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by

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Committee in charge:

Professor Cori Hayden, Chair
Professor Vincanne Adams
Professor Lawrence Cohen
Professor Wen-Hsin Yeh

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Abstract

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Based primarily on fieldwork conducted over one year in Beijing and Nanjing, two centers of scientific research and environmental activism in the People's Republic of China, my study explores the ways both scientists and social scientists envision and establish the relationship between exterior environmental problems and interior reproductive health concerns. I argue that during investigations into the quality and quantity of sperm in contemporary China, scientists both examine and produce toxic 'environments' of exposure. Toxicologists find that their research subjects embody China's history of industrialism and rapid social change**,** which become investigable through genetic and epigenetic studies of sperm. Through interviews with faculty and graduate students at multiple universities, participant observation at reproductive toxicology laboratories, and interviews at environmental activist organizations, I explore the way experts and activists bring Chinese environments into being, and the way these environments are found to correlate with changes to reproductive health in China.

Reflections from fieldwork have been brought to questions of interest within anthropology more generally, including the definitions and relationships between nature and culture, the universal and particular, the individual and the collective, as well as the body and what stands outside it. Each chapter is concerned with how anthropologists today make sense of interiors and exteriors, content and context. I bring these concerns first and foremost to scientific practice, using the methodology of those I study as a guide for what an anthropology of sperm (and perhaps the body and illness) might look like. In particular, I argue that epigenetic studies of male infertility and birth defects use sperm-environment interaction as a means to understand the biological impact of social processes on the body. The infertility of a toxic Chinese environment, whether brought into being in the laboratory or conceptualized as a devastated national landscape, is understood as correlated with the infertility of male Chinese bodies. Scientists are, then, embracing an understanding of biosocial problems that transcend both biological causation and individual responsibility to enable a form of social critique that takes

seriously the epistemological and ontological stakes of thinking environmentally across bodies, generations and domains.

Second, I bring these concerns of interiors/exteriors, content and context to questions of scientific translation, asking: how do scientific findings move between transnational, expert and disciplinary domains, even as these contexts (or environments) are brought into being through scientific practice? I argue that scientific practice in China today is effective at translating between domains because of, not in spite of, the toxicity and ambiguity of the environment. Toxicity allows science to proceed, even as reproductive toxicologists work to expose the damage that accompanies toxic exposure. Understood as multiplicity, the ambiguity of the environment benefits scientists, who meet multiple ethical and material research demands. The environment's ambiguity also facilitates an indirect environmental activism, which strives to evoke public attention toward environmental destruction through correlation, not causation. Here, the political stakes of correlative findings prove as if not more powerful than causative evidentiary claims.

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these most important issues of health and happiness in the futures of both our countries. You have my utmost respect for the honor you bring to your work, and the time you have committed to investigating reproductive health.

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C O N T E N T S

Introduction

Only a few weeks into my 2011 fieldwork in the People's Republic of China, I sat on a couch in the office of a university administrator. The steam from a hot cup of tea stung my nose, not from the fragrant smell but from the contrast in temperature. It was January and snow fell outside. The warm office at the medical school where I hoped to secure a secondary research site provided solace from the streets, and from the supposedly heated apartment where I was staying temporarily upon arrival in Nanjing. For ten minutes I waited—half listening to the telephone call my host was wrapping up, half scanning his wall of books for insights into his past life in bioscientific research—when I heard him shift registers. "Okay, tell me more about your research." Two sentences into my practiced yet vague description of my interest in Chinese male infertility, he stopped me. "I've been wanting to talk to someone like you, someone who might be able to tell me how can I get students like you, students from abroad, especially from America, to enroll in this program." The program this administrator wanted to discuss was a three-year training course resulting in a medical degree. The question he was calling on me to help him answer was, he thought, more complicated than it seemed.

The administrator continued. There were plenty of language students, college kids studying abroad, but the value of a medical degree from a top university in China was yet to translate to the United States or Europe. Moreover, while short-term visiting scholars were common, attracting permanent faculty from overseas was an uphill battle. Over lunch at the cafeteria we started to brainstorm – what might draw international students and faculty here and what would make them stay? My first answer to his question was decidedly not right. Even as I began to suggest traditional Chinese medicine as a potential draw for U.S. students, my words felt dated and fell flat. University administrators were looking to do more than simply attract foreign students and faculty to study "Chinese culture" or "traditional" Chinese practices, medical or otherwise. Administrators were looking to highlight what today's China offers as a unique environment to study bioscience and biomedicine, in which research opportunities, employment possibilities and scientific resources are abundant in both quantity and quality.

At that moment, only a few days into fieldwork, I did not know how a university administrator in an urban center of China might attract U.S. graduate students or faculty to their laboratories and their university lives. A few months later, after working and speaking with physicians and scientists from different universities within the city of Nanjing, and after observing how scientists craft, package and conduct research projects on the human health impacts of rapid social change, I could have answered his question quite differently. Or at least I could have told him whom to turn to for more informed answers to his question: the research scientists at his and other universities. Many of the scientists I met while in China are striving to enter a transnational research scene based on collaborations, publications and joint-funding mechanisms that both utilize and produce "a Chinese environment." Understanding and bringing these Chinese environments into being was a large part of the hard work conducted by the reproductive toxicologists among whom I conducted fieldwork, who were committed to making their science speak to national and transnational audiences.

This dissertation is an exploration of the Chinese environment as it is brought into being through research on male infertility. No clear evidence exists for above average national male infertility rates in China, however the diagnosis, treatment and research of male infertility centered around sperm quality and quantity has dramatically increased in

the country since Reform and Opening policies began in the late 1970s. Alongside other reproductive and sexual concerns (Zhang 2007), infertility is an increasingly diagnosed condition and an area of anxiety for Chinese men and women alike (Lee and Chu 2001; Handwerker 1998). Birth planning restrictions put in place in 1979 have exacerbated the pressure on infertile couples and have led to the rapid uptake of Assisted Reproductive Technologies (ARTs) (Greenhalgh 2008; Handwerker 2002).[1] While the use of ARTs might increase attention to male factor infertility, as many discover during treatment processes that it is as common as female factor infertility, this study moves away from a focus on treatment and patient experience to focus on the ways infertility is being researched, especially within toxicology and within China.

In China, sperm has become a site for investigating the link between development and environmental destruction today and the country's future fertility. In Chapter one, *Sperm with Chinese Characteristics*, I explore sperm as a barometer for the environment in contemporary China, an indicator of rapid social change, and an archive of toxic exposures impacting the country since reform and opening policies (*gǎigé kāifàng*) began over 30 years ago.[2] I argue that reproductive toxicologists see the biological object of sperm as a materialization of the social problems confronting Chinese environments today. Furthermore, while sperm studies emphasize the threat of human and non-human infertility, they are also a means through which scientists generate knowledge and knowledge practices in a growing scientific research environment. China's future is, then, imagined through what male infertility both makes possible and impossible.

In Chapter two, *The Promise of Toxicity,* I argue that the infertility of the environment, understood through toxic exposures, also makes space for the pursuit of research. This research relies on a resource seen as uniquely Chinese – the vast amount of pollution and toxicity that exists in China. Faced with rates of pollution, pesticide use, and toxic waste that far exceed other countries, reproductive toxicologists highlight the risk of high-level exposures faced by their research subjects. Yet they also strive to capitalize on the toxicity of their research environments and subjects (Petryna 2002), using the quantity and degree of exposures to their advantage. While most social science research on China's environmental problems interprets industrialization's detrimental effects on the environment as a burden (Banister 1998; Economy 2010; Shapiro 2012; Smil 1993), to many biological scientists in China today toxicity becomes a unique environmental resource through which they pursue international scientific research. The Chinese environment – understood as a landscape, nation or population with unique levels of toxicity – can be understood, then, not only as a challenge but as a resource in itself. Infertility and toxicity are as much an impetus for research as they are the conditions through which research is pursued.

Chapters three and four speak through the particularities of research being conducted in a toxicology laboratory in the center of the city of Nanjing, located in Jiangsu province along the eastern coast of the People's Republic of China. Formerly the

[1] The ramifications of this policy might be reconfigured by the November 2013 announcement of the extension of the two-child allowance to couples in which one parent is an only child. This allowance was previously reserved for couples in which both parents were only children.

[2] The concept of an object as a barometer of environmental change comes from Brett Walker's (2013) comments on Hugh Raffles' *Insectopedia*, presented at the 2013 Society for the Social Studies of Science Conference.

country's capital, today over eight million people, many of whom are students studying in one of over 25 universities, live within the ever expanding city limits of Nanjing. This city was the primary site of the 1937 Japanese invasion that resulted in hundreds of thousands of deaths – a statistic that is much debated. The pace of killings during Japan's successful attempt to seize the city was undoubtedly swift, and the tactics used by the Japanese army to kill and torture Nanjing residents were brutal. At the Nanjing Massacre Memorial in the city's Jiangdong district, which I visited in 2011, video testimonials from now elderly victims force visitors to come face to face with the details of rape and brutality suffered during the massacre. Girls as young as 11 years old were raped repeatedly while families stood nearby, barely able to protect themselves, let alone their loved ones. Women and girls dressed as men and boys in an attempt to dissuade soldiers from using rape as a weapon of war. As I stood in the memorial listening to the stories of sexual violence being told by women in their 90s, female visitors lingered at this section of the exhibit while their male counterparts quickly shook their heads in disgust and moved on. Inhaling over gritted teeth and exhaling with a muted exclamation of exasperation (*aiyo),* I was struck by the reaction of women to the recounting of rape during those weeks in 1937, a time that in many ways seems a world away from the Nanjing that exists today.

Today Nanjing is better described as a large and growing provincial capital, a place where foreign and domestic companies expand their reach within China. People from all over the province and poorer nearby provinces make their way to Nanjing, where job opportunities are abundant, even while property prices and other cost of living expenses are on the rise. Although not as stark as in Beijing or Shanghai, the gap between rich and poor can be seen by watching thieves slyly pluck smart phones and handheld video game consoles from the pockets of university students who naively stroll down the main drags surrounding Nanjing University. One can also see this gap by watching the variety of consumers in a mere three-block radius, visible from the window of my 30th floor apartment in downtown Nanjing. On Saturday nights, groups of migrant workers from the neighboring construction site would dine together at a nearby noodle stand that served soup bowls for six Yuan, approximately one U.S. dollar. Earning around 200 Yuan per month, this was their weekly break from round-the-clock construction efforts.[3]

Inside the construction area migrant men worked and slept in makeshift homes, the only foundation being the metal beams that would one day support the skyscraper they were helping to build. Outside the ten-foot high perimeter erected around the construction site, days and nights transformed the city from old to young, from families and professionals to groups of college students. Droves of these students crowded the city center on weekends, strolling in between downtown's many malls, most of which are connected through elaborate underground walkways that also connect to the subway. Shopping, eating, drinking fresh juices and milk teas, accompanying friends through the commercial buildings above and below ground – these activities made weekends downtown a simultaneously suffocating and marvelous experience for someone who grew up in a rural area, including me. Between the migrant laborers and myself, the asymmetries were also obvious. I watched them work from a skyscraper next door, while

[3] This salary estimate draws on the work of Julia Chuang, who researched migrant workers and labor-law reform in Beijing (Cockrell 2008).

it was impossible for them to watch me in the 30th floor apartment where I lived or the university laboratories where I conducted fieldwork.

When I arrived in Nanjing in 2011 to begin long-term fieldwork, I had already been to the university campus where I would conduct research. During a preliminary visit I had met with a group of students about to graduate from a clinical program in reproductive endocrinology. They would soon transition to jobs at infertility clinics in hospitals throughout Jiangsu Province. But during their last summer on campus they were happy to discuss the costs and regulations involved when treating infertility with ARTs such as *in vitro* fertilization or intra-uterine insemination in China. We met at the laboratory where reproductive substances from infertility patients were inspected and prepared for procedures. I was told about the costs and restrictions on infertility treatment – the mandated health inspection for married couples (which has since been removed), the lifestyle adjustments that were highly recommended if not required before biomedical treatments (stop drinking, stop smoking, try Chinese medicine). Like other rooms within this new building, the laboratory where we discussed ARTs was sparkling clean: the stools where we sat a shiny black pleather, the sink a glistening stainless steel. I felt like I was back at the fertility clinic in New York City where I had worked before entering graduate school. Comparisons between ARTs in the two countries came easy.

However, when I eventually made it back to the university in the winter of 2011, my research site had changed. Nanjing was cold, inside and out, covered in a light blanket of snow instead of the thick humidity of summer. But it was more than the weather that moved me. I was now working with students and professors in the department of toxicology and the building, disciplinary motivations, and the object of study – infertility – were each different on this side of campus. The first time I was taken up the stairs to the second floor department I was told, "this is an old building." As I climbed the stairs I took note of the difference between this department and the revenue-generating treatment center across the road. But even with the rotting floor tiles, soiled windows and moldy ceilings, the research conducted by this reproductive toxicology program was certainly cutting edge. In fact, it was one of few groups in China conducting epigenetic research on male infertility.

Today scientists from an array of disciplines are conducting epigenetic research that takes "environmental factors" as exposures impacting the genes of populations and those who inherit them. How these environments are imagined and brought into being in epigenetic reproductive toxicology is the topic of chapter three, *Enacting Environments*. As a way of thinking through how objects are brought into being in a variety of ways, I find Annemarie Mol's concepts of *enactment* and *coordination* especially useful.[4] Similar to Judith Farquhar's work on non-biomedical practitioners of Chinese medicine, Mol shows how biomedical practitioners bring multiple bodies into being even as they discuss a single patient or disease. This body multiple is "more than one—but less than many" (Mol 2002:55) and is enacted or brought into being through the observation,

[4] Additional texts which have helped me think through onto-epistemological multiplicity in practice include Judith Butler's *Bodies that Matter: On the Discursive Limits of Sex* (1993), Judith Farquhar's *Knowing Practice the Clinical Encounter of Chinese Medicine* (Farquhar 1996), Shigehisa Kuriyama's *Expressiveness of the Body* (2002), Thomas Laqueur's *Making Sex: Body and Gender from Greeks to Freud* (1990), and Anne Fausto-Sterling's *Sexing the Body: Gender Politics and the Construction of Sexuality* (2000).

experimentation and examination practices. Each body is a different variety than the other, yet Mol shows how coordinating activities make varied enactments hang together, creating "the body multiple." In my work, I am thinking through the ways in which research scientists, led by professor Zhang Zhiyuan, [5] coordinate the multiple environments they enact. Zhang is motivated to research gene-sperm-environment interaction because of concern about the "environment" as a location within China rife with pollution. He also brings into being more specific environments: chemical exposures that interact with genes and sperm during laboratory research on animals. These multiple environments hang together, coordinated and correlated through activist pursuits in a manner that allows research to reach audiences outside the confines of the laboratory. Zhang conducts research that takes questions of sperm and reproductive health not only to the environment enacted through particular chemicals associated with industrialization, but also to the environment enacted as an object of more general ecological concern.

Whether studied through mice or humans, at the heart of reproductive toxicology is an understanding that bodies and biological substances interiorize "the environment" in all its complicated forms. Many of these environmental factors overlap with what medical anthropologists have deemed the social determinants of health (Rapp 2005). In Chapters three and four I explore anthropology's hesitant excitement about the biological sciences' incorporation of social forces in health research through epigenetic research, which considers changes in the way environments beyond the gene impact genetic information in present and future generations. Popular and academic understandings stress how epigenetic research reworks the divide between nature and nurture. But alongside the divide between nature and nurture, a dichotomy between the individual and society is also at stake in epigenetic thinking (Strathern 1991). In Chapter four, *Infertile Futures,* I discuss this issue through contemporary birth cohort studies of Hirschsprung's Disease, where relatedness between human bodies is created through *in utero* environments. In spite of the gendered nature of such research, these studies afford anthropologists the opportunity to think through modes of non-individualistic responsibility for sustaining fetal health that are both new and familiar.

The final chapter, *Fishing for Affinity,* explores how environmental activists at Greenpeace Beijing unexpectedly brought about the regulation of nonylphenols (NPs), a class of endocrine disrupting chemical commonly used in the production of textiles and household products in China. The success of the campaign and the regulation of NPs relied on correlations – or affinities – in a number of ways. First, scientific evidence of correlations between chemicals and transformations in gendered anatomy were drawn upon as evidence for the damaging effect of "gender-benders." Second, this notion of chemical gender-benders was correlated with a growing presence of gender-bending or androgynous humans in urban China. By relating intersex fish found in China's Yangtze River to the growing number of rapidly maturing and androgynous Chinese youth, activists traced and thereby produced a fear of "gender-benders" – chemical, fish and human. Finally, correlations were cultivated through a series of inter-species analogies. By indirectly connecting gender norms and anxieties between species, and intentionally

[5] In light of human research subject protocols and privacy concerns, the names of the scientists, activists and friends whom I conducted research with have been changed and their affiliations made anonymous. Due to the specific nature of the scientific research discussed, some details of experiments and studies have also been changed.

conjuring an ontological collapse between species, environmental activists successfully created a media blitz that disrupted the changing political and moral landscape of contemporary China. This *indirect activism* based on the cultivation of correlations or affinities led to an environmental policy change in a country where direct action is certainly discouraged and often ineffective. Learning from the correlations through which science and activism move, my project attempts to conduct a kind of medical anthropology that moves away from a preoccupation with causality, which tends to presume a human that stands apart from social/physical environments that do harm.

From Causation to Correlation

A logical fallacy commonly referred to within statistical or scientific analyses is that correlation does not equal causation. This phrase suggests that correlations are less forceful or convincing explanations of the relationship between two entities than causations. In studies of sperm decline, and perhaps increasingly in epigenetic research (Fullwiley 2013), causation is not the central focus. Exactly which chemical toxin causes sperm decline is a question that might never be answered with so much certainty. It is what we do with this uncertainty that is truly at stake, at least in the thinking of Zhang Zhiyuan. Professor Zhang is very comfortable with the complicated mess of exposures that exist in China, most of which will probably never be understood as the specific cause of infertility. This, however, does not stop him from doing research because more than just finding the specific cause, Zhang is interested in the ways things correlate.

The term "correlative thinking" has been used in studies of Chinese philosophy to describe a mode of thought based in analogies, associations and affinities (Hall and Ames 1995:295).[6] In my research I am not arguing that Chinese scientists in particular, opposed to Western scientists, engage in correlative thinking.[7] Nor am I arguing that correlative

[6] Attempting to understand "whether, perhaps, [the ancient and traditional thought-system] contained something characteristic of the civilization which produced it," Joseph Needham (1978) provided one of the most famous accounts of correlative or associative thinking (a term he credits to modern sinologists before him) in his *Science and Civilization in China*. Drawing on descriptions of primitive magic (presumably from early anthropologist Sir James Frazier's *Golden Bough*), Needham describes correlative thinking as distinct from modern science (and more like magic) in that it operates through a logic and order with internal laws of cause and effect, not an emphasis on external causes. He writes, "Things influence one another not by mechanical causes but by a kind of induction effect" (Needham 1978:163). Elaborating on this comparison, Needham oversimplifies the same historically complex, richly ordered, and shifting tendencies of Chinese thought that he also describes, to make the argument that has perhaps become his most known and controversial. Primitive thought, he writes, can progress in one of two ways: the way of the Greeks or the way of the Chinese. The way of the Greeks, which goes on to form the basis for modern science, leads to a mechanical view of the universe. The way of the Chinese is to view the universe as an organism, as a system of events and things where different parts are mutually influenced by structured patterns (Needham 1954:166). If in Greek thinking, a particle occupies a certain space at a certain time because it was pushed there, in the Chinese system, "the particle's behavior was governed by the fact that it was taking place in a 'field of force' alongside other particles that are similarly responsive: causation here is not 'responsive' but 'environmental'" (Needham 1954:166). Here, environmental thinking relies on correlation between parts—not a call and response, but an echo.

[7] In fact, the distinction between these two types of scientists is itself not always clear. Andrology and reproductive toxicology were brought to China from the West through specific training and research exchange programs, and the later generations of scientists who practice reproductive toxicology today publish internationally and interact with the U.S. and Europe regularly, even while addressing and being motivated by issues of national concern.

thinking more generally is exclusive to Chinese philosophy and science. I am arguing, instead, that for those reproductive toxicologists I studied the inability of sperm-environment interaction studies to prove causation is not a problem. Whether part of an emerging trend in epigenetic research, or a tendency specific to a disciplinary specialty where one's toxic objects of study are notoriously complex (Fortun and Fortun 2005), Zhang's research does more work by making things correlate (or bringing things into relation) than it does by proving causation (that one thing came after another). The ambiguity afforded by correlations works to the advantage of reproductive toxicologists in China who hope to transform the levels of toxicity and rates of infertility in Chinese men and the Chinese nation more broadly. Even when precise causes cannot be identified, the scientific findings of Zhang's lab and similar laboratories are able to circulate in environmental activist and media circles (as discussed in Chapter 5).

In this research correlations are not only between insides and outsides, but also biological and social conditions. Ayo Wahlberg has investigated the emergence of the problem of infertility in China over the last few decades, arguing that "in urban China nature and society remain infused" (2014:194). Wahlberg speaks to the ways in which problems of biological infertility are always also imagined as social problems in China – related to social habits, psycho-social issues, or the degree of participation in societal transitions. In this dissertation I make a similar claim, however my work problematizes the notion that the understanding of nature as infused with society is a uniquely Chinese way of viewing infertility. Instead, I think of biosocial understandings of infertility as tied to trends in epigenetic research practices that problematize a strict divide between nature and nurture, as well as individual and society. I argue that epigenetic research, with its focus on the power of correlation amidst toxic uncertainty,[8] has a political efficacy in China that it may not in the United States (see Chapter five). I also argue that the challenge epigenetic research practices pose to nature/culture binaries might not be as revolutionary in China as often thought to be in the United States because of different histories of genetic thinking and scientific practice (see Chapter four). I am not, however, arguing that a science that takes seriously the social nature of biological problems is more likely to be found in toxicological research conducted in China than elsewhere.

My research builds on Wahlberg's findings, however, to suggest that the reflection on social problems through the biological condition of infertility goes even

[8] I take this term from Javier Auyero and Debora Swistun (2008), however, I use the term differently. Aureyo and Swistun use *toxic uncertainty* to describe how residents of an Argentinian shantytown (actually named Flammable) make sense of pollution. They suggest that residents cope with toxic conditions by creating uncertainty around them, even in the face of concrete evidence of detrimental effects. This work is similar to that of Adriana Petryna (2002) in the sense that in both uncertainty is produced by the economically and politically vulnerable in order to deal with conditions beyond their control. In Petryna, "survivors" utilize uncertainty to negotiate entitlements from the new Ukranian government after Chernobyl. Without uncertainty the means through which entitlements are granted would be more cut and dry, and many who suffer for reasons that exceed demonstrable nuclear exposure would not be able to secure the economic or healthcare benefits that come from being qualified as a "survivor". Of course, the productive potential of toxic uncertainty might be used by a variety of actors, not just the suffering. Michelle Murphy stresses the urgency of social science research that transcends boundaries of body and nation in order to assess the complexity of exposures, especially because complexity is sometimes strategically asserted by chemical companies to enable uncertainty about harmful effects to continue (2008).

deeper than individual concerns about social roles and psycho-social adjustment. The problems that accompany biological infertility are at an "environmental" scale – where the (potential) infertility of one's physical, economic, political and social surroundings do not influence but correlate with the (potential) infertility within male bodies (see Chapter three).[9] Among the reproductive toxicologists I studied, male infertility is being conceptualized as a disease that brings what might usually be thought of as "social problems" into the bodies and biologies of Chinese men and women. Furthermore, my research looks at the ways in which male gendered bodies, both animal and human, are engaged in experiments and studies that focus on sperm as an indicator of fertility within bodies, and within China more generally. My project analyzes reproductive toxicology's research focus on men as the victims of disease without locating the burden for disease on individuals. When lifestyle factors do enter the picture, these factors are generally attributed to an environment of rapid social change more than the responsibility of the individual male, or even females. The dissertation considers how, not only the boundaries of nature and nurture but also individual and society are being remade through epigenetic research practices, particularly through chapter four where I take up the case of birth defects, in which the Chinese environment impacting genetic health is a person.

From Subject to Object

Many anthropologists have written about Chinese medicine or Traditional Chinese Medicine (TCM) (Farquhar 1996; Kleinman 1981; Zhan 2009), the Chinese body and health (Kohrman 2005; Zhang 2007), and bodily practices in China (Chen 2003; Farquhar and Zhang 2012; Farquhar and Zhang 2005). There is also a large amount of anthropological literature discussing Chinese birth planning regulations, addressing the intersections of economy, health and policy around questions of reproduction (Mueggler 2001; Greenhalgh 2008; Anagnost 2004). China's important role in biosciences has been less studied, although with increasing exceptions. In 2007, a journal specifically on East Asian Science and Technology Studies based out of Taiwan was launched to explore science and technology in East Asia, a geographic area and analytic category whose usefulness is itself questioned (Fu 2007). Shortly after this journal was launched, the first edited volume specifically on "Asian" biotechnology was published (Ong and Chen 2010). This volume includes important works on Chinese genomics (Liu 2010; Sung 2010), blood donation (Adams, Erwin, and Le 2010), and genetically modified foods (Chen 2010). These publications point to a growing body of social studies of science research in and about China.

Although little anthropology of China specifically focuses on science, common themes provide impetus for my own. In a moment of anthropology highly influenced by

[9] In the article "Environments Within," Marilyn Strathern shows that: "On the one hand, scale matters: to perceive the effects of human activity on a world imagined as an outside or encompassing environment is to take responsibility for such actions. It is equally the case, on the other hand, that scale does not matter: imagining the dimensions of that responsibility draws, as it were, the environment within ourselves" (Strathern 2013). Zhang holds multiple versions of the environment together which allows his research to connect up with audiences both within and outside the sciences, and speak to the multiple circumstances – academic, chemical, ecological and political – that drive his research. These environments are coordinated with one another, and make their mark on policy through correlation. Here, correlation is a means of understanding responsibility without relying on cause and effect or individualization.

Michel Foucault, the transformation of subjectivity has become a frequent focus of ethnographic work in general, but especially in geographic locations undergoing rapid change. This is certainly true of the anthropology of China. Here, the emphasis on subjectivity has led to important work that might be extended by considering the ways reproductive toxicologists are thinking of subjects and objects, the biological and the social, in tandem. Many anthropologists study the effects of social change on people, arguing that economic and political shifts have brought about a post-Mao era of changed lifestyles, habits and attitudes. Recent scholarship often focuses on new forms of privatization, and the ways in which consumer and lifestyle aspirations have become a means of adjusting to economic and political changes, while distinguishing oneself from those citizens excluded from such processes (Rofel 2007). Other works argue that tradition, Chineseness, or even just a Chinese sense of self is not something that can be lost in the rush of change, but that can be used – even in its negativity – for the specific purpose of negotiating identity, economy and status in the contemporary Chinese world (Kipnis 2006; Rofel 2007; Ong 2006; Ong 1999; Yang 2002). Such assessments introduce an important instability and contingency into social scientific accounts of China or Chinese culture as a knowable object or force affected by structural change in predictable ways. Here, culture is a process instead of a thing. Furthermore, culture is also what Mayfair Yang refers to as a "resource" (2002:459) – an identity with specific applications in post-Mao China that might not be claimed if it weren't for its purposefulness. These accounts of subjectivities show how Chinese change affects the level of the psyche and identities, whether for psychological or pragmatic reasons.

My research brings recent scholarship in the social studies of science focused on object-oriented ontologies and materiality to this anthropology of Chinese subjectivities. Lack of attention to the role of objects in the production of subjectivity reconstitutes the divide between material and social worlds as well as the sciences that study them (Barad 2007; Haraway 1991; Grosz 1994; Mol 2002; Murphy 2006). My research, first, shows the ways scientists view humans as inextricably tied to non-human objects by making the particular objects of rapid social change (plastics, chemical pesticides, industrial pollutants) the focus of research, and stressing the unfortunate impact such materials might have on reproducing citizens. Second, I show that in reproductive toxicology, especially epigenetic studies, objects such as the environment are brought into being within research subjects, creating inner landscapes of exposure. Sperm studies show how China's recent history of industrialism and development enter into science at large and sperm in particular, both literally and figuratively (Haraway 1991). By taking seriously the ways in which contemporary reproductive toxicologists consider the role of objects in the transformation of bodies and diseases in China today, I press anthropologists of China to consider the important role non-subjects play in the understanding and treatment of human disease.

While those mentioned above are largely concerned with post-Mao subjectivities, Judith Farquhar's research has consistently focused on both subjects and objects through attention to practice. She points out that in practices of Chinese medicine (*zhongyi)* objectifications are recognized as the necessary means through which diseases are momentarily knowable (1991).[10] Farquhar concludes that the primary difference between

[10] Note that this insight also applies to "Chinese medicine," which is not something that Farquhar considers a stable or singular entity.

Western and Chinese doctors treating infertility is that Chinese doctors, "neither strive to achieve 'objectivity' nor dwell upon objects" (1991:374). Accordingly, observations and tests "are of little significance in themselves" (Farquhar 1991:374). My research brings Farquhar's insights about Chinese medicine to bioscientific practices, exploring momentary and multiple objectifications of the environment in studies of sperm-environment interaction. Here, unlike in Chinese medicine, momentary objectifications (which might also be called reductions) are significant in that they lay the groundwork through which scientific findings and publications might be produced. However, because these objectifications of the environment are also multiple they are not dwelled upon in singularity, but made to speak to other forms of the environment, both big (national ecological devastation) and small (*in utero*). While not a particularly Chinese mode of science, this environmental multiplicity does have specific effects within China. An unpublicized environmental concern that exceeds the laboratory motivates scientists to enact reductionist environments within the laboratory that might lead to publications, press and future studies, a finding I explain further in Chapters four and five.

From Treatment to Research

Likely due to its large population and strict birth planning policies, social scientific attention to reproduction in China often concentrates on the quality and quantity of populations, citizens and children in the post-Mao landscape. As I discuss in the first chapter, concerns about quality (translated as both *suzhi* and *zhiliang*) transcend human and non-human domains, showing the way the quality of the Chinese nation is figured in the quality of its population (Anagnost 2004). This relationship between the reproduction of the nation and the individual is also obvious in nations with declining birthrates (Krause 2001). Here, national policies make the reproductive motivations of the state overtly clear, which Lynn Morgan and Elizabeth Roberts (2012) have deemed *reproductive governance*. Processes of bio-medicalization also link reproduction to state and economic power, where gendered national expectations are embodied by patients of infertility and fertility treatments **(Clarke 1998; Franklin 1997; Rapp 1999).**

As with demographic concerns, concerns about infertility are about more than individual reproductive decisions and actions. Ann Laura Stoler has shown that European magistrates' concern about women's sterility was entangled with concern about cultural reproduction and political viability in the colony (2002:72–74). Here, infertility is more about the inability to fulfill a national duty as it is about the ability to secure a gendered sense of self through achieving reproductive norms. Infertility, in particular, is a social and medical problem that latches onto female bodies, as discussed by Stoler. In the words of Frank van Balen and Marcia Inhorn, "Infertility, the world over, remains largely a *women's* problem" (2002:19). For both symbolic and material reasons, ARTs have become a *locus classicus* for proving this point. As stated by Margarete Sandelowski and Sheryl de Lacey, when it comes to treating infertility "females are often the objects of treatment because of the dearth of treatments that apply to male bodies"(Sandelowski and De Lacey 2002:36). In infertility clinics, diagnostic practices and treatment procedures such as intrauterine insemination (IUI) and *in-vitro* fertilization (IVF) often focus on the female. Certain more complicated conditions related to male factor infertility -- such as retrograde ejaculate, varicoceles or azoospermia -- do require the use of surgical procedures in order to access sperm. But as Charis Thompson writes of IVF, "Regardless

of whether the man has been a patient or simply has to ejaculate at the right time, any resultant embryos still need to implant in the women's uterus, thereby obliging her to become a patient" (Thompson 2005:94). Despite this incongruity, social scientists have recently begun to explore the ways that infertility, while always gendered, is not necessarily experienced more, or more profoundly, by women.

Frank van Balen and Marcia Inhorn state that when it comes to the social sciences male experiences "represent the great uncharted territory in infertility" (Van Balen and Inhorn 2002:19)**.** Within the past decade, Inhorn and other social science scholars have taken up the topic of male infertility, which I address further in Chapter one. These studies tend to focus on the medical diagnosis and treatment of male infertility or the way men's experiences with or conceptualizations of infertility vary from infertile female subjects. My research also shifts attention from females to males, although primarily as the result of shifting concentration from treatment to research. This dissertation looks at male infertility from the perspective of scientists (reproductive toxicologist, in particular). Perhaps because of research scientists' ability to focus less on treatment and resolutions, here the stakes of infertility go beyond the individual's ability to reproduce, or even the family's ability to sustain a bloodline, to considerations of the fertility of the nation as an environment.

While I am contributing to research on male infertility, I also recognize the impossibility of studying male infertility without a broader reflection on reproduction or gender. My own study is both interested in the focus on males in toxicological research, as evident in my emphasis on sperm, and tries to assess the ways females are included and excluded in research.[11] Even when the studies conducted by toxicologists involved female animal or human subjects, males were always at the focus of the study and females were the vehicles through which mechanisms leading to infertility traveled. I am particularly struck by the gendered nature of toxicology research on infertility creates interesting contrasts in the study of reproductive roles and substances. Research on sperm (opposed to eggs or another female reproductive substance) is at the heart of some of the most pressing debates in reproductive toxicology (Perry 2008). Here, sperm becomes an indicator of environmental destruction that reproductive substances of the female body do not. Why would this be the case?

While the still relatively small field of andrology, the study of male reproductive health, was established in the 1970s, long after gynecology (Daniels 2006), the field of toxicology and its scholarly predecessors has been looking into the impact of synthetic chemicals on reproductive health for quite some time. Christopher Sellers (1997) discusses the 1910-1930 U.S. precursor to modern toxicology: the field of industrial hygiene, which investigated the effect of chemicals on primarily male laborers in the factory workplace.[12] Although much toxicological research is now done in laboratories to aid in the regulation of industrial and product safety (Fortun and Fortun 2005), perhaps the disciplinary history of focusing on mechanical and chemical hazards of industrial work has gendered effects (Murphy 2006:57). Current studies of male subjects continue to outnumber studies of female subjects in the field of toxicology (Gochfeld 2007).

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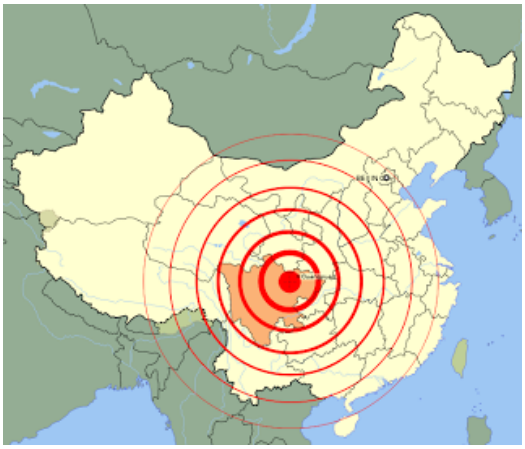
[11] My work also addresses the way gender norms and gendered bodies beyond male and female figure in scientific assessments of endocrine disrupting chemicals (see Chapter 5).

[12] Sellers sees the factory in these studies as an early form of the environment, and regards industrial hygienists as the pioneers of environmental health research.

Perhaps there is also something about the accessibility of sperm, as compared to eggs, that makes toxicologists more interested in males (Craft 2003; Daniels 2006; Hayden 1995). Sperm (unlike eggs) travel in and out of bodies with relative ease and are produced frequently enough to show the markers of varied environments. Often these environments are understood and materialized through endocrine disrupting chemicals (EDCs) and their feminizing effects. Feminization is often held up as the means through which disruption of the endocrine system occurs. This process links femininity to sterility, and ultimately reproductive failure. The surge in feminization research gets at yet another potential factor in toxicology's emphasis on sperm. Sperm counts and declines are often heralded as national issues that speak to the way that the masculinity of entire nation-states is threatened by male infertility, something that is perhaps more obvious in scientific research (opposed to biomedical clinics) due to the degree to which scientific and nationalist pursuits are so often intertwined.

Concentric Circles

The chapters herein are meant to be meaningful on their own. However I would prefer that they be understood as Fei Xiaotong described Chinese kinship: "similar to the concentric circles formed when a stone is thrown into a lake" (Fei 1992:63). This image of concentric circles has been with me since I visited China in the summer of 2008, during my first attempts at preliminary fieldwork in Shanghai and Chongqing. During this trip, I was struck by the way the May 12, Sichuan earthquake, which had resulted in the death of over 70,000 people, many of whom were children, resonated in the streets and conversations of these two cities. Newspapers continued to publish images of reconstruction efforts and maps of western China with concentric circles rippling out from the earthquake's epicenter at Wenchuan County.[13] I felt these ripples, even two months later, and I wondered how the aftermath of a similar event in the U.S. would have reached me.



Concentric circles have been used to describe the multiple scales of human relationships stressed in Confucian Chinese texts. The self lies at the center, then the family, community, country and eventually, all of humanity at the outer limit. Circles are not boundaries, however. Through cultivation one might move from concerns of the self to concerns of those greater circles to which one belongs, ultimately becoming one with humanity (Tu 2001:254; Smith 2009:81). But being one with humanity is not the end of cultivation's intent. Do the ripples in a lake formed when a stone is dropped suddenly, truly end? Ripples captivate because they are both contained by the surface of the water and transform it. As they travel they fade into the water, dispersing to the point of disappearance. But where do they go? They become again what they always were –

[13] Everett Zhang's (2013) is currently researching the varied structures of feeling present in and produced through reactions to the Wenchuan Earthquake in comparison to the Tangshan earthquake which occurred just months before Mao's death in 1976.

water, once more. In a similar sense, humanity cannot be the final ring of the concentric circles of a cultivated self. As Tu Weiming writes,

> If we stop at secular humanism our arrogant self-sufficiency will undermine our cosmic connectivity and constrain us in an anthropocentric predicament. The problem with secular humanism is its self-imposed limitation. Under its influence, our obsession with powerful mastery over the environment—to the exclusion of the spiritual and natural realms—has made us blind to ecological concerns. [Tu 2001:254]

Tu is struck by the analytic potential of the concept *tianrenheyi* for environmentalism and for the future of China. Other environmental activists share his enthusiasm (Zhang and Barr 2013), as do social scientists. Anthropologist Mei Zhan, for instance, has encouraged other anthropologists to consider the disciplinary stakes of taking seriously that heaven (also understood as Earth) and human are one (Zhan 2011).

I am also intrigued by an approach based on *tianrenheyi* as a means to understand the relationship between the body and the environment, between sperm and its contexts. However, my primary interest in the analytic potential of *tianrenheyi* and concentric circles comes from a comparison to dominant modes of modeling relationships in the West, for instance the Venn diagram. In this diagram separate circles overlap only at a certain point. As a model used to teach the ways in which two distinct entities have certain shared properties, the Venn diagram both reinforces and contests the infamous dichotomies of Western thought. Concentric circles, however, do away with dichotomy entirely, simultaneously including and excluding each other at each scale. Throughout the dissertation I have tried to test the limitations of nature/nurture, biology/culture, cause/effect and East/West dichotomies by keeping in mind the potential of different models. I hope to have created a work more akin to the ripples in Fei's lake than a diagram indebted to John Venn. Whether and how I make this intent clear is another matter. [14]

In the structure of the text itself I move through settings and scenes that grow increasingly interior beginning with a broad discussion of the relation between sperm and society in Chapter 1, then working through an idea of the environment as a toxic regional and national setting in Chapter 2. In Chapter 3, I move on to laboratory enactments of the environment, and then to the internalization and inheritance of environments in human and animal subjects in Chapter 4. The final chapter is a reflection on the interaction between scales. Here, I discuss the ways in which correlations between species are crafted in order to move knowledge through expert and lay communities. I hope this structure speaks to my broader interest in imaginations and reimaginations of interiors, exteriors and the connections between them.

[14] Arthur Kleinman also finds concentric circles useful to think with, and employs them in a diagram of the concept *health care systems*, which is meant to stress "the microscopic, internal, clinical view, but… does not ignore the large-scale external factors that other models [of health care] emphasize (Kleinman 1981:27). The Venn diagram is also employed by Kleinman a few pages later, where he uses a variation of this model to explain social hierarchies from lay to professional within health care systems (1981:50).

Chapter 1:
Sperm with Chinese Characteristics

This is an image of Chinese sperm. At least this is what viewers are meant to think when seeing this 2009 condom advertisement, published in Germany. The advertising campaign depicted Adolf Hitler sperm, Osama Bin Laden sperm, and as seen here, Mao Zedong sperm, encouraging their audience to reduce the potential of propagating future dictators by putting on an Extra Safe latex condom. Here, as often is the case in more scientific depictions (Martin 1991), sperm is personified. It is given human qualities, or anthropomorphized, as a means of solidifying the connection between sperm as reproductive substance and potential future subject. Through sperm's potential -- its ability to inadvertently propagate a future dictator -- the risks of unintended pregnancy are heightened. Here, the regeneration of a "dictator" is meant to be at stake.

Unfortunately for the advertising company, this interpretation of the People's Republic of China's history and Mao's role in that history is more complicated than it seems. In the aftermath of the advertisement's publication, Doc Morris Pharmacies, who had commissioned the campaign, dealt with some unexpected consequences of its own. Chinese netizens (or online citizens) reacted negatively to the ad, offended by its placement of Mao in the same category as Hitler and Bin Laden. Mao was not, as they had assumed, a universal figure of brutality and destruction. As in this advertisement, where sperm quickly became a symbol for transnational debates on the cultural interpretation of Chinese communism, attention to reproductive substance is always caught within the metaphors and meanings of its surroundings (Martin 1991; Morgan 2003).

Like all symbols, sperm's potency comes from its ability to make meaning across domains – political and reproductive (Wagner 1986; Strathern 1988; Strathern 2005). But like blood (Carsten 2011) and genes (Haraway 1997), sperm is more than a symbol. It is a *material-semiotic figure* (Haraway 1991) through which anxieties about the nation, masculinity, development, and environmental destruction are produced and reproduced.

Gendered anxieties and concerns about contemporary life in China collect within and around sperm. These anxieties are often about more than the threat to male reproductive capacity and patrilineal heritage that reduced sperm quality and quantity might bring. They are also about concern for the fertility of China more generally, and the future of production and reproduction in a country that has become renowned for its environmental destruction as much as its rapid industrial progress.

Countries around the world (but especially within the U.S. and Europe) investigate the decline of sperm quality and quantity. Sperm, like most objects of biological and social scientific study, are sometimes understood as universally comparable and at other times understood as shaped by the (shifting) contexts in which they exist (Strathern 2004). Through sperm, scientists both attempt to achieve a level of transnational scholarly comparability and attempt to understand how Chinese environmental contexts correlate with changes occurring within the Chinese male body. At times, sperm are a vehicle through which reproductive toxicologists speak a language of universalism that allows conversations on reproductive toxicology to translate and replicate findings. At other moments, sperm is both a material and symbolic indicator of the environmental destruction faced and facilitated by the world's most populated and rapidly developing nation. The national context of sperm is, then, sometimes effaced and sometimes embraced.

Keeping this tension in mind, this introductory chapter traces the ways in which those who study sperm come to understand the Chinese characteristics of reproductive substance. I take seriously Sarah Franklin and Susan McKinnon's argument that "the same substance (blood, genes, eggs, sperm) that is mobilized to create kinship ties in one context, will in different institutional contexts… be made to create other kinds of relations, or no relations at all (2001:13). But I also hold that contexts (in this case "China" or "Chineseness") are themselves produced through sperm. In a similar fashion to the reproductive toxicologists I study, here I explore not only what can we learn about sperm (or reproductive substances or male infertility) from studying it in China, but also how we can come to understand China differently through an exploration of sperm.

What's Chinese about Chinese sperm?

More than 20 years after Danish andrologists concluded that sperm decline was a worldwide phenomenon likely related to "environmental or endogenous factors" (Carlsen et al. 1992:612), debate and disagreement on the veracity of this claim persists. Many toxicologists hypothesize that the fall of sperm quantity, if not quality, during the 20th century can be attributed to the endocrine-disrupting chemicals (EDCs) that increase alongside industrialization. A class of chemicals thought to disrupt normal hormonal functioning by mimicking hormones, EDCs send inauthentic signals to the endocrine system. These signals are said to lower androgen production and increase estrogen production, leading to "feminization" or transformations in reproductive anatomy. While many think such chemicals have resulted in decreased sperm counts, others argue that this reported decline cannot be proven.

The debate among andrologists centers around two points of contestation. First, are sperm really declining? Second, and if so, what has caused such decline? One of the main skeptics of the sperm decline hypothesis is Clinical Professor of Urology and Reproductive Medicine at New York Presbyterian Hospital, Harry Fisch. Fisch writes,

> Even granting the reality of the declines reported for a handful of localized regions, no conclusions can be drawn from any of the existing studies about the role of putative causative agents. The range of such agents is wide, and no associations have yet been found between any of the reported declines and exposure of the men involved (either in utero or as adults) to ''endocrine disrupting'' compounds. *The cause (or causes) of the well-documented geographic variations in semen parameters deserves further investigation*; *however, the evidence accumulated to date showing no decline in sperm counts or sperm concentration in populations throughout the developed world should be accepted.* Advocates of ''endocrine disruptor'' theories are unjustified in using an alleged ''decline'' in semen parameters to support their cause, and public officials should be advised that this ''leg'' of supposed evidence for proposed legislation is weak to the point of breaking.[15] [Fisch 2008:145]

Here, despite all that Fisch tells us sperm studies cannot prove, he remains open to the possibility that sperm counts vary geographically. While it is unclear why Fisch thinks developing sperm display a well-documented variation, it is clear that those he characterizes as performing "weak" science envision a correlation between sperm decline and chemicals, chemicals and development. In this vision of sperm decline, as countries develop the amount of chemicals potentially impacting sperm increase. According to Fisch, those scientists intent on showing the impact of endocrine disrupting chemicals on sperm in the developed world should accept defeat. Meanwhile, the geographic variation of sperm in the developing world "deserves further investigation" (Fisch 2008).

Fisch leaves open the questions of difference between sperm in developed and developing nations, a categorization to which China holds a unique relationship. While over 100 million Chinese citizens continue to live in poverty, in the last 25 years of the 20th century China has moved from isolated socialism to "a powerhouse of the global economy" (Naughton 2007).While it may not have reached the status of "developed" (something I was often reminded of during everyday conversations in China), China has become known as "the workshop of the world," experiencing superlative rates of economic growth, industrialization and urbanization (Naughton 2007). Today, China's human and environmental challenges not only continue despite economic growth, they are exacerbated by such growth. For example, alongside China's development over the last 30 years comes high rates of pesticide production and use (Hamburger 2002). Because many of these pesticides contain one or more of the EDCs that (according to Carlsen et al. 1992) are associated with sperm decline, certain locations in the country have equal or more exposure to those chemicals implicitly connected with a definition of the developed world in studies of sperm decline.

At times, this chemical context shapes the way scientists in China study sperm, or at least understand its importance as an object of study. Since official Reform and Opening policies began in the late 1970s, gradually transforming a socialist economy into a partially (and increasingly) capitalist economy, some scientists claim that infertility rates have dramatically increased for both men and women. Male reproductive health experts in particular report striking shifts in sperm counts: from approximately 100 million per ml in the 1970s to 40 million per ml in 2007, according to an article by Xinhua News. The article quotes Huang Hefeng, a Professor in Reproductive Endocrinology at Zhejiang University: "The problem deserves attention from all walks of

[15] Italics are mine.

life because it threatens the quality and structure of our future population" (Xinhua 2007). Here, Huang argues that the quality of Chinese sperm should be taken seriously as a scientific problem because of a broader or perhaps deeper concern about the quality of China's population. Even though in Chinese the words for quality are different for subjects and objects (people have *suzhi*, while sperm and products have *zhiliang*), in Huang's comments about sperm decline the resonance between these two domains is made explicit.

Taking this led, how might post-Reform and Opening concerns over sperm quality be linked to concerns about population quality? According to Ann Anagnost (2004), value was reconfigured during China's "momentous social transformation" from planned to market economy, including the value of population. During the 80s, a low quality population was popularly viewed as a potential reason for China's lack of development. In the 90s, the term "population quality" (*renkou suzhi*) was codified in government policies and directives, and continued to increasingly circulate as the reason for China's supposed backwardness (Anagnost 2004:188). Anagnost argues that over the last 25 (now more than 30) years, humans have become accumulators of capital as much as products of capitalism. She argues that capital accumulation is embodied in figures that occupy opposite ends of the value spectrum: the rural migrant and the urban, middle-class only-child. In toxicological research, value is similarly embodied by sperm, which itself becomes valuable due to its ability to aid in the assessment of China's rapid social and environmental change. Similar to the brine shrimp described by Cori Hayden (2003), sperm has a capacity to elicit the toxicity of China's environs, embodying the detrimental effects of China's rapid social change.

Talk of the geographic variation of sperm moves sperm science into questions not only about what makes sperm counts fall in general, but also what makes sperm counts fall in particular. But as shown through the title of an article in the first issue of the Asian Jounral of Andrology, "The Contribution of Asian Scientists to Global Research in Andrology," studies from within China often speak more to a global sperm science than to particular Chinese contexts of sperm. The growing amount of toxicological research in non-developed countries both places sperm and its science within an exceptional "developing" context, and seeks to generalize Chinese sperm and its science into any other modern andrological or toxicological pursuit. Here, as in other interactions with processes aligned with modernization and development, "power and knowledge crafted in the name of modernity are simultaneously naturalized and exposed as contingent, at once maintained and altered" (Rofel 1999:13). Sperm science is a means of achieving scientific development in China, even while it examines the global or universal consequences of the chemical side effects of development for sperm more generally.[16]

China is one of three top publishers of scientific reports on sperm, just below Japan and the U.S. (Yang, Pan, and Chen 2006:433). China speaks an international language of sperm quality and quantity, which was facilitated by the World Health Organization who sponsored andrology training workshops around the world between 1980-1993 (Waites 1999). At the WHO workshop in Beijing, which took place in 1983, budding andrologists learned guidelines for semen analysis, outlining specific techniques and standards for measuring sperm characteristics such as motility, mobility and morphology. These guidelines solidify sperm as an object of study separable from its

[16]See also the work of Anna Tsing (2005).

contexts (semen, region, nation, etc). The guidelines also attempt to standardize sperm into a universally comparable object of study, achieved through the same techniques of isolation, handled through similar procedures of extrapolation, assessed through the same standards of quality and quantity. Such guidelines, however, are necessarily instantiated in particular places. In 2002, one research group suggested that semen analyses in China should account for the fact that only 42.3% of sperm collected in China met WHO parameters of normalcy. After testing sperm from seven geographical areas in China, andrologists adjusted these standards in a way that seemed "more appropriate for young Chinese men" (Junqing et al. 2002). Like China's mixed socialist-capitalist economic and political system, called "Socialism with Chinese Characteristics," here semen analyses are also given a unique Chineseness.

Even when the Chineseness of sperm is not to blame for its poor quality or falling quantity, some andrologists in China have determined that Chinese manufactured analysis equipment and levels of quality control might be skewing semen assessments. A recent report by Chinese andrologists evaluated three different sperm counting chambers – one made in New York, another in Haifa and another in Beijing. The brand from New York proved most accurate, according to the report, and it was recommended that since "semen evaluation is the most important test for assessing male fertility" the Cell-VU chamber produced by Millennium Sciences Inc. in New York City be used. The report goes on to say, "Lack of strict quality control makes it difficult and meaningless to compare semen data between different laboratories" (Lu et al. 2004). More informally, the reproductive toxicologists I worked with in Nanjing were very conscious of the ways in which the origins of equipment – from multi-million dollar machines to test tubes – might affect not only their test results, but the perception of their test results by those scientists who would peer-review their submissions to European or American journals. As above, here discussions of quality resonate between domains, from the quality of Chinese products to Chinese science.

Nevertheless, today efforts to develop andrology in China, and to develop "Asian" andrology continue. The Shanghai based "Asian Journal of Andrology," in which Fisch recently published another article debunking sperm decline, was established with the assistance of the International Society of Andrology in 1999 and acquired by Nature Publishing Group in 2005. It now has an impact factor of 2.51, an achievement that bounces around the journal's website in a word bubble that is hard to ignore. Moreover, Chinese scientists and media consumers have become increasingly interested in the threat to sperm posed by the Chinese environment. A study on climate change released by the China Meteorological Association (*Zhongguo Qixiang Ju*) made passing reference to problems in reproductive health organs brought about by exposure to smog (2013), which opened up an international conversation on the declining quality of Chinese sperm. Interviewing scientists from China's major urban centers, Li Zheng, an andrologist and sperm bank coordinator from Shanghai, writes "[if] the environment is bad, sperm become ugly" (Chen 2013). Zheng goes on to address a problem that has been described in China for over a decade: sperm bank shortages caused by both the inability to recruit donors and the poor quality of the sperm samples that are obtained.

The inability to recruit donors is thought to be connected to "traditional" ideas on the importance of bodily fluids in Chinese medicine, especially sperm. During research on the ways in which contemporary China governs populations through facilitating

"altruistic" blood donation, Vincanne Adams, Kathleen Erwin and Phuoc V. Le conducted interviews that touched on the relational importance of blood and sperm. By asking interviewees if they had heard the common saying, "One drop of semen equals ten drops of blood," Adams, Erwin and Le found that sperm continues to be identified as a precious bodily fluid that must be balanced through sexual moderation (2010:170). Moreover, the quality of semen is thought to be directly tied to the quality of ones blood and bloodline. While their work shows that the relationship between blood, semen and lineage has contributed to a shortage of blood donors, similar concerns seem to have created a situation where sperm donation is equally unattractive. When eventually able to convince young Chinese men to donate sperm, often with generous compensation packages similar to those available in blood donation schemes, the quality of those donations has been subpar, according to andrologist Li Zheng. Such are the conditions of sperm in a rapidly transforming Chinese society.

Invoking and Exploring the Cultural Contexts of Sperm

While sperm scientists explore the ways social and environmental transformations in China impact their object of study, social scientists have researched the way rapid social change impacts Chinese subjects. Reproduction, reproductive health and kinship are main arenas through which these transformations are understood. Lisa Handwerker argues that alongside post-Reform and Opening market influences and birth planning policies, a 1980s surge in use of biomedical reproductive technologies in China was the result of "(1) a long-standing cultural imperative for women to become mothers and, ideally, to produce sons, [and]; (2) Maoist social ideology and practices" (Handwerker 2002:298). She sees these historical factors as the structure that gives way to increased use of new technologies, thereby increasing pressure on infertile men and women to produce a single, high quality child. From conversations with young men and women in China, especially those women who were pursuing higher education, I found a common sense that to not marry or procreate is to not participate in the furthering of the kinship network. Most women I discussed this with, female only children in two parent households, were especially conscious of the way in which their marital inaction put the future of their family line at stake. These structures of feeling can be read as the product of a transformed China, the gendered expressions and yearnings of a new cohort of Chinese women (Rofel 1999), a generation coming to age in post-reform and opening China (*bashi yihou*).

Everett Zhang attempts to understand the transformation of Chinese society from the Maoist to the post-Maoist period through another common reproductive health concern, impotence. Zhang's work on male medicine (*nanke*) in China traces impotence as a category of diagnosis and treatment that changed as the political and social environment transformed. Zhang states that in post-Mao China impotence was increasingly visible and treatment for impotence became "contagious". He contrasts this time period with the Maoist period during which, he states, people were discouraged from seeking medical treatment for impotence or expressing any sort of personal desire. Zhang explores how particular institutional mechanisms, medical apparatuses and moral implications within a given cultural and historical setting made impotence possible as a treatable disease. On the one hand, Zhang hopes to show how social conditions produce or constrict desiring subjectivities. On the other hand, Zhang attempts to build on

literature about rapid social change's impact on subjectivity by looking at impotence as more than a symbol of dissatisfaction with both the past and potential future. Zhang suggests that the impacts of rapid social change are linked between the physical and social body. While my work takes a similar approach, attempting to capture how conditions within and outside the body correlate, I hope to complicate the idea of historical and cultural contexts as explanatory. Infertility, and perhaps impotence, do not emerge because of rapid social change, but are part and parcel of the same biosocial transformations.

My thinking follows Lawrence Cohen's (Cohen 1999) work on semen loss anxiety or "*dhat,*" which challenges invocations of cultural contexts of diseases as explanatory devices, especially within literature on culture bound syndromes. Also writing about semen loss anxiety, although in China, Arthur Kleinman describes culture bound syndromes as "any culturally distinct categorization of illness behavior," especially those that "appear unique from an extra-societal comparative perspective" (Kleinman 1981:165). Like other culture bound syndromes such as *koro* in China, hikkomori in Japan, *susto* in Latin America or *latah* in Southeast Asia, kidney deficiency (*shen k'uei*) in Taiwan is an illness category found primarily or only among a certain population, in this case young Chinese men. As the category of culture itself came to be understood as less bounded (Raffles 2002), formulations of "culture bound syndromes" were criticized for reinstating the cultural differences they attempt to understand. By applying the work of Zhang to Kleinman, one can see how the creation of a special disease category –whether impotence or kidney deficiency – can itself bring about disease. Moreover, using culture bound syndromes as an attempt to understand populations reinforces an understanding of populations as themselves bounded and stagnant.

For example, Cohen describes the way AIDS researchers explain the sexual behaviors of Indian truck drivers through "beliefs" rooted in "culture." Culture is here invoked to explain both the truck drivers' justification for semen expenditure as the necessary ridding of bodily heat through sex, and the opposite belief based on traditional Indian medicine that one must preserve semen by holding it in. Cohen continues, "The problem is not the cultural rootedness of both anxieties but the way that the reduction of all deviation from a supposed universal rationality to an essentialized realm of "local culture" reduces any efforts at cultural analysis to tautology and confusion" (Cohen 1999:115). Cohen finds that Ayurveda is a circular device, "invoked rather than engaged" in discussions of semen loss anxiety, thereby reducing it "to a set of gross attitudes and prescriptions" (Cohen 1999:115). The difference between invocation and engagement is important. When invoked as an explanation for semen loss anxiety's predominance in India, traditional Indian medicine itself becomes a discrete and stable object. As Judith Farquhar and Mei Zhan argue about Traditional Chinese Medicine, when invoked Ayurveda becomes bound, essentialized, and permanently located (Farquhar 1996; Zhan 2009; Cohen 1999:115). Through engagement, however, Cohen sees the potential for rethinking not just the limits of cultural/biological definitions of illness, but also the presumed historical and cultural contexts of disease – here, belief and Ayurveda.

The distinction is subtle but important. To invoke historical and cultural contexts of health is to point to the local cause (context) that produces an effect (disease/illness). To engage with the cultural contexts of health is to recognize that cultures and histories

not only produce ideas of health, but are also transformed by them. This distinction is similar to the one described by Tim Choy in his book about environmentalism in Hong Kong, *Ecologies of Comparison.* Discussing the possible sublimation of discussions of political autonomy into assertions of cultural identity and specificity, Choy writes,

> It is tempting for social scientists to frame scientific matters within the political. In the present case, this would entail invoking not only the handover but also the financial decline of the late 1990s and China's entry into the WTO…to contextualize the broad range of endangerment tropes within this particular moment. [Choy 2011:62]

Choy critiques the reading that science is politics by other means as "sociological" and unidirectional (Choy 2011:62). Instead of viewing endangerment tropes as a symptom of political and economic transition in Hong Kong, Choy would prefer we read things the other way around. From ecology to sociology. Cultural forms to sociological imaginations. In this rearrangement it seems Choy is playing with a similar question as Cohen: how does one engage, rather than invoke, historical and cultural contexts?

In Choy's second chapter, he attempts to engage, rather than invoke, the cultural and historical contexts of Hong Kong ecology by analyzing tropes of endangerment that circulated in two arenas: media about Hong Kong's future and environmentalist discussions of pink dolphins. Choy uses resonance between domains to consider why and how endangerment might assist in the reconceptualization of Hong Kong politics and the politics of nostalgia more generally. Choy puts into work a reverse analytic -- from ecology to politics, not politics to ecology -- to consider how thinking in the other direction might open up a different perspective. In refiguring the ecological as the sociological's context, as that which shapes formations of the political, Choy hopes to illuminate "the way certain cultural forms come to structure our very sociological imaginations" (2011:62).[17] Choy's provocative denunciation of unidirectional social science makes for an interesting comparison with anthropological work on reproductive health and infertility. How would an anthropology of male infertility look if it moved from sperm to social contexts, instead of from social contexts to sperm?

Sperm as contextual

Similar to accounts of sperm decline by andrologists and toxicologists, infertility experiences are often discussed by social scientists in terms of a national or regional framework. As the author of one of few social science manuscripts dedicated specifically to sperm, sociologist Lisa Jean Moore's book *Sperm Counts* discusses both historical and contemporary understandings of "man's most precious fluid" (2007) primarily in the United States. Moore speaks of sperm as a substance that means different things to different people. She takes a "follow that sperm approach," a play on Bruno Latour's

[17] It seems Choy is drawing implicitly on the work of Marilyn Strathern who has pursued a similar argument and engagement with context over many years of research on anthropological knowledge practices and relational thinking. Strathern states that "anthropology's relation" – a dual focus on both interpersonal and conceptual relations – was developed in tandem with "science's relation" (2005:9). Strathern writes, "Anthropologists frequently claim that much knowledge is embedded in habits and practices that render it implicit…Supposing that science is already 'in' society, then, where is it? What do I need to make explicit in order to find examples of its embedding" (2005:33)? She goes on to state that science, including social science, is based on a methodology that 1) defines discrete entities in order to show the (surprising!) relation between them, and; 2) discovers (surprising!) relations that already exist.

follow the scientist approach (1987), dedicating each chapter to a different genre of sperm representation. The representation of sperm through scientific practice is her first chapter, where she traces how sperm moved from being understood as eel-like animalcules to being understood as a mixture of prostaglandin, fructose, and fatty acids. These understandings came about first through physical observation with early microscopes in the 1670s, and are now based on mechanically quantified parameters through Computer Assisted Semen Analyses (CASA).[18] While Moore points to increasing masculine insecurity due to women's access to new reproductive technologies that potentially eliminate the necessity of the role of men in reproduction, political scientist Cynthia Daniels argues that masculine security has kept attention away from the harm being done to men's reproductive health, especially sperm. The primary difference in their approach, however, is that Moore is interested in how sperm is represented, not impacted, by its social context.

Similarly concentrating on how sperm has been represented through science, Emily Martin (1991) finds that descriptions of egg-sperm interaction defy her observation of biology in a petri dish at a John Hopkins laboratory. In the laboratory Martin observes that sperm are imprecise and dependent, while eggs are active and vital. In scientific descriptions, however, eggs are passive and weak while sperm are strong and active, echoing the gendered stereotypes dominant in U.S. society. Descriptions of egg and sperm, then, follow from cultural contexts.

Similarly, Lynn Morgan (2003) finds that descriptions of embryos take on the anxieties and controversies of whatever historical context they are in. Morgan writes,

> Embryos take their meanings from the scripts they are asked to read, rather than from features of the embryos per se or from an unambiguous reading of selected specimens. Embryos do not create social controversies; rather, social controversies create embryos. [Morgan 2003:289]

By making explicit the social, political and economic contexts that influence scientific descriptions, social scientists of reproduction argue that biology is viewed through a social lens. Here, gendered and otherwise biased descriptions of biological substances are seen as caused by the cultural and historical circumstances that surround scientific practice. In the language of Tim Choy, this depiction of the relation between biological substance and society would be "sociological" – identifying the cause of cultural forms in the context.

This sociological rendering of contexts is also present in accounts of male infertility. For example, in the first ethnographic manuscript devoted to male infertility, Marcia Inhorn (2013) points to a shift in the responsibility for infertility from women to men in the contemporary Middle East, specifically Lebanon. Inhorn's work describes "narrative etiologies" through which she seeks to understand Middle Eastern men's notions of what causes infertility. Inhorn argues that despite stereotypes that would lead one to think the opposite, Middle Eastern men are proactive in attempting to solve reproductive failure – seeking to understand the cause of their infertility, taking responsibility for actions which may have contributed to infertility, and working to resolve infertility through participation in treatment with assisted reproductive

[18] Other contributions to the understanding of sperm historically include Thomas Laqueur's (1990) *Making Sex* discusses the transformation of sperm/a from a reproductive substance which both men and women have, to an object of study only produced by males.

technologies. Moreover, Inhorn shows that Middle Eastern men's understanding of infertility point to broader Lebanese social concerns surrounding masculinity and manhood in the Middle East today, including inheritance, stress, war, illicit sex and pollution. In other words, a variety of social concerns common among men in Lebanon shape patient understandings of infertility's causal factors. Here, the national landscape of Lebanon shapes the ways in which male infertility patients understand and express concerns about masculinity.

In the first edited volume dedicated to social science on male infertility, edited by Inhorn and colleagues (Inhorn et al. 2009), the national contexts of infertility again take a prominent role in defining masculinity and infertility experiences. Chapters vary in national specificity, and like reports of sperm decline, speak to the ways local environments shape experiences of infertility. In their contribution to the volume, Inhorn and Matthew Dudgeon write, "Anthropology, as a humanistic social science, is particularly well suited for assessing men's reproductive health needs through its emphasis on both the specificity and the variability of those needs within local cultural contexts**"** (2003:75). Here, it seems that Inhorn and Dudgeon see the role of anthropologists of reproduction as the "advocate or spokesperson of the particular" (Choy 2011:79).

More interesting for my own work, is the way Inhorn and Dudgeon's go beyond proffering the cultural contexts of infertility as an explanatory or causal force to understanding what they call the biosocial context of reproduction. Inhorn and Dudgeon's chapter goes on to suggest that more than providing the cultural contexts of science and medicine, anthropology (particularly biological/physical anthropology) offers insight into the "important variations in reproductive physiology within and between groups of men in different environmental contexts" (2003:75). A unique contribution to the volume and to the anthropology of infertility more generally, Inhorn and Dudgeon build on Margaret Lock's theory of *local biologies* to urge simultaneous attention to the physical *and* cultural surroundings that make infertility, infertile subjects and infertility experiences. Here, infertility does not stand outside of a national or local cultural context, but is made through environments, at multiple and shifting scales.

Conclusion

In the remainder of this dissertation I look more closely at how contexts and biologies are being theorized and studied together, and how both the conceptualization and the relation between these interacting entities will structure the future of anthropological interventions into conversations on the social determinants of health and disease etiology. I engage contemporary anthropological critiques that address the limits of cultural and historical contexts as explanatory forces by attending to the methodologies of sperm studies conducted by the laboratory of Zhang Zhiyuan. In Zhang's epigenetic studies of sperm quality and birth defects, the Chinese context is not *invoked* as an explanatory mechanism for disease. Instead the Chinese context is *engaged* through a framework of interaction that centers on sperm. Zhang views China – its rapid social change, its industrial development, and its toxicity –through sperm. He does not view sperm through China.

In Zhang's research, Chinese sperm is more than a symbol. It is a material-semiotic figure (Haraway 1991) through which scientists examine the relationship

between Post-Reform and Opening rapid social change, industrial development, environmental destruction and the fertility of Chinese men. Their studies make claims that the lowering of sperm quality accompanies the environments of industrial toxicity part and parcel to China's rapid economic development. But the relationship between sperm and environment is not a story of cause and effect. Through sperm, one not only can understand the transformation of the cultural and historical contexts of China, but also learn how contexts become incorporated into the Chinese body.

Chapter 2
The Promise of Toxicity

No one doubts that environmental toxins are abundant in China. Every week, if not every day, newspapers from around the world publish articles about the latest Chinese food scandals - where everything from melamine to aluminum has been found in products from infant formula to dumplings. The air quality in Beijing has its own twitter feed, captured online in daily ratings provided by the American Embassy. News of China's AIDS village, the result of unsterile blood donation/collection practices (Jing 2006), has been quickly replaced by coverage of the growing number of cancer villages, or villages stricken with extreme rates of cancer often thought to be caused by pollution (Lora-Wainwright 2009). Yet there is also something to be celebrated when it comes to China's transformation. After 30 years of official Reform and Opening policies, China's great industrial growth has brought millions out of poverty and the national standard of living has dramatically increased.

Taking these accomplishments together with environment destruction, a paradox emerges. Captured in newspaper headlines such as the 2007 New York Times series, "Choking on Growth," with articles such as "Beneath Booming Cities, China's Future is Drying Up," the paradox is as present in academic accounts as it is in media portrayals. Social science research on the Chinese environment generally focuses on the challenges that land, air, water, and earth face while the country is in the throes of rapid development (Smil 1993; Edmonds 2011; Shapiro 2012). Many ask, will such environmental destruction in the name of economic development continue or will China find a way around the devastation that industrialization brings? Here, China's environmental crisis is looked upon as an opportunity, a chance for China to develop differently than those "developed" countries before it, utilizing the latest innovative technologies or conservation tactics to address the future before it arrives (Shapiro 2012). But the opportunity or advantage that scientists take, and that this chapter attempts to capture, is not about making the most of a bad situation through innovation. It is about viewing the current conditions of toxicity as an environment that itself makes certain types of research possible.

In contemporary research on the paradoxical human health impacts of environmental devastation brought about by development, the Chinese environment has been held up as an optimal place in which to conduct research. Faced with rates of pollution, pesticide use, and toxicity that far exceed other countries, as well as a large population, China has become an appealing place to conduct research (Ong 2010:25-26). Through conversations with toxicologists and observations of their research settings and practices, one can see the processes through which scientists both fight against and embrace China's high levels of toxicity. In order to potentially improve the human and non-human fertility of China, and the regulation of industrialization and its chemicals, reproductive toxicologists and other scientists who rely on human subjects highlight the quantities and qualities of high level exposure faced by potential research subjects. At the same time, scientists strive to capitalize on what is understood as a unique research environment, using the quantity and willingness of China's population as well as the multiplicity and degree of exposures to secure international collaborators, publications and funding.[19] While most social science research on China's environmental problems interprets industrialization's detrimental effects on the environment as a burden, to many biological scientists in China today toxicity actually becomes a unique environmental

[19] I do not necessarily exclude anthropologists, including myself, from this observation.

resource through which they pursue international science. The Chinese environment, with its unique levels of toxicity, is understood not only as a challenge, but also as a resource in itself.

Toxicity as Rumination

Acid Rain. Water Pollution. Air Pollution. Carbon Dioxide. Greenhouse Gases. Emissions. Salinization. Chemical Plants. Endocrine Disrupting Chemicals. Environmental Hormones. Chloroflourocarbons. Hydrofluorocarbons. Hydrochloroflourocarbons. Heavy Metal Pollution. Toxic Dumping. Toxic Waste. E-waste. Toxic Sludge. China has no shortage of possible contributors to ill health. When living in Nanjing, I wanted to believe it was the toxic chemicals and fumes from the industrial factories, those same ones that the scientists I researched were looking into as associated with male infertility, that was making my asthma flare up. But I couldn't be certain, and at first I kept speculations to myself. As Tim Choy (2011) writes of his initial refusal to vocalize or to even notice the Hong Kong air while conducting fieldwork, I imagined noticing China's pollution would make me even more of an outsider than I already looked and felt. Unfortunately, as was the case for Choy and his partner, my cultivated indifference only went so far. Sometimes the body forces you to notice those things you'd rather pretend to forget. In March of 2011, after a few months into my long-term fieldwork, I couldn't help but start noticing, China was difficult to breathe in.

Two views from my apartment window. Left: Downtown Nanjing on a remarkably clear day; Right: Downtown Nanjing on an average day.

Living in Xinjiekou, the central shopping district of Nanjing, the pollution outside my windows was glaringly obvious, as was the rapid pace of China's development. Usually the view didn't allow me to see more than a block in front of me, but I needn't look farther than that to observe the round the clock construction of what I could only

assume would soon be another skyscraping department store. Rarely the mountains that surround the city would enter into view. Every other week I would take a bus or cab to the edge of the park surrounding Purple Mountain and climb the steps or ride the cable car to its peak. On the mountain, I picnicked with sandwiches from that one French bakery in town. I photographed plum blossoms with hundreds of other tourists. I swam in a lake with twenty middle-aged men, enchanted by the spectacle of a foreigner actually going in the water that, they told me, "was very dirty, too dirty to swim in," even as they stood there dripping wet. I wandered up and down steep dirt trails, occasionally encountering a random group of Chinese tourists (inevitably including a woman in heels) or a military group out of breath, conducting training drills. On this mountain I tried breathing deeply, all the while telling myself that the air was fresh there.

Scenes from Purple Mountain, Left: View from Cable Car; Right: Overgrown waterslide; Lower: Zixia Lake

Still, my lungs weren't happy. I had never had asthma before on a trip to China, but I had never been there in winter. After arriving in January, I was told *the cold, dry air was unhealthy for everyone*. I bought a fleece facemask to protect myself from bitter wind while riding my bicycle. In March, when I finally spoke up about my difficulty breathing, I was told *it was all the smog I was inhaling from living downtown*. I should *move to the suburbs, with the other foreign families*. In June, a friend who noticed my scratchy voice and shortness of breath told me *it wasn't smog, but the agricultural haze that travels east from poorly regulated industrial farms in nearby Anhui province with the strong summer winds*.

In the worst of summer, walking through the air felt like pushing through cobwebs. My friends and I stood near the water fountain above the subway exit, sweating while we decided where to go. *This is the time to go to the mall, they told me.* I finally, caved, *the mall it is.* We sat in a food court, densely packed with families and friends leaning over red trays on plastic tables. *Let's get ice cream,* I suggested, after an unsatisfying stirfry. Just as we stood up to leave, a loud noise outside left everyone inside quiet. We rushed to the windows to see curtains of rain falling from the sky. *Now, it won't be so humid,* they celebrated. As we left we realized our celebration would be cut short by flooded streets. We would not be walking, but wading home through brown water up to our mid-calves. My friend told me to bathe when I get home. *This water is filthy. It carries everything. All the garbage, the sewage, everything.*

As in Choy's Hong Kong, here air and water were mediating friends' and interlocuters' ruminations on national transitions (2011:142), not from independence to Chinese sovereignty, but from rural to urban, industrializing to industrialized, stifling humidity to pouring rain. My lungs and what filled them became a way into conversations about the perils and pleasures of China's urban atmosphere and transitions. Air, as Choy writes, "is the substance that bathes and ties the scales of body, region and globe together, and that subsequently enables personal and political claims to be scaled up, to global environmental politics, and down, to the politics of health" (Choy 2011:157).[20] Conversations about my personal inability to breathe led to reflections on physical, political and urban environments -- China, the Yangtze River Delta Region, or the now sprawling city of Nanjing. The connection of my health to each of these environments, and the environments themselves, were substantiated through such reflections.

As the year progressed, though, I came to feel my only way around the city was to leave it. I yearned for China's rural southern oases and wondered why I had decided to do research in an urban area. But when I came back to the city and really began tracking my health, I started to sense that my asthma was better when I stayed out all day in the smoggy air and worse when I woke up in the mornings. It took me awhile to consider that my apartment itself -- my imperfect solace teetering in the winds 30 stories above the noise and traffic of Nanjing's streets -- was inflaming my lungs more than anything outside. Paint, dust, molds, or whatever was lingering in or behind the walls -- something was setting me off. For all the times I noticed (or refused to notice) the air out there, perhaps the environment inside was causing the most harm. I started reading accounts of

[20] Mitman, Murphy and Sellers make a similar point in their 2004 discussion of the 2002 Asian Brown Cloud. They write: "The Asian Brown Cloud is but a visible sink of transnational material flows that bind economics, resources, people, and pollutants across molecular, local, regional and global scales" (2004:5).

indoor air pollution in China. To my dismay, I found that while air pollution is typically depicted as a problem that exists outside, indoor air pollution was far more deadly than anything lingering outside my window.

Toxicity as a Resource

According to a report conducted for the Woodrow Wilson Center, "indoor air pollution" is the fourth leading cause of death in China, accounting for 20% of annual mortalities. Of course this pollution is usually not caused by paint, dust or molds, or even the sick building syndrome chronicled by Michelle Murphy (2006). Deadly levels of indoor air pollution in China, and elsewhere in the world, are usually brought about by the burning of solid fuels in poorly ventilated homes. According to the Woodrow Wilson report, coal is the largest source of heating and cooking fuel in China, used by 75% of all households and nearly all rural households (Hosgood III 2011). Because of this, China is the largest consumer of coal in the world.

In the 2007 brief on indoor air pollution referenced above, superlative figures about coal and indoor air pollution do not merely present data for the challenges that China faces. These figures are also evoked to demonstrate the opportunity that such situations create for advancing scientific research. While discussing the effects of indoor air pollution interventions, the report also describes the preferable attributes of a rural town in southwestern China for studying its effects. The report reads,

> The population in Xuan Wei poses a unique opportunity to assess in-home coal smoke exposure because it has the highest prevalence of lung cancer in China and more than 95 percent of residents use coal for heating and cooking. In Xuan Wei, nearly all women and a few men cook, while most men and nearly no women smoke tobacco. Further, 90 percent of Xuan Wei's residents are farmers and have minimal industrial and automotive air pollution exposures. [Hosgood III 2011]

In other words, Xuan Wei presents the perfect conditions for a living laboratory, a place where an environmental experiment of the most extreme and conveniently contained type plays out in the ordinary activity of humans. Such exposures could never be ethically replicated, however this small town in Yunnan province presents the next best thing.

The idea that China presents a laboratory for conducting experiments that would otherwise be unethical can be found among many reports on its environmental challenges. *Respiratory Problems. Asthma. Chronic Sinus Infections. Chronic Bronchitis. Chronic obstructive pulmonary disease. Lung disease. Lung Cancer. Thyroid cancer. Prostate Cancer. Cancer Villages. Tumors. Tuberculosis. Upper aero-digestive tract carcinomas. Nasal Polyposis. Cataracts. Childhood Mortality. Birth Defects. Decreased Birth Weight.* Each of these human conditions is found in China in uniquely large quantities. Coupled with burgeoning scientific research centers and funds, China's toxicity becomes desirable as an object of study, an extreme version of challenges faced in other parts of the world.

For example, in an article published in *Science*, titled **"**China's Unique Environment Favors Large Intervention Trial," science reporter Jeffrey Mervis writes, "With some of the highest rates of certain cancers and other diseases, and a compliant population with limited geographical mobility, China offers unparalleled opportunities for large-scale intervention trials" (1995:1149). Mervis details the internationally funded research of Chinese epidemiologist You Weicheng, depicted as an intrepid nationalist,

committed to scientific results one might only receive when pursuing research in a Chinese environment and with the ability to withstand Chinese working conditions, "anathema to Western scientists" (Mervis 1995:1150). While the article highlights both the quality (compliant) and quantity (large) of willing research subjects, what is less tangible are the reasons why the specific location where You's team is pursuing research – Linqu county, Shandong Province - is so rife with gastric cancers, the then leading cause of death in China. As the scientists behind "the world's first randomized intervention aimed at inhibiting or preventing gastric cancer," it seems You and Mervis might do well to recognize the specific reasons cancer is especially prevalent in this region, and the obstacles to preventing such conditions in the first place.

Others research reports are more straightforward about the lure of exposure, not simply high rates of disease present in Chinese regions. Another piece, titled "Linking Genes and Environmental Exposure: Why China Presents Special Opportunities," reads

> One approach to combating relevant problems would involve simultaneously assessing genetic and environmental determinants of disease. For this, special study populations are required. The Chinese population offers a unique resource for the study of human genetics and the ability to capitalize upon the recent revolution in biotechnology for several reasons. First, it is very large (i.e., 20 percent of the world's population), and second, it has unique and marked contrasts in urban and rural areas (Figures 18 and 2#) resulting in differences in disease occurrence (Table 11). [Xu and Schork 1997:519]

Here, Xu and Schork (1997) discuss researching complex diseases (diseases thought to be caused by the environment, a topic I discuss further in the next chapter) as placing new kinds of demands on scientific research. Studies designed to research the link between genes and the environment must meet a number of criteria, all of which the special Chinese environment provides. The article continues,

> China can be considered an almost paradigmatic population for genetic studies of complex diseases since it could accommodate novel study designs like those described above, for the following reasons: (i) the population size… (ii) the Chinese people have remained, for better or worse, relatively isolated in the past, which has preserved a relative genetic homogeneity of the population in many regions; (iii) due to its size, geographic diversity, and social practices/customs… there *is a great deal of population stratification within China, which would likely be of great benefit for population-genetic and genetic-epidemiologic investigations,* such as linkage disequilibrium analysis; (iv) there are very marked urban/rural and geographic contrasts both in environmental factors and disease occurrence within China…*The westernization and urbanization in many Chinese cities could accommodate studies that investigate the role of factors such as air pollution, diet and lifestyles*; (v) Chinese populations are relatively stable in residence and relatives tend to live in the same area, which makes it possible to study both index cases and their family members and carry out long-term follow-up; (vi) it is very cost-beneficial to conduct genetic epidemiologic studies in China. [Xu and Schork 1997:522][21]

This extended passage, quoted at length to preserve tone, is disturbing not just because of its ability to make utilitarian applications of (simplified) social scientific claims for the sake of a "novel study," but also because it fails to give a sense that putting an end to the high rates of disease, stratification, and air pollution that make China an "ideal

[21] Italics are mine.

environment" for conducting research might also be motivating this research. Instead, the discovery of gene-environment interaction becomes the end-all, be-all of the study. What is at stake here is the conception of the environment as desirable research conditions, not as the conditions which lead to the health challenges this research supposedly seeks to address.

Toxicity as Exposure

How did China get to the superlative rates of toxicity described and desired by research scientists? Following the discovery of cervical cancers, congenital sexual abnormalities and higher infertility rates among children whose mothers were given Diethylstilbestrol (DES) during pregnancy to avoid miscarriage, the potential harm of synthetic chemicals across generations attracted international attention (Clarke 1998:246). The United States began to recognize the harms of chemical pesticides, strictly regulate their production and use, and seek alternatives to those most popularly known to cause harm (Nash 2004). While the U.S. began to more strictly monitor the effects of agricultural practices, China rapidly embraced what Vaclav Smil describes as unsustainable farming practices, including the overuse of pesticides and synthetic fertilizers (Smil 1993:139). After 1976, the consumption of chemical fertilizers throughout China quickly increased, then doubled between 1978-84 (Ash and Edmonds 1998). Agro-chemical or pesticide application followed a similar rate of growth, though much of this activity occurred at much higher rates in Northern and Eastern China (Ash and Edmonds 1998:145). These rapid changes to agricultural practices were part of broader transitions that continued into official industrialization and economic policies adopted during Reform and Opening (*gǎigékāifàng*). Such transformations in economic and isolationist policies exposed China's citizens not only to rapid social change, but also to rapid increases in chemical pesticides and fertilizers (Sanders 1999). Today China is one of the largest users, producers and exporters of chemical pesticides, if not the largest.[22] Acute pesticide exposure is said to result in 53,000 to 110,000 deaths annually in China alone (Hamburger 2002; Yang 2007).

As in the California Central Valley in the 1950s and 60s (Nash 2004), today China is a place in which most of the human research on chemical toxins is conducted. According to the 2012 Statistical Year Book of China, in 1978 over 82% of China's population was rural and in 2012 over 47% of households were reported as urban (Yang 2013).[23] While this demographic shift is staggering, the number of rural households in China today is still large. 266 million people are reported to be in the agricultural labor force (Yang 2013), a population that spreads from China's southwestern tropical climate to its northern subarctic plains. Among these hundreds of millions of agricultural laborers many are farmers who use pesticides on their crops. Ginseng, rice, millet, tea, and cotton are cultivated to meet a growing domestic demand that has come along with a widespread

[22] There are many factors involved in this large amount of pesticide use ranging from national and international consumer demand, the approximately 1:3 ratio of China's arable land to its human population, local and national policies (which through the 1980s and into the 90s facilitated farmer demand for chemical agricultural aids), and overuse due to the belief that many of the chemicals are fake. (Yang 2007; Hamburger 2002).

[23] For more on the problematic nature of statistical data and collection processes in China and beyond, see Liu Xin (2012). On the issue of the problematic data surrounding 'phantom farmers' in particular see Rawski and Mead (1998).

rise in the standard of living (Lora-Wainwright 2009). The use and overuse of harsh chemicals impacts crop yields for good and bad. Decades of extensive literature has attempted to understand how China can best move forward agriculturally, given its small percent of arable land (11-12%) for its large population (over 1.35 billion). Scholarship on the impact of chemical pesticides on the humans who manage crops has recently increased. Health concerns surrounding pesticide use and overuse are extensive. Scholars from public health and economics have argued that there is little being done to account for or address the ways in which farmer health is being impacting by pesticide exposure (Chen, Huang, and Qiao 2013; Zhang et al. 2011).

Anthropological contributions to this literature have been fewer, however Anna Lora-Wainwright (2009) has written about farmers in rural Sichuan as well as southwestern China. Approaching her research from cancer villages, Lora-Wainwright attends not to the cause of cancer, but to etiologies of cancer, seeking to understand the unique perspective of rural farmers on the relationship between farming and disease. By attending to local etiologies of cancer, she hopes to understand how farmers make sense of illness and perceive the threat of chemical pesticides, whether or not scientific research is able to prove such harms. During ethnographic research, Lora-Wainwright finds that farmers grow organic produce for family consumption, but douse crops that will go to market in large amounts of harmful chemicals, often without wearing safety equipment. This two-tiered farming system illustrates both an understanding of the harmful nature of pesticides when consumed, and an ignorance, apathy, or denial of the harmful nature of pesticides during processes of application.

The overabundance of toxins in China creates a complicated landscape of toxic exposure. Coupled with a national drive to enhance international scientific presence, China's toxic environment creates a research setting that opens a wide spectrum of possible national and international scientific pursuits. Almost any exposure can be studied outside the laboratory on human subjects in China. For instance, a recent study by Zhang's laboratory explores the potential connection between the chemical 3-phenoxybenzoic acid (3-PBA) and reduced "sperm integrity" in "non-occupational environments." In this study, the non-occupational environment potentially associated with DNA alteration and reduced sperm quality is measured by taking samples of semen and urine from groups of infertile and fertile men who have no known exposure to synthetic chemicals through employment. Sperm quality is measured through semen analysis as well as tested for DNA integrity. Here, Zhang's team offers one of few human studies of an exposed population, utilizing China's toxicity and population to their advantage. Concentration of 3-PBA are detected in the urine of all Chinese men at up to seven times greater levels than other countries that have conducted similar research, the study explains.

The use of exposed populations in research on male infertility is similar and different than the identification and brokering of human research subject populations written about by anthropologists. Adriana Petryna discusses how *ethical variability* shapes the decisions pharmaceutical companies make about where to conduct research in transnational clinical trials (Petryna 2009; Petryna 2005). Differences in ethical guidelines and government regulations of the recruitment and treatment of human research subjects have led to a situation where industry-sponsored clinical trials are being "outsourced" and "offshored" to countries whose ethical frameworks benefit the

experimentation needs of the pharmaceutical industry (Petryna 2009:5). Concentrating on the roughly one-third of clinical trials that are sponsored by the pharmaceutical industry, Petryna follows entrepreneurial actors and government regulators as they calculate the risks and benefits of drug trials for various international and illness communities, as well as for their own entrepreneurial intentions. She writes, "As health risk becomes a resource for capital, ethical variability becomes a core value and a presumed modus operandi in globalized clinical research" (Petryna 2009:7). In the name of cost-effective trails, treatment naive populations and the diseases they carry become resources through which third-party companies fulfill the human subjects testing mandates of regulatory bodies for pharmaceutical companies and turn a profit.

Kaushik Sunder Rajan suggests a similar kind of variability in his argument about the "context of consent". Concentrating his research on clinical trials occurring in India, Sunder Rajan makes the connection between the outsourcing of clinical trials and previous patterns of economic activity between the U.S. and India. He writes, "Just as much of the manufacturing labor previously performed by the working class in the First World was later exported to Third World peripheries, so much of the Phase I experimentation, initially performed on marginalized populations in the US, is now being exported to Third World sites such as India" (Rajan 2010:384). Further, Sunder Rajan succinctly makes a point that is more subtle in Petryna's discussion of ethics. He writes, "For this situation, the partial ethic enshrined in 'good clinical practice', far from mitigating the structural violence of capital serves instead to facilitate it" (Rajan 2010:285). For Sunder Rajan, *bioavailable* populations who make their bodies available for experimentation are the exploited peasants of a new type of capitalism – biocapitalism -- which makes money not only through the poor's labor, but also through their biology (Rajan 2010; Rajan 2006). In the guise of providing free healthcare for India's vulnerable lower classes, Contract Research Organization's profit off of ethical variability or varied contexts of consent. But what Sunder Rajan gains through brevity and clarity, he also loses. A sense of the difficulty and ambiguity that surrounds the ethical decision-making practices and the fleeting contingency of 'populations' as they are recruited and dismissed is overlooked in an analysis of global body burdens that relies on economic structure as an explanatory mechanism.

The notion of bioavailable research populations in Sunder Rajan builds from Lawrence Cohen's nuanced work on organ donation. Here, bioavailability is a concept that Cohen borrows from pharmacology to describe "the selective disaggregation of one's cells or tissues and other reincorporation into another body (or machine)" (2005:83). Cohen states that organ transplant bioavailability relies on large populations that are "available enough" to enable matches – usually blood relatives or the dead. As immunosuppressant drugs emerged and the standards for an organ donor match became more flexible, bioavailable populations multiplied. Gender, economic status and political vulnerability became factors in how likely one might be to "donate" an organ. But bioavailable donors placed their organs up for donation for more than simply economic motivations. Operations, for both organ donation and family planning purposes, were mechanisms through which donors secured "modern participation in the nation-state" (Cohen 2005:87). Similarly to the biological citizenship achieved through being deemed a survivor in Petryna's Chernobyl, bioavailability and operability together point to more than simply exploitation of disadvantaged populations by capitalist or entrepreneurial

actors. Being rendered or making oneself bioavailable points to a "far more productive and complex governmentality" (Cohen 2005:87).

My research does not seek to understand the complex reasons that Chinese research subjects participate in studies of sperm that do not offer compensation.[24] However, I do hope to begin opening up a set of questions regarding the complex way research scientists identify and relate to the bioavailable populations made possible by China's toxic environs. The researchers I engage with are not simply out to boost their careers by exploiting those populations who are heavily exposed to toxins. Nor are they naively pursuing research under the guise of biosocial justice. The reproductive toxicologists I studied, perhaps like many in fields related to public health, are both seeking solutions to toxicity and using toxicity to their advantage. Through an awareness and advertisement of their exceptionally toxic conditions they procure the means (funding, collaborations, audience) to proceed with conducting research in the very toxic conditions they are trying to expose as harmful for health.

The Benefits and Burdens of Toxicology with Chinese Characteristics

Scientific publications that stress China as a unique research environment, such as those above, formalize the cross-cultural reflections reproductive toxicologist Zhang Zhiyuan shared in his laboratory. While Zhang's research does a better job of engaging with questions of how we got to the levels of toxicity that others simply view as research potential, his scientific practice still must reflect upon China's 'unique' research environment. Through formal research and informal dialogue about the multiple contexts – national, institutional, educational, industrial, etc. – within which they conduct research, reproductive toxicologists themselves identify and characterize the differences between the West and China as a condition of participation in those very networks they hope to (one day) transform.

As an ethnographer of science in China, one enters the field haunted by the infamous Joseph Needham question and its apparent outdatedness. Needham's 1943 (1954) *Science and Civilization in China* is perhaps the most well known attempt to systematically document China's history of science, technology and mathematics. Needham's research worked through a theoretical premise one can trace back to Max Weber's 1915 (1968) *The Religion of China: Confucianism and Taoism.* No matter if the subject was religion or science and technology, historians from Weber to Needham and beyond were striving to discover why China had failed to develop like the West. The guiding problematic of Needham's research was the question: why didn't China develop science like the West? In light of the more recent proliferation of the hard sciences in China, for many Needham's question has been updated to ask: how did China manage to so swiftly create the scientific presence that it has today (MacPhail 2009)?[25] Indeed, any ethnographic insight that I was able to eventually provide on Chinese science came about

[24] An article which explores motivations and hesitations among blood donors in China is included in the edited volume, Asian Biotech. (See Erwin, Adams, and Le 2009).

[25] Even before China's more recent surge in the biosciences, historians and social scientists started to question this framing of China as held back by Confucianism and pragmatism, an early example being Joseph Levenson's 1968 (2006) trilogy, *Confucian China and Its Modern Fate*. Levenson argues that Western interaction had brought about a watered-down Confucianism, and that China's authentic soul and inspiration to progress was lost when it became a nation among many nations, opposed to the center of Chinese cosmology.

after I stopped asking what makes science more difficult in China and started asking: what advantages does China hold as a place to conduct scientific research?

When Zhang and his colleagues offered observations on what made China a less complicated place to do research than the United States, I furiously took notes. These were the detailed contexts of Chinese science that, as an anthropologist, I was supposed to capture. The nuances of "Chinese science" that I gleaned, however, came about not through my own comparisons, but through theirs. Understanding the benefits and burdens of doing reproductive toxicology in China was even more important to Zhang than it was to me. My question became: how do academic administrators, scientists and graduate students understand the material, organizational and interpersonal structures of Chinese science that allow them to do things that would "not be possible in America," in the words of Zhang.

In 2002, after a year working for the Jiangsu Province Center for Disease Control, Zhang Zhiyuan was recruited back to the university to study for his PhD. He would hold a new seat in the same office where he had earned his Master's degree just a year before, cozy alongside ten other assistant professors and graduate students in Reproductive Toxicology. Many graduates of the toxicology center cherished the stable and well-paid appointments in regional CDCs – "especially females," a student told me in the laboratory one day.[26] But Zhang was eager to be back at the university. The choice to return to scholarly life came easy for a man dedicated to discovering how the side effects of rapid economic development and industrialism were impacting the region's reproductive health.

Zhang would now rejoin a growing team of nationally recognized scientists who were proudly conducting some of the most cutting edge research in China. The national government had just given their group "key laboratory" designation.[27] The university was expanding, and the entire School of Public Health would soon be relocated to a shiny new building that looked more like the Center for Infertility Treatment across the road. While infertility treatment generated income, and was increasingly used in China despite being very expensive for patients, infertility research did less to foot its own bill.[28] But with their new status and a growing number of articles published in not just national but international journals, laboratory funding and partnerships were well on their way.

Zhang had acquired hundreds of thousands of dollars in equipment over the last three years, making more research possible and meeting the informal criteria for international collaborations. While at the old campus the Polymerase Chain Reaction (PCR) and Computer Assisted Semen Analysis (CASA) machines were still in use, much

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[26] In China there are three sexes – the saying which I was repeatedly told goes – males, females and female PhDs. Female PhDs were not only a rarity in this laboratory, they demanded their own classification nationally, as women who must face a differently gendered path through life in order to pursue an academic career. Recruiting females from outside for PhD research, according to graduate students male and female alike, was as difficult as keeping them on after a Master's.

[27] Key laboratory status (*guójiā zhòngdiǎn shíyànshì*) is given to departments and laboratories in the natural sciences when they gain the financial support of China's central government. This initiative began in 1984, shortly after China's reform and opening, in an effort to grow Chinese science. The Ministry of Science and Technology (MOST) has recently announced a $2.4 billion investment in "12 Mega Projects for Science Research in the 10th Five-Year Plan" for growing science research, innovation and development.

[28] As discussed in the introduction, on the growing use of IVF and other reproductive technologies in China, see Lisa Handwerker's (2002) contribution to the edited volume *Infertility around the Globe*. On the economics of reproductive technologies see Charis Thompson's (2005) *Making Parents*.

of their new equipment sat in waiting, stored in the University's new suburban outpost.[29] Soon, Zhang would be there. Laboratory ceilings would no longer be water-stained. Dependable electricity would power the refrigerators and freezers full of thousands of blood samples from men diagnosed with infertility and parents of children with birth defects. The architectural limits of his crowded office and cramped laboratory would give way to a spacious setup that could only be procured by a move to suburban Nanjing, where international scholars and expats often chose to live and where Zhang's own family kept their home to escape the stresses, noise and air pollution that came with living in urban China.[30]

After an extended trip to the U.S. for academic conferences, meetings and networking, Zhang returned to the lab sharing his own cross-cultural comparisons. After invited by a U.S. university to present a paper, it took three weeks and four signatures for Zhang to get reimbursed for travel expenses. "Here, we just ask the boss, then give people the money before they leave," he said. If it was that hard to get reimbursed for travel in the United States, Zhang wondered, then how long must it take to do research – to meet safety standards, pass human and animal research subject safeguards, and navigate administrative mazes? The pace of scientific life in the U.S., even outside of bureaucracies, astounded him. "In America the most important thing is family," he said "Everyone leaves the office by 6:00 to eat at home. Here, the most important thing is work.'[31] Indeed Zhang approached his research less like a 9:00-5:00 job and more like a

[29] See Paul Rabinow's *Making PCR* (1996) for an overview of the PCR's invention at Cetus Corporation in the 1980s.

[30] In this description of a university laboratory in Nanjing, I hope to capture both the material lack and the feeling of comparative longing I encountered while conducting observation and interviews. As told by one graduate student interviewee who was about to become a doctor (as he emphasized) at a less well funded hospital within a less urban city in the less wealthy northern Jiangsu Province: "America's today is China's future." I heard and read similar temporal comparisons numerous times, especially as they relate to science and technology development and environmental decline. Here, we see not the anthropological classification of other people behind in time (Fabian 2002), but the classification by interlocutor of self behind the times. As Aihwa Ong writes, "The biotech revolution represents a Sputnik opportunity for Asian states seeking to "catch up with" and potentially surpass 'the West'" (Ong 2010:5). Ong understands 'the West' as a "native category" -- the imagined geographic "source of biological science, and the negative Western judgments of Asian knowledges" (2010:5). Among those I studied, catching up with 'the West' was certainly characterized as an opportunity, but an opportunity often experienced as a lack – a lack of funding, training, mobility, material resources, standardized and quality controlled experimental products and reputation. This may be especially the case among graduate student physicians and scientists of the Post-80s generation (*bashi yihou*), many of whom feel intense pressure to improve upon their international reach through studying abroad and mastering the English language, and who described the experience of this imagined potential as a kind of deprivation (Appadurai 1996).

[31] While I take Zhang's point about the difference in the importance in family and work between the U.S. and China, I also might suggest that the very notion of family and work might be conceptualized differently, as his colleagues seemed to a large extent be family, sharing in daily intimacies of eating, grooming, living and working in a more intimate fashion than the term "work" might suggest. Following the trend Li Zhang observes of relocating from urban to suburban China to create a private home, Zhang Zhiyuan has a house where his wife and parents live on the outskirts of Nanjing. However, during the work week he and his students all live near or on the university campus, only journeying to the suburbs or the city center on Sundays, their single day of rest. While certainly not the *danwei* (socialist work unit -- see Harrell (2001)) of China's past, the geographic proximity of housing enables and ensures that laboratory members work, live and eat together on a regular basis. Such proximity exists to an extent that Zhang certainly found differences when he compared scientific life in China and the U.S.

calling or even an addiction. In his own words, Zhang left the CDC because he wanted and still wants to do more – "more studies, more findings, more places, more time periods, more samples, more generations." As his own studies grew increasingly ambitious during his PhD and first few years as an Assistant Professor, Zhang realized that often more was possible in China than in the United States.

There were other things that made China an easier place to do research: a high population, affordable labor (largely in the form of graduate students) and, perhaps most importantly, pollution. The chemicals that international reproductive toxicology experts commonly claim cause male infertility were aplenty in China -- produced, used and discarded in large numbers in a largely unregulated fashion. Because of toxicity, Zhang has the opportunity to conduct scientific research on human populations that in other places would only be possible through animal studies.

While Zhang's national success is solidified, and codified through government funding and accolades, his ability to succeed internationally relies on participation with dominant networks, languages, and empirical forms of a reproductive toxicology grounded in "the West." It is essential that Zhang understand his laboratory's position – especially the material advantages and disadvantages -- in relation to the dominant networks through which reproductive toxicology expertise comes into form. In order to establish the kinds of authoritative knowledge connoted by transnational expertise (Choy 2005) and continue to secure monetary support from the Chinese government and international collaborators, Zhang must understand the benefits and burdens of his laboratory's toxic contexts.

Paradoxical Reconsiderations

Imaginations of the Chinese landscape as a place that must retain a balance between humans and non-human resources stretches back far beyond the modern age, through pre-modern periods and deep into Classical Chinese philosophy.[32] Tu Weiming describes the Confucian notion of *tianrenheyi* translated as 'heaven and human are one,' where heaven includes a notion of earth as "an anthropocosmic worldview, in which the human is embedded in the cosmic order, rather than an anthropocentric worldview, in which the human is alienated, either by choice or by default, from the natural world" (Tu 2001:244). In such understandings of the oneness of heaven, earth and human, the flourishing of one cannot occur without the flourishing of the other. Instead of a body separated from its environment, here the environment and the human body would be seen as unitary (Tu 2001:185).

During the last decade, some U.S. based environmental historians (Mitman, Murphy, and Sellers 2004) and China studies scholars (Holdaway 2010; Lora-Wainwright 2013) have called for a consideration of the environment that similarly goes beyond non-human ecological or economic dimensions of environmental destruction.

[32] Mark Elvin argues that the environmental imperatives stressed by Classical Chinese texts should not be interpreted as signs of an ideal environmental past, but as signs of a growing ecological crisis that demanded "rational reaction" (Elvin 1998:14–15). Moreover, Elvin concludes that "agrarian-urban economic growth" is the primary factor in the country's environmental destruction, and that this growth extended even to pre-modern China. He writes, "Growth in and of itself can create a certain pressure to "cash in" resources" (1998:24). While Elvin thinks differently about the temporality of China's environmental challenges, ultimately rejecting the idea that China's past was ever harmonious with nature, he maintains the growth/destruction paradox.

Scholars hope environmental research will travel into areas of human health, drawing interdisciplinary attention to the environmental drivers of disease (Holdaway 2013).[33] Through social science research, scholars hope to dislodge assumptions "that human health questions are somehow less ecological than those addressing the non-human world" (Mitman, Murphy, and Sellers 2004:2). For Anna Lora-Wainwright, putting a human face on the paradoxical nature of China's environmental problems means providing not only ideas about how the environment impacts human bodies, but also understanding human interpretations of the conundrum they face. In "Dying for Development," Lora-Wainwright (2013) furthers the environmental paradox commonly used to describe China by utilizing the double meaning of the term dying, expressing both the dire health conditions and the deep yearnings of those she studied who continue to use pesticides while farming crops in a Sichuan village. Only through researching the inevitably intertwined human elements of China's environmental destruction/development paradox, scholars argue, can we begin to truly understand the depth of the challenges we face.

While Lora-Wainwright, Holdaway and other scholars are correct to characterize social science research on environmental challenges as often concentrating on the non-human impacts of human activity, biological scientists within and outside China have been studying the human health consequences of environmental destruction and development for decades. By looking at the kinds of scientific research being done on and in the Chinese environment, as well as the specific sperm-environment research being done at the reproductive toxicology laboratory where I conducted fieldwork, this chapter ultimately shows that what makes the state of China's environment unique today may not only be the degree to which toxicity plagues its quickly developing landscape. China is also defined as an opportune place for biological research. The two sides of China's environmental paradox –destruction and development – are here even more interdependent than previously imaginable. The ability to conceive of toxic burdens as scientific benefits furthers the consequences of China's environmental decline/development paradox in and for environmental health research.

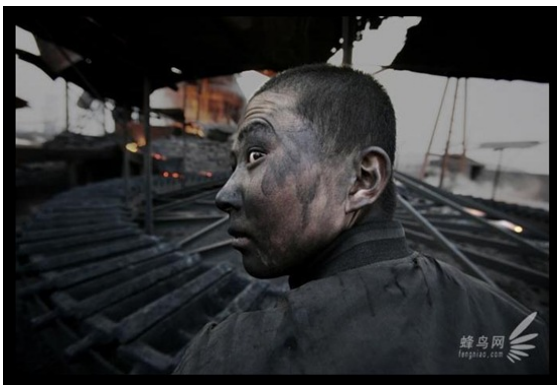
Perhaps in addition to conducting research on the human dimensions of environmental problems, anthropologists should also reflect upon the way in which research on human-environment interaction is currently being conducted in the biological sciences, including the ethical problems such research presents. Inevitably, the humanist motivations that compel a serious rethinking of how researchers and policy makers define the environment must also be put under the microscope. Otherwise we risk valuing exposed populations and the research one is able to produce through them, more than valuing improvements to conditions of toxicity. Given the ways in which toxicity has itself become a resource through which scientists from both within and outside China can enhance their research, will China be impelled to resolve environmental problems? Will calls to continue research on the human dimensions of environmental destruction truly

[33] Inspiration for the position varies. For instance, "In medieval times, Europeans envisioned extensive correspondence between their bodies and the cosmos; in more recent times, the rise of specialist disciplines has tended to sever this connection. Thus today's historians of environment and health face a long tradition of chopping 'health' and 'environment' into distinct and separate realms of knowledge and practice" (Mitman, Murphy and Sellers 2004:3).

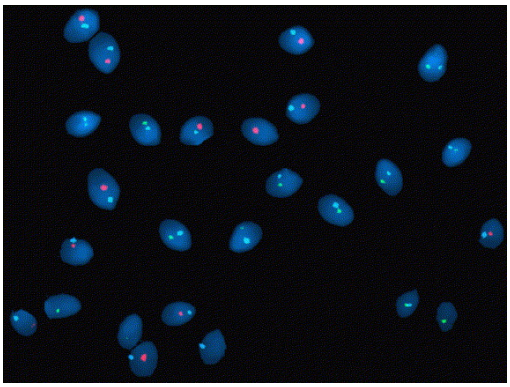
remedy the toxic conditions, or contribute to their continuation as the ideal conditions in which to conduct research?

Zhang's imagined future laboratory will grow the field of reproductive toxicology in China. He will continue to attract national recognition, achieve international publication partially because of his eagerness to grow Chinese science through a specialty with much global currency, partially because the Chinese environment is so ripe with toxicity. This toxicity enables and inspires him to make more of his research… more samples, more studies, more complications -- even in the face of, as he says, "no exact conclusions."

Chapter 3:
Enacting Environments



Consider this image. A photo by internationally renowned photographer Lu Guang. A close up of a young man's coal smudged face in profile, his widely opened left-eye turned to the viewer as if someone has called his name. Although certainly a color photograph, the scene is largely black and white. Grey smog hangs thick in the background. Rail ties extend on the ground before him covered in a coat of coal ash, cuing us in on his life as a laborer, probably a migrant laborer from an even more remote part of China. Indeed this photograph was taken in one of the small coalmining cities in Shanxi Province, which holds China's highest rates of cancer and birth defects. Other photos in Lu's "Pollution in China" collection show the country's toxic environs smudged across the faces, necks and backs of his photographic subjects.[34] Bodies are deformed. Rivers are so polluted that trash and oil densely float to the surface. Hopeless human postures indicate that no economic boom can end this environmental plight. But not all evidence for China's environmental problems is so obvious.



This is another image of a young male Chinese laborer impacted by the environment, or at least a part of him. This is the sperm of a worker in a Chinese pesticide production facility magnified 1000 times, undergoing testing through multicolor fluorescence in situ hybridization (FISH). FISH is often used in the diagnosis of infertility, but here the test is being conducted in order to compare the chromosomal quality of sperm from populations variably exposed to chemical pesticides. The number of chromosomes X (the green dots), Y (the red) and 18 (the blue) in sperm were counted to evaluate the potential effects of indirect exposure. Results from this image and others

[34] View the additional 39 images in Lu's collection and learn more about the photographer here: http://www.worldpressphoto.org/lu-guang.

led reproductive toxicologists to argue that there may be a relationship between prolonged pesticide exposure endured by male factory workers and infertility.

If the environment, or perhaps its demise, is at fault for the potential health inadequacies of both young male Chinese laborers portrayed here, what kind of environment is it? The Chinese term *huánjìng*, often translated as "environment," is increasingly present in everyday conversations and official discourse in the People's Republic of China (Hoffman 2006). Interactions with international legal, political and economic structures have promoted national institutions and conversations devoted to the "environment" (Edmonds 2011; Hoffman 2006). Concerns about the health impacts of environmental degradation have increased among ordinary Chinese citizens, the Chinese government, and the growing number of regional and national non-governmental organizations (Zhang and Barr 2013). But it is not just attention to the environment that has increased; the environment itself has multiplied.

Today the Chinese environment comes in multiple forms, many of which differ from ecological conditions or the "natural environment" (*zìrán huánjìng*). As Lisa Hoffman discusses, Chinese government officials and citizens are increasingly concerned about the investment environment (*tóuzī huánjìng*) and the working environment (*gōngzuò huánjìng*), the recreational environment (*yúlè huánjìng*) and the family environment (*jiātíng huánjìng*) (Hoffman 2006). These multiple environmental forms do more than simply give terminology to a growing set of pre-existent arenas of social life. Environments are brought into being or *enacted* (Mol 2002) through the scientific practices that make them knowable objects.[35] To translate literally from the Chinese term *huánjìng*, where *huán* means ring or circle and *jìng* means condition or circumstance, the environment is a circumscribed set of circumstances. The enclosure itself is what makes the circumstance isolatable to begin with.

The reproductive toxicologists I researched in Nanjing, China, both examine and produce toxic 'environments' of exposure through epigenetic studies of male infertility that. Like all epigenetic research, the studies conducted by members of the laboratory directed by professor Zhang Zhiyuan move away from genetic determinism in that they examine how 'environmental' exposures may cause genetic markers for diseases inherited by offspring (Lock 2005). These environments might include anything beside, beyond or outside 'the gene,' from food (Landecker 2011; Yates-Doerr 2011) to social incapacities (Rapp 2011) to endocrine disrupting or xenobiotic chemicals (Mansfield 2012). Through genetic tests, epigenetic experiments and semen analyses, environments are brought into being as toxic exposures contributing to sperm decline.

In 1980, while researching Chinese medicine in Taiwan, Arthur Kleinman made a case for medical and scientific research based on a consideration of the cultural and social determinants of health. He writes,

> Cultural and sociopolitical analyses of the determinants of health care delivery, for example, have not been considered appropriate venues for medical research, and the description and analysis of the total environmental context that ethnography provides has not yet been accepted as an appropriate scientific approach for medical research. [1981:32]

Today environmental factors that medical anthropologists such as Kleinman deemed the social determinants of health are being understood in epigenetic research as

[35] See introduction for a further explanation of Mol's concept of enactment.

'environmental' exposures affecting genes and those who inherit them (Rapp 2005). Such acceptance of social and cultural determinants of health within the biological sciences has led to a hesitant excitement within the world of anthropology. How these environments of health are imagined and enacted in toxicological research of Chinese sperm is the topic of this chapter, which asks: what might anthropology learn from research on (Chinese) sperm-environment interaction, and how might research on (Chinese) sperm-environment interaction learn from anthropology?

The Environment at Large

Within 30 minutes of meeting Zhang Zhiyuan I found myself thinking differently about the causal factors of sperm decline in China. Having been trained in a school of medical anthropology where critiques of biomedicalization and scientific reductionism were commonplace, I came into fieldwork pushing back against what I interpreted as pessimism. I wanted to be optimistic about the approach some scientists had to research, about the complicated nature of their thinking, and about the way scientific research spoke to social concerns, even without straightforwardly attempting to do so.

Before coming to Nanjing, I had read a dozen articles about the state of Chinese sperm – a substance being influenced by "white pollution" such as plastic bags and food containers, as well as a number of other substances from contaminated seafood to cigarettes. I viewed these objects as material traces of an unbridled capitalism (with Chinese Characteristics), and suggested that maybe without really knowing it, scientists viewed them this way, too. Before befriending a medical student whose colleague worked with Zhang's laboratory during preliminary fieldwork in Shanghai, I had analyzed many of these articles, claiming in seminar papers that Chinese semen analyses did not just analyze Chinese semen, but the quality of life in China more broadly. Before meeting Zhang in person, I was arguing in grant proposals and workshop meetings that, although unaware, analyses of sperm coming out of Zhang's laboratory were actually analyses of the political and social conditions faced by men in post-reform and opening China. But after meeting with Zhang at a deserted Italian Restaurant within walking distance of the laboratory, I would soon come to know that much of what I had interpreted from a distance as unintentional or at least implicit in Zhang's research was, in his mind, explicitly connected. For him, studies of sperm were as much analyses of the industrial and development policies and politics that had led to a devastated environment, as they were semen analyses.

We sat across from each other in a booth – the only lunch customers in an endearingly tacky Italian restaurant run by an American expatriate whose velvet suit and strange toupee led me to believe he had been in China for some time. Over spaghetti and meatballs that tasted like sweet ketchup and the inside of dumplings, Zhang introduced himself and his laboratory's research. His long fingernails tapped the forward arrow of a Lenovo laptop computer, moving through the slides of a PowerPoint presentation. As an audience of one, I learned about the newly minted key laboratory's transition from classical toxicology, focused on occupational exposures, to multi-factoral studies that his group conducts today. I learned about how soy consumption changed the metabolism of men, how chemicals moved from institutional to human bodies, how pollutants ingested by unsuspecting mothers were passed on to future generations. As we moved through the detailed explanations of his laboratory research, I tried to cling to the scientific content of

his presentation. I kept listening for a notion of the environment that exceeded the details of the laboratory experiment. There had to be something more that was driving this research, some kind of commitment to an environment that stood outside the confines of the chemical, the laboratory or the factory.

Largely written out of his many scientific articles, Zhang does hold 'environmental' concerns about the vast pollution faced by humans and animals along the Eastern seaboard, about the impact of industrialization on the fertility of the land and its people, and about the emphasis placed on development by a government out of touch with the health concerns of the population it governs. When I ask if his research has any policy applications, he tells me about the role his office plays in making recommendations. He then immediately asks me if I've read the Greenpeace report on the fish in the Yangtze River—the river that runs through this city, Nanjing. Shaking my head no, he tells me more, letting me know that this document, a study of environmental (or endocrine disrupting) hormones was very effective in translating scientific research into public and policy circles. Zhang was not involved in the research but seemed to see the anti-industrial pollution, pro-government accountability tone of the report as correlated with his efforts nonetheless. Although difficult to gather from detailed PowerPoint presentations or the highly technical literature his laboratory produces, and although impossible to deduce from the epigenetic experiments that are increasingly the focus of his laboratory, what drives Zhang's research is a concern about the 'environment' more generally and less specifically than his scientific publications might imply.

The Environment in Particular

In the words of Evelyn Fox Keller, the epigenetic environment is often understood as anything acquired. Keller calls attention to the troublesome ambiguity of the term environment employed in epigenetic studies (2010:2). Ambiguity, she claims, can lead to the stabilization and objectification of conditions beyond the gene that are, in actuality, always more complicated and unstable. But in Zhang's research the multiplicity of the environment plays an important role. In order to potentially aid in the transformation of the Chinese state's development priorities, the environment's ambiguity is as or more important than its specification. A malleable notion of the environment allows researches to speak to an array of chemical and ecological issues, while furthering both international publications goals and national environmentalist agendas.

In Zhang's epigenetic studies of sperm, something called the environment – variably understood as pesticides, industrial pollutants, or toxic residues – travels into the male body and out again in the form of low-quality semen. The environment is both an instantiation of a specific exposure and a more generalized notion of a circumstance that stands beyond but connects with the gene. Such was the case in studies of fenvalerate, the toxin of choice in Zhang's initial studies of male infertility, which tested environmental factors thought to be involved in a reduction of male sperm quality. Fenvalerate is a pyrethroid, which is a class of insecticides developed in the 1970s as an alternative to dichlorodiphenyltrichloroethane (DDT). This model chemical was itself modeled after the pest repellant found in chrysanthemum flowers. Similar to the impact of OPs, pyrethroids overexcite neural membranes. Although listed in a report by the International Programme on Chemical Safety published by the World Health Organization as tolerable

to mammals at low doses, fenvalerate is extremely toxic to insects, including honeybees, and many aquatic species at any dose. Body size, temperature and metabolism are thought to protect humans from the low dose impacts of pyrethroids, yet humans have been found to react to these chemicals, including fenvalerate, with high-dose exposure (Bradberry et al. 2005).

According to the International Programme on Chemical Safety (International Programme on Chemical Safety 1990), no outbreaks of pyrethroid poisoning in humans had been reported until 1982 when cotton growers in China handled the pesticide without any precautions, told in error that the pesticides were non-toxic. Later studies showed that over 573 cases of acute pyrethroid poisoning occurred in China from the time of this initial outbreak in 1982 to 1989 (He et al. 1989). Much, if not all, available information on the effects of direct, high-dose human exposure to fenvalerate comes from China. Zhang's research is no exception.

Zhang's first approach to studying sperm-environment interaction concentrated on what were called *genotoxins*: toxins thought to negatively alter genetic material (Weisburger and Williams 2000). Genotoxic studies used fluorescence in situ hybridization (FISH) to detect DNA sequences. FISH was originally developed as a means to evaluate the ways in which toxic medications used to treat cancer patients may have affected fertility. The test is now prescribed by reproductive endocrinologists and andrologists to some male patients facing unexplained infertility, and is frequently used by research scientists inspecting chromosomal abnormalities in sperm caused by synthetic chemicals. During infertility studies, florescent probes locate genetic abnormalities in sperm. As new genetic technologies such as FISH were developed in the 1970s, new means of locating the progressively smaller and more interior low-dose effects of chemical exposures came into view.

Since the late 1990s scientists have used FISH to test the effects of chemicals including fenvalerate on sperm. Reproductive toxicologists in India, the United States, Spain and Finland have shown that fenvalerate leads to reproductive health problems in animals. Due to the market in chemical production in China and proximity of chemical production plants to their laboratory, Zhang's team was able to conduct research on fenvalerate-exposed humans. Zhang designed his research around those living and working in the Yangtze River Delta, where rates of pesticide production are high, rising alongside the region's economic and industrial development (Ash and Edmonds 1998; Hamburger 2002). Using FISH, Zhang sought to answer international questions about the impact of chemical exposure on fertility. In one study, Zhang used FISH to compare the sperm quality of three groups – product laborers at a pesticide factory, laborers at a nearby office and people in a nearby city. Semen was collected, centrifuged and magnified 1000 times in order to be compared to the sperm of others at the chromosomal level. Results from the study led Zhang to argue that chromosomal abnormalities occurred more often in fenvalerate exposed populations and that there may be a relationship between the prolonged pesticide exposure endured by factory workers and infertility, still births and spontaneous abortions.

In these studies, fenvalerate is deemed "a suitable model compound," a chemical that not only stands for the environment, but also becomes the environment interacting with sperm and genes. Once generalized from fenvalerate to environment, Zhang's laboratory uses the evidence of fenvalerate's impact on sperm to show that genes and

environments interact more broadly. Alongside fenvalerate, many other compounds come to stand for the environment. But at other moments, the environment Zhang researches is not so concrete.

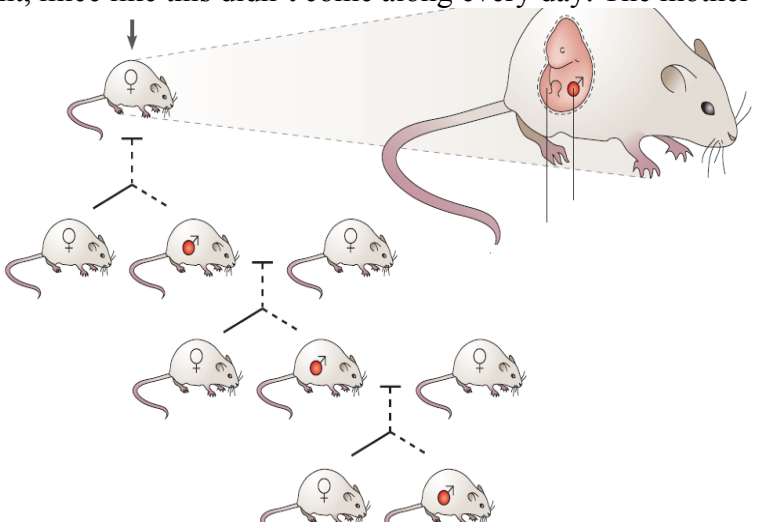
The Absent Environment

In recent years toxicology has shifted focus from testing to experimentation (Fortun and Fortun 2005:46), and Zhang's research is no exception. His team is now increasingly focused on animal experiments. He calls this a shift in focus from the effect to the "mechanism of the effect." Efforts to discover the mechanism of the effect strive to show not what is but how what is came to be.

During one of Zhang's extended international conference and recruitment trips to the United States, something smelled different in the laboratory. Usually a cross between dust, muggy air and chemicals, when I enter the room today I am compelled to take a tissue from my pocket, covering my face before I sneeze. As no blessings follow such expulsions in Chinese, I am left to excuse myself, and keep the tissue at my nose to cover the odor that I now realize is coming from stacked cages in the corner of the lab. In each cage is a mouse – small and frantic, suckling from water bottles and scurrying around a 12"x12" terrain densely packed with shavings. This was the reason the graduate student leading the experiment in Prof. Zhang's absence, Wang Bo, sent me a text message early this morning – an unexpectedly urgent invitation for a laboratory visit.

When I arrive in the toxicology building I am directed straight to the laboratory. Here, at least six graduate students have gathered, standing in a semi-circle as they await their role in the larger task ahead. "Today we do the experiment," Wang states as he sets a handwritten copy of the directions sent in an email from Professor Zhang on the counter in front of us. Zhang had emailed them from the U.S., expecting laboratory life to continue as usual in his absence. But up until now research had stalled. A key member of their research team was yet to present, and this was certainly not me.

For weeks they had been waiting for the critter that Wang now holds in his hand and would soon kill. Bred in the university hospital's research animal unit to the specifications of the experiment, mice like this didn't come along every day. The mother of the mouse that squirms between Wang's two fingers, held by the scruff of the neck, was bred with an RNA micro-deletion that has been shown to be a common epigenetic effect of exposure to endocrine disrupting chemicals. This should have impacted the quality of sperm in her son – the mouse Wang holds. At least that is what Wang is hoping, for if such sperm decline is shown, the epigenetic mechanism that lowers sperm quality will be isolated and the results will be significant. Significance, as Wang reminds me, leads to publication.



For Zhang's laboratory, epigenetic experiments with rodents are a means of discovering the mechanism through which a toxic Chinese environment – in its various forms – is passed through generations. While many studies within Zhang's lab focus on the epigenetic impact of specific chemicals as environments, in this study of sperm-environment interaction there is no specific chemical in question. The level of abstraction goes beyond the interior replication of an exterior condition in the laboratory (Knorr-Cetina 1999), focusing only on the mechanism through which an environmental effect might come into being. As epigenetics enters studies of infertility, what was once the effect of an indirect environmental exposure – low sperm quality – becomes the effect of yet another mechanism – an epigenetic factor. In this case, an RNA micro-deletion in the female predisposes future generations of male offspring to lower sperm quality. Although the bulk of the experiment is spent isolating then testing sperm, conclusions about sperm quality do not speak to a present exposure. Instead they point to a mechanism brought about by an imaginary toxic past, an inherited byproduct of an environmental exposure passed through the female line.

Faster than I can see Wang has killed the mouse and now dangles its open mouth over a small vial, which quickly fills with blood. "You killed it already?" I ask. "Yes" he answers. "How?" I inquire. "His neck," he responds. I look closer, becoming as uncomfortable as Wang is careful. There was no cut, only a turn. He shakes the last trickle of blood from the mouth as the mouse spasms in mid-air. Wang turns to me as I let out a mini-shriek. "It is dead," he offers to calm me. I nod and breathe deeply as he sets the mouse on the table and hands the vial of blood to another student.

The mouse is turned on its back and the skin on its belly is cut vertically and horizontally. Fur and a surface layer of skin are carefully removed before its organs are separated out and placed into separate containers. Wang consults the instructions: he is to remove certain organs and analyze them as well. But the focus of the experiment are the testes and epididymis, a small tube that runs from the testes through the penis along which sperm travel from the inside out. After removed the epididymis is placed in a vial. Wang brings the small glob of flesh to the other side of the island counter and cuts it into tiny pieces with a miniature pair of scissors so the sperm can "go out." Earlier this morning results from a Computer Assisted Semen Analysis (CASA) had left them without sperm. The epididymis had not been cut finely enough to eliminate tiny chunks of flesh from disturbing the clarity and accuracy of the count. So this time the graduate students are more careful to cut up the epididymis multiple times.

Immediately after the dissection of the mouse and mini-dissection of the epididymis are complete, we take the test tube in hand and briskly walk down the hallway and stairs of the decrepit reproductive toxicology building, out the entryway and across the road. Here lie the laboratories that perform procedures to aid the treatment of infertility through assisted reproductive technologies such as *in-vitro* fertilization and artificial insemination. Another student meets us at the six-story building's entrance and together we take the elevator to the fourth floor laboratory with the CASA machine, to which I had been formally introduced during a previous laboratory tour.

On top of the machine sits a tiny wooden box. Our CASA handler unlatches the case with hands covered by the required rubber gloves. A tiny bit of the small sperm sample collected from the mouse is taken out of the tube and put onto the platelet slide. After covered, the rectangular dish is inserted into the machine and very quickly an

image of sperm pops up. Pressing a button on the control keypad, the machine handler moves between five captured images. He chooses one with the help of Wang and the machine then analyzes this image. All of the measures previously conducted by laboratory technicians under microscopes – quantity, mobility, motility, viscosity – are taken here in less than ten seconds. Wang then pulls out a digital camera from his pocket and takes a photo of the analysis results. "USB drives are not allowed," he explains, for fear that the CASA machine may contract a virus. The activity is repeated for four samples. One is still "too dirty" (*tài zāng le*) – meaning there are too many particles of flesh mixed among the sperm, but only three are needed to meet the specifications of the experiment designed by Zhang.

Within the week Wang and colleagues find that the epigenetic mechanism they hoped to isolate cannot be identified through this experiment. The mice with the micro-RNA deletion thought to be common among those exposed to endocrine disrupting chemicals had not given birth to a son with significantly reduced sperm quality. The results were, therefore, insignificant. The experiment would be redone with new mice, new micro-deletions, and perhaps to new parameters of significance. Standing with Wang and his mouse parts in the lab that day, the significance of his study truly did feel like it hinged on the quality of the sperm we would find. After carefully administering the sperm test, after hours of dissection and separation, after days of waiting and weeks of breeding the mice he and his colleagues had sacrificed, we all hoped that the sperm depicted would be malformed, slow or few. In that moment the only environment that mattered was the one we had invented and that had been inherited by this mouse as a RNA microdeletion.

As toxicology shifts from human studies to animal experimentation, and from effect to the mechanism of the effect, specific toxins no longer need to be extrapolated into environments. Instead the environment is assumed, its effect already known. This is toxicology with no toxin. While much of Zhang's work takes advantage of a toxic China, relying and depending on the chemical exposures and exposed humans that could only be found in a specific Chinese environment (as discussed in the previous chapter), other research proceeds in the absence of an environment entirely. It is not that an artificial environment is produced in the laboratory, but that the environment is simply bypassed altogether. This, of course, does not keep results from such experiments from being framed as findings on sperm-environment or gene-environment interactions. In epigenetic studies, the environments researched do not have to be a specific place, a set of conditions, or an ecological entity. In fact the framework for their investigation – gene-environment interaction – relies on the gene interacting with an environment that does not necessarily even need to exist. However, this enacted environment might still be taken up as proof that "environmental destruction" is harming the reproductive capacity of China.

In the research practices of reproductive toxicology graduate students striving to get sperm to speak to the mechanisms of epigenetic effects, we see that as Knorr-Cetina states, scientists are aware of the cursory nature of the facts they produce. She writes, "Success in making things work is a much more mundane pursuit than that of truth, and one which is constantly turned into credits in scientific everyday life via publication. Thus, it is success in making things work which is reinforced as a concrete and feasible goal of scientific action, and not the distant ideal of truth which is never quite attained"

(Knorr-Cetina 1981:4). Through momentary successes, not truths, graduate students strive to establish themselves as scholars capable of participation in the international reproductive toxicology scene. This desire is partially what drives them, however it is not the entire picture. For Wang and others I spent time getting to know in 2011, parental expectations, economic concerns, and frets about post-graduate job placement and security made long hours and long weeks of laboratory research both worthwhile and painful.

Professor Zhang understands that toxic environments are not only inherited by male mice in the present, but also make for potentially infertile futures of men and the Chinese nation. But with Zhang's absence in the laboratory on that day and other days, I also felt the absence of this broader sense of the environment. Might this disconnect from the moral motivations for doing research on the "environment" be made possible by the abstraction that epigenetic animal experiments allow? Perhaps because this remains a question, anthropology should retain a critical stance toward epigenetic research, even as it inspires us to rethink our own definitions of environment, context and culture. Today, anthropology can offer epigenetic sciences the tools to look at the ways environments are at times still momentary reductions of complicated phenomenon that, like culture, should not be reduced to an explanatory mechanism.

The Environment Multiple

The reproductive toxicologists conducting epigenetic research in Nanjing today take the relationship between the body and the environment as a given. Accordingly, their studies shift from asking whether or not the environment interacts with sperm to how the environment interacts with sperm. Furthermore, the environment with which sperm interacts is multiple. When present, the environment is an occupational environment that results in chromosomal abnormalities in the sperm of those exposed to chemical pesticides while working in factories. It is also a non-occupational environment located in the urine of men who seek infertility treatment. At times, it is an inherited environment, taken into the female body then passed onto male offspring who suffer reduced sperm quality. And it is sometimes an environment that stands outside the research parameters altogether, as a barometer for the health of not just sperm, but of the Chinese nation. Like artherosclerosis in Annemarie Mol's work, the environment is multiple but still hangs together. Mol writes,

> In a single medical building there *are* many different artheroscleroses. And yet the building isn't divided into wings with doors that never get opened. The different forms of knowledge aren't divided into paradigms that are closed off one from the other. It is one of the great miracles of hospital life: there are different artheroscleroses in the hospital but despite the differences between them they are connected. Artherosclerosis enacted is more than one – but less than many. *The body multiple* is not fragmented. Even if it is multiple it hangs together. [2005:55]

Multiplicity, then, is not the same thing as ambiguity. It is an understanding of varied bodies, or environment, enacted as both themselves and as part of something more.[36]

[36] An understanding of disease/illness as multiple is also something discussed by Kleinman, who argues that "Disease/illness can be thought of as expressing different interpretations of clinical reality, or representing different aspects of a single clinical reality, or creating different clinical realties (1981:73). It is in this final instantiation of disease/illness multiplicity that I believe Mol, who emphasizes the ontology

The idea that multiple understandings of the body exist simultaneously is certainly not new. For decades, anthropologists have put dominant Western conceptions of the body into perspective by comparing them to non-Western ideas. Chinese thinking on the body is often held out as the epitome of the Cartesian body proper's comparative other, and is described partially in order to throw into question the bodily foundations of modern biomedicine (Kleinman 1981; Lock and Farquhar 2007; Scheper-Hughes and Lock 1987). Conceptions of the body from traditional Chinese medicine and Taoist philosophy have been especially inspiring for many. In particular, the idea of *tianrenheyi* has undergone resurgence as of late.[37]

Anthropologist Mei Zhan shows that in Chinese medicine humans are thought to encompass environments both inside and outside the body (Zhan 2011:108). These interior environments are not mere representations of exterior landscapes; they are instantiations of exterior circumstances. Zhan argues for the potential of an analytic of oneness for anthropology, which she explains: "simply put, is the idea of *tianrenheyi*, where, "heaven and human are one." She continues,

> In everyday discourses of tianrenheyi today, tian, which literally translates as "heaven," "sky," or "cosmos," is invoked and reinterpreted to reference not only "nature" (ziran) but also "environment" (huanjing) broadly construed. At a time when nature and environment in various incarnations have come to occupy a salient place in translocal political and existential imaginations, tianrenheyi suggests — though by no means guarantees — the possibility for recuperating and envisioning a worldly future of healing and being oriented to the undividedness of the human and the world. [Zhan 2011:108]

Zhan argues that an analytic of oneness demands that we rethink what it means to be human. Might epigenetic research make similar demands?

Professor Zhang makes no such explicit gesture. Yet in some ways his vision of the body and sperm, as both an indicator for the health of the nation and an inseparable part of China's recent history, is more reminiscent of classical Chinese philosopher Laozi's inner landscape than the Cartesian body proper that Farquhar critiques after years of research on Chinese medicine. In 1987, when the impacts of Reform and Opening on China's scientific development were just starting to register, Farquhar argued that the classic texts and senior doctors of Chinese Medicine allowed medical knowledge in China to keep its distance from the epistemological foundations of Western thought. Perhaps today, the mainstream development of epigenetic research is thinking *with* some

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of the body and disease, would agree. Mol, however, stresses the coordination of multiple clinical realities instead of Kleinman's conflicting clinical realities.

[37] Tu Weiming (2001) examines the ways that revisiting the idea that heaven, Earth and human are one (*tianrenheyi*) sparked an ecological turn in Neo-Confucianism in the 1970s. Zhang and Barr contend that multiple Chinese stakeholders, from government officials to environmental activists, frequently mentioned this concept when they took part in interviews about environmental problems in China (2013:6). While *yangsheng* movements in Beijing embrace the philosophy as a means of cultivating self and life (Farquhar and Zhang 2012), anthropologist Mei Zhan proposes *tianrenheyi* as a new analytic for the discipline of anthropology (Zhan 2011). From anthropologists and Chinese medicine practitioners, to environmentalists and neo-Confucian politicians, the increased interest in *tianrenheyi* perhaps points to the way that concerns about the environment makes their way into various domains.

of the ontological foundations of Eastern philosophy.[38] In the language of Chinese medicine, Zhang's research into sperm-environment interaction looks for the relationships between – between substances, between systems, between bodies.[39] Zhang is looking not for the cause or the effect but for the root of infertility, which appears to be the multiple Chinese environments that have emerged alongside China's industrialism and the policies that continue their assaults on fertility at many scales. Again, these environments are not interpreted as external causal factors. They are exterior conditions that are internalized, leaving epigenetic traces in the body and leading to infertility in generations to come.

For good reasons, anthropology has been tentative in its embrace of theories of the body that see biology and culture as mutually transformable. Take for example Margaret Lock's notion of *local biologies*, which to a great extent overlaps with contemporary epigenetic thinking (Lock 2013a). Lock (1993) originally introduced this idea in order to counter the scientific and medical practitioners' universal claims of disease categories. Lock's idea was initially met with hesitation (Rapp 1995)**.** However over the last 20 years, and especially within the last five years, Margaret Lock's revisitations and revisionings of the local biologies concept are abundant and include variations such as stigmatized biologies (Horton and Barker 2010) and subaltern biologies (Bharadwaj 2013). So what has shifted to account for the partial embrace of local biologies by anthropologists? Perhaps the answer to the question is the transformation of theories of biology in other fields. As good anthropologists (of science), now that those we study are taking seriously the idea that environments impact the most basic organizing codes of the body, we too are taking this idea seriously.

With skepticism but not pessimism, anthropologists might further explore the means through which to consider the biological impacts of social processes. Instead of critiquing science for being either too reductive or too ambiguous, we might instead look at the mechanisms through which environments come into being as biosocial factors interacting with genes and with sperm. Whether studied through mice or humans, at the heart of reproductive toxicology is an understanding that bodies and biological substances interiorize "the environment" in all its complicated forms. Sperm and genes actually take environments within, becoming something substantially different through genotoxic or epigenetic mechanisms. The social economic and cultural contexts of Chinese science, then, do not stand outside sperm and deliver an impact. The seed is the soil. The outside inside. Epigenetic environments at multiple scales offer anthropologists an opportunity to see that connections and resonances between domains are neither merely knowledge practices (Strathern 2005 and to some degree Choy 2011), nor strictly ontological enactments (as in Mol 2005). This is a biosocial becoming-with, where environments at varied registers and onto-epistemological states coordinate and correlate.

[38] Farquhar has argued that a distinction between ontology and epistemology simply has never existed in Chinese Medicine, but here I am attempting to stress, as Farquhar writes, "fixity and status occurs only as the result of concerted action" (Farquhar 1994:25).

[39] In this sentence and the next I draw on the language of Chinese Medicine, as described by Farquhar (Farquhar 1996:91).

Chapter 4:
Infertile Futures

The transformative potential of epigenetics for the biological sciences and beyond has captured the attention of many. Cultural anthropologists, social scientists and journalists alike describe epigenetics as a new way into old questions about nature and culture. As discussed in the previous chapter, epigenetics is a research approach and technique that modifies genetics to include factors previously considered social or environmental, therefore insignificant to genetic processes. As described by anthropologist Margaret Lock, "This emerging [epigenetic] knowledge has exploded the central dogma on which molecular biology was founded" (Lock 2007:62).

Marilyn Strathern seemed to have seen such epigenetic excitement coming, cautioning in a 1991 article that, no matter how revolutionary this paradigm may seem, epigenetics relies on a similar theoretical foundation as previous modes of genetic thinking. For Strathern, this theoretical foundation was not the nature/culture dichotomy. Instead she focuses on how, even when thinking "beyond the gene," epigenetics perpetuates a distinct understanding of the relationship between individuals and society. Pointing to the consistencies between epigentic and genetic research, Strathern presents an analogy: the gene is to the individual as the epigenome is to society (Strathern 1991:585).

For Strathern there seem to be at least two similarities between society and the epigenome. First, both are abstract, though can be made concrete. As with society, which is often understood to include everything that exists beyond the individual, everything is potentially epigenetic that is "beyond the gene." But epigenetic environments, just like society, can be brought into being through scientific practice. Strathern writes, "We may concretize the environment through examples of its parts, as uterus or as trees and mountains, as we may concretize society through referring to groups and institutions." Abstractions can be concretized through partial examples, or as discussed in the previous chapter through scientific enactments. The second similarity between society and the epigenetic environment that Strathern suggests is that both are thought to deliver an impact. Indeed, a survey of current publications in the biological sciences would show that the epigenetic environment's relationship to genes is often described much like the relationship between societies and individuals in the social sciences -- through a language of transmission, impact, and marking, where the environment acts upon genes, and genes remain discrete entities which have been affected by an environment.

As an anthropologist who has problematized the West's notorious individualism, Strathern attempts to similarly problematize epigenetics (1991:585). She does this, first, by reminding readers of alternative modes of understanding the individual in context (AKA the gene in the epigenome). Melanesians, for example, conceive of themselves not as independent persons but persons always in relation to other persons, or dividuals (1991:588). She then brings this idea of the person always in relation to epigenetics by following the lead of a gynecologist also in attendance at the 1990 meeting of the British Association for the Advancement of Science. The gynecologist and Strathern ask: what if the epigenetic environment with which the gene/individual interacts is another person? This question disrupts the relationship commonly depicted between the isolated gene and the encroaching epigenome and, in social science, between a free standing individual and an enveloping society. It is also a question frequently asked by the reproductive toxicologists I have studied.

This chapter discusses how contemporary birth cohort studies of a complex epi/genetic disease, Hirschsprung's Disease, are not only transforming the boundaries of nature and culture, but might also rework understandings of the relationship between individual and society. Here, I argue that in China—where the nature/culture dichotomy has arguably never been as strong as characterized in the West and where a different history of genetics might make way for a less explosive arrival of epigenetics—it is perhaps more fruitful to think through the implications of new genetic sciences for understanding the individual in relationship to varying scales of the collective, rather than the complications epigenetics bring to conceptions of nature and nurture. In research and treatment practices, those I studied are carefully thinking through the potential implications of individualization for understanding disease causality and responsibility, as well as for what it means to be a citizen of China today.

Researching Hirschsprung's Disease

Hirschsprung's Disease (HSCR) is complex. Infants with HSCR lack ganglion nerve cells, or cells in a mass of nerves, in the large intestines that usually develop during the embryonic stage. Often discussed as a disconnected communication signal or powerline, these lacking nerve cells leave the intestine unable to "send messages" or "transmit signals" that should move fecal matter through the colon and out the rectum, resulting in constipation. Constipation can then lead to a distended abdomen, malnutrition, infection, and even death. The most reliable diagnostic symptom of Hirschsprung's Disease is a lack of a bowel movement in the first 48 hours of life. But if a bowel movement does manage to pass, as many with the disease have occasional bowel movements, HSCR is often difficult to diagnose. The disease can be life threatening if undiagnosed or untreated. But this is not what makes HSCR a complex disease, at least not according to the contemporary definition of complex genetic diseases.

According to this definition, HSCR is complex because it is not a single gene disease, meaning that it is not caused by mutations in a single gene that might be straightforwardly inherited from parent(s) to child (Genetics Home Reference). Instead, the cause of disease is thought to be multifactorial - involving multiple genes and/or 'lifestyle' or 'environmental' factors. Note that this definition of complexity is applied to diseases not to processes of inheritance themselves. Inheritance is still reified as a singular event that transmits genes, most likely occurring at conception. These genes, still envisioned as a blueprint (Keller 2002), may or may not be affected by other inherited genes or future epigenetic interactions. Disease is classified as complex when the default explanation, a straightforward Mendelian inheritance, is insufficient for explaining the interactions of genes involved in the disease. In the case of HSCR, this insufficiency creates curiosity. HSCR occurs in multiple members of the same family only 20 percent of the time (Hirschsprung Disease 2013). 80 percent of people with the disorder, then, have no family history of HSCR. This makes HSCR complex, and it is this complexity that attracts Professor Zhang Zhiyuan and many other scientists internationally, to the study of HSCR.

Not only is HSCR complex, it is also rare — occurring in approximately 1/5,000 births (Hirschsprung Disease 2013). Some, however, have found that the disease occurs more frequently among "Asians" than any other ethnic group. A Taiwan based study of HSCR claims that for every 2 Caucasians, 2.8 Asians were found to have HSCR.

Unfortunately, the study fails to provide a citation for these statistics, let alone an explanation of how the ethnic/racial categories in use were established. Regardless, the premise that this disease occurs more frequently among Asians is important for Zhang's research. As both an "ethnic" and sporadic disease, HSCR becomes a vehicle through which researchers can explore genetic relationships between persons even when diseases are "non-inherited."[40]

In order to understand what contributes to higher levels of HSCR in China, and more basically how HSCR works epigenetically, Zhang has recently laid the groundwork for a series of birth cohort studies. As of 2011 Zhang's team, which includes physicians and medical students that treat disease as well as professors and graduate students that research disease, had collected samples from 24 hospitals in multiple provinces on the east coast of China. As often as possible sample collection occurs cross-generationally. For instance, in the study of HSCR samples of blood, urine and colonic tissues are taken from infants, parents and grandparents who are present at the time of treatment. The frequent presence of multiple generations in Chinese hospital settings, and high rates of study participation facilitate the timely gathering of a large quantity of birth cohort data. Future studies will potentially allow Zhang to detect epigenetic patterns in disease, as well as have ample material for multi-generational control populations ready in waiting.

The first publication to emerge from Zhang's birth cohort study comes from samples collected at one hospital near the medical university where he works, a children's hospital in Nanjing. Here, the neo-natal surgical team treats between 70-80 cases of HSCR per year. The birth cohort studies that will and have been produced with samples from this hospital allow Zhang to ask, first and foremost, what is the potential role of epigenetic factors in HSCR? These studies, as part of a larger group of research studies about Hirschsprung's disease, also ask Strathern's provocative question: what if the epigenetic environment is a person? Here, the potential epigenetic factors related to the development of HSCR complicate simplified ideas of inheritance.

Speaking directly to whether or not Hirschsprung's is inherited, which is how the National Institute of Health's Genetics Home Reference frames the question, the organization writes, "Hirschsprung disease appears to have a dominant pattern of inheritance, which means one copy of the altered gene in each cell may be sufficient to cause the disorder. The inheritance is considered to have incomplete penetrance because not everyone who inherits the altered gene from a parent develops Hirschsprung disease" (Hirschsprung Disease 2013)**.** Such declarations of incomplete penetration speak not only to the inability of the language of genetics to capture the complexity of non-obviously

[40] This includes understandings of "race," which is a term often interchanged with ethnic/ethnicity/ethnicital in this work, in contemporary genetic research. For example, while Chin's research, based in Taiwan, uses the higher rates of Hirschsprung's among "Asians" statistic, the study also does work to break down the category of "Asians" by studying the different rates of mutation in the RET gene (one of many genes thought to be associated with HSCR) among "Southern Han Chinese" and "Han Chinese in Taiwan". While important to note that such science may be reinscribing biology and genetics along nationalist lines, as shown in the work of Anthropologist Jennifer Liu (2010), it is also interesting to look at the deconstruction of racial categorizations frequently used in genetic research as a kind of post-colonial reaction to dissatisfaction with the assumptions that China's problems are Taiwan's problems, whether thought to be caused by environments or inheritance. That said, the lack of explicitness in making a claim about the racial categories in use in statistics allows Zhang's research to go forward only paying attention to the statistic about "Asians," not the implicit critique of the category.

inherited genes without connoting failure, but also to the inability of a paradigm of strict genetic determinism to capture complexity.[41] However, the incompleteness of 'familial forms' of inherited HSCR is not a deficit for Zhang's research laboratory. Instead this complexity is their starting point.

Zhang's research investigates the cause of HSCR by turning to the potential role of epigenetic changes to/of/in the Endothelin Receptor Type B (EDNRB) gene. This gene is widely understood as correlated with HSCR and, according to the U.S. NIH's Genetics Home Reference, this gene's interactions with the protein Endothelin 3 - characterized as signaling mechanism and information transmissions — play an important part in the formulation of neural crest cells, which "migrate" from the spinal cord to other locations, such as the intestines. The cells then go on to become many things, but important for Zhang's research is their formation into enteric or intestinal nerves (EDNRB - Endothelin Receptor Type B 2013). Without this formation, which usually occurs during embryonic development, intestinal nerves do not develop and bowel motility is reduced to varying degrees depending on the length of the affected intestine, classified as "short-segment" or "long-segment." In Zhang's study, mutations and methylations in the EDNRB gene have been found to be associated with HSCR.

Birth cohort studies allow Zhang to investigate the existence of methylations of the EDNRB in infants with Hirschsprung's Disease. This establishes that, although not an inherited, single gene disease, HSCR is epigenetic, correlated with changes that occur to genetic structures during development. This "molecular marker" for HSCR opens up a further means of detection for the disease. Because HSCR is a congenital birth defect, and changes to the EDNRB gene would have occurred during fetal development, this finding also prepares Zhang to use samples from parents and grandparents in order to pinpoint when and why such epigenetic changes occur, investigating the epigenetic environment as the sample substances of another person. This explanation for disease presents a different kind of relation than conveyed through the "inherited genetic disease". As stated by Zhang, this is a non-Mendelian notion of genetic disease causation, largely differing from the kind of fixed, stable and predictable genetic relatedness that characterized what Evelyn Fox Keller has called *The Century of the Gene* (2000). But simply because this is non-Mendelian does not mean it is unfamiliar. Perhaps even less unfamiliar in China, where epigenetic etiologies of disease seem to correlate with longstanding "folk notions" of birth defects as the biological retribution for social ills (Dikötter 1998), still present among many of the parents of patients with birth defects today.

Treating Hirschsprung's Disease

The streets of Nanjing are much like those in other large Chinese cities — of two types. First and most obviously, wide thoroughfares facilitate the growing number of cars, trucks, buses and occasional pull carts that speed through the city to get from one point to another. Alongside these streets are motorcycle and bike lanes as well as pedestrian sidewalks, often barricaded from traffic with intermittent posts or steel fences. The

[41] Even as theories of inheritance become more complex, language itself is a limitation to capturing this complexity. See Jablonka and Lamb's most recent work proposing four different kinds of inheritance for an example of a biologist/social scientist striving to revise this language (Jablonka, Lamb, and Zeligowski 2006).

second type of street is the secluded, small and winding alleyway where pedestrians, slow moving cyclists, tricycle trash carts, multi-passenger motor scooters and even cars negotiate the twists and turns of Nanjing's urban interior. These streets — lined with small open-air restaurants, cigarette shops and fruit stalls — are largely hidden away from the malls, banks and mega-stores of the broad passageways, telling a different story of how life is lived in urban China. It is this kind of road, the more quiet and meandering variety, that Wang Bo and I walk from the university to the hospital, stopping to buy a watermelon about half way through our mile long journey. This will be our gift to Li Ming, a graduate student who has agreed to discuss his contributions to Zhang's laboratory's latest research endeavors.

As we arrive I realize that when I first moved to Nanjing I lived just down the street from here. Each time I walked down this street, I would get stuck in the crowd that gathers right outside the hospital. Here, hawkers sell cheap plastic toys and inflated balloon art to parents of children whose kids were arriving or leaving this institution, a premier treatment center for not only Nanjing residents but for those living in the surrounding areas of both Jiangsu and Anhui Provinces. Mothers and fathers, grandmothers and grandfathers, pile in and out of cars that stop in the four-lane, two-way street, slowling traffic in either direction. This street and sidewalk were always crowded. And as we made our way through the collection of children and families, I discovered that the crowd was as much inside as it was outside.

We move into a crowded elevator, children with bandages and face masks meeting us at eye level, as all are carried on the hips of the caretakers. On the 6th floor Neo-natal surgery unit we exit, and are greeted by our host for the day Li Ming. I've met Li before, in the laboratory where he quietly toiled away on specimens. Here, in the setting where he spends most of his time, quietness becomes confidence. Li is clearly in his element; Wang Bo and I are clearly out of ours.

The lead nurse joins Li as we move through the five or so rooms of the surgical floor. In each room are between three and five infants, and these patients are accompanied by parents and, in many cases, grandparents. Between nine and 15 people occupy each room— some adults sleep, some sit on makeshift and hospital beds, some cradle their babies who are either awaiting or recovering from surgery. All are there for the duration of their infant's stay, only stepping outside and into Nanjing for food, fresh air or respite. As we move from patient to patient, parents and grandparents assist in removing blankets and surgical dressing to ease our view of the defects and fleshly traces of operations. I do my best to remain stoic, for fear of expressing the sadness and fear that strikes me with each opening of cloth. I save my questions for afterward and nod as I learn about each infant — their condition, whether or not surgeries have been successful, and when they will be discharged. Parents and grandparents watch me as carefully or more so than I am watching what the head nurse and Li show me, the birth defects of the infants so close in front of me. One child has recently had a mass removed from her head. Some infants are born without an anus. Many have other rectal deformities.

After our patient visits we wash our hands and sit for an interview, which is much more like a conversation as Wang Bo ends up asking as many questions as I do about the infants – what conditions do they face? what treatments do they receive? HSCR almost always involves surgical procedures, commonly a "pull-through" procedure which does not involve a colostomy. More severe cases often require a more involved treatment,

multiple surgeries and colostomy. Both types of surgeries remove the colonic segment that lacks ganglion nerve cells, allowing patients to achieve "bowel mobility" or regularly pass bowel movements. The procedure is relatively simple, but like many infant birth defects, the condition itself is difficult to diagnose.

The sense of frustration and urgency that comes when not knowing what is wrong with one's extremely ill child came through in a story Li told of a night when he was on-call. A couple came to the hospital with their newborn son. Desperate for some kind of answer to their child's inability to eat, sleep, digest, or pass a bowel movement, they had traveled from the Hubei countryside to Nanjing. They pleaded with Li to save their child's life. After hours of examinations and tests, Li finally was able to diagnose the child with an intestinal abnormality and rush him to surgery where physicians performed a simple procedure. He was proud of his accomplishment, that he had correctly diagnosed the child, truly saving him. But the moment that Li says truly changed his life is when he went to tell the parents this news. As he explained to the parents what occurred and the diagnosis, both fall to his feet, thanking him in procession, the ultimate symbol of gracious humility.

While he tells me this moving story, Li himself is moved. It was this interaction that made him realize he was happy to be a doctor. That regardless of the high risk, low pay, long hours and frustrating patient interactions which accompany his career path (not necessarily choice), the profession brings him great joy. The joy that comes with helping others is also something that makes him hope that his generation of Chinese students and professionals will find. But in actuality, he thinks his peers are much more concerned with making money and buying a house (which is practically a requirement to any man hoping to marry). After a pause, Li second-guesses himself, giving his peers the benefit of the doubt. Many of them are from the country, so the idea of buying a house in the city is so far-fetched that they feel they must put all their energy into such material pursuits. For Li, the moral and ethical expectations of today's youth must be couched within an understanding of the importance of geography to opportunity in China. Geographic separations, which are largely economic divisions as well, keep certain graduate students from pursuing careers for more than monetary value, which is seen as their only hope for fulfilling familial duties. Without a career there is no money, without money there is no marriage, without marriage there is no child.

According to Li Ming, geographic divisions also shape understandings of disease. Families who travel from rural areas or surrounding provinces often are embarrassed by their infant's deformities, especially when they have no anus (as open pants, not diapers are commonly used in China, this potentially regularly exposes a child's body to others). Regardless of the ways in which citizens may become figures for high or low quality (Anagnost 2004), all citizens have concerns about the quality of the next generation they bring forward. As they have for centuries, birth defects today can be an incredibly poor reflection on parents, especially mothers. Li blames traditional and Buddhist beliefs of rural parents, who understand their children's birth defect to be retribution for bad things done in past lives. Like the materialism in a young, urban generation that Li both condemns and excuses, such affect is sedimented by the importance given to future lineage in both China's past and present. Specifically, concerns about the relationship between population quality and the "in utero environment" have both a longstanding and reconstituted place in medical treatment and research. While in the contemporary hospital

setting medical student Li hopes his research will encourage parents to move away from what he identities as false folk etiologies of disease, historian Frank Dikötter argues these etiologies were reinforced by early modern scientific and medical thinking in China.

A Century of Chinese Genetics

Evelyn Fox Keller's (2002) historical work on the "Century of the Gene" carefully traces the ways in which genetic thinking came into being and transformed over the last hundred years. For Keller, even after the 1900 rediscovery of Gregor Mendel's rules of inheritance, the first four decades of the century were riddled with questions about what actually constitutes the gene. But with Avery MacLeof and McCarty's 1943 identification of "DNA as the carrier of biological specificity," then Watson and Crick's convincing 1953 announcement that "genes are real molecules" made up of deoxyribonucleic acid, consensus began building around the constitution of the gene. She writes, "Thus, by midcentury, all remaining doubts about the material reality of the gene were dispelled and the way was cleared for the gene to become the foundational concept capable of unifying all of biology" (Keller 2002:3).

While China has certainly been dedicated to genetic research for much of the past century, here scientific research has come to a different kind of agreement about what constitutes the gene, or at least come at the agreement in a more varied way. In his study of birth defects, Dikötter inadvertently traces Chinese genetic thought through late imperial times into the present, showing how a premise of "soft inheritance" that stressed the potential for human alteration of natural forces was often the theoretical premise of inheritance debates, "opposed to the 'hard inheritance' of genetic determinism" (Dikötter 1998:71). Through the examination of popular medical handbooks, Dikötter shows that the *in utero* environment has long existed in Chinese visions of inheritance as one of many environments thought to impact the quality of China's citizens.

Dikötter argues that, as it does today, the importance of lineage, especially the reproduction of male descendants, made the environment of the unborn child a "point of convergence of a number of very different interests" in Late Imperial times (Dikötter 1998:13). During this period (c. 1550-1911), "Gestation was understood as a malleable process which could be positively influenced from the moment of conception to the moment of delivery" (1998:13). Inheritance is then the process that happens during gestation and not just the event of passing on genes from one body to another. Other environmental factors were also viewed as important. "Correlative thinking" between microcosm and macrocosm or between the social and individual bodies meant that a variety of factors would need to be considered during and after conception. In the words of Dikötter, "The resonance between the female body and the heavenly body could be thrown out of balance by a natural catastrophe. By analogy, any cosmological disruption during the coupling of male and female could leave a physical lesion on future offspring" (Dikötter 1998:45). Birth defects were thought to be the result of weather events such as earthquakes, eclipses, floods, thunderstorms that had occurred during conception. Emotional imbalances, immoral behaviors (drinking or sex during marriage), sacred or taboo spaces, and hot or cold foods could also affect fetal quality.

Here, the environment affecting inheritance was not only another person, but also a variety of emotional, behavioral, political and even weather climates. As described by Dikötter, "In a holistic universe governed by somatization, the pregnant woman was at

the centre of a fragile system of correlations in which the slightest emotional disturbance could bring about a physical lesion" (1998:48). Accompanied by shifting demographics, women's low social status, and the state facilitated rise in a Confucian climate of filial piety, lineage and ritualism, anxieties about marital fertility and healthy offspring increased (Dikötter 1998: 26-32). Preference for male descendants was reinforced by kinship arrangements that directly tied the presence and success of parent's male children to one's own future health and security. The importance of quality progeny brought about increased pressure on Chinese parents, especially women, to provide a high quality fetal environment.

After the fall of the Qing Empire in 1911, the Republican Era ushered in support for China's modernization, particularly through science. As genetics and embryology were taken up, ideas of "soft inheritance" gained popularity. However "soft," China's concept of inheritance was certainly related to a burgeoning commitment to strengthening the Chinese race and nation (*minzu*) through eugenics and social Darwinism (Dikötter 1998:69; Dikötter 1992:97). Even as members of the nation were judged in fixed hierarchical states dependent on their nature, according to Dikötter, they were still viewed as part of a collective to which they were subordinate, "as self-disciplining cells subordinated by the larger collectivity," and "interdependent units rather than merely equal citizens (1998:70). Dikötter claims this simultaneous feeling of increasing responsibility for one's individual health and for contributing to the quality of the national population was expressed and reinforced by the selective embrace of biological and genetic thinking in China during the Republican era. In China's growing explorations into genetics, neo-Lamarckianism was embraced and mixed with Mendelian genetics "in a holistic approach which stressed the interdependence of nature with nurture and the subordination of the individual to the nation" (Dikötter 1998:118). In the United States, neo-Lamarckianism, which emphasized the plasticity of inheritance and the environment's role in evolution, was held to be in opposition to a Mendelian notion of fixed, genetic characteristics (Raffles 2007:542-543). While Mendelian genetics dominated scientific circles, neo-Lamarckianism was largely deemphasized by the beginning of World War I (Jablonka and Lamb 1999; Stern 2005). In Republican China, what Dikötter characterizes as a "holistic approach" to genetics did not make these two trains of thought mutually exclusive. However, as China approached Communism these two genetic theories could no longer be bedfellows.

After the Communist Party took formal control in 1949, Mendelian genetics was denounced as "bourgeois science," and affiliated with the eugenic campaigns of Hitler as well as the hegemony of Western science (Dikötter 1998:120). Lysenkoism, which built on neo-Lamarckianism to stress the malleability of inheritance and the responsiveness of nature to practical human efforts, became the primary form of research into heredity. Geneticist Ching Chun Li published a short article in the Journal of Heredity in 1951 which captures the conflict over Lysenkoism from a U.S. trained Chinese Mendelianist's perspective. Li writes "Even with unlimited patience, my colleagues and I have been unable to save the science of genetics from its death in China. The situation becomes one in which one must declare his allegiance to the Lysenko theory or leave. The latter has been my choice" (Li 1950:90). Sympathetic to Li, both for his displacement but also for being on the right side of science, historian Laurence Schneider claims that Lysenkoism delayed or prevented decades of China's scientific potential. Here, Lysenkoism takes a

position in a long line of Chinese characteristics that keep China from keeping pace with the West – from Confucianism in the work of Weber (Weber 1968), to feudalism in the work of John Fairbank (1953), to pseudo-science in the view of Yen Fu as described by Benjamin Schwartz (1964). In 1989, Schneider argues that China's Lysenkoist history is a cautionary tale through which one might see the ways in which government and Party politics stymies scientific progress (1989:46).

The self-consciousness with which science and politics conflate in China is deeply troubling to Li, as well as to Schneider. Lysenkoism was adopted in China because this theory of heredity fit in with socialist dialectical materialism, folding the history of the Chinese people into the history of the material world that surrounded them, arguing plants and potentially human bodies would carry histories within them (with the understanding, of course, that humans make history). Moreover, China's government argued that Lysenkoism was easy for the masses to understand (1989:48), a conjecture that was backed up by the belief that a dialectical materialist approach was more easily digestible to the non-intellectual populous. Whereas the Chinese communist government committed to pursuing a science in the interest of the people, Schneider celebrates the fact that since Reform and Opening, Chinese society has once again opened itself to a science driven not by politics, but by truth. Schneider is dismayed by a forthright ideological commitment to Lysenkoism, to the demise of Mendelian genetics, during China's communist era. But his glorification of the return of Chinese genetics to an apolitical embrace of genetic theories dominant in the West masks the more implicit political and theoretical commitments that underlie Mendelian genetics. Mendelian genetics were rejected in China not only because they were dominant among Western countries, but because of the implicit values and epistemic presuppositions of human nature that this approach to genetics stressed. In particular, communist governments of the Soviet Union and China rejected the premise of nature outside human agency as well as the autonomous and individualist notion of heredity.

These same values of autonomous individualism and the nature/nurture dichotomy rejected in communist China are today being critiqued by social scientists who enthusiastically study epigenetics as an alternative way of not only viewing genetics, but viewing the world. Many social scientists of epigenetics have charged that epigenetics is a late embrace of Lamarckian or neo-Lamarkian ideas (Jablonka and Lamb 1999; Lock 2013b; Rapp 2005).[42] As Rayna Rapp writes,

> Histories of toxic environments, dietary patterns, exercise, and the black box of psychosocial stress now appear to mark our bodies across multiple generations. It is here that we see the widening gap between genotype and phenotype which seems to index a movement from the modern(ist) rule-governed patterns of rare genetic disease to the epigenesis of common contingency: a Lamarckian revenge of sociocultural patterns now rears its head. (2005:S65)

These common contingencies are the social and cultural factors now biologized and molecularized through epigenetic research (Landecker and Panofsky 2013; Niewöhner 2011; Rapp 2005; Yates-Doerr 2011).

Zhang's research on HSCR certainly embraces this neo-Lamarckian tenet, though considering the history of Chinese genetics perhaps here Lamarck's return is with less

[42] On the difference between Lamarck's ideas and their reinterpretation, which is often called Lamarckianism or neo-Lamarckianism see Jablonka and Lamb 1999.

vengeance and more familiarity. As a reproductive toxicologist Zhang has always been searching for those toxic substances and environments that fundamentally alter the chromosomal or genetic structures of human biologies and substances. In Zhang's birth cohort studies of HSCR the toxic environment he investigates is *in utero*. Attempts to isolate the mechanism through which a non-inheritable disease moves across generations place a new kind of emphasis on the *in utero* environment as that which directly contributes to methylations to the EDNRB gene thought to cause HSCR. In Zhang's work, and Rapp and Lock's above references to Lamarck, all seem hopeful about the potential of epigenetics to deliver a biological research more attentive to social determinants of health.

As China's Reform and Opening period dramatically transformed the Chinese Communist Party and opened the country to economic investments, trade partnerships and scientific exchange, new eugenic policies not only limited the number of children couples were allowed to have, but also demanded a high quality population (Anagnost 2004; Mueggler 2001; Handwerker 2002; Rofel 1999; Kipnis 2006; Greenhalgh 2008). Dikötter states that at this time, the impact of both environments and heredity were taken into consideration as sources of fetal quality. A degraded environment, afflicted by modernity, created an atmosphere of anxiety – where growing amounts of potentially toxic polluted air, poisoned water and contaminated food create anxieties about the detriments of changing lifestyles, especially on reproduction (Dikötter 1998:126). Dikötter claims that while health manuals put pressure on pregnant women as the entity responsible for providing a healthy fetal environment, the fetus was also thought to be "inexorably part of a larger environment in so far as the individual belongs to a collectivity" (1998:127).

This paradox between individual and social responsibility for disease is similar to the one that troubles Emily Yates-Doerr when she analyzes the effects of epigenetic discourse on Guatemalan women. She writes, "Although epigenetic views of heredity assign to women deep responsibilities for dietary health, at the same time they suggest that these "diseases of modernity" are far beyond their control" (2011:296). This idea that individuals lack control over diseases of modernity, and that individuals are inexorably part of other environments large and small (societal and uterine) is exactly what Zhang's work hopes to expose. Zhang's hope for epigenetic birth cohort studies is that the toxic contexts of HSCR can be conceptualized as a variety of measurable entities that potentially deliver an epigenetic impact. In these concretizations or molecularizations of the socio-cultural environment through epigenetic science (Rapp 2005), an important enactment of the environment allows biological scientists to point to those things which exist beyond the gene, and beyond the individual that have been largely neglected in a period of hard genetic determinism. For Zhang, epigenetics is done not to bring about the "responsibilization" of the individual, but to make concrete those difficult to pin down toxic environments and, potentially, the companies, local governments and national policy makers who use, produce and oversee them.

Reflections on Individualism in Epigenetic Science

More than thirty years after China's Reform and Opening policies began, and many of the communal services, organizations and institutions have been disbanded, collectivist values, mentalities or worldly orientations are still viewed by many to be fundamentally

instilled in the people of China and East Asia more broadly. A large number of social scientists continue to measure the effect of collectivism on a variety of social behaviors (note the absence of research on the effect of individualism or on the relational nature of the research). For instance, sociologists attend to the effect of collectivist values on "environmental ethics," (Wang and Young 2013), communications experts study the effect of collectivist East Asian culture on intercultural communication (Yuan et al. 2013), and psychologists study the effect of membership in a collectivist nation on moral decision-making (Lau et al. 2013). Prior to my own departure for preliminary fieldwork sponsored by the East Asia and Pacific Summer Institute, I was required to attend an orientation in Washington D.C. sponsored by the National Science Foundation. This included a lecture by an anthropologist entitled "Incense in the Lab" during which a chart comparing the values and behaviors of collectivist vs. individualist societies was presented in order to prepare graduate students for working alongside scientists in China. At the moment I was horrified by the outdated and simplistic information. But the longer I stayed in China the more I realized how important this dichotomy was to negotiating Chinese and U.S. identity in contemporary interactions.

Many of the graduate students and young professionals I met in Nanjing enjoyed comparing their own lives of self-sacrifice, painfully hard work and familial demands on career, reproduction and sexuality to mine, figuring that as an American I had unparalleled access to the pursuit of my individual dreams and desires. The fact that I was a female anthropologist conducting fieldwork in Nanjing -- pursuing my doctorate in a field that few parents in China, let alone the United States, would encourage their child to pursue -- only served to confirm their assumptions. I myself gradually transformed the language used in interview questions, rephrasing inquiries about professional trajectories from a framing of choice (Why did you choose to study reproductive toxicology?) to one of contingency and familial expectation (How did you end up in this laboratory? Did you expect to become a research scientist, doctor, etc?).

While most (not all, see above) anthropologists dispute the simplified characterization of China as a collective society, they also have shown a sustained interest in capturing the different kind of personhood that is emerging in China, usually through the lens of transforming subjectivity, changing morality or heightening individuality in post-Reform and Opening China. The most complex of these analyses stress that modernity does not necessarily result in increased individualism (Kipnis 2012), or that modernity itself, thereby any corresponding notion of a modern subject, are not singular things (Rofel 1999; Yan 2003). Furthermore, anthropologists argue that individualism or newly emerging subjectivities are not so much a social fact as they are a "psychological problematic" (Kipnis 2012) or "narratives of desire" (Rofel 2007). In the words of Kipnis, "the 'individualization' of modernity must be seen as a myth, or a structure of feeling, or a problematic" (2012:7).

For Zhang, modernity, or at least its side effects, are materially brought to life as pesticides, epigenetic alterations or endocrine disrupting chemicals. In his study of birth defects, Zhang attempts to address how the impacts of rapid social change themselves become inheritable, and future multi-province birth cohort studies will give a broader and deeper indication of how the differences and similarities between Chinese generations who grew up in different social "environments" are embodied through epigenetic predispositions to "non-inheritable" genetic diseases, transmitted through (female)

parents and grandparents in moments of fetal development. Rapid social change can, then, be seen at the epigenetic level. Following a language more common to anthropology, epigenetics is a materialization of a history of the present, tracing back the toxic legacies of contemporary disease.

Like Zhang, some social scientists have found that cohort studies provide the best means of understanding similarities and differences across generations. Rofel's study of factory workers looks at gender and identity in three generations of factory women, demonstrating how narratives of gender reconstitute biological understandings of womanhood in the youngest generation of Chinese citizens. Judith Farquhar claims generational differences exist "not so much in ideals as they are in bodily dispositions, inculcated by the conditions of everyday life in a postsocialist reform process that quietly evolved, beneath the hubbub of a much debated politics, over the course of a decade" (Farquhar 2002:17). Farquhar stresses the importance of the body in Foucault's thinking on genealogy, writing genealogy's "task is to expose the body totally imprinted by history and the process of history's destruction of the body" (2005:32). While Farquhar hopes ethnography can, like genealogy, expose this body, here I look at epigenetics as a kind of bio-scientific genealogical rendering of the body in history.

Epigenetics *In Utero*

To summarize, epigenetics has been identified by social scientists and others as a potential scientific field through which long held nature vs. nurture debates may be laid to rest. With foresight, in 1991, Marilyn Strathern pressed social scientists to consider a different theoretical foundation of Western society at stake in debates on epigenetics: the relation between an autonomous individual and an enveloping society. At that time, Strathern regarded the question "what if the epigenetic environment was a person" as a radical possibility for contesting a hegemonic conception of personhood. Today that same question is explored in many epigenetic studies, including the birth cohort studies of HSCR conducted by Zhang and his team. Given the prevalence of research on the *in utero* environment in epigenetics today by scholars across the globe, is the hegemonic view of individuals and society and the relationship between them that so concerned Strathern transforming?

Perhaps unsurprisingly, this chapter offers little in the way of a deterministic answer to this question, but does attempt to complicate this question in at least two ways. First, the view of individuals and society written into epi/genetics is not necessarily hegemonic in those places conducting epigenetic research today. Second, epigenetics itself is not a singular field with one way of conceiving or reconceiving the role of the individual in genetic and epigenetic transformation. As shown, the field of reproductive toxicology is largely concerned with isolating those epigenetic transformations that occur not due to individual behaviors but to widespread lifestyle or social factors, the pollutants and contaminants that affect broad populations. Here, I show how epigenetic and social scientists are thinking about the impacts of rapid social change in related ways.

Lastly, and in an effort to bring these first two points together, the broad geographic and disciplinary dispersal of epigenetics potentially means that the effects of conducting, publishing, and publicizing research in different physical and intellectual spaces, with different histories of conceptualizing the relationship between individual and society, will also be different. For instance, *in utero* epigenetics in China has the potential

to enter into new conversations about the biological effects of social policies, partially because of a longer history of thinking beyond individual responsibility, and partially because of a more recent post-Reform and Opening emphasis on limiting the quantity and raising the quality of citizens. Zhang's research into the mechanisms of HSCR speak not only to an *in utero* epigenetic environment but also to an abstract, enveloping social dimension that may be as likely to get picked up on as the site of responsibility as the individual mothers in Yates-Doerr's Guatemalan city. In this sense, Zhang's biological research is indeed about the accumulation and inheritance of social determinants of health, and the duty of the nation to provide the epigenetic environments that will allow for the quality of the population to flourish. Zhang's team of reproductive toxicologists is attempting to make reproduction not a responsibility of citizens, but a responsibility of the government. Whether and how such findings might result in changes to the industrialization practices and economic decisions that release large quantities of toxins in the first place is another question, one explored in the next chapter.

Chapter 5:
Fishing for Affinity

Shortly following the 1995 Stockholm Convention on Persistent Organic Chemicals, which reported that nonylphenols (NPs) were endocrine disrupting chemicals, the European Union decided that nonylphenolic compounds would be phased out of industrial processes (Soares et al. 2008). While not restricting the production or use of NPs, the United States Environmental Protection Agency now highly discourages these chemicals, which they consider to be "persistent, moderately bio-accumulative and extremely toxic to aquatic organisms" (Boswell 2010). However, China -- as a center of the industrial production of household products, pesticides, and fire-retardant textiles -- continues to increase the production and use of NPs. Environmental scientists at Beijing University report that largely due to China's rapid industrial growth, China's consumption of NPs nearly doubled from 40,000 tons per year in 1995 to 90,000 tons per year in 2003 (An and Hu 2006). As the fourth decade of China's reform and opening began, it seemed that unless industrial markets or regulations changed, China would continue to take on toxic risks that the U.S. and Europe no longer would.

This is why an announcement in January of 2011 by China's Ministry for Environmental Protection surprised environmental activists who had been pressuring the government to regulate EDCs. NPs would be added to their list of toxic chemical substances whose import and export must be regulated through the government. Those who wished to trade NPs would now have to apply for permission and certification. So why did the regulation come about now, especially when scientists internationally and within China had been reporting the negative outcomes of EDCs in China for years? In the eyes of Greenpeace China, their 2010 report called *Swimming in Poison* led to the Ministry of Environmental Protection's announcement that the import and export of a chemical at the focus (NPs) would be regulated. This report had announced the results of a study they conducted on (a very small sample of) fish in the Yangtze River.

The initial goal of the *Swimming in Poison* report in particular was to generate public awareness of EDCs. The report exceeded expectations, going viral in print and social media. How and why did this report get "hot" – circulating in news articles, microblogs and letters to the editor across multiple provinces in China that demanded government intervention? What made gender bending chemicals and fish in the Yangtze River resonate so strongly? Based on fieldwork among scientists and activists in Beijing and Nanjing conducted in 2011, this chapter suggests that two aspects of the Greenpeace campaign led to its surprising degree of success and the new regulation of gender-benders. First, Greenpeace's campaign relied and thrived on normative ideas of gender, practicing what environmental and gender studies scholar Giovanna di Chiro calls "eco-normativity" (2010). Underlying the *Swimming in Poison* report are ideas about what it means to be male and female, masculine and feminine, normal and abnormal that both expose and produce contemporary anxieties around sex and gender in China. Di Chiro and fellow social scientists Celia Roberts and Dayna Nadine Scott respectively argue that environmental groups such as Greenpeace should proceed with more creative approaches to stopping EDCs than allowed by the current framing of sex pathology as injury (Di Chiro 2010; Roberts 2007; Scott 2009). In the words of Scott, "We should find harm where we find illness and suffering and not simply where we find difference" (Scott 2009:241). This is a welcome reminder for both environmental groups and

anthropologists about the importance of affinity politics between environmental and gender activists.[43]

Second, while the eco-normative critique as well as the call for affinity politics are both fair and familiar (Haraway 1985), the campaign's success hinged on its ability to harness and promote the propensity to think about gender-benders across species and across domains. The report focused on industrial pollution accumulating as chemical toxins in fish from the Yangtze River. The accompanying press release seamlessly moved from chemical to fish to human gender-benders, focusing on the threat of accumulating gender confusion in the River, in the body and in the population of the nation. Adverse reproductive health effects of EDCs in Yangtze River fish were carefully related to growing concern about the sexual development and androgyny of Chinese youth, seizing a number of unexpected contingencies along the way (Farquhar and Zhang 2005; Jullien 1995; Stengers 2005). In addition to moving across species, the report was originally inspired by evidence of correlation between fish and high levels of a variety of endocrine disrupting chemicals. Although these studies could not clearly prove causation, correlative evidence from these studies was replicated in the Greenpeace reports on a smaller scale, then used to evoke popular attention to gender-bending, which eventually resulted in a policy change.

The success of the campaign and the regulation of NPs, then, came about not only through eco-normativity, but also through the unpredictable effects of a kind of indirect activism based in cultivating cross-species analogies and cross domain correlations (Choy 2011; Haraway 2008; Strathern 2005). By looking at how an international environmental organization facilitated connections between species, and between scientific and activist networks, perhaps we see how an organization known for direct action – Greenpeace – successfully disrupted the changing political and moral landscape of contemporary China, leading to policy change in a country where direct action is certainly discouraged and often ineffective.

Swimming in Poison

> Just as the fish in water, man lives surrounded by influences. If the water is turbid, the fish waste away; if the influences are irregular, man falls ill.
> *— From The Origins of Illnesses, in the Comprehensive System of Medicine of All times, compiled by Hsu Ch'un-fu around 1556*[44]

Winters along the Yangtze River can be remarkably cold. The same banks that bring relief from summer heat and humidity make winter's chill all the more unbearable. When a long day of fishing or dock work ends, little more protection can be found by returning home. Along and below the Yangtze and even in Nanjing, a former capital city with nearly eight million residents, there is no central heating. Seeking refuge indoors may shield you from the wind, but single pane windows and non-insulated apartments do little to keep heat in. As temperatures plunge below freezing and the snow begins to fall, people rely on winter jackets as sweaters, cups of tea as hand warmers and thermal underwear as a necessity indoors and outdoors alike. But farther north of the Yangtze

[43] The term affinity is also used in the language of chemistry, where affinal bonds are compounds formed between dissimilar chemicals. See Hayden (*forthcoming*) and Stengers (2005).
[44] As quoted in *Medicine in China: A History of Ideas* (Unschuld 1985:324).

River, and north of the Yellow River still, government sponsored coal furnaces pump seemingly endless heat into residences and office buildings during the cold winter months.

Yu Xiao, a Toxics Campaigner for Greenpeace, was accustomed to this Beijing heating system when she set off on her research along the Yangtze River. Having recently returned from England with a Master's degree, Yu hadn't imagined working at an environmental non-governmental organization (NGO). When describing her work to family and friends today she often finds herself not only explaining her position at Greenpeace in particular, but also the basic organization and function of any NGO. Her story, which she told me during meetings in 2011, is similar to that described by Greenpeace East Asia's Communications Director Tom Wang on Greenpeace International's News Blog. Wang's mother bragged about his previous jobs as a college teacher or journalist, but when he began working for Greenpeace she lacked an understanding of the organization. In order to explain Greenpeace to his mother, Wang describes the organization's mission through an understanding of the world to which he is sure she will connect: a quote from Laozi's *Tao Te Ching*. Wang writes, "When I quoted [Laozi], in 2005, to explain to my mother what Greenpeace is doing, she understood me immediately. She agreed. It is quite simple: "We must co-exist with nature in harmony; for nature ... must not be exploited or abused, it should be befriended, not conquered" (Wong 2011). Wang's invocation of Laozi for the sake of translating the value of his work at an environmental NGO to his unimpressed mother is just one of the many ways ancient texts are being rearticulated in environmental imaginaries of the present (Tu 2001; Zhang and Barr 2013).[45]

Unlike her colleague Wang, Yu Xiao does not invoke the great philosophers of China's past when raising awareness about Greenpeace and her place in it. However, the two young professionals do share a history. They both came into the NGO as environmental activists from a career in journalism. While witnessing, empiricism and independence might be shared values of these two professions, Greenpeace's mode of environmentalism moves beyond these tenets of journalism to include direct action and creative confrontation. Greenpeace not only wants its members to be the change they wish to see in the world, but also to demand such change, up-close and in person, at the very sites where they determine environmental harm is being done. This radical image is strongly linked to the organization's foundational story, in which a few passionate gentlemen sailed its namesake ship – the Greenpeace -- to the Arctic to stop the testing of a nuclear bomb by sailing directly to the site of interest. When Yu set out on the research for her first campaign on the presence of EDCs in fish from the Yangtze River, she was not the emblazoned muckraker of Greenpeace's past or geographically distant present. She didn't need to be. Instead of following in the footsteps of Greenpeace founders, Yu followed the findings of toxicological and environmental scientists who had previously concluded that fish in China were heavily contaminated with EDCs, and that such chemicals could lead to gendered bodily malformations, impaired sexual development and even infertility.

Between January and April of 2010, Yu and her Greenpeace colleagues journeyed to the Yangtze River. With previous scientific research on EDCs effect on fish as a model, the parameters of their study would be a simplified version of these more

[45] This point is discussed further in Chapter two.

complicated experiments. This condensed version of previous studies would also need to pack a great deal of impact into a small amount of data. With this in mind, Yu explained to me that the Yangtze River was selected because of its high historical and cultural value in China. Often called the Mother River, *Chang Jiang* (Yangtze River, literally long river) runs nearly 4,000 miles. As the longest river in Asia, running from the Tibetan Plateau to China's eastern seaboard, the river is used for commerce, industry, tourism, and irrigation. It is also one of many sources for the large amount of fresh water fish eaten in China. Songs and documentaries dedicated to the Yangtze River continue in popularity.

Yu's almost anthropological reading of the symbolic valence of Changjiang, carried into her methodology for selecting which of the many fish species from the river would be collected for testing. Wanting to take advantage of not only the importance of fish as a symbol of longevity, but also the material connections made between fish and human through patterns of consumption, Yu and her team decided on the common carp and catfish. Four samples of each of these commonly eaten species would be collected. In order to ensure the authenticity of the specimens collected, a question that would certainly arise in a place where the production of fakes is common, the group personally visited the shores of each site they had selected – Nanjing, Ma'anshan, Wuhan and Chongqing. Yu described the cold, wintry riverbank visits as both exciting and difficult, adventurous and mediated, intrepid and self-conscious. Like her desire to capture and test authentic specimens, Yu's recollections of her interactions with local fisherman spoke to both a longing to connect with China's common folk (*laobaixing)* while also reestablishing her distance from them. Yu did not pull the fish from the water herself, but she and her colleagues did recruit local fisherman at fish markets to help them with the retrieval, and watch the fisherman's boats come in and the fish come off.

Fish were purchased for what Yu described as fair market price and stored on dry ice in insulated containers. They were then shipped to Greenpeace's European laboratory for testing. After being stalled in Hong Kong due to the delayed flights caused by the eruption of Eyjafjallajökull, the fish finally arrived in the Greenpeace Research Laboratory at the University of Exeter. There, scientists conducted tests to decipher the amount of hazardous or endocrine disrupting chemicals in the fish. Key findings from this laboratory were as expected. As mentioned above, many scientists within China had done similar research on fish from the Yangtze River and other bodies of water that had indicated toxic accumulation, providing a blueprint for Greenpeace's research.[46] Of the chemicals found in the fish, three were considered endocrine disruptors. NPs and Octylphenols (OPs) were the chemicals found in all species at each site. Perfluorooctane Sulfates (PFOS) were detected in the livers of most fish, with the exception of the carp from Chongqing, which was explained to perhaps be the result of this site being most upstream. Specific levels of PFOS, NP and OP were higher in fish livers in Wuhan and Nanjing. Yu was hesitant to speculate why this might be the case, noting electronics manufacturing and accumulation as two possible reasons, but also pointing out that sample sizes were much too small to reach any conclusions, except the general fact that EDCs were found in all samples of fish taken at each point along the Yangtze River.

With the sample collection complete, and the results of the fish research

[46] For example see "Perfluorinated compounds in urban river sediments from Guangzhou and Shanghai of China" (Bao et al. 2010).

anticipated and confirmed, this very general finding was enough to set the *Swimming in Poison* report in motion. The report frames the study as an attempt to discover whether or not toxic chemicals would be found in the fish regularly consumed by locals living around the Yangtze River. Greenpeace hoped that their report would be a more compelling version of similar findings by academic researchers. The final product is a beautifully designed and produced booklet, showcasing the high-impact photography of Qiu Bo across many of its pages. The particularly Chinese nature of this toxic problem is stressed throughout the report. The report tells readers that China has chemical production and use statistics that vastly exceed that of other nations. China lacks the regulation present in other countries, the U.S. and E.U. in particular. Another page tells the story of how while aquatic animals throughout the world have been found to have PFOS in their system, in China scientists have also detected this chemical in human breast milk and infants. As the report continues, Greenpeace calls for required registration of the use and production of EDCs, and points to China's need to "reduce, restrict and ultimately eliminate the release of a wide range of hazardous chemicals" (Greenpeace 2010).

The report goes on to show how the now recognizably Chinese problem of toxic accumulation has numerous health effects. It reiterates that the specific toxic chemicals found in the tested Yangtze River fish have been shown to cause a range of concerns—from endocrine (hormone) disruption and altered sexual development to sterility and infertility. Like the choice to concentrate on what is thought to be China's most meaningful river, or what is considered to be the most consumed fish, here China's infamous emphasis on the continuance of patrilineal lineage through reproduction is harnessed in order to encourage concern about environmental pollution. In a country where the value of children cannot be contested (even while this value may still vary depending on the child's gender), the Greenpeace report relies on the fact that any threat to normal sexual development or fertility was likely to concern the vast majority of Chinese citizens, male and female alike.[47]

However, echoing the trends in toxicological studies of EDCs to concentrate on feminization, the greatest threat of EDCs is for men. The report reads, "NP and OP are endocrine disruptors, able to mimic natural estrogen in organisms. This can lead to altered sexual development in some species, most notably the development of female organs in male fish" (Greenpeace 2010). While the anthropological study of Chinese masculinity, especially its transformation from socialism to postsocialism (Zhang 2007), may be lacking, the impact of EDCs on males in particular was here stressed. Yet in no way were the gendered anxieties Greenpeace both used to their advantage and produced through the Swimming in Poison report restricted to feminization. Masculinization was also at stake, less in the scientific findings than in the popular imaginations guiding her self-identified "intuition."

Waiting for Super Girl

In 2005, China Daily published an article on changing role models in China. The article was written partially in celebration of the approaching annual celebration, "Emulate Lei

[47] For further discussion of children, quality and only children in China see the work of Ann Anagnost (2004), Susan Greenhalgh and colleagues (Bongaarts and Greenhalgh 1985; Greenhalgh and Winckler 2005; Greenhalgh 1994) and Vanessa Fong (Fong 2007).

Feng Day". Even those who do not know of Lei Feng may have seen his image on souvenir military style shoulder bags or green winter hats with earflaps. As written about by Judith Farquhar, Lei Feng was an icon of Mao's China, seen as both "a model of and a model for" socialist values. He was a peasant, a worker and a soldier—a trifecta of upstanding social classes—who led a well-documented life that ended early in a tragic automobile accident. His image and writings were the topic of socialist education programs and study groups for years to follow. His diaries extolled the necessity of sacrificing individual fulfillment for the sake of the greater good, the socialist cause and the collectivist ethos (Farquhar 2002). Farquhar's book begins and ends with reflections on Lei Feng, leading us to recognize the transformations that have occurred in China through the changing use of his image. The book ends with a reflection on a small billboard advertisement on the sidewalk of Beijing in 2000, which featured a revamped, but recognizable Lei Feng touting the benefits of a health website. 40 years after Lei Feng was a model of self-sacrifice and commitment to the political collective, here he was being portrayed as "an icon not of state demands but of a consuming personal future," (Farquhar 2002:288).

China Daily's March 2005 article commemorating Lei Feng also looks toward the future. While retelling the biography of Lei for the young and foreign, the article also suggests new role models that may be more appropriate to the values of a changing Chinese citizenry. Among the list of new models of and for the nation are bloggers, business owners and classical musicians, all men with the exception of one: Li Yuchun, otherwise known as Super Girl. *Chāojínǚshēng* (Super Girl or Super Voice Girl) was a hugely successful television show in Mainland China. The show was adapted from Britian's *Pop Idol* and its U.S. spin-off hit, *American Idol*, with contestants singing before a live audience, judges evaluating the performance of participants, and at-home viewers casting votes after each airing. The show was launched in 2005 by the Chinese television network Hunan Satellite Television, and it featured only women performers (unlike its British and American counterparts). Like its overseas predecessors, the show's format is said to allow everyday Chinese citizens with vocal talent to compete for a spot on the show. The judges (and surely the producers) choose the dozen or so contestants who appear on the show. But once the show starts, the audience is supposedly left to determine who will be Super Girl.

The Chinese Get the Vote, if Only for 'Super Girl'

Li Yuchun (who now also goes by "Chris Lee") was the first of the Super Girls to create a national phenomenon, and to the surprise of many she did this with an androgynous look and voice. Li wore short hair and pants, and stood out from the other contestants who were said to exhibit a more "traditional" feminine look. As the season progressed, Li's popularity soared. Out of the show's hundreds of millions of viewers she gathered many adoring fans and won the 2005 title. In the same year, *Time World* named Li an icon, writing that she, "Represents unabashed individuality." But for some critics

Li was not inspiring individuality. Instead she was encouraging young Chinese women to be more materialistic and self-obsessed, to buy consumer products and embrace the latest fashion trend: *jiăxiăozi*, which literally translates as fake little boy, but is better translated as tomboy or sometimes butch.[48] *Jiăxiăozi,* who are sometimes referred to as "T" for tomboy, also draw inspiration from androgynous fashion in South Korea, Taiwan and Japan. Regardless of their origin, after Li Yuchun amassed millions of young, female Chinese fans, tomboys were increasingly present on the streets, in the malls and throughout the universities of urban China, embracing an androgyny that seemed both new and familiar.

The popularity of Super Girl was not met without criticism and censorship. The show started in 2005, was cancelled by the central government's television regulators in 2006, returned to television in 2009, and was again cancelled in 2011. Some international press suggested the decision was based on an anti-democratic government's want for control of the masses. Andrew Jacobs of *The New York Times* claimed Super Girl was cancelled because it was too democratic, too "popular." He writes,

> At a time when the Communist Party has been avidly reviving revolutionary mass culture from the Maoist era, some critics say the sassy and startlingly individualistic performers who scored well on "Super Girl" represented something of a threat. Like many previous winners, this year's victor, Duan Linxi, 20, was a strikingly androgynous self-taught musician who beat out a pack of long-haired beauties, the standard archetype of state-engineered variety shows. [Jacobs 2011]

But had the communist party truly been reviving revolutionary culture, wouldn't we have found a version of gender akin to Li Yuchun's androgynous look? Unisex trousers, jackets and haircuts were required in the Maoist era, and items that strayed from such clothing were considered bourgeois luxuries. Ideals of equity were written into the clothing, and carried into mandates of labor where women were to be treated as equally capable to men.[49] It wasn't until 1986 and 1987 that Reform and Opening policies led to a diversification of many commodities and hobbies including fashion, gradually increasing access and appetites for such things (Farquhar 2002; Rofel 2007). Farquhar and Rofel both discuss the appetite and desire for femininity that is produced (not unleashed) in women who have lived through the reform and opening of China. Perhaps the tomboys and girly-girls among Super Girls' contestants and fans are reinterpreting both the androgyny of a communist past they are too young to have experienced and a femininity of a potential 'cosmopolitan' future that has become desired in contemporary China.

Today Super Girls and millions of others in China's urban areas are experimenting

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[48] It is important to note that tomboys are not necessarily self-identifying queers or lesbians, and that there is no definite connection between identifying/appearing as a tomboy and being of a certain sexuality. As Butler writes in the new preface to *Gender Trouble, "*It is important for me to concede, however, that the performance of gender subversion can indicate nothing about sexuality or sexual practice" (Butler 2011:xiv).

[49] According to some, the equality expressed through androgynous dress in revolutionary China was only skin deep. Lydia Liu (1993) and Emily Honig (2002) both point to the complicated and often contradictory interior lives of women, even in the face of officially sanctioned equity supposedly expressed through androgyny. While many western feminists were excited about what they recognized Communist China's politics based on equity, Honig argues that often equality was merely exterior and that Confucian gender hierarchies remained even when political garb and rhetoric attempted to write away such differences.

with a range of gendered self-presentation. While conducting fieldwork at a toxicology laboratory in Nanjing during 2011, I would often spend my evenings sitting on a wooden bench in an open-air pedestrian square near the Fashion Lady Shopping Plaza, the high-rise apartment building where I lived peeking out in the near distance. I would watch hundreds of young people passing by, mostly students from the city's over 25 universities and colleges. Hundreds more passed below my feet - shopping for fake (*jia de*) shoes, clothes, and handbags in the dozens of tiny shops lining the neon-lit corridors underground. On Friday nights as I sat on benches and drank milk teas with friends, or on weekday evenings by myself after long days in the lab, I would often see two college-aged girls walking by holding hands. One would wear a brimmed hat, baggy jeans and a blazer over a white t-shirt loosely tucked in to show off a loud belt doing little work. The other would wear white knock-off Converse, a flowing skirt down to her ankles, a matching pastel tank top and a cropped jean jacket. I saw dozens and dozens of these girls, journeying down the square, arm-in-arm or hand-in-hand, and when I did I tried to refrain from reading into their interior via an exterior that so easily might translate into my own ideas of queer identities and sexualities, of butch and femme.

As in many places, Chinese men and women often express the intimacy of friendship more physically than in America. Young Chinese women especially have close physical contact with friends, usually holding hands or keeping their arms around each other while walking about. But such gestures are simply not expressions of sexuality, I'd been told by friends. The ubiquity with which such hand holding, public cuddling and private physical encounters between women seem to take place in urban China today suggests that indeed the intimacy of friends cannot be interpreted as the intimacy of lovers. And yet something in the appearance of these young Chinese women that I saw nearly every day in Nanjing, Shanghai and Beijing – these tomboys and girly girls – was indeed different, even from my first visit to China in 2006. By now, in 2011, a phenomenon had swept the nation. Perhaps, this phenomenon was Super Girl.

During Super Girl's first run, when Li Yuchun's androgynous look first began taking off, then Director of the Chinese Science, Education, Culture, Health and Sport Commission, Liu Zhongde, described the show as hurtful low culture. According to the People's Daily, "Liu and his supporters claimed that contestants dressed 'in vulgar fashion' that was socially 'harmful', especially to young people's 'aesthetic values'" (Xinhua 2006). This characterization of Super Girl's human gender-benders as harmful is the precise normative sentiment Greenpeace Toxic Campaigners hoped would find its way into and out of their story, implicitly providing the broader stakes of gender-bending for the Chinese nation, as well as what potentially might be considered evidence for gender-bending across species.

Econormativity Disrupted

The framing of EDCs as substances that disturb "normal" hormonal function and sexual development has gained the attention of feminist social scientists. These authors point out how scientific and environmental activists' depictions of EDCs pathologize bodies that do not appear to have a "normal" sex. In research on EDCs, bodies that stray from clear identification with standards of male or female are consistently deemed abnormal, especially in the animal world, where even socially progressive anthropologists discuss how intersexed beings are "queer, in a way that cannot be applauded," as Kim Fortun

writes (Fortun 2012:449).[50] Perhaps Fortun's quote, which is taken from a piece on toxic industrialism, speaks to the difficulty of creating political affinity between gender and environmental activists. It is difficult to both be against the destruction caused by toxic exposures and remain critical of the eco-normative discourse through which EDCs function.

Roberts saliently makes this point in her chapter "Hormones in the World," where she writes, **"**even critical environmentalist arguments configure normative sex/gender relations as 'natural' and consequently in need of protection" (Roberts 2007:165). Biologist Lynda Birke likens this difficulty to sitting on a fence. This fence sits between the "real," albeit eco-normative, threat of gender-bending hormones and the criticisms of this endocrine disruptor rhetoric by gender theorists who recognize the social and cultural mediation of the "natural world" (Birke 2000:588). Feminist legal scholar Scott similarly finds herself pulled in two directions. She is "attempting to validate the real and material consequences of synthetic chemicals acting on bodies—but uncovers that finding harm depends on a static conception of the human form, based on unfounded assumptions of 'naturalness' and 'normalcy'" (Scott 2009:1). Environmental and social justice scholar Di Chiro, similarly wonders, "Can we imagine environmental-feminist coalitions that can forge a critical normative environmental politics (we *all* should live in a clean environment; we should *all* have the right to healthy bodies) that resist appeals to normativity" (2010:203)?

Instead of identifying with this tug-o-war, Roberts takes a cue from Donna Haraway. In her classic account of the struggle between social constructionist and realist perspectives, Haraway writes, "It is of course hard to climb when you are holding on to both ends of a pole, simultaneously or alternatively. It is, therefore, time to switch metaphors" (1991:188). Roberts does just that. She claims Birke does not need to fence sit and switches to the very metaphor used by scientists of the endocrine system: messaging. Roberts recoups the language of messaging present in descriptions of hormones in order to offer up another position for feminists still stuck between concern about the normative language and the real harms of EDCs. She writes,

> There is no need, in this analysis, to fence-sit in the way that Birke describes; indeed there is no fence… As messengers, hormones do not carry an independent entity from one place to another, but create a kind of relationality in which their messaging activities constitute the entities that they are thought to message between. This relationality is suggested by the hyphen in bio-social, which represents a constituting, active relation between two entities (the biological and the social) that do not pre-exist on their own but are constituted through their connection with each other (in this case a connection made through hormones.) [Roberts 1997:182]

Roberts's ability to turn the primary metaphor of the hormonal system of messaging into a means of understanding the co-constitution of the material and semiotic, the biological and the social, is impressive.[51] Just as hormones are entities constituted only through

[50]For an interesting account of the lack of creativity around gender and sexuality in the science of insects see Raffles (2010), particularly the chapter "The Quality of Queerness is Not Strange Enough."

[51] The technique of using metaphors from scientists and other interlocuters in one's own anthropological analysis is similar to that used by Marilyn Strathern (2005) and other anthropologists, including Bill Maurer (2011), Annalise Riles (2001) and Stephan Helmreich(Helmreich 2005). Cori Hayden (Hayden

activity, so are biological materialities constituted through the social.[52] She implies that ideas of sex are literally entangled with material reality to the extent that as ideas and meanings of sex/gender change so, too, does matter.[53]

In China, the increasing interest in EDCs points us toward more than the eco-normative understandings of gender written into science and environmental activism. EDCs also point us toward broader anxieties about endocrine disruptors and the gender-benders that result from them. These anxieties are certainly brought about by science and activism around chemicals and fish. But they are also brought about by the increasing presence (or perhaps increasingly noticed presence) of human gender-benders in the contemporary Chinese world. In other words, normative scientific metaphors of sex do not just work upon pathological bodies**,** but those pathological bodies also work upon the norm.

Anthropologist Lisa Rofel argues that today the post-Mao Chinese government and Chinese 'citizen-subjects' narrate modernity and desire in new ways. These narrations lead to newly gendered and sexualized yearnings, identities and practices. Rofel states that many "American commentators imagine" the casting off of socialism and subsequent revealing of a true inner self. She argues against this and, more specifically, resists the notion that formerly socialist countries experience a release of gender from social constraint, allowing for the return of innate/natural femininity or masculinity that liberates essential desires and identities that were stifled under communism (Rofel 1999). In a discussion of a Chinese women's museum's radical potential, Rofel recounts Esther Newton's 1972 study of gay male drag performers and the argument "that the 'substance' of gender lay in the performance itself, not inside with an artificial exterior" (2007:79). Rofel connects this work to Judith Butler's 1993 idea of performativity, in order to consider the role of "normative demands for identification" (2007:80). In Rofel's version of Butler's account, power relations compel individuals to assimilate to symbols of heterosexuality through reiterating gender identities. During this reiterative process, gender instabilities open up. Ideas about the natural or biologically determined sex are potentially disrupted during the reiterative process. Gender norms are not only constrictive, but also leave open the possibility for disruption because they must be continuously reasserted.

In the case of China today, a country undergoing rapid social and economic change, perhaps the opportunities for playful reiterations are both more frequent and more powerful. Fake little boys or *jiaxiaozi* send disruptive signals of inauthenticity that

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2003) adds an interesting twist to this maneuver, showing how a common STS metaphor is used in bioprospecting.

[52] This statement draws on Foucault (1990) and Butler (2011), who argue that gender is not the socially constructed other to biological sex, but that both gender and sex are constructed. The biological is an activity, not an entity, which functions through language and social categories as much as through gender.

[53] While Birke might find the intended optimism of Roberts' revision helpful to her goals of managing intellectual concerns alongside women's health, I have my suspicions about the helpfulness of this fenceless playground for those who are invested in specific issues surrounding EDCs—pinpointing chemical risk to gain legal compensation for indigenous communities (Scott), and creating better environmental policies (Di Chiro). What might they be able to glean from the extension of this messaging metaphor and realization that material-semiotic worlds are co-constituted when the institutions they interact with make demands for evidence of harm based on a strictly defined notion of normal and pathological sex/gender/sexuality. Unfortunately these concerns, and a comparison between U.S. and Chinese legal systems and the notions of harm they demand and produce, are outside the realm of this article.

mimic naturalized sex/gender biologies in a mode similar to the inauthentic hormonal messages sent by EDCs. By drawing attention to the flexibility of sex/gender categories, gender-benders—whether chemical, fish or human—force a reiteration of boundaries of the authentic and the natural. While the econormativity surrounding EDCs reinforces a notion of sex pathology as injury, the heteronormativity surrounding *jiaxiaozi* reinforces notions of gender and sexuality, femininity and masculinity that are also relatively new or a least resurgent in China.

Hormone Gate

While the popularity of Supergirl and the rise in androgyny that the show inspired speaks to growing anxieties surrounding gender-benders in China, a more explicit relationship between disruption to gender norms and reproductive health made its way into the publicization of the Greenpeace report. In early August of 2010 another concern about female sexual development spread throughout China. Three girls from Hubei province were diagnosed with "precocious puberty" or "early sexual maturation," after parents brought them to the doctor for fear that their babies had started growing breasts. After confirming that the children were experiencing early onset puberty, doctors suggested that the parents stop feeding their children milk powder. When these two sets of parents discovered that they had each given their child the same brand of milk powder, Synutra, complaints to local authorities and the press followed. Chinese authorities tested the milk powder and it was eventually announced that this powder was not the source of the elevated hormone levels that had led to the girls' condition. Outspoken father Wang Gang and many others remained convinced that milk powder was the cause of these hormonal changes in China's developing children despite government tests stating otherwise (Bao Chang 2010; Reuters 2010).

Enter *Swimming in Poison.* The press release for the report was distributed two weeks after the Synutra milk powder scandal caught fire. While Greenpeace made no explicit connection between the scandal and the report, journalists and so-called "netizens" (internet-citizens) quickly started making them. They labeled the event *jī sùmén* (hormone scandal). *Jīsùmén* (hormone scandal) was then brought into relation with the Greenpeace report's *huánjìng jīsù* (environmental hormones or EDCs). Some associations were subtle, verging on the seemingly unintentional, such as this editorial comment from the QianJiang Evening News, "In 1981 a famous song was written, 'The Yangtze River Song,' which praised the river: 'Your milk is so sweet it could feed all the nation's children.' Is the Mother River's 'milk' still so sweet?" (Hong 2010). Next to this article is a picture of two Chinese children running from a mutated, evil fish with a skull and the words "environmental hormone" written into its body and fins. Other connections tried to make sense of the initial hormone scandal via the Greenpeace report.

Another paper asked in a headline, "Are the Yangtze River's wild fish the real culprit behind 'early sexual maturation'"? The same online news article offered a photo interpretation, whose interlaid caption shows the exasperation of predictable disgust through color and onomatopoeia. It reads, "Phu! Yangtze River fish bodily interiors have poison leading to female early sexual development" (Bi 2010b).

The ability to shift blame for premature sexual development in children from milk to fish, perhaps lies in the handiwork of Greenpeace who began to state in their press release that *cíxìngxìngzǎoshú* (female precocious puberty) is one of the possible outcomes of accumulated environmental hormones like those found in the Yangtze River fish, although this was not in the original report. Some readers picked up on the timing of such a coincidence. One media report on responses to the news of poison fish claimed that over 50% of blogosphere participants "*bùyuē'értong"* (agree by chance) that the Greenpeace report was in fact fabricated in order to pull attention away from the powdered milk manufacturer and place blame elsewhere (Wang 2010).

Whether understood as a better explanation or a convenient truth, here the discourse of endocrine disruption is doing exactly what it was originally intended to do by those who invented/popularized the term, Theo Colborn and co-authors of the book *Our Stolen Future*. EDCs cut across species divides in order to draw attention to the all-encompassing cross-species nature of environmental problems. And that it did. An author for the Commercial Times ominously writes, "Environmental hormones are already ubiquitous, not only can wild fish not escape, humans also have nowhere to run" (Wu 2010). An editorial in Beijing Evening News jokes, "Did these fish eat milk powder when they were growing up?" Lastly, an editorial in the Shenyang Daily reads, "We, as the upper reaches of the food chain, are inevitably becoming the next 'Yangtze River fish'" (Bi 2010a). Here, the affinity of fish and human becomes clear. In a blurring of cross-species harm, the fish itself becomes human, what some might call a moment of ontological collapse (Raffles 2010) or becoming-with (Haraway 2008) facilitated by Greenpeace China.

Fish are not the first members of the aquatic world at the center of environmental campaigns. Nor are they the only animal to cross domains. In the early 1990s, in the middle of debates about Hong Kong's post-colonial Chinese future, anthropologist Tim Choy noticed pink dolphins washing up on beaches and in newspaper headlines. This animal became key to the mobilization and subsistence of environmentalism in Hong Kong for years to come. The central role of a marine mammal was perhaps not unique, following a history of "environmentalist mobilization of sentiment" around marine mammals like whales, otters and dolphins (2011:23). Choy points out that endangerment is a key trope used by environmental organizations, and was a vernacular that perhaps traveled particularly well in Hong Kong because ideas of endangerment resonated with conversations on the "politics of cultural survival" (2011:27). By looking at

reverberations between the endangered dolphin campaign and anxieties about Hong Kong's endangered future, Choy points to an idiom of endangerment that persists in these seemingly disparate arenas – human and animal, environmental and cultural.

As Strathern argues of reproductive technologies, such idioms can be understood not only as forces that act on and adjust human relations within their context of deployment, but also as expressions of larger cultural logics. Strathern wants to look beyond the "bread and butter" of popular media debates surrounding genetics, and get at something more – the fact that relations are everywhere, that ideas about kinship are ubiquitous both inside and outside the biomedical clinic. Here, I argue that campaigners at Greenpeace China pursue activism via the related interests of their audience by implicitly conjuring such connections as they emerge in unpredictable moments and fashions. Cross-species gender-bender analogies do not only exist within science, but are also deployed by activists, who creatively encourage affinity or correlation between scandals, hormones and bodies.

Indirect Action

The *Swimming in Poison* report went public in August of 2010. According to Greenpeace, there was "heated" media coverage (where the connotation of heat is popularity not contestation). According to Yu, findings were discussed in over 115 domestic media outlets, including 76 print news articles, 10 internet news articles, and 29 op-ed articles. Moreover, there were thousands of mentions and reposts in microblogs on Sina Weibo, which many call the Chinese version of Twitter. Greenpeace set out on this campaign with the goal of raising awareness, and these numbers alone were indicative of a successful campaign. But within just a few months the campaign's success reached an even greater accomplishment, one so far fetched it was not anticipated.

Campaign organizers could have never imagined the degree of success the *Swimming in Poison* report would have. In hindsight it was easy to bullet point certain angles that resonated with media and individuals as reasons for the campaign's success—the recent cases of tainted milk and early maturation of girls, wider public concern about gender and sexuality, and the feminized men and masculinized women that were becoming more present in popular culture. But as she was preparing the campaign, for the most part, Yu says she was simply following what she called her "intuition." What might she mean by this statement? In her own words, the extreme degree to which the report resonated with the Chinese public was a "stumbling" and "learning" experience through the "unexpected" in a country where "it is not transparent what will work." But at the same time, Toxic Campaigners had carefully designed the research for the report, hoping that it would gain traction through one of the many angles addressed – the cherished river, the importance of fish in diet and culture, and the focus on a possible threat to reproductive health and fertility. Just as carefully, campaigners later adjusted the language used in press releases and discussion of the report to reflect the changing concerns of the Chinese public regarding the Hormone Scandal.

In January of 2011, when Yu was describing to me the strategies of Greenpeace China, she went through a list of tactics. Research. Raising Awareness. Putting pressure on industry. But shortly after Yu quit speaking, she chimed back in. "Oh, and direct action!" For many, direct action may seem the foremost strategy of an organization whose foundational image is bearded white men aboard a small sea vessel protesting a

giant ship in the Arctic. But for Greenpeace China, politics must take many forms. Perhaps direct action was nearly forgotten for a reason.[54]

According to Greenpeace, Chinese toxicologists had been reporting about intersex fish in the Yangtze and other Chinese rivers for many years, but until 2011 no regulatory action had been taken to prevent the pollution of the endocrine disrupting hormones thought to cause gender bending. Then, one Greenpeace report later, the toxic threat got hot (or went viral) in new articles, letters to the editor, and blogs. It had also led to a new government regulation on the EDC at focus, NP. Somehow something had strongly resonated. Was this success simply a matter of changing technological times, when the rising number of Chinese netizens makes accessing and spreading news increasingly easy? The power of Chinese media, especially the internet and microblogs, has indeed become the latest way to measure, in a long history of tests, the (non-)existence of China's public sphere.[55] Whether or not the campaign's regulatory success was simply a byproduct of China's burgeoning online forums (and I imagine we will never truly know), why did this particular issue make the report resonate so well?

From the outset Greenpeace Toxics Campaigners were able to take scientific studies and mimic them, essentially producing a distilled version of the correlations scientists had found between EDCs and disrupted reproductive health. Greenpeace never claimed that chemicals caused deformities. Their own experiment simply built on the correlations of previous studies, then located the chemicals in discussion within the bodies of fish in the Yangtze River. The lack of evidence for harmful effects was never an issue for Greenpeace. What was an issue was making abbreviated findings, connotations and implicit conclusions resonate with an audience already anxious about gender bending and the harmful effects of chemicals on reproductive health.

Greenpeace effectively framed the *Swimming in Poison* study in a way that would speak to a large audience by drawing on notions of what they believed to be Chinese cultural values – the importance and widespread concern about Chinese rivers, fish, under or over developed feminity or masculinity. The campaign's reliance on normative ideas of gender focused on the threat and connection between gender-benders – chemical, fish and human. The propensity of another national news headline, Hormone Gate, was then harnessed through strategic language.[56] By indirectly linking *Swimming in Poison* with another hormonal scandal, the campaign quietly created affinity between hormonally disrupted fish of the Yangtze River and the early maturing girl children from Hubei, allowing fish to "become" human.

In the end it seems what led to the government regulation of NPs was the successful maneuvering of a different kind of political affinity than the kind explicitly coming together between environmental and gender activists that Di Chiro and others might hope for. This is an affinity through implicit connection, where associations traveled through species, bodies, and the press with a voice indirect enough to remain

[54] This is not to say that China does not have a strong history of protests, the most recent in Qidong during which hundreds of citizens stormed local government offices, resulting in a Japanese company changing their plans to run a toxic sewer line through the city. For more on the history of protests in China see Elizabeth Perry's (2002) book, *Challenging the Mandate of Heaven*.

[55] For more on western debates about China's public sphere see Frederic Wakemen's (Wakeman 1993) "The Civil Society and Public Sphere Debate: Western Reflections on Chinese Political Culture."

[56] Here, I draw on language used by Jullien (1995). His work is cited by both Stengers (2005) and Farquhar and Zhang (2005).

mobile in a closely monitored Chinese activist media landscape. The science of EDCs instills the notion that disruption is negative, troubling normative sexual development. But in China's activist contexts, around both pollution and sexuality, perhaps the value of disruption should be reconsidered. A disruption is not a revolt, revolution or riot. It is an interference of the norm, possible and powerful because of its persistence and subtlety. For both environmental and gender activists in China today, perhaps this kind of activism – indirect, correlative, affinal -- is the most realistic and efficacious possibility.

Conclusion

In this dissertation I have proposed that approaches to the study of sperm in reproductive toxicology have contributed to thinking about infertility (at least male infertility) environmentally. As discussed in Chapter one, in the epigenetic research of reproductive toxicologists in China, the contexts of cultural, social, economic and environmental changes are materialized in sperm. Through sperm we can come to a unique understanding of China, even while China's uniqueness is stressed by research scientists looking for ideal research environments, as discussed in Chapter two.

Through sperm-environment interaction studies, discussed in Chapter three, the boundaries between bodily interiors and exteriors are found to be more than porous. Bodies and environments correlate at epistemological and ontological levels. Correlation, I propose, is a means of understanding the interaction between environments inside and outside the body as well as the connection between economic and reproductive development.

Despite the problematically gendered nature of such research, the epigenetic inheritability of infertility provides an opportunity for social scientists to reconsider not only the boundaries between nature and culture, but also individuals and society in the present and future, as discussed in Chapter four. Only by attending to correlations between subjects and objects, biological interiors and ecological/social exteriors can anthropologists join reproductive toxicologists in taking biosocial harm seriously.

Correlation is not only the primary means through which the scientists I study explain the relationship between toxins and male infertility. Correlation also moves knowledge through policy and activist domains, indirectly elaborating the connections between the threats to reproductive health and broader concerns about gender in arenas that stand outside the laboratory. In Chapter five, I show how effective correlation can be, not at providing evidence but at bringing about political action indirectly.

Environmentalists and scientists alike set in motion questions about the effects of rapid social change on China's human and non-human environments, prompting a reconsideration of what constitutes the political in science and in China. My hope for this dissertation is that it encourages a further exploration of how the possibilities for critique and activism might be reimagined through the approaches to environmental and social justice taken by reproductive toxicologists and the activists who follow them.

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