Introduction

Anthropology in an Age of Genetics

Practice, Discourse, and Critique

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On June 26, 2000, the rival scientific factions vying to complete the DNA sequencing of the human genome declared a truce. The race that might have been won by a single victor was set aside, and credit for completing a working draft of the sequence was to be shared by the Human Genome Project's international, publicly funded consortium and by Celera Genomics, a private company. At the press conference where this laying down of arms was announced, President Bill Clinton stood flanked by Craig Venter, the head of Celera, and Francis Collins, director of the National Institutes of Health's Human Genome Project (HGP) in the United States. The sequence was front-page news; the top banner of the *New York Times* declared, "Genetic Code of Human Life Is Cracked by Scientists" (June 27, 2000).

This very public and reluctant coalition of a government-sponsored, transnational scientific program and a biotechnology industry heavyweight is just one node in a wide-ranging, heterogeneous network of human and nonhuman actors that constitutes genetics-in-action (*pace* Latour 1987; cf. Flower and Heath 1993; Heath 1998a,b). The knowable, manipulable human genome also belongs to health advocates living with particular heritable diseases, who raise research funding and run on-line forums (Heath et al. 1999; Taussig, Rapp, and Heath, chapter 3, this volume). It belongs to scientists in Japan, China, the United Kingdom, France, and Germany, as well as to DNA "donors" (voluntary or not) from Iceland and the Amazon. And it is the province of essential nonhuman players, from centralized sequence databases and their search engines to genetically modified organisms (GMOs). Genomes, human and other, are dynamic, emergent entities still under negotiation as territory, property, soul, medical resource, and national prize. Meanwhile, narratives of both technoscientific expertise and everyday life have come to be scripted in a genetic idiom deployed by laypeople and experts alike.

In the decade and a half since the Human Genome Project was launched, new technologies, institutions, practices, and ideologies built around genes have constituted a technocultural revolution. The age of genetics is also an era of what Abby Lippman calls geneticization (1991, 1992) and what Paul Rabinow (1996) calls biosociality. Lippman's geneticization describes a widely dispersed network of genetic resources, power relations, and ideas elaborating the meanings of the gene. Rabinow playfully transposes the terms of sociobiology and the credo that biological forces (genes) explain behavior and sociality. Drawing on Foucault's notion of biopower, he underscores the coconstitution of nature and culture and all their familial iterations. Both concepts aptly map the genetic borderland that this volume explores, as we present the fruits of a dialogue on genetics that brings together cultural studies of genetic knowledge production and natural-scientific studies that foreground cultural-historical context.

For anthropologists, genetics, as both technoscientific and technocultural practice, has provided a fertile medium for cultural and biological studies. Biological anthropologists who study human genome evolution and diversity have benefited immensely from the transfer of technologies like polymerase chain reaction and bioinformatics that have been integral to the HGP. Ethnographers, in turn, have found a rich array of new field sites in and beyond the lab. Sometimes they have brought to their own research firsthand participant-observers' knowledge of those aforementioned technologies so central to the work of contemporary biological inquiry. At the very moment when some have trumpeted their intentions to cleave the divisions between science and not-science more deeply, genetics has provided anthropologists from both sides with opportunities for constructive, intellectual engagement. The potential for these and broader engagements was chief among the optimistic aspirations that launched this volume.

The essays collected here began as contributions to the Wenner-Gren International Symposium "Anthropology in the Age of Genetics: Discourse, Practice, Critique." Our symposium was a social experiment informed by scholarship in science studies, in which the technical, the cultural, and the ideological are inextricably bound together. The mix of participants was carefully constructed as a test of the premise that world-making takes place in an interactive web or network, and that pulling together different bits of the network brings the silences of any particular position into sharp relief. Having come from diverse fields and stood in different places, we learned theories, practices, ideas, and perspectives from each other. And sometimes we listened but remained puzzled. In our juxtaposition and framing of the essays in this volume, we have tried to mark both the synergies of this experience and the questions that remain to be answered.

Among the most striking synergies was a deep, shared interest in the multiple meanings and consequences of "opening the veins" of indigenous

people in Brazil, the Icelanders, the Amish, Africans and African Americans, Little People, Native Americans, at-risk populations, and even man's best friend. Our discussions returned again and again to the many threads running through these acts of collecting biological samples: blood, cheek swabs, bone, hair. While there may be no particular intellectual privilege in any given microcosm, this highly charged moment was clearly a point of entry to compelling concerns about love, power, and knowledge. The narrative, we concluded, can be more painful than the blood stick. In thinking about the disembodied sample and the database that can never be the product of a "clean birth," we found a shared concern with the cultural-historical contexts that link power relations and the politics of difference to the production of knowledge, with systems built around biologicals. By what standards can genetic data be made to speak about population differences, colonialism, global capitalism, human suffering, and social order?

The investigation of complexity, or complex relationalities, also emerged in our discussions as a salient concern for all participants. One participant stated flatly that s/he had a "stake in complexity," not to obscure the issues but to deepen the perspective. Complexity is important to both cultures. This insight has been reinforced since the inception of the Human Genome Project, which institutionalizes intense reductionism by its fixation on a static map, as well as increasingly facilitates the scientific study of complexity—of interaction, expression, development, and context, an era of proteomics.[1] With this in mind, one might say that genetics is taking an *anthropological turn*. We hope that this volume can begin to map the overlapping networks that bind a sheep named Dolly to the Yanomámi of South America, and the African diaspora to the genome of the daffodil.

Two stories from our conference are illustrative. One evening in Teresópolis, a group of locals, primarily employees of our hotel and surrounding horse ranch, staged a traditional Brazilian harvest festival around a bonfire in an open meadow. The actors were wildly attired and included men dressed as women and both men and women with painted black faces or long blonde wigs or both. Presented in Portuguese and therefore incomprehensible to most of the attending scholars, the skit seemed to involve a minister, a marriage, and jokes about sex, religion, and drunkenness. It produced laughter in some members of the audience, which included local residents, and bewilderment in most of us. Some of us found the skit and the costumes offensive and left. Others, unaware of their colleagues' departures, joined the dancing around the fire at the end of the show. Coincidentally, we were scheduled to discuss race, genetics, and anthropology the next day.

The following morning, the skit and varying responses to it became a way to explore the specificity of racialized meanings and experiences. Brazilian racial politics made interpreting the blackface difficult. The dancers themselves were people of color, at least by European and North American stan-

dards. They were also lower-level employees in the service economy of a less than affluent region. And their burlesque could be seen to be racist as well as sexist and classist. The carnivalesque elements in the skit suggested the overthrow of accepted hierarchies of power (the mocking trickster), while the costumes and sexualized joking seemed to replicate the long history of Western oppression of marked bodies. In some ways the skit was a perfect lesson, an intersection of power, culture, history, and biology that refused all categories. When we discussed it the next day, nearly every participant had a different perspective.

The same week, a controversy erupted in Brazil over genetically modified soybean seeds, illegal in Brazil but apparently being smuggled in and used without deference to the proprietary rules devised by Monsanto, which produces both the transgenic seeds and the powerful pesticide Roundup that the seeds can tolerate. Farmers buying the modified soybean seeds have to agree not to save seeds for the following years and to permit Monsanto investigators, known as gene police, to walk their fields and take samples to ensure compliance if they stop buying the seeds. But farmers in Brazil apparently were acquiring the seeds on a GMO black market and reusing them without approval from their corporate overseers (DePalma and Romero 2000). During our meeting, several of us were interviewed by Brazilian television journalists about GMOs and the soybean trade.

We thus participated in Brazil's complex history of racial politics and in the complex local and global politics of GMOs. These two incidents capture a central concern of the essays to follow: the tangled politics, and coconstitution, of nature and culture.

PROVOCATIONS

Anthropology has been in some ways ground zero in the latest elaboration of what C. P. Snow construed in 1959 as the "two cultures"[2]—the apparently incompatible humanistic and scientific ways of understanding the world. Anthropology as a discipline has been deeply affected by the imperfect fit between technical and cultural explanations. It is a field that takes seriously both nature and culture, and both scientific and humanistic analyses. And the techniques and practices of the new genetics, as they have come into wider use in anthropology, have become a source of contention (see Sydel Silverman, foreword to this volume).

Paul Rabinow has proposed that the new genetics represents the apotheosis of modern rationality in that the object to be known "will be known in such a way that it can be changed" (1996: 93). And this power to produce change, including technical change mediated through laboratory or industrialized manipulation of biological materials, will also produce a new nature "remodeled on culture." Nature, he suggests, will become overtly artificial

just as culture becomes natural. The technical-discursive achievements of modernity will lead to the collapse of the distinctions out of which that modernity emerged. Biosociality describes what we are calling nature/culture, or the labyrinthine intermingling of realms that calls into question both categories.

In an attempt at productive provocation, we have organized chapters under these categories—nature and culture—as we simultaneously interrogate and destabilize them. In part 1, which we are calling "Nature/Culture," we turn our attention to the sites of the critical cultural project of constructing and defining boundaries between populations and between species. In other words, we consider the technocultural domain of making differences and making nature. These are places where the age of geneticization plays out in extraordinary ways. In some cases, they are places deeply imbricated in the history of anthropology, such as the study of indigenous populations and the identification of a "pure line" in human groups. In other cases they are novel sites reflecting shifts in the landscape of the field, including the materiality of the "bodies that matter" (Butler 1993). These corporeal encounters involve Little People or the Amish, Icelanders or indigenous groups in Brazil, all of whom confront the interventions of geneticists. They also involve the genomes of the dog, the cloned sheep, and the chimpanzee, and the many ways that other species are implicated in contemporary genomics. We are interested in the stories told about such sites, and in the storytelling art in all its manifestations.

In part 2, titled "Culture/Nature," we consider the intersections of biosociality, complexity, and reductionism. Transnational processes and national identities are increasingly bound up in genetic history and genetic debates, about GMOs and their national meaning, the new eugenics, sovereignty, ethnic or racial identity, and the biological or cultural differences between groups. "Culture/Nature" includes the future of Japanese genomics, and of Japan, as imagined through the genome; the politics and complex historicities of genetic inquiry in South Africa; and the historical events and present-day identity politics embedded in ancient DNA. It includes fears and hopes about the future expressed in the responses of French farmers to GMOs, and the fears and hopes expressed in the enduring scientific effort to make sense of that chameleon-like categorizing idea, race. As our playfully serious couplings indicate, all the essays in this volume engage in resistance to simple determinisms.

Certainly, for both anthropology and genomics, this is a period of growing attention to complexity and new questions about the reductionism that has served so amiably as a self-evident justification of the ascendance of molecular genetics. In this light, we consider how critical theory can swerve anthropology and genetics in ways that respond to these issues. Genetics itself has become a focus of anthropological research; in a sort of feedback

loop, critical cultural studies of genetics are raising questions relevant even to the most unrepentant reductionist. This is part of our project: we want to suggest how the productivity and potential of genetic explanations can be effectively integrated with other ways of understanding words, blood, and history. How can the burgeoning, and increasingly well-institutionalized, genetic narratives so characteristic of this era become a resource for justice and equity? How can both genetics and anthropology work in ways that recognize the tight bonds linking the techniques and practices of molecular genetics to the systematic exercise of power?

NATURE/CULTURE

The Human Genome Diversity Project (HGDP) as first proposed by Luca Cavalli-Sforza and colleagues (1991) strongly resonated with salvage anthropology, though in this case what was to be salvaged was DNA rather than culture and people (Goodman 1995; Marks 1995).[3] Blood samples from isolated or specialized populations of anthropological interest from around the world would be stored indefinitely, immortalized so to speak, in a public archive that could have many possible uses.[4] Cavalli-Sforza was a strong promoter of the historical relevance of DNA. He believed that the HGDP could help answer questions about ancient human population shifts such as the spread of agriculture, the peopling of Africa, and other events that were undocumented in any written record. DNA also appeared to be material that could be acquired without any particular attention to culture. Proponents, in their meetings and appeals for public funding in 1994 and 1995, seem to have assumed that taking blood was a simple technical act. Their plans became the focus of intense criticism by not only the indigenous groups targeted and their supporters, including the Rural Advancement Foundation International, but also anthropologists concerned about research ethics, power relationships, and scientific soundness (Goodman 1995; Marks 1995). The original plans for the HGDP combined technical sophistication with inattention to the political or cultural implications of opening the veins of people around the world.

The controversy may have killed the HGDP as a global project, but it did not stop the continued collection of biological samples and analysis of genetic variation. That larger project continues to be funded not only by the anthropology program at the National Science Foundation but also by the National Institutes of Health, where changes in focus are taking place. The goal of the HGDP has shifted from understanding "the" genome to exploring variations in genomes.[5]

The HGDP was a collision between postcolonial theory and geneticization. By the 1990s, the blood samples that could have been collected without controversy by earlier generations (who would not have been able to use them so effectively) were seen as deeply embedded in power relations and subject to all the constraints of informed consent, ethical disclosure, and sensitivity to cultural context—and this at the very moment when their utility as scientific objects of interest was highest. Interestingly, the power of the Internet, the motor and icon of informational capitalism, allowed indigenous groups to communicate and thus form a more powerful coalition to resist the HGDP (Lock 1994). In a sense this illustrates the power of the technical to undermine its own authority (Rabinow 1996), or what might be called the self-sabotage of the technical.

As the HGDP controversy suggests, those whose bodies are necessary participants in the networks of the new genetics can no longer be construed as invisible or silent. The postcolonial critique, human rights movements, changing standards for human subjects research, and the rise of the institutional review board have all affected field research in human genetics and biological anthropology. In the wake of recent controversies over the work of Napoleon Chagnon and James V. Neel with the Yanomámi in Venezuela, such questions have taken on a new, highly public urgency (see Ricardo Santos, chapter 1, this volume). How can anthropologists construct their work in ways that benefit vulnerable populations? Human subjects have long been important to biomedical knowledge, but this importance is now underlined by their institutional and organizational power to shape the research in ways that reflect their perceived advantage.

Human Populations/Genetic Resources

Some groups have become active and effective participants in genetic science. Four essays here explore populations that have been remade as genetic resources, examining how these scientific subjects have participated in the construction of new knowledge.

Ricardo Santos begins by considering the fieldwork of the geneticist James V. Neel, of the University of Michigan, who became the focus of a dramatic international controversy in the fall of 2000. Though Santos wrote this essay before accusations appeared claiming that Neel's use of a particular measles vaccine caused an epidemic among the Yanomámi in Venezuela in 1968, his text provides critical perspective on a scientist whose work has provoked intense debate. Exploring Neel's construction of the indigenous populations in Brazil as one of the last representatives of "primitive man," Santos compares Neel's work in the 1960s with the HGDP and with other research involving indigenous populations in the 1990s, much of it conducted by Neel's former students. Subjects seen as untouched by Western history became resources in various biological projects, including the Human Adaptability Project of the International Biological Programme, and Santos suggests that the concerns driving biological research among indigenous

peoples since the 1960s have been relatively consistent, even if the population response has not.

Considering field studies of a very different population in the 1960s, the Pennsylvania Amish, M. Susan Lindee explores the intense social work built into producing the pedigree, as this textual record of a family line was transformed into a molecular resource by Victor McKusick, a contemporary and competitor of Neel. McKusick's work with the Pennsylvania Amish was an effort to track the biological—in this case, the gene for Ellis–van Creveld syndrome—through the disciplined deployment of the social, including birth and death records, the culture of the Amish, social networks, and specialized texts such as notations in Bibles. His Amish subjects were often cooperative, though some contested their status as objects of scientific curiosity, and McKusick was able to track a rare form of dwarfism through community history and through state records in Harrisburg, Pennsylvania. Lindee's study suggests that the pedigrees built on the exhaustive field studies carried out by many investigators interested in human genetics in the 1960s became molecular records and laboratory objects precisely because of their detailed social embeddedness.

Karen-Sue Taussig, Rayna Rapp and Deborah Heath explore the complex stakes made manifest in the contemporary phenomenon they call flexible eugenics as it plays out in the technical and social cultures built around dwarfism. The practices and discourses of the Little People of America, and of the scientists and physicians they engage, reflect a new convergence of genetic normalization and biotechnological individualism. As these authors demonstrate, the Little People of America's coalition with technical people, machines, and processes facilitated both a productive resistance to prejudice or exclusion, and a sociotechnical normalization that is in tension with that resistance. The "obligation to be free," they suggest, is a social practice shaped by technical interventions ranging from the molecular or genetic intervention of the prenatal test or the genetic diagnosis, to the older, if increasingly baroque, interventions of surgery and pharmacology.

Hilary Rose explores still another population that has been the focus of intense genetic interest, the people of Iceland, who sold their genome to deCode Genetics in 1998 in what seemed at first to be a bizarre and unprecedented act of national commercialization. The Icelandic genome and its commodification provide Rose with an opportunity to explore the rise of pharmacogenomics, in which the joint interests of the state and of venture capital remade a seemingly isolated population into a commercial and public health resource. As she demonstrates, the Icelandic case must be understood as part of a much wider program of supposedly cost-effective preventive medicine and genetic pharmacology. Rose excavates the concerns of those who have chosen not to participate, considering particularly how women expressed distrust of the database and questioned the confidentiality of information collected. Finally, she suggests that the database is a manifestation of expert-driven technological innovation common in the old welfare states, and an example of long-standing traditions badly in need of reform.

Animal Species/Genetic Resources

As human populations have provided data and ideological support for cultural hierarchies and corporate value to the emerging biotechnology industry, animals have been an equally exploited genetic resource. The negotiations between nature and culture are in some ways easier to see when they focus on companion animals, experimental organisms, genetically engineered mice, or cloned sheep.

Drawing on the technical frames of feminist theory, kinship theory, and molecular genetics, Sarah Franklin explores the notion of viable offspring when viability is biological, economic, strategic, and corporate. Dolly, Franklin proposes, is viable not only in the sense that she is capable of living outside the womb but also in the sense that she demonstrates a viable technique, a viable merger between corporate sponsorship and academic science, a viable investment driving up the value of the stock of the company that financed her creation, and a nuclear transfer technology producing a reliable natural-technical product. With Dolly, not only life itself but also the means of its production can be owned. She is therefore an unnatural kind, in an uneasy relationship to existing ideas of species, breed, property, gender, and sex.

Donna Haraway offers a "low-resolution linkage map" of the complex cross-species world of canine genetics. Presenting us with an "apparatus of naturalcultural production," Haraway shows us how the dog genome serves as the catalyst and central node in a network of human and nonhuman actors who engage one another through an interwoven array of practices and narratives, both popular and scientific. Offering a historical perspective on the genetic concerns of the present era, the article considers paleoarcheological portraits of canine agency, with the descendents of wolves successfully enlisting humans as purveyors of garbage dumps—perhaps before companionship—and puppy tenders. If an earlier epoch gave us the Birth of the Clinic, what can we learn from the elaborate technologies of canine care engendered by what Haraway would call the Birth of the Kennel?

Animals function as boundaries and can come threateningly, or alluringly, close to humanity. Jonathan Marks's quarry is a single factoid: chimpanzees and humans are commonly described as sharing a significant proportion of their genes—between 97 percent and 99 percent. Yet what does this number mean? That humans are hardly more than chimps, genetically, or that genetics is irrelevant because humans are obviously very different

from chimpanzees? Proposing that the genetic claim of great likeness is often deployed to suggest that human beings and chimps share unsavory qualities, Marks goes on to play with the numbers himself, taking quantification to absurd lengths. By exploring a particular fact and its cultural moorings, Marks demonstrates the stakes involved in cross-species comparisons. The meanings of relatedness—between individuals, groups, nations, regions, and species, past and present—are always contested and contextual. Making relationships solid is a high priority in many different disciplinary and institutional settings; getting the world to hold still is one of the great Western projects. For many observers, including geneticists and anthropologists, genetics has promised to provide a particularly compelling way of defining relationships of all kinds, producing solidity and stability. At the same time, new genetic technologies such as cloning undermine the notion that genes can or should define both naturalness and relatedness in some straightforward way. Similarly, the technical invocation of DNA as the site at which race can be obliterated because we are genetically alike must confront the social reality that race has been literally written onto and into the body by history and social practice (see Alan R. Templeton and Troy Duster, chapters 12 and 13, this volume). When biology is a product of social organization, what is biological?

CULTURE/NATURE

Anthropologists historically have played a critical role in conceptualizing and studying human variation and identity. Race, ethnicity, and nationality are salient identity signifiers regardless of whether they are biologically legitimate categories. Sovereignty has sometimes functioned as a biological resource, a form of power that reinforced claims about the body and its value. And racial science—the science that validated the legitimacy of racial categories and that provided stories about racial difference which conformed to prevailing power relations—has been a sovereign resource deployed in law and nation building. In this group of essays, contributors explore the deep linkages binding state, race, and genome.

Political and Cultural Identity

We first present three essays that explore nature as an explicit cultural and political resource. While anthropology has begun to problematize the geneticization of medical domains such as disease-gene mapping and screening, it also must address the cultural reverberations that emerge as genetic science moves into the world of plant biology and agriculture. Indeed, as agricultural and pharmaceutical production are absorbed into the global biotechnology industry, novel sets of actors, including small farmers and local community activists, are emerging to contest an industry that is encroaching on cultural understandings and practices of food, land, and nature. Chaia Heller and Arturo Escobar explore two social movements, one in Colombia, the other in France, that represent early and formative case studies in what has since continued to become a global and potent movement in which activists around the world are contesting biotechnology.

Anthropology is well suited to exploring the novel intersection of genetic knowledges and globalization. For Heller and Escobar, this intersection results in the emergence of powerful networks that both produce and are produced by novel discourses of biodiversity and genetically modified organisms. While these networks are the site of science, capital, and government bodies, they are also the site of new social movements in which actors resist a perceived commodification of nature and a loss of cultural autonomy linked to agricultural and other land practices.

Joan Fujimura here explores views of genomics promoted by two prominent Japanese scientists, each of whom is engaged in imagining the future consequences of genomics as a social system and as a technological enterprise. She proposes first that imagination is a critical social practice through which global futures are designed, emphasizing the practical, fundamental importance of the discourses deployed around biotechnological change. She also points out that the Japanese tradition of translating foreign technology in ways that make the foreign "native" plays out around genomics in novel ways. The pseudonymous genomics promoter Suhara, for example, constructs the findings of genomics as a spiritual problem for the Christian West, which, in his interpretation, resists the embeddedness of human beings in nature. The Japanese, in contrast, he proposes, can readily accept the biological truths that genomics will reveal, including the truth about "what man is." Culture, therefore, in his account, encourages genomics in Japan but retards it in the West, a play that deftly severs science from "the West" and locates the problems of science not in technoscientific rationality but in the problematic orientations to life expressed through Christianity.

As Fujimura suggests, genomic scientists are building maps of genomics, of national and transnational identities, and of culture, and new institutions that encode structural visions of new futures. National identities linked to genomic science are not second-order effects, she proposes, but are instead inseparable from the first-order effects of gene maps and databases, cloned organisms, and pharmacogenetic commodities.

Africa is a hot spot of anthropological genetics. The continent was a focal point of the HGDP, and the interrelationships of African populations have long puzzled scientists. For example, Linnaeus thought that the San people of southern Africa were a different species, and it has been said that, up to the 1950s, some scientists even questioned whether the San could reproduce with Europeans. Himla Soodyall here explores how those outmoded scien-

tific perspectives intersect with her own field research. Officials of the new South Africa embrace genetics to show the goodness of Africa, just as others once embraced genetics to show its backwardness. Yet how much can the technoscientific network be reformulated as an African resource? Soodyall relates her first venture out of the laboratory to take samples from conscripted San soldiers, and her realization that others had sampled the same group of individuals. How different is the drawing of blood for racist reasons from the same act undertaken for libratory reasons? Does it matter if the blood samples are sent to U.S. laboratories or held at a local lab in South Africa?

Race and Human Variation

The idea that technical expertise can be libratory, despite its historical relationships, threads through the next four essays, which explore race and human variation. The authors elaborate on the plastic and contested qualities of racial and ethnic variation by considering race and difference as historical problems accessible through the politics of processing and making sense of ancient DNA, as mathematical problems of gene frequencies, and as medical problems of phenotypic diagnosis and effective intervention.

Racial privilege and the injustice it has produced have a precise technical dimension in Rick Kittles and Charmaine Royal's exploration of an excavated burial ground in New York City. The authors draw on results from mitochondrial DNA studies both to illuminate the ethnicity of African Americans brought to North America enslaved and, thereby, to understand the ethnicity of contemporary African Americans. They studied mitochondrial DNA extracted from the bones of individuals who were buried in the 1700s at the New York African Burial Ground in lower Manhattan. Kittles and Royal hope that the DNA preserved in bones of eighteenth-century slaves will serve as a historical resource for populations whose history has been effectively obliterated (or almost so) by the slave trade.

While acknowledging the tangled history of biomedical research and practice on African Americans, particularly the history of medical racism and barriers to care, Kittles and Royal strongly support genetic studies of African Americans. Like Soodyall, they propose that technical knowledge can become a cultural resource even for those who historically have been oppressed by it. Alan Templeton implicitly adopts a related perspective in his examination of gene frequencies.

Since Richard Lewontin's famous study of the apportionment of human genetic diversity (1972), it has been shown repeatedly that most variation occurs within populations and races rather than among them. Populations can be defined as races, but they can also be defined in other ways, for

example, strictly in geographical terms. Lewontin's conclusions called into question the biological reality of race; the genetic study that an earlier generation expected to demonstrate that races were biologically distinct (Boyd 1950) instead suggested that race had no biological meaning at all. Alan Templeton goes a step further in the formal disproof of race. He applies Wright's F_{st}, a measure of diversity within and among groups, to show that humans did not evolve as separate lineages (races). Templeton also provides an alternative explanation for human genetic variation: geographic distance. He argues strongly that applying different standards to human populations is scientifically indefensible. If race is to be considered biologically valid, then it must meet the standard scientific criteria for subspecies: Genetic diversity is genetic diversity, no matter the species. The science that helped to reify race, now buries it.

From a different perspective, Troy Duster explores the fluidity of the scientific concept of race by following the feedback loops linking biological research to culture and to practices of social stratification. While many anthropologists have sought to declare that the scientific concept of race is meaningless, Duster suggests that "purging science of race" is not practicable, possible, or even desirable. Scientific communities, legitimately troubled by commonsense interpretations of race as a biological justification for inequality, have oversimplified the issues.

Race, Duster asserts, is a stratifying practice of profound importance, and while the socially decontextualized concept of race as biological taxonomy is clearly groundless, the stratifying practice is a complex interactive feedback loop directly relevant to science and health care. Racial and ethnic classifications are in practice critical resources for the routine collection and analysis of medical data. Duster proposes that, when race is used as a stratifying practice, there is a reciprocal interplay of outcomes in which it is impossible to completely disentangle the biological from the social. Race is always, he suggests, a complex interplay of the social and the biological. It is neither meaningless nor trivial, and science cannot be purged of a category that has had such dramatic consequences for social organization. Ignoring race, Duster argues, also ignores or denies racial privilege. The paradox is that, as long as race plays a role in stratifying practices, it cannot be ignored.

The final chapter, by Frederika Kaestle, provides a site-specific window onto the technical, moral, and political worlds built around a found object, the remains of a human being. The Kennewick Man, the nearly complete skeletal remains of a man found in Washington State and dated to about 8,500 years before the present, is subject to a complex web of legal and historical frames. The man was first interpreted as Caucasoid from the historic period, but an archaic spear embedded in his hip suggests an older origin. If he were modern, the case would fall under the jurisdiction of the coroner.

If he were historic and non–Native American, then his disposition would fall under the jurisdiction of the U.S. Archeological Resource Protection Act. And if he were ancient and Native American, then the remains would be subject to the Native American Graves Protection and Repatriation Act. The body would have to be given to a Native American group—but which one? When one congressional representative proposed that human remains should not be returned to particular tribes unless "we can be reasonably confident that the remains are affiliated with that particular tribe," the National Congress of American Indians and the Clinton administration opposed the plan. Anthropologists sued to continue their studies, suggesting that scientific evidence drawn from DNA could be interpreted to contradict the creation myths of the tribes living in the region.

The Kennewick Man saga illustrates many of the cultural, ethical, and scientific issues that increasingly collide in the study of ancient DNA. Biological materials drawn from ancient remains may belong (in some senses) to indigenous groups in which there is profound mistrust and even outright rejection of Western science. Reflecting the genuine injustices of the past two centuries of racially driven research with Africans, African-Americans, South American groups, and Asian groups, such skepticism has a dramatic effect on contemporary research. Scientists and anthropologists working with such groups face complicated ethical dilemmas and biological problems. So, for example, the Native American Graves Protection and Repatriation Act requires proof of cultural (which often means biological) connection to a recognized Native American group in order for repatriation to occur; but populations are not closed systems, and many remains have contingent links to many groups, depending on how evidence is organized and interpreted. The linear connections over millennia that such legislation demands are neither realistic nor easily traceable.

Race, ethnicity, nationalism, and global capitalism increasingly play out in technoscientific debates that draw on cultural identities and laboratory techniques. Genes are resources for many different groups, deployed to resolve long-standing disputes about race, negotiate international trade, explain historical events inaccessible in any other way, and contest oppression and racism. Genetics in practice is plastic and contingent, embedded deeply in culture, time, and place.

CONCLUSION

The cover story of the September 13, 1999, issue of *Time* focused on the IQ gene purported to have been found in a strain of mice. The same issue included a report on the acts of resistance of the French farmers of Confédération Paysanne to genetically modified organisms, including the farmers' recent trashing of fields growing GMOs and of McDonald's restaurants. What are the links among IQ genes, the farmers' resistance to GMOs, the global hegemony of McDonald's, and the intelligence of laboratory-manipulated mice, which were among the first standardized animals and among the first patented experimental organisms? How does the network of complex meanings operate?

Bruno Latour, in a survey of a single daily newspaper, suggests that reports of computers, ecological disasters, pharmaceutical regulation, AIDS, and forest fires bring together "heads of state, chemists, biologists, desperate patients and industrialists" in a single story. The "imbroglios of science, politics, economy, law, religion, technology, fiction" produce a world in which "all of culture and all of nature get churned up again every day" (1993: 2). Meanwhile, the biologist Scott Gilbert has recently suggested that the grand narratives of the biological sciences are taking the place of the grand narratives of Western civilization. The "Western Civ" course, with its political origins in a "War Issues" course developed during World War I, has faded from the curriculum at most institutions. But introductory biology remains a vibrant core course, and biological narratives now provide what once came from Greek mythology, Dante, Shakespeare, Rousseau, and Goethe. The stories that are said to define our culture increasingly involve DNA, cells, organs, animals, plants, and ecosystems, Gilbert has suggested.

As though to validate Gilbert's claim, *Newsweek*'s first issue of the new millennium featured a striking image of a young man, bare-chested, longhaired, cradling in his hands a glowing strand of DNA. He looks down at the double helix while a serpent whispers in one ear and a dove in the other. In this obvious iconography, the young man is Adam, or perhaps the new American Adam, the contemporary molecular geneticist. The serpent is a devious character we all recognize, and the dove is the Holy Ghost, the voice of God, presumably offering good advice about what to do with the powers symbolized by a molecule whose existence and properties the majority of readers must take on faith.[6] A few weeks earlier, the cover of *Nature* featured an amended reproduction of the familiar detail from Michelangelo's Sistine Chapel. The hands of God and Adam, stretched toward each other, were connected by the sequence of chromosome 22, the first human chromosome to be fully sequenced.[7] The spark of life passing from the divine to the human was not the soul but the DNA sequence. Such images suggest the cultural significance attached to DNA, and this significance, as it plays out in multiple sites, poses the central problem of this volume.

One of the great ironies of the celebration of reductionism that produced the Human Genome Project is that the genome-in-practice has proven to be a bit more like the coyote than the architectural blueprint, the dictionary, or the machine. As the mapping proceeds, a Harry Potter world of unex-

pected doorways, secret passwords, and strange monsters has emerged. The early comparisons to the Bible begin to seem cogent in new ways, for like the Bible the genome is full of contradictions, inexplicable passages, historical errors, and ambiguity.

In the early years, when it was necessary to convince Congress that the genome should be mapped, James Watson and others prophesied a complete text that would explain "who we are."[8] Yet the genome, as Watson and other leading genomics scientists recognized, is in practice exceedingly complex, and any explanations it can provide of who we are will be equally complicated. While the *New York Times* of June 27, 2000, featured the cracking of the genetic code on its front page, the headline of the "Science Times" section was more somber: "Now the Hard Part: Putting the Genome to Work."

Perhaps genetic science is entering an era in which complexity and context are more important, both internally and externally, than reductionistic causal models. Perhaps genetics and anthropology have the potential to provide a sort of fusion in which questions about how facts become obvious and how categories silence questions are relevant to all sides. Perhaps the age of genetics will allow "geneticists to remake themselves as anthropologists."[9] And if the language of the gene is not well suited to anthropological questions, is the language of anthropology well suited to genetic questions?

Genetics at the beginning of the new millennium is a corporate, personal, medical, ideological, emotional, and bodily conglomerate stretching across and through many institutions and many layers of society. It is a way of thinking about the body and about the state, a way of organizing social expectations and making decisions about what questions are worth answering. Haraway has proposed that there is no innocent place to stand in this network. The common life and future imagined through genomics and all its corollaries imposes on us all, and the "sticky threads of DNA wind into the frayed planetary fibers of human and nonhuman naturalcultural diversity" (chapter 6, this volume). We are both bound to all other living things through DNA and separated from them by DNA, which defines both similarity and difference.

For anthropologists, genetics increasingly defines new questions and new methods, sharpening tensions within the field, attracting public notice, and raising new ethical quandaries. The new genetics has entered an older landscape in anthropology with a range of revolutionary or apocalyptic claims. Blood rewritten as genes provides powerful frames for kinship and identity, race and culture, history and the human future. What stories do genes tell? And what stories do we tell about genes and, in so doing, about others and ourselves, science and society, and nature and culture?

Anthropologists have long been critical players in constructing the narratives that define culture. Making the world, building narratives, is a craft, and we need to become skilled at that craft. We must learn to notice the networks of systems that sustain geneticization and identify some of the conceptual barriers that have made these networks so difficult to trace. The following chapters explore some problems posed by the intersections of words, blood, and history and show how those intersections reflect inequities, shape social policy, and privilege particular frames of meaning.

NOTES

1. As the HGP's era of DNA sequencing nears completion, there are those who project an impending era of proteomics, marked by increased efforts to achieve rapid progress in studying the complex structure and function of the proteins encoded by DNA sequences.

2. D. G. Burnett (1999) demonstrates the continuing power of what was in retrospect a relatively pedestrian analysis presented in a 1959 Rede Lecture at Cambridge University. The positing of "two cultures" provoked a spirited response and became a way of talking about many crises in the 1960s.

3. The idea of rapid loss of valuable data frequently has been used to justify "salvage anthropology." Much credit for this insight goes to Jonathan Marks.

4. In fact, a point of the scientific critique was the dubious utility of the data. Cavalli-Sforza first seemed to be interested only in using the data for historical reconstruction. When this purpose was deemed insufficient by many, not least the objects of the study, other reasons for the study, such as showing race to be a biological myth or using the data for genetic epidemiological purposes, were forwarded. The scientific design, however, is insufficient for genetic epidemiology, and we already know that race is a myth (Goodman 1995, 1996).

5. The future course of the HGDP is uncertain. The project is related to a much broader research program in genetic diversity, which can be expected to continue whether or not a formal HGDP program gears up. Soon after the announcement of a plan for global collection of human genetic data, biological anthropologists became involved; the Biological Anthropology Program at the National Science Foundation helped fund an HGDP conference in 1992 and held an HGDP grant competition in 1996. In 2001 no projects explicitly investigating human genome diversity were supported, but genetic diversity research continues to be funded. Anthropological studies of diversity are now overshadowed by genetic epidemiological studies, particularly of single nucleotide polymorphisms and their potential as risk factors for diseases.

6. See *Newsweek* (1 January 2000): 75. We are grateful to Scott Gilbert for calling this image to our attention.

7. *Nature* 2 (December 1999): cover, "The first human chromosome sequence." Thanks again to Scott Gilbert.

8. For a discussion of the early negotiations over the Human Genome Project in the United States, see Cook-Deegan 1994, especially pp. 148–85.

9. This was a comment by the biological anthropologist Frederika Kaestle on the first day of our meeting at Teresópolis.

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