical company. This ongoing project has resulted in the participation of more than 125 families with individuals who have asthma and the collection of DNA samples and phenotype and questionnaire data on socioeconomic indicators and on the history and severity of asthma. The team has included geneticists, epidemiologists, and clinicians. This research has now extended into exploring gene–environment and gene–gene interactions and the genetics of asthma severity and atopy (allergic response). The research thereby brings the most sophisticated technologies exploring the environment in relation to asthma available in Barbados. As such, concepts of environment, public health, race, and genomics are being reconfigured in revealing ways.

Barbados has one of the highest levels of asthma of any country in the world, at 18–20%, several times the level in the 1970s. Newspaper and radio accounts, medical and pharmaceutical attention, and public and private outreach programs have made asthma an

object of public discourse. Today, almost everyone in Barbados has a family member or friend diagnosed with asthma, an opinion about the causes, and concerns about the prevalence. Amid the startling increase in asthma diagnoses in Barbados, the causes of the condition are routinely discussed. During my research among families of asthmatics, I was often told that there were more asthmatics in Barbados because of the “pollution,” a term covering exhaust from vehicles, chemicals used as pesticides, and particles produced by roadwork.

Maureen is a mother who participates in the Johns Hopkins study on asthma in Barbados. She lives in a rural area that had recently had roads put in. She summarized the causes of the many cases of asthma in Barbados:

But to me our atmosphere in Barbados is very, very dusty now. It wasn't like this before. Right. To me in recent years it is got very, very, very dusty. And it wasn't like that always. ... It's just *dusty*, and to me our atmosphere is polluted. It's not clean! And you driving behind vehicles that are making a lot of *smoke* and that sort of thing.

Almost every Bajan family I talked with about asthma shared this emphasis on “dust.” They felt that there is more dust in the air than when they were younger, that this contributes to the increase in asthma, and that this is a serious problem. Dust includes exhaust from vehicles, roadwork particles, dirt, and smoke produced by other households burning refuse (a common practice).

Ashley is a particularly highly educated, middle-aged participant mother with an asthmatic son and daughter. She talked about the link between industrialization and asthma:

The exhaust from the vehicles, then there's a lot of *manufacturing* going on, and then there are more houses to me than there are trees now. And I think that there has a lot to do with it because the *oxygen* buildup and things be less. That's what I believe. You can only speculate. But that is what I really believe. That it has a lot to do with it. Because we have a lot of factories now that we never had. Regardless of what you say, you're going to have exhaust, you got more vehicles on the road, and it's more exhaust in the atmosphere. The chemicals from the plants. And then like there is more buildings, so you got more cement particles in the atmosphere. All of that there contributes to it!

Most asthmatics I met talked viscerally about this unclean air; many described directly experiencing it in the body. This dust, exhaust, dirty air was considered both the cause of immediate attacks and a more insidious pollutant increasing the number of children with asthma.

Leslie and Steve are a couple who participated in the research and live in an urban area with their two asthmatic children. During an interview, the two talked angrily about the change outside and inside the home, which they believed caused their child to have asthma:

Steve: Dust in the carpet. You can see that that is dust there. It's just—you wipe off this, and in a matter of minutes it's like that again because of the frequent traffic. ... It has increased, I would say about 90 percent! Because I remember times when you would hardly see a car sometimes. ... It's pollution, there are so many cars.

Leslie: Especially the air, that's what affect whatever you do.

Steve linked this increase to the constant road construction work: “This is the *city*. And the houses are so close, as I said, the dust rates. *So* dust. *So* much dust! It is difficult to maintain around this sort of dust. There are people that are worse off anyhow.”

The increased highway and car use resulted in little difference in such narratives between rural and more urban families. Frank is a participant father of an asthmatic. He and his wife Alison live with their son in the northern region of the country, far from the urban areas. During an interview with the couple, Frank remarked:

If you are in a traffic jam from the morning, you get that air, right? If you are in a traffic from the morning you get a lot of exhaust. Not *if*, you *will* be in a traffic jam, because the amount of cars upon the road now.

Families talked forcefully about the need for government attention to this unclean air of modernization that produces new diseases like asthma.

This discourse by the families and some health care workers led me to interview members of the government involved in regulating and monitoring these practices, including representatives of the Environmental Engineering Department and the Pesticide Control Board and environmental health officials. These accounts echoed the emphasis on the poisonous effects of car exhaust and construction.

Raymond is a high-ranking official from the government agency that monitors motor vehicles. During an interview in his office, he talked with me about pollution and asthma:

Of course, Barbados is not as polluted as some other localities. But exhaust emissions has increased significantly. The number of vehicles on the road is now 90,000 to 100,000. This has increased significantly in the last 10 years, from 50,000 to 100,000, which means high exhaust emissions. Also, Barbados has an increasing amount of chemicals, aerosols, being put in the atmosphere as well.

According to Raymond, this results in increased diesel consumption and carbon monoxide levels in the air. He noted that his department has “decreasing activity on air pollution however, recognizing a higher population.” As the government adapts to the changes brought by modernization, such regulations of air quality become deemphasized in favor of other priorities.

The traffic is also related to increased roadwork, which physicians in the urban areas discussed in particular as causing the rise in asthma. Emily is a public clinic doctor who has a particular interest in asthma and diabetes. Her clinic is next to a large road construction project, and she had documented the increase in the number of asthmatics

coming to her clinic during periods of construction. As another doctor noted, when asked about demographics of asthma prevalence: “If we see clusters, it’s because roadwork and construction is going on.”

When officials and physicians reflected on this worrying rapid industrialization, they emphasized that the poor are the ones who experience the ill health. They are more likely to be exposed to road construction and exhaust in the air. Raymond talked about the implications of increased traffic for individuals “walking the highways,” referring to the generally poorer people who do not own automobiles who are continuing the tradition of walking along what are now heavy-traffic roads. Often these individuals are mothers carrying their children, and officials like Raymond, as well as many families, attributed more children having asthma to this.

The family use of the term dust gave this miasma a different tenor from the pollution discussed by officials and doctors.⁴ In the extensive conversations I had with families about dust, the category had a particularly vague valence. I continually tried to reduce this ambiguity by asking people to tell me the one or several components that make up this dust. I failed and only belatedly came to realize that this vagueness was integral to the concept. The ambiguity of dust was not due to varying definitions, but rather to a fundamental slippage in the category. Such vagueness made the category usable for multiple criticisms.

Diane is an asthmatic in her twenties. I interviewed her and her asthmatic sister, Cathy, as well as their mother, in Diane’s home. At one point we discussed the causes of asthma in Barbados:

Cathy: I think it is the air too! Because how can—[indicating her mother] you are an adult! Like my mother now, you started wheezing now, how?

Mother: A couple of years ago.

Cathy: A couple of years ago, in your forties, right?

Mother: I was like in my late thirties, in my thirties, the dust.

Cathy: Exactly, right, and that never used to affect her before.

Mother: Right.

Cathy: To me it’s more than just—

Mother: It’s the dust and smoke—

Cathy: It’s the atmosphere, man, the atmosphere is dirty—.

Diane: It’s the atmosphere change, a definite atmosphere change.

Mother: I feel it is more chemicals and the carbon monoxide.

Cathy: Exactly. The air is just not clean. You know, sometimes you can actually feel yourself catching an asthma attack just being outside in the open! You can smell things that make you feel yourself short of breath.

Mother: You don’t have to exert yourself.

For these families, the increased wheezing across Barbados is caused by dust that constitutes a kind of modernizing miasma. A multivalence in the meaning of dust allowed the laden term to be used by families to include roadwork, manufacturing, and automobile use as well as neighbors burning trash and smoking cigarettes.

Eating Modernization

This consumption of foreign pollutants extended to broader dangers from modernized diets. Changes in food are considered the systemic cause of the high prevalence of asthma by almost every Barbadian not involved in health care who I talked with, regardless of socioeconomic background, whether asthmatic or not. As integration into a global economy brings unclean air; it also brings unclean food, in the view of many Bajans. The high asthma prevalence is seen as the result of eating foods that are overprocessed, as Maureen, who talked earlier about fast food, explained:

[In the past] you would be eating ground provisions like yams and potatoes and that sort of thing. And your grandmothers and things soon mix up enough things, like enough porridge and all that and *feed* you and that sort of thing. But now everything coming out of a *box*. Or a can. And you know people don't eat ground provisions like before.

This distrust of importation carried an affirmation of the natural and local, associated with the past (and the current return to the past, as in an advertising campaign in which local farmers label their products "100 percent Bajan"). This influence of markets has also changed farming, in the views of these families. Celia, a participant mother of three asthmatics, talked about increasing pesticide use:

They spray the ground where the foods are for the cicadas and so on. They put enough spray in the foods. I think it is the food that making the children weak. More asthma and so on. ... And when they spray the cane, all of we be sick. All of we is be *wheezing*. I got to carry we to the hospital. So I think it is the foods.

The asthmatics I spoke with contrasted this poisoning of the foods with previous times, as did Maria, a mother of an asthmatic daughter. After I had eaten some food she had made, she remarked:

Because I mean food has deteriorated a lot. We don't get the nice ground provisions without any chemicals and all that. Everything we get is chemicals, chemicals, chemicals. Even this meat that we're eating. Chemicals. They doing things, even the bananas, all that to force them to ripe. So it could be something along that line!

Ashley talked about the market incentives that polluted the purity of older farming traditions:

A lot of the things that you eat are not pure anymore! ... The people treating the fields to get bigger yields. The chemicals coming from outside and they want bigger tomatoes, bigger carrots, so all these chemicals, the chickens, they bigger, they injecting them, all of that there contributes to it! ... because when I coming I never had nothing so. So that got to be in

the '70s, the '80s, and onward and I believe that you seeing an increase in asthma!

In these evaluations, market forces and the foreign were critiqued as bringing a poisonous modernization that causes asthma. Officials also implicated an increased consumption of other chemicals, particularly pesticides. Due to the prevalence of dengue, a considerable government prevention campaign has been launched that includes seasonal spraying of insecticides in neighborhoods. Families are told to leave the windows and doors open during these sprayings to allow the chemical into the house and then to close the doors, to keep the insecticide in for maximum effect. Mosquito insecticides are also marketed for home use to prevent dengue. Raymond noted:

The increase in chemicals is perhaps accompanying the standard of living that has improved, before we would use burning coils, now we see the use of, what I call, these sophisticated poisons, the mosquito sprays, and bug sprays. ... The Pesticide Control Board, which is an agency of the Ministry of Agriculture, regulates chemicals and is also supposed to regulate use. Use is not as tightly controlled as importation.

Raymond considered such pesticide use a possible cause of the increase in asthma.

Environmental officials also noted the hazardous mixing of chemicals by families using cleaning products, as well as by businesses. Jeremy is the head physician of a public clinic who focuses on asthma intervention. He summarized this consumption of chemicals and air pollutants and dust in his notion of a more “polluted society”:

There is a more polluted society here. There's more use of industrial cleaners, more construction, industries burning rubber, factories with exhaust. It was investigated and there wasn't found to be a link, but the complaints kept coming and they didn't stop. There are pesticides in the home. Dengue is endemic, so now what a lot of parents do is spray then let the children back in.

Families extend this medical discourse about pesticides and food to include a critique of the change in food importation, implicating international commerce, Americanized farming, and the rejection of tradition.

The participant families consistently invoked the United States as the source and pinnacle of the changes occurring through international markets. Several talked about Barbados as following U.S. trends of diet, pesticide use, and car use. Kimberly is in her mid-thirties and a mother of two asthmatics, “We used to rely more on fruit, whereas we do using a lot of stuff that manufactured. ... I find that Caribbean people are more Americanized.”

Frank is particularly knowledgeable about pesticide use, having worked in sugar cane fields. He and Alison talked with me about the link between international commerce and pesticide use. Frank explained why pesticide use has gone up:

Frank: Because it's easier work? It's easier work, right, for the people that do agriculture.

Alison: And they see what Americans doing, and do the same thing.

Frank: It's true.

Alison: And everyone saying that there's trouble, and everything U.S. do, people here is do.

Frank: Not really, I don't really blame the U.S. for that, right, because you getting it in Europe and all around. It is a way to produce food cheaper. People looking to produce food cheaper. And faster. The turnover faster. You got to control the disease, and then the amount of chemicals that you're using to get the plants ready in a short space of time, right.

For Frank, and for many others, the focus on speed and reducing cost in food trade is a naturalized force with its own logic and momentum. In their perspective, these trends bring chemicals, pesticides, and overprocessed foods that pollute Bajan health. Many families talked about inhaling pesticides while walking by plantations or in their own homes. Some discussed individual cases they were aware of where chemicals or other hazardous materials were disposed of in wells or near crops.

Consumption practices reflect these critiques of foreign pollutants and markets. Families minimize eating of artificial dyes and colors, stop frying foods, avoid processed foods, and purchase "100 percent Bajan" products. Most attenuate these practices according to cost—for example, canned milk substitutes from New Zealand cost considerably less than fresh milk and so were generally used by poorer families. Through the consumption of food, families of asthmatics claim some control over these nebulous processes of international markets and modernization.

These problems of chemicals, pesticides, and manufactured food are often talked about in terms of Barbados being dependent on U.S. agricultural markets and production, creating a sense of the United States as a powerful and inevitable force on Barbados. Modernization is like the foods and the dust—an indefinite harbinger, mundane and everyday, a manifestation of our desires for bigger and faster that has run amok. Asthma in these accounts is a disease caused by "consuming modernization" in a sense: inhaling and eating the foreign pollutants of becoming modern.

Troubled Genomics

In the Johns Hopkins genetics research, environment takes on a different significance. For the researchers, asthma incidence and severity occur through the interaction of multiple genes and environmental factors.⁵ The study, as understood by the researchers, transcends the limitations of purely genetic or purely environmental studies. On one side, as a gene-environment study, the project design was contrasted by the team with genetic susceptibility studies that fail to account for gene-environment interactions such as the reciprocal influence of immune-response gene expression and allergen exposure. On the other side, the study design was posed against purely environmental studies that were considered more susceptible to factors that complicate results, such as age and socioeconomic status.

Considered independent from these factors, genes are interpreted to be more stable and thereby more reliable in assigning causality. Genes exist here in their ability to interact with known triggers such as smoke, dust, and cockroach dander, and environment exists in its interaction with alleles associated with allergic response. This categorization requires the myriad complexities of Barbadian environmental meanings to be shaped in a way that can interact with the gene. In the study, environment takes shape through home visits. Home visits are where the data are collected for the study, as researchers travel to patient's houses to collect blood, dust samples, measure lung function with a spirometer, and take personal histories of asthma with a questionnaire. These measures search for allergens in the home that interact with genetic regions to cause asthma. This environment that interacts with genes is exposure to endotoxins (an allergen associated with animals and insects, including pets, livestock, and cockroaches).

The science of gene–environment studies thereby fashions a Bajan biology, environment, and illness. The dust samples are turned (in the lab) into presence of p-gram negative bacteria or other endotoxins. The blood samples are turned into genotypes depicting the presumed real familial relationships between participants (sometimes in opposition to what they describe as family) and particular alleles that are thought to contribute to asthma. The spirometry and questionnaire results are turned into asthma severity and environmental exposures. Through this depiction, genotyping technologies become critical to analyzing “environmental” causes of asthma.

This comprises an environment very different from what Bajan families view as the causes of asthma: the roadwork, diet changes, insecticide sprays, and vehicle exhaust, pollutants brought by recent modernization. The questionnaire focuses instead on household behaviors that are thought to be related to asthma. This is not to suggest that the study instruments are inattentive to the particulars of the Bajan asthmatic experience; the questionnaires are quite sensitive to such specificity. For example, analysis of one questionnaire on household endotoxin exposure includes weighting for windows left open, recognizing the high level of endotoxin exposure from livestock around the house, often chickens, and grain handling. Similarly, in the questionnaire seeking times of particular exposure, a Bajan seasonal division is used, into summer, the rainy season, and Christmas break until Easter. The study is thus highly attuned to Bajan household practices based on more than 15 years of work in the country. But this emphasis on household is divergent from the ways the Bajan families interpret asthma causes. This considerably different focus often resulted in the lack of clear responses, as in this conversation:

Facilitator: Did your mom smoke when you were a baby?

Mother: I don't know.

Facilitator: Your dad?

Mother: I don't know.

Facilitator: To the best of your knowledge, how much did you weigh at birth?

Mother: I ain't sure. [laughs] To tell you the truth, I ain't sure.

Facilitator: Were you breast-fed by your mom?

Mother: I don't know those things! If she was alive I could probably find out.

These domestic behaviors were not part of the repertoire for understanding asthma for the Bajan families. Their unimportance to the families usually necessitated several exchanges as facilitators attempted to make differentiations out of their absence among family members. A similar negotiation frequently occurred over whether the participant had asthma at all. During one home visit, a mother diagnosed as asthmatic explained that she had “grown out of that” and that the questions about the symptoms (e.g., cough, tightness of chest) were not applicable to her. In another home visit, a mother deferred to the expertise of the team as to whether she had asthma. When the study facilitator asked, “Have you ever had asthma?” The mother responded, “No, please. Not to my knowledge.” She was interested in whether the spirometry revealed her status. A reciprocal process was also highly visible during home visits, as families attempted to designate practices undifferentiated by the study. As the above questionnaire continued, the mother’s emphasis on causes of asthma emerged:

Facilitator: [Do you wheeze] when you are exposed to chemicals, like strong perfumes, hairsprays, insecticides?

Mother: Yes, dust.

Facilitator: Dust, which we already did.

Mother: And certain things like at work, chemicals, that is make me sneeze a lot!

Facilitator: Yeah, that went under chemicals.

The woman then told a story about being at work and the particular chemicals in use that made her unable to breathe and forced her to sit down. The genetics research classifies such work environments, chemicals in the air, and construction materials with household practices, such as use of hairsprays and perfumes. “Environmental” causes of asthma transform from the pollution of global commerce to the household background.

The team stabilizes this environment into interaction with genetic variants. For example, the team reports low level among Bajans of a genotype thought to protect against asthma around small amounts of endotoxin but cause worse asthma around high levels of endotoxin. The team interprets the genotype finding and the endotoxin levels in Barbados to reveal a particular biology arising from tropical climates. They hypothesize that the low level of this genotype among Bajans occurs because it was evolutionarily advantageous amid exposure to high levels of endotoxin in Africa (see Whitmarsh 2008a). In this interpretation, the lower levels of endotoxin exposure in modern homes (which causes asthma according to the “hygiene hypothesis”) is a particularly significant cause of asthma for people “of African descent.”

In the team’s analysis, the study’s (arti)facts (to use Abu El-Haj’s phrasing [2001]) can thereby give new significance to genomes, making them relevant to racial disparities, health, and modernization. The blood samples taken during home visits become racial biologies; the p-gram negative bacteria produced out of the dust in the home become a signifier for the environment of Africa in an ancestral past; and the wheezing and symptoms measured in spirometry and questionnaires become indicative of racial health and illness propensity. The “environment” that interacts with the genome is thereby the marker of new ethical and social significance.

This man of environment thereby allows the genomics research to be positioned along with other causes of racial inequalities. For the team, the search for genetic predispositions for common diseases like asthma is a search for a more personal medicine, one that will account for the mix of genetics and environmental factors that make this particular subject ill. As is common in American ideals, this claimed individualization is paradoxically populist. More personalized genomics is considered by the researchers to be a route to a more socially responsible medicine.

On the way to a future of personalized medicine, genomics increasingly uses race. This is a field that relies on long traditions in U.S. concepts of race to make claims about underlying biological differences accounting for disparities in health and sickness (for social analyses of such research, see Braun 2002; Duster 2005; Fullwiley 2007; Jones and Perlis 2006; Kahn 2004; Koenig et al. 2008; Lee et al. 2001; Montoya 2007; Palmie 2007; Reardon 2005; Shields et al. 2005; Whitmarsh 2009a; Whitmarsh and Jones 2010). Its practitioners consequently consider themselves engaged in the project of urgent redress to inequalities.

The Johns Hopkins study in Barbados is part of this moral science (as I have explored elsewhere [Whitmarsh 2009a, 2011]). The researchers seek out gene–environment interactions in Barbados as a way of accounting for racial disparities in asthma outcomes. Disparities in illness become a racial biology that is manifested when placed in particular environments. An American geneticist who collaborates with the Johns Hopkins team suggested that genetic predisposition might be part of the reaction to cockroach antigen that causes a high asthma prevalence and severity in urban areas such as Harlem (Lester et al. 2001). This science posits a biological race that must morally be accounted for in analyzing social problems like exposure to disease, pollutants, and housing conditions.

Environment shifts from being causative to being part of the background, from being demographic to being individualized, from a classification of industrial and agricultural pollutants to a set of household behaviors and livestock ownership. This transformation of environment is what allows the search for racial biological predisposition to be a claimed redress to the social inequalities of race disparities—a kind of social justice. Genes confer stability on “environment,” making it measurable, giving it utility as a variable. Reciprocally, environment confers significance on genes, making these abstract objects matter to racial inequalities and public health. In the process, bioscience posits a kind of racial fate playing out within particular geographic locales.

Foreign Environments

If the Johns Hopkins gene–environment studies are a kind of redress to inequalities for the researchers, they carry a different cachet for the Barbadian medical practitioners and officials working on the crisis of asthma. Anyone working on asthma in Barbados is aware of the Johns Hopkins studies, which are highly influential in the Ministry of Health. The study has significance as an American high-tech exploration of the causes of the alarming rates of asthma in the country. This relevance as being foreign relies on perceived gaps in the Bajan government’s response to the crisis. In the eyes of medical practitioners, pharmacists, and nurses, the Bajan government has masked the environment that is causing the spread of wheezing in the country. This lack is created by

a perceived overemphasis on patent pharmaceuticals. As I have explored elsewhere, through a national drug formulary, multinational pharmaceutical companies are integrally involved in the government's medical system, from education to public health policy (Whitmarsh 2008b). Medical practitioners, pharmacists, nurses, and many government officials themselves argue that this makes for a narrow focus on pharmaceuticals and away from the causes of asthma.

Such criticism of the narrow lens of Barbadian medical care came across at a seminar I attended about asthma education conducted for primary school physical education teachers at the Pan American Health Organization headquarters. During the seminar, the facilitator asked the audience to comment on the meeting. One teacher talked about the increase in cars and pollution in Barbados. She then went on: "Babies are being carried on the side of the road, and the cars and they're breathing all these fumes, and I'm kind of surprised no one brought up that point. That as a trigger. All I remember from the talk is Ventolin. It's imprinted on my mind."

Asthma as a condition born of modernization represents a critique of that particular extension of modernization, pharmaceuticalization. The pollutants of modernization provide an often unspecified counterpoint to the restrictive pharmaceutical-disease link posited by the industry. The perceived overemphasis on pharmaceuticals makes this a paradoxical modernity, in which the global commerce that creates the illness brings an obsessively narrow intervention on that illness. Medical practitioners and officials involved in environmental regulations reproved researchers for ignoring these causes. As one environmental health official remarked to me after talking about the harmful use of chemicals by businesses and families in Barbados: "No studies are being done on this!"

In this context, the gene-environment research is taken as an intervention on this dearth, addressing the "environment" described by environmental health officers and medical practitioners that the government overlooks in its focus on pharmaceuticals.⁶ I attended a meeting at the public hospital between three Johns Hopkins researchers and a Barbadian physician, Taylor, to discuss a potential study on the genetics of asthma severity. At one point, Barbadian industrial practices were discussed. Taylor talked about the increase in dust at certain times of the year, relating it to roadwork and building construction: "I stress the prevention with my doctors, because there is more construction now. When you wash your car and set it outside and let the rain fall, it would look like you didn't wash your car. So we are breathing that right now." He went on to talk about a construction company near his house that caused dust.

Other causes of asthma-related visits to the emergency room were raised, including Sahara dust (the allergens, smoke, and dirt brought to Barbados from Africa by winds) and the dust from cane harvesting (as Taylor put it, "During the crop season, the harvester spews dust about a mile high. The guys doing this can hardly see their eyes."). Through the genetic study, these causes, often discussed by Barbadian health care practitioners, are addressed. The collaborations are seen as bringing U.S. expertise to the particularities of Barbados asthma, placing the environment in interaction with genes.

The gene-environment research becomes a way of making the familiar strange for medical practitioners and officials. As the studies refigure the Barbadian environment as interacting with genes in a way that requires genotyping technologies to understand asthma, the intimate knowledge of wheezing, pollutants, and allergens in Barbados

becomes part of an arcane science of DNA: The familiar are made foreign for Bajan medical practitioners.

In the question-and-answer period of the conference I mentioned, the Barbadian practitioner audience worked to make the genetics team findings relevant to Barbados's environment. For instance, one doctor wanted to know whether the team's filters worked on both allergic and nonallergic types of asthmatics. Several questions appealed to the genetics team's expertise. One doctor asked about the filters designed to reduce contact with air pollutants: "How effective are air purifiers? I have been telling my patients to invest in them." The responses were ambiguous, as these issues were not the focus of the studies. Medical practitioners in interviews talked repeatedly about the lack of genotyping facilities in Barbados, saying that the research relied on high technologies that make it inapplicable to the country.

Gene-environment studies—in replacing the environment of pollution and modernization with the environment of the domestic space interacting with genes—become both authoritative and useless to Barbados. At times, medical practitioners reframe ideas of pollutants, dust, and pesticides as interacting with genetic predispositions, as they attempt to localize the research to the specificity of Barbados; at other times, they use this formulation of gene-environment to accentuate the lack of importance of genes to the Barbadian experience. For the Bajan doctors and officials, the research binary of genetic/environment creates new ways of formulating the effect of modernization and diet, making the familiar strange, an environment requiring arcane expertise and technologies to understand and act on.

Environment-Gene Exchanges

There is an increasing discourse calling for the inclusion of medical genetics into public health interventions (for an analysis, see Shostak 2003). Francis Collins, now director of the National Institutes of Health, also stresses the forthcoming importance of genomics to the population's health: "The implications [of genomic research] for diagnostics, preventive medicine, and therapeutics will be profound" (Collins and McKusick 2001:540). This public health genetics relies on the promise of the future of genomics: Collins and others refer to the pending availability of genetic tests for common disease susceptibility, personalized medicine, and the rapidly lowering costs of conducting such tests (Collins and McKusick 2001).

Increasingly, national governments join in the cutting edge of biomedicine as a way to act on the health of their populations (e.g., Canada's health genome project (see Hinterberger 2010), and Estonia and Iceland's national genomic databases (see Fortun 2009; Pálsson and Rabinow 1999, 2005). Each of these governments places its citizens at the center of large-scale genomics. As genetic analysis employs national databases of biomedical records and biological samples, governments position their participation as a public health program, helping improve the lives of their populations. In Barbados, the government poses the population as biologically black in attracting international genetics research, reflecting on their vulnerable position in the global economy and their desire to take part in the future of biomedicine. This expanding use of genomics in public health relies on new formulations of the context for these genes: the environment.

The peculiar formulation of this environment becomes particularly visible in contrast to the environment imagined by the subjects of this postgenomics, Bajan asthmatics. In Barbados, the families and researchers both posit a modernization in explaining asthma; but where the families look to pesticides, artificial foods, and exhaust—these market pollutants—the team looks to changing households, a domestic modernization. This postgenomic “environment” reveals the ways biomedical concepts like the genome must contain ambiguity to have significance. Following Lévi-Strauss, nature (here, genetics) and culture (here, environment) are each reliant on the other for meaning, in a radical relationality that precludes some consistent whole. Such plurality is what makes science and medicine have a cultural life (see Lovell 2006; Whitmarsh 2009b). The environment then pushes the genome into new exchanges, making it relevant to racial inequalities, illness experiences, and disease susceptibilities.

As Lévi-Strauss argues, following Mauss, what is generated by exchange is *mana*, a power accorded to the object. In this case, the genome is given a new life, new significance as socially and medically relevant. This postgenomic environment is a mediator in Lévi-Strauss’s sense between the social world of illness and the naturalized world of the biosciences. Like other such mediators in Lévi-Strauss’s (1983:292) phrasing, the environment both “averts total disjunction” and “its presence is also interposed, [such that] it obviates the risk of a total conjunction”: Without the connection between the biological and the social created by adding “the environment,” the genome risks remaining outside any social significance, irrelevant to issues of racial inequalities, the spread of disease, and so on. And without the separation introduced by interposing this “environment,” genomics research might be considered to be claiming that the social sphere of illness and inequalities are reducible to the genome, which would make such work seem absurd.

Seeing the environment with a Lévi-Straussian lens reveals inadequacies of formulating gene–environment as encompassing the range of determinants of health. Recognizing the contradictory meanings of myths takes us away from standardized ways of talking about variation, like range, continuum, and spectrum. These concepts tend to flatten differences by reducing the plurality to a single criterion used to differentiate, muting other forms of contrast and connection. Mediators—such as the environment here or the possum for Lévi-Strauss (1983)—reveal the plurality of relational distinctions. Environment, like Lévi Strauss’s possum, does not make sense on a scale. Instead, these figures are what allow a scale to be made.⁷

The possum, like all mediators for Lévi-Strauss, reconciles a contradiction by being the object that can cross a categorical boundary: in the case of the possum, decay and cultivation; in the case of environment, the static, arcane, abstracted biological world of the genome and the social, political, economic world of illness, inequalities, and the burden of disease. These terms can have multiple meanings and therefore myriad effects, giving them, as all myths, their facility. But their use is not free play: This is not social construction, but instead operations (always) within systems of meaning, in the exchange that constitutes gene–environment research as a public health endeavor.

In science, as elsewhere in James Boon’s phrasing, “the foundational dialectics of exchange [are] inherently deflected toward diverse destinations” (1990:137). Gene–environment researchers posit a population with a biological predisposition that emerges in the particular environments experienced by that population. This inclusion of

environment as an open signifier makes for a bioscience that runs counter to any individualized liberal subject posited at the heart of biomedicine or genomics. Instead, the genomic science is considered relevant to the social problems that have historically come under the purview of public health—racial health inequalities, socioeconomic housing conditions, exposure to toxins.

The environment in gene–environment research allows a claim for genetics to be relevant to social concerns. The result is an object that only exists at the moment of its formulation as a domestic space for genetic fate to play out. The Bajan medical practitioners and participants have views of asthma, ethnicity, and environment that are contrastive to the study, at times intentionally.⁸ For Bajan medical practitioners and families, genes are not the fate envisioned by the genetics researchers but a high-tech way of interpreting the environment as modern miasma—a method that turns the modernized chemicals and dust causing asthma into a domestic modernization. The exchange between Johns Hopkins researchers, Bajan medical practitioners and officials, and participant families constitutes a contradictory environment that is shifting the meaning of genes as relevant to public health. Asthma transforms from a condition brought on by the poisons of modernization to a home environment interacting with those abstract objects called genes.

“Environment” in gene–environment studies gives new life to the genome, supplementing the lack at the heart of simple searches for genes for common diseases.⁹ This environment makes genomic research circulate in current bioscience, conferring relevance on gene–environment research to public health, to racial disparities, to medicine. In Barbados, this constitutes an intervention on that disease of modernization, asthma, that reconfigures the illness as a biological racial predisposition brought to fruition in the tropical home, requiring genotyping technologies to grasp: that is, an environment particular to the strange technological world of genomics.

Notes

1. Lock et al. write:

Many studies reinforce the inconclusiveness of current understanding about AD [Alzheimer’s] genetics. As these findings accrue, they give the distinct impression that too much weight has probably been given to the contribution of the ApoE gene at the expense of considering environmental, social, and political factors that are known to be implicated but are poorly researched. [Lock et al. 2007:260]

2. Shostak (2005) argues that this research emphasis on the environment interacting with genes places the gene within its context, and so avoids the reductionism of a purely biological focus. She attends to potential pitfalls of gene–environment research—to biologize, to individualize. But she reads the potential for a kind of holism in the possibilities of gene–environment research. Here, I use nature/culture distinction instead to show that this is always a relational division, carrying a particular cultural interpretation of the environment, and, for that matter, biology.

3. For anthropological analyses of the subjectivities of scientists as they create knowledge and new configurations of scientific, economic, and social trajectories, see Bliss Forthcoming; Fullwiley 2007; Gusterson 1996; Helmreich 2007; Lock 2005; Montoya 2007; Rabinow 1996, 1999; Rees 2010.
4. A contrast also inheres in the medical diagnosis of asthma in Barbados versus family ideas of wheeze (see Whitmarsh 2008b). As elsewhere, ambiguities inhere in biomedical meanings of asthma and are accentuated as these meanings intersect with parental understandings (see Schwartz 2004).
5. As Lock et al. (2007:272) argue in the case of Alzheimer's (contrary to conventional wisdom), genes can work to create and maintain uncertainty—the interactions between medical practitioners and families around Alzheimer's genes reveals expanding unknowns, toward prognosis, risk, and the “tentative state of current scientific knowledge.”
6. Here, health policy practice reveals the state as a fractured and internally contested set of techniques (see Morgan 1989).
7. Lévi Strauss writes:

The opossum being ... the reverse pattern of absent agriculture, was an indication of what its future form would be, and at the same time, ... it is the instrument whereby men obtain agriculture. The introduction of agriculture by the opossum is therefore the result of the transformation of a mode of being into its converse. A logical opposition is projected in time in the form of a relation of cause and effect. What creature could be better suited than the opossum to reconcile the two functions? Its marsupial nature combines antithetical characteristics, which become complementary only in it. For the opossums is the best of wetnurses, and yet it stinks. [1983:183]

8. I call such reciprocal interpretations a medical schismogenics (see Whitmarsh 2009b).
9. This new significance and life can also be attributed in the reverse direction: Shostak (2005) finds toxicologists, anxious about their discipline becoming obsolete, “molecularizing” by embracing genomics in the new field of toxicogenomics.

Arribas-Ayllon et al. (2010) find a similar life given by the multivalence of complexity in psychiatric genetics: They argue that using complexity to understand the morass of genetic and environmental causes allows researchers to rescue methodologically problematic research from the past and account for lack of findings today.

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