

## Genomics, Race Mixture, and Nation in Latin America

Peter Wade, Carlos López Beltrán, Eduardo Restrepo, and Ricardo Ventura Santos

This book presents findings from an interdisciplinary project involving three research teams working in Brazil, Colombia, and Mexico. Collaborating closely, the teams carried out in-depth research in a small number of genetics laboratories in these countries, while also drawing on local histories of physical anthropological and biomedical research into human biological diversity.

Laboratories in Brazil, Colombia, and Mexico have been mapping the genomes of local populations, with the objectives of locating the genetic basis of diseases and of tracing population histories. Geneticists are frequently concerned to calculate the European, African, and Amerindian genetic ancestry of these populations or to compare them to samples of European or Amerindian populations. In the process, scientists sometimes link their findings explicitly to questions of national identity, racial-ethnic or population difference, and (anti)racism, stimulating public debate and sometimes engaging in the definition of public policies.

The chapters in this book explore how the concepts of race, ethnicity, nation, and gender enter into these scientific endeavors and whether these concepts are reproduced, challenged, or reformulated in the process. Our work links current research in genetics to recent changes in the three countries, which in the last two decades have moved toward official multiculturalism, as have many countries in Latin America. The way genetics creates new imagined genetic communities, which may take forms that, to observers outside the genetic field including experts from other areas (anthropologists, sociologists, historians, etc.) and laypeople, might appear to have racialized and national dimensions, has implications not only for changing conceptions of race, ethnicity, and nation, but also for citizenship and social inclusion and exclusion.

The growing literature on race, identity, and genomics focuses mainly on the United States and Europe. Latin America, with its national identities based on *mestizaje* or *mestiçagem* (roughly translatable as “race mixture” in Spanish and Portuguese, respectively), presents a fascinating but little-explored

counterpart (see, however, Gibbon, Santos and Sans 2011; López Beltrán 2011). Our project team, comprising eight Latin Americans based in Latin American countries and two Europeans based in Europe—all with extensive experience of the Latin American context—was well placed to approach this literature from a different angle. In Latin America, clear categories of racial identification have been blurred by centuries of biological and cultural mixture, and ideas of race are often less socially salient than in the United States or appear in a very cultural form, in which biology and naturalization are often seen as less important. Critical race studies of Latin America have challenged the myths of “racial democracy” that have sometimes been erected on the basis of these characteristics, also showing that Latin America is very diverse with respect to ideas and practices around race (Maio and Santos 2010; Restrepo 2012; Wade 2010). Still, a view from south of the border tends to take race less for granted as a normal part of the social and political landscape and thus to question in detail exactly what is being reproduced when concepts of race, ethnicity, and nation become entwined in genetic research.<sup>1</sup>

Our research indicates that, despite the fact that most geneticists in Latin America actively deny the validity of race as a biological category, genetic science might produce knowledge and interpretations that, while they appear nonracial to genetic experts, might look a lot like race to the nonexpert in genetics. This occurs in social contexts in which race has a particularly contested presence and definition to begin with (as we show later on). Even when scientists explicitly deny the association between ancestry and race, the way genetic knowledge reaches society at large can give unintended but public salience to a notion of race based on ancestry—to be specific, biogeographical ancestries of continental scale (African, European, Amerindian)—in a context in which *raza* or *raça* (race) can evoke many different ideas of ancestry, appearance, culture, class, region, and nation. In emphasizing biogeographical ancestry measured through the use of selected DNA markers, genetics rejects older notions of race as biocultural types of human beings, yet it can be interpreted and understood (outside the genetic field) as reinforcing commonsense understandings of human diversity as divided up into continent-shaped groups.

Ancestry is not the only way in which ideas about race may recirculate. Genetic science in Latin America frequently evokes the nation and, insofar as the nation has long been a key vehicle carrying the idea of race in the region, and race has likewise been a central category in Latin American nation building, this evocation in genetic idiom can also entrain racialized meanings. In addition, a gendered discourse (*mestizaje* and the nation as originating in sexual relations between European men and indigenous or African women) is

particularly powerful in Latin American genomics. While genetics tends to highlight ancestry, this is mediated through ideas about nation and gender in ways that reiterate the diverse meanings of *raza* in Latin America.

At the same time, commonsense notions of race are transformed as well as being reinforced. Genetic reckonings of ancestry involve abstraction, metrification, differentiation, and multiplication—processes discussed in detail in the conclusion—which lead to contradictory effects of stabilization and destabilization, of fixing and unfixing, in which categories of race, ethnicity, and nation reappear to nongeneticists' eyes in a genomic idiom, which however simultaneously contests that appearance. The Latin American material brings into sharp focus, first, the way genetics can operate to biologize and naturalize commonsense and vague ideas about race, while also multiplying the diverse meanings of race; and, second, the way genomics can do this via concepts of nation and gender.

As we will see throughout this book, the categories used in genetic research are far from being neutral technical devices—as is the case with many scientific categories. Instead, they are natural-cultural objects that circulate through both scientific and nonscientific realms, blurring the boundaries between these realms, acquiring many different meanings and being subject to different readings.

## Human Diversity Research and Race Studies

### The History of Researching Human Diversity

Interest in human diversity has a very long history, in which what we would now call the cultural and the biological have not always been separated out in the clear fashion to which Western thinkers are now accustomed (Hodgen 1964; Jardine, Secord, and Spary 1996; López Beltrán 2007; Thomson 2011; Wade 2002b). In the nineteenth century, when biology and physical anthropology began to emerge as the distinct fields of enquiry they were to become, the division of humans into categories according to their physical characteristics—their biology—became increasingly established as a specific endeavor (Lindee and Santos 2012; Marks 1995; Spencer 1997; Stocking 1982, 1988). Biology, however, was often regarded as interwoven not only with environment, but with behavior and habit too.

The idea of race emerged as early as the thirteenth or fourteenth century to refer to lineage, breed, or stock in animals and humans (Banton 1987; Stolcke 1994).<sup>2</sup> It became entwined in notions of “purity of blood” (*limpieza de sangre*) and religious affiliation, especially in Iberian encounters between Christians,

Jews, and Muslims (Hering Torres 2003; Poole 1999; Sicroff 1985; Zuñiga 1999). During the discovery and conquest of the Americas, this idea of lineage and purity of blood became one way (among others) of thinking about differences between the key categories that emerged in these colonial encounters—blacks/Africans, whites/Europeans, Indians/Native Americans (as well as Asians and other non-Europeans) (Martínez 2008; Rappaport 2012; Villella 2011). Differences in perceived appearance as well as behavior were naturalized in ideas about heredity.

During the eighteenth and nineteenth centuries, the idea of race developed as the key conceptual category with which to classify humans into “types.” By the nineteenth century, with the development of biology and physical anthropology, these types were conceived as physically distinct entities, even separate species, and were ranked in a hierarchy of biological and cultural value (Banton 1987; Restrepo 2012: 153–173; Smedley 1993; Stepan 1982; Stocking 1982). This idea of race—often called “scientific racism”—remained influential in the early decades of the twentieth century. According to many narratives, the concept began to be dismantled from about the 1920s, as scientific evidence mounted against it as a workable classificatory device. It was then consigned to the dustbin of science in the wake of Nazism, with a vital role being played by the postwar statements on race produced by UNESCO in 1950 and 1951, about the lack of scientific evidence for a biological hierarchy of racial types (Barkan 1992; Haraway 1989; Reardon 2005; Stepan 1982).

Race then remained as a social construct, an idea that people, not scientists, used to categorize themselves and others, perhaps referring more to culture than biology, perhaps avoiding the term itself, but still generally using classic racial phenotypical cues to make categorizations, typically essentialist in character and typically referring to familiar racialized categories (black, white, Asian, African, European, mixed-race, Native American or *indio*, etc.). It is this combination of reference to physical appearance, heredity, essences, culture, and the specific categories of people that emerged in colonial histories that we, in this book, take as defining “race.”

In fact, the use of the concept of race as a way of thinking about human diversity, if not hierarchy, did not disappear in the life sciences in the period following World War II (Maio and Santos 1996; Reardon 2005; Reynolds and Lieberman 1996). Many life scientists amassed biological, including genetic, evidence to indicate that humans could not be biologically partitioned into separate entities called races (Brown and Armelagos 2001; Montagu 1942). Humans, as a young species in evolutionary terms, did not evolve into clearly distinct types in different geographical and demographic niches; in addition,

they constantly moved and interacted, with increasing frequency over time. Still, life scientists worked with and developed the idea of populations, which could be understood in terms of demography and/or genetics, and which were dynamic and not clearly bounded. In this view, populations were still distinguishable in terms of frequencies of certain traits and, in global and evolutionary terms, could still be broadly differentiated into continental-scale populations that looked rather like the older races or evoked race-like notions, now in terms of genetic frequencies (M'charek 2005a). Influential geneticist Cavalli-Sforza and his colleague Bodmer even argued for “a genetic definition of race”—one more accurate than everyday concepts of race—in a book published in 1971 and republished in 1999 (Reardon 2005: 54, 70), even though Cavalli-Sforza also argued that clusters of populations could not be identified with races (Cavalli-Sforza, Menozzi, and Piazza 1994: 19).

With advances in genetics, this picture became increasingly complex. On the one hand, the fact that humans all share 99.9 percent of their genomes acquired iconic status. On the other hand, new technologies gave scientists increasing powers to explore that 0.1 percent of difference, which by definition caused much of the evident physical diversity of humans. Long-standing interest in mapping this diversity expressed itself anew in the Human Genome Diversity Project, begun in 1991, which, despite its checkered career, created a database that is widely used today. Other global initiatives include the Polymorphism Discovery Resource (1998), the International HapMap Project (2002), the Genographic Project (2005), and the 1000 Genomes Project (2008).

The aims of mapping diversity revolve around (a) understanding processes of human evolution and global migrations—which may include a kind of rescue genomics, seeking to sample “isolated populations” before they disappear or lose their supposed genetic particularities (Abu El-Haj 2012; Marks 2001; Reardon 2001; Santos 2002; TallBear 2007); (b) improving human well-being, by locating genetic components of disorders, using techniques that compare different populations or that control for genetic differences related to geography; and (c) developing databases for the forensic identification of individuals.

The aims related to medical genomics are very powerful. More recent debates about race in genetics revolve centrally around health. The issue is whether variations in the incidence of disease and in human drug responses relate in significant ways to genetic differences that may be characterized as racial, ethnic, or more neutrally in terms of continental-scale “biogeographical ancestry” (with the latter usually breaking down into categories such as African, European, Asian, Amerindian) (Abu El-Haj 2007; Burchard et al. 2003; Cooper, Kaufman, and Ward 2003; Fujimura, Duster, and Rajagopalan 2008;

Fullwiley 2007a, 2008; Koenig, Lee, and Richardson 2008; Nash 2012b; Skinner 2006, 2007; Whitmarsh and Jones 2010).

### How Race Can Enter Genomic Human Diversity Research

Many geneticists reject the concept of race as a meaningful biological category, although some do not (Bliss 2009b; Burchard et al. 2003). Several leading Latin American geneticists have campaigned explicitly against the concept of race (Lisker 1981; Pena 2005, 2006, 2008), and all of the geneticists we worked with resisted the suggestion that their work somehow reproduced race—a suggestion that they often understood to be the accusation that they were reproducing old-style scientific racism. This resistance produced important exchanges between us and the geneticists, which helped us clarify our arguments.

There are several reasons why the concept of race or something that appears to nonexperts in genetics to invoke categories that look very like racial ones—if not the term itself—seems to derive from genomics research. First, research into human genetic diversity may employ sampling strategies that seem to evoke familiar race-like categories, while referring to “populations” (TallBear 2007). Thus the HapMap includes samples of Yoruba people from Ibadan and people from Utah with northern European ancestry and, despite HapMap cautions about generalizing, these samples are often used as proxies for African and European ancestry (Bliss 2009a). The HapMap organizers deny any connection with race, yet sampling “the Yoruba” ends up being a way to sample “Africans” and to specify “African ancestry” (Reardon 2008: 314). Or, as we found, DNA extracted from Zapotec individuals in Mexico is used as a proxy for Amerindian ancestry. The use of AIMS (ancestry informative markers) is “designed to bring about a correspondence of familiar ideas of race and supposed socially neutral DNA”: populations of Africans, Europeans, and Native Americans are sampled and then used as “putatively pure reference populations” to define the genetic ancestry of “admixed” populations, as geneticists generally call them (Fullwiley 2008: 695).

For the geneticists, AIMS are selected genetic markers that can help to identify geographical ancestry; AIMS do not comprise the genetic profile of an entire population and they may bear no relation to phenotypical expression, being located in the noncoding sections of the DNA.<sup>3</sup> For geneticists, the use of these isolated markers is far removed from early twentieth-century concepts of races as clearly defined biological units, with associated behavioral characteristics (Abu El-Haj 2012). Yet for the nongeneticist observer, the use of reference populations to identify African, European, and Native American ancestry in admixed populations almost inevitably reinscribes, not race in a simple sense,

but racialized concepts of human difference, as it reiterates these familiar categories, with the apparent underlying implication that they are biologically distinguishable as populations.

Second, specific diseases or conditions may be associated with particular populations or with particular ancestries, in ways that again evoke familiar race-like categories and seem to give them a genetic basis. Thus Mexican Americans or Mexican ancestry may be associated with type 2 diabetes (Montoya 2011); African ancestry may be associated with the frequency of asthma (Fullwiley 2008); and medicines may be marketed to Americans of African ancestry (Kahn 2008). Related to this issue is the question of whether, and exactly how, racial and ethnic labels should be used in medical research and clinical practice. Differences—and especially inequalities—in health outcomes that are structured by racial and ethnic identities can be measured by using such labels, but they may also entrench differences and even invite geneticized explanations for health differences, which may be more social than genetic in origin (Braun et al. 2007; Ellison et al. 2007; Kahn 2005; Kaplan and Bennett 2003; Koenig, Lee, and Richardson 2008; Whitmarsh and Jones 2010). The use of racial and ethnic labels may become quite standardized: in her study of a U.S. genetics lab, Fullwiley (2007a: 4) found that, because it worked as a classifier in many different U.S. contexts, race functioned as an institutionalized way to organize and interpret data (Epstein 2007). Genomics does not, however, necessarily associate disease with race-like categories; it may contest such associations, as is the case for sickle-cell anemia in Brazil, where state screening programs, based on genetic evidence, test all members of state populations, despite strong discursive links between the condition and “black people” in Brazil (Fry 2005b; see also Pena 2005). This is an important indication that genomics does not simply reproduce but may also destabilize racialized categories (see also Pena 2008).

Third is the technique of controlling for “population stratification.” A medical genomics project that is seeking a genetic variant associated with a given condition generally compares diseased cases with healthy controls. If the cases happen to possess various genetic variants more frequently than the controls, then a number of genetic variants may appear to be associated with the disease, some or all of which may have nothing to do with the disease, being the product of other demographic or evolutionary processes. One possible difference between cases and controls is caused by the genetic ancestry of populations: populations have different genetic profiles by virtue of their ancestral geographical location. Thus it is important to make sure that your cases and controls are matched in terms of ancestry: if you compare African cases

to European controls you will find lots of genetic differences, without being able to tell which are simple accidents of geographical ancestry and which are actually linked to the disorder in question (Fujimura and Rajagopalan 2011). Basic matching is generally done by asking sampled individuals to self-identify in ethnic or racial terms.

Matching may need to be refined further: because of historical admixture, any sample of “Mexican” cases or controls is likely to include individuals with very varied mixtures of ancestries, many of whom might identify as mestizos. But by genotyping each individual to quantify biogeographical ancestries (in this case, mainly Amerindian and European), it is possible to statistically control for admixture, so that cases and controls are finely matched (Choudhry et al. 2006). A genetic trait that is linked to, say, asthma will thus hopefully stand out, independent of other traits that happen to be associated with a given ancestry. Of course, once you have good evidence that a given genetic trait is linked to a disease, you may find that this trait is more prevalent among certain biogeographical populations and ancestries than among others.

The three preceding points show that biogeographical ancestry appears again and again in relation to populations conceived as different because of their evolutionary and demographic histories in diverse geographical locations. This evokes race-like categories through “genome geography” (Fujimura and Rajagopalan 2011), even when the scientists in question deny the biological validity of race and see ancestral populations defined by specific sets of markers as quite unlike races. It is important to emphasize that these are race-like or racialized categories, rather than simple reiterations of early twentieth-century racial types. The categories referred to are populations (which may be quite specific) and ancestries inferred from selected populations. Yet, to the eye of the nongeneticist, larger, race-like categories, such as African, European, and Amerindian, constantly emerge from these more specific references.

A fourth way in which racialized thinking appears in genomics is via the idea of the nation. Race and nation have long been linked in the idea that nations are biologically distinctive in ways linked to racialized classifications, such that Britishness or Englishness might be conceived in terms of whiteness or Brazilianness seen in terms of having mixed ancestry (Anthias and Yuval-Davis 1992; Appelbaum, Macpherson, and Roseblatt 2003b; Foucault et al. 2003). To the extent that genomic research attempts to create a national genomic science, a national biobank, or a map of national genetic diversity, there is the possibility that the idea of the nation will be given a genetic connotation, albeit an imagined one, which may reinforce racialized meanings (Benjamin

2009; Gibbon, Santos, and Sans 2011; Hartigan 2013a; López Beltrán 2011; Maio and Santos 2010; Nash 2012c; Pálsson 2007: ch. 4 and 5; Rabinow 1999; Taussig 2009).

### Race, Genomics, and Society

These specific ways in which race-like categories appear to the nonexpert eye in genomic research need to be seen in the context of the impact of genomics on society more generally. Existing literature on the social changes wrought by the advent of the “new (human) genetics” presents us with a number of possibilities.<sup>4</sup> “Geneticization” refers to “an ongoing process by which differences between individuals are reduced to their DNA codes” (Lippman 1991: 19) and, more generally, implies a shift toward conceiving of belonging and identity in terms of genetic traits. This appeal to genetic determinism can be paradoxically combined with choice and self-fashioning, for example, through “recreational” ancestry testing (Bolnick et al. 2007; Comaroff and Comaroff 2009: 40). “Gene fetishism” involves reifying and attributing powerful agency to the gene, and also turning it into a cultural icon (Haraway 1997; Nelkin and Lindee 1995). “Biosociality” suggests that people will increasingly create social relations around perceived biological ties, such as shared genetic disorders (Gibbon and Novas 2007; Rabinow 1992; Taussig, Rapp, and Heath 2003). “Biological citizenship” refers to the use of biological traits to define belonging and entitlement in a nation-state (Rose and Novas 2005); in this, biomedical classifications are increasingly important and may entail genetic considerations (Heath, Rapp, and Taussig 2007).<sup>5</sup>

These concepts are varied, but they share the idea that the biological and the genetic are an ever greater part of social life. While this is undoubtedly true in a general sense, some literature also shows that this is an uneven process, with some, perhaps many, sectors of different societies having only superficial contact with genetics, while it is not clear that their ideas about identity and belonging have become geneticized or even biologized (Edwards and Salazar 2009; Hedgecoe 1998; Wade 2007b). To the extent that geneticization has occurred, there is also no simple sense of the consequences of the greater social presence of genetics, although some have feared that there is a shift in society toward greater genetic determinism and reductionism (Lewontin, Rose, and Kamin 1984), even if this goes against current genetic science, which tends to be less deterministic than before (Keller 1995; Pálsson 2007: 44–49).

Discussions about the concept of race are significant in relation to these ideas. Concerns about the reappearance of racialized thinking in genomics are linked to worries about processes of geneticization and genetic determinism.

The fact that race—usually understood to be deterministic—seems to be reiterated in some form in genomics encourages fears about this.<sup>6</sup> However, recent work on genetics and society suggests that such a characterization of race and genomics is overly simple, in part because geneticization is not socially pervasive as a way of thinking about belonging and identity. In addition, just as geneticization does not necessarily lead to greater determinism, partly because apparently rigid separations between nature and culture are not as clear-cut as they appear and are blurred still further precisely by geneticization itself, so the concept of race, as a natural-cultural assemblage, is not simply about biological determinations (it is, and always has been, also about environmental determinations and cultural habits).<sup>7</sup> Thus the reappearance of race need not only lead to greater determinisms, although this may be one aspect of the story (Condit 1999; Condit et al. 2004; Nelson 2008b; Roberts 2010; Wade 2002b).

#### Race, Gender, and Human Diversity Research in Latin America

The preceding discussion sets one key frame for the findings from our project. Latin America has attracted interest for some time, due to the presence of indigenous peoples, who can provide data for understanding microevolutionary processes and human migrations (Salzano and Callegari-Jacques 1988), and due to the presence of genetically admixed populations, which are seen as useful for tracing interesting genetic variants, untangling genetic and environmental causes of complex disorders, and making inferences about population migrations (Burchard et al. 2005; Chakraborty and Weiss 1988; Darvasi and Shifman 2005; Salzano and Bortolini 2002; Sans 2000). The impact of genetic medical and human diversity research on Latin America has been increasing over the last twenty years or so.

One of our conclusions is that, due to the complex routes through which science reaches the public at large, genomics in Latin America can provide a genetic language for thinking about something recognizable in the wider society as race—but it does not do this in a simple, unidirectional way and indeed it complicates race in the process. The reinscription of racialized concepts is particularly apparent in societies where a public discourse of race has either been historically marginalized since the demise of eugenics (as in Mexico) or has been subsumed into discourses about mixture and the transcendence of racial difference (as in Brazil); and in societies where a biological language of race—although by no means absent, especially insofar as phenotypical appearance can be important in making racialized judgments—has historically

been less evident than in the United States or Europe. (We expand on this in the next section.)

However, our material also shows how genomics provides a different way of thinking about race so that it appears in a new molecular and bioinformatic mode. As noted earlier, scholars have observed that genetic science seems to reinscribe racialized categories, but less attention has been paid to the way genetics also transforms these categories and concepts. After all, genetics has been an important tool in contesting the biological concept of race, such that, if racialized concepts are reproduced in genomics today, they take a different form. Abu El-Haj (2012), for example, notes that anthropological genetics often uses noncoding genetic markers that are understood to be completely non-determining of phenotype, let alone culture, a fact that distances today's genetics from early twentieth-century concepts of race. While this is true for the kind of genetic analysis that is her focus and that looks at population history, more medically inclined genetics often looks precisely for links between diseases and ancestries. So the picture is uneven: racialized categories disappear and reappear, sometimes in quite familiar guises, but race is also refigured as genetic ancestry, which can be finely differentiated, multiple, and historically so distant as to be invisible and highly abstract (see conclusion, this volume). This mode of racialized thinking combines, in new ways, elements of reification and stabilization with processes of deconstruction and destabilization. Racialized thinking is an ongoing natural-cultural assemblage, which has always combined aspects of naturalization and determinism with aspects of culturalization and indeterminacy; genomics produces this ambivalence in a new way.

One aspect that the existing literature on race and genetics does not highlight, but which emerged in our data, is the role gender plays in intersections between genomics and ideas of race, ethnicity, and nation. The fact that discourses and practices of race, ethnicity, and nation are usually gendered and sexualized is well known and has produced an abundant literature.<sup>8</sup> But there is very little that examines how intersections of gender and race/nation operate in genomic research on human diversity (but see Hartigan 2013a; Nash 2012). Yet, as M'charek (2005a: 130) points out, the use of Y chromosome and mitochondrial DNA analysis—common in much of the research we studied—is “a technology for producing sexualized genetic lineages.” This requires a brief explanation.

Some DNA tests (autosomal) estimate ancestral contributions by looking for markers in all an individual's DNA, inherited from his or her myriad

ancestors. In contrast, analysis of mitochondrial DNA (mtDNA, inherited only from the mother) and Y chromosome DNA (inherited only by men and only from the father) focuses on genetic material that has been passed in a single continuous line of descent, either maternal or paternal. These tests look for specific mutations that occurred in an ancient individual and which have been passed on unaltered in unbroken lines of unilineal descent. Thus many Amerindian males share a mutation on the Y chromosome thought to have occurred in a male born in Asia about 15,000–20,000 years ago; among many indigenous populations in the Americas, around 50 percent of men have this mutation (see Genebase Tutorials 2013). Possession of this mutation means a male must be a descendant of the original ancestor and defines him as belonging to the Q haplogroup and as having indigenous ancestry—via this very specific unilineal connection. Belonging to the Q haplogroup indicates indigenous ancestry, but not belonging does not mean absence of indigenous ancestry, as this can be indicated by other genetic markers and by autosomal DNA tests. The point is that unilineal tracing of this kind is a powerful way of tracking prehistoric population migrations: these parts of the genome act well as “molecular clocks,” because they establish a continuous lineage back into the distant past, with estimated mutation rates allowing deductions about the passage of time.

The maternal and paternal lineality of these parts of the genome means that they can effectively stand in for men and women (although men also have mtDNA) and for the sexual relationships between them, as of course DNA is transmitted through sexual reproduction. Their function as molecular clocks also enables narratives to be told about histories of sexual and gender relationships—although sometimes it is more a case of allowing existing historical narratives to be retold as genetic ones.

In our research, this was a consistent theme, as many labs found high levels of Amerindian markers in mtDNA and high levels of European markers in Y chromosome DNA. This was explained in terms of colonial patterns—already established by historians—of European men having sex with indigenous and, especially in Brazil, African women. Thus ideas about the birth of the nation through *mestizaje* were reiterated in a genetic idiom (Wade expands on this in the conclusion to this volume).

### **Mestizaje, Race, and Nation in Latin America**

A major frame for understanding the material generated by our project is the ideologies and practices of nation formation through the gendered and racialized processes of *mestizaje*. “*Mestizaje*,” or “*mestiçagem*” in Brazil, can

be roughly translated as race mixture, and the word “mestizo” (*mestiço* in Portuguese) was typically applied in the sixteenth-century Iberian American colonies to the child of a European (usually male) and an indigenous person (usually female). The term is not purely biological in meaning and also carries connotations of cultural mixture. In colonial Spanish America and Brazil, complex ways of reckoning social status emerged, with Spaniards and Portuguese and other whites at the top of the hierarchy, slaves and black and indigenous people at the bottom, while the middle positions were occupied by a regionally and historically diverse set of intermediate categories, including *mestizo*, *mulato*, *castizo*, *morisco*, *pardo*, *libres de todos los colores* (free people of all colors), and many others. These were very indeterminate categories that served a heterogeneous set of social functions. Parentage was often an important factor influencing one’s place in the hierarchy, but occupation, wealth, and reputation also counted and indeed could shape perceptions of parentage. Categories were highly fluid and contested (Bonil Gómez 2011; Forbes 1993; Garrido 2005; Gotkowitz 2011a; Jaramillo Uribe 1968; Katzew and Deans-Smith 2009; Martínez 2008; Schwaller 2011).<sup>9</sup>

With independence, formal discrimination against the intermediate categories was dismantled, slavery was abolished (although not until 1888 in Brazil), and elites attempted to create liberal societies along European lines. The special institutional status of indigenous people as colonial tributaries was abolished, but in many areas, the *indios* remained isolated and retained some specific rights before the law. During the nineteenth century, in varied ways, elites recognized that their new nations were populated largely by mestizos of diverse kinds and, in the context of new nation-building projects and European theories about race, this was often seen as problematic and an obstacle to progress (Appelbaum, Macpherson, and Roseblatt 2003b; Schwarcz 1993; Skidmore 1974). However, ideas of what Stepan (1991) calls “constructive miscegenation” were already counterbalancing negative evaluations of mixedness and holding out the possibility that *mestizaje* could have positive outcomes. Already by 1861, the Colombian writer and politician José María Samper could write that “this marvellous work of the mixture of races . . . ought to produce a wholly democratic society, a race of republicans, representatives simultaneously of Europe, Africa and Colombia, and which gives the New World its particular character” (1861: 299). That Samper’s travel writings also betrayed a powerful contempt for the mixed people he encountered in the flesh is not unusual: the abstract veneration of mixture was no bar to prejudice against dark-skinned mestizos, steeped in “barbarism” and languishing in the tropical lowlands (Wade 1999: 178).

By the early decades of the twentieth century, the active glorification of *mestizaje* as the basis of the national character, as distinctively Latin American and as at least potentially democratic was evident above all in Mexico and Brazil, where it became part of state discourse about the nation. In Mexico, the idea of *mestizaje* was promoted as the basis of the national character by intellectuals such as José Vasconcelos (1997 [1925]), politician, educator, and author of *La raza cósmica*, a book in which, contrary to dominant European thinking about the inferiority of mixed-race individuals, he argued for the potential superiority of mixed peoples (Basave Benítez 1992; Miller 2004; see also chapter 3, this volume). In Brazil, Gilberto Freyre, author of many books on Brazilian history and culture, also promoted the idea of a mixed tropical society with unique and valuable characteristics, particularly via his influential 1933 text *Casa grande e senzala* (Benzaquen de Araújo 1994; Freyre 1946 [1933]; Maio and Santos 1996, 2010; Miller 2004; Pallares-Burke 2005).

In Brazil especially, but elsewhere too, the idea of mixture was linked to the idea that race and racism were not important features of Latin American societies, claims made from the early decades of the twentieth century, often with a self-conscious look toward the segregated United States (Fry 2000; Marx 1998; Seigel 2009). The core idea was that in societies in which extensive race mixture had blurred clear boundaries of racial categorization, racial stratification and racial identity were not as important as they were in the United States, South Africa, or Europe. This was sometimes phrased as a claim to “racial democracy,” a slogan often associated with Brazil (Guimarães 2007; Twine 1998), although similar sentiments can be found in Colombia. Politician and writer Luis López de Mesa (1970 [1934]: 7) wrote that Colombia was no longer “the old democracy of equal citizenship only for a conquistador minority, but a complete one, without distinctions of class or lineage [*estirpe*].” Meanwhile, in various countries, immigration policies sought to attract Europeans and limit the entry of black people (Graham 1990).

Black and indigenous people, not to mention the working classes, did not necessarily believe formulations of racial democracy and sometimes made their views known through various political and cultural mobilizations (Andrews 1991; Sanders 2004). From the middle of the twentieth century, they were joined by academic critiques that challenged the existence of a racial democracy, particularly in Brazil: evidence mounted that racial discrimination is a significant factor in Brazilian and other Latin American societies (Bastide and Fernandes 1955; Telles 2004; Wade 2010). Academic critiques also began to reread *mestizaje* as an elite ideology that marginalized or erased black and indigenous people, while aiming toward a whiter future (Gall 2004; Gómez

Izquierdo 2005; Rahier 2003; Stutzman 1981). More recent approaches have understood *mestizaje* as being subject to contradictory readings, such that it can be appropriated as a subaltern discourse as well, and may make room for certain constructions of blackness and indigeness rather than simply erasing them (Appelbaum, Macpherson, and Roseblatt 2003b; De la Cadena 2000; Gotkowitz 2011a; Mallon 1996; Wade 2005). There are multiple *mestizajes*, rather than a single ideology or process.

In much of Latin America since about 1990, there have been important shifts toward official multiculturalism, manifest in political and other legal reforms, which have given new recognition and rights to indigenous and Afrodescendant minorities (Sieder 2002; Van Cott 2000; Yashar 2005). This multiculturalism was a significant departure from the attention long paid to indigenous minorities by many nation-states, which was often from the perspective of a paternalist ideology of *indigenismo* (indigenism), which celebrated the indigenous past but also sought to assimilate contemporary indigenous groups (Knight 1990; Ramos 1998). Brazil and Colombia stand out in these reforms, especially in relation to Afrodescendant groups (French 2009; Htun 2004; Restrepo and Rojas 2004; Wade 2002a). The multicultural shift has generally been understood as a significant move away from official ideologies of “the mestizo nation,” especially in countries such as Brazil, Colombia, and Mexico, where the ideology had been strongly developed over the late nineteenth and twentieth centuries. Some scholars have questioned whether the shift is quite so significant, especially as it seems to fit rather neatly with neoliberal agendas, raising questions about whether official multiculturalism really adds up to much in terms of changing racial and ethnic political and economic hierarchies (Escobar 2008; Hale 2005; Rahier 2011; Speed 2005). But there is no doubt that multiculturalism has altered the public landscape of politics, culture, and the national imaginary, with indigenous and Afrodescendant groups having greater visibility, nationally and internationally. This landscape is important as a frame for contemporary genomics, as this volume shows.

### Multiple *Mestizajes* and Taxonomies

The multiplicity of *mestizaje* is also manifest in the different ways in which ideas about nationhood and mixture have developed in different areas of Latin America—a diversity that may transect the nation itself. For example, in Mexico, the key process of mixture is considered to have taken place between Europeans and Native Americans (now estimated to be about 10 percent of the population, widely spread across the national territory), resulting in the dominance of a dualistic taxonomy that divides indigenous and mestizo.<sup>10</sup> The

indigenous category is divided by ethnic identities and labels, such as Maya or Zapotec. Although Africans were present in colonial New Spain in significant numbers, they were marginalized in representations of the republic (Aguirre Beltrán 1946). Recent shifts toward multiculturalism have focused on rights for indigenous groups, but there has been some attention to the “third [African] root” of the nation (Hoffmann 2006). Afrodescendant people tend to be referred to as *negros* or *morenos* (browns). Although most people would identify simply as Mexicans, it is taken for granted that this is more or less synonymous with *mestizo*—to the extent that Afrodescendants there have recently been labeled *Afromestizos*.

In Brazil, the role of blackness in ideologies of mixture is greater.<sup>11</sup> Cultural icons, such as samba and carnival, which are associated strongly with Afro-Brazilian roots, became national icons decades ago. African-influenced religious practices, such as *candomblé*, are also part of urban popular culture. Indigenous people are about 0.5 percent of the national total, but the idea and image of the *índio* is nevertheless strong and figures importantly in ideologies of *mestiçagem*, although the image of the *índio* is associated with Amazonia and thus seen as distant and exotic. From the 1930s, the image of Brazil as a mixed, tropical society became part of the official representation of the country. Still, it has been one of the few Latin American countries to include a “color” (or more recently a “color/race”) question in its census (Morning 2008); partly as a result, public discourse referring to color is more common than in Mexico or Colombia. In the 2010 census, 48 percent of people identified as *branco* (white), 43 percent as *pardo* (brown), and 8 percent as *preto* (black), with the remainder as *amarelo* (yellow) and *indígena*. While *pardo* is the bureaucratic label for mixed people, the term “*mestiço*” may be used in everyday parlance. Ideas about mixture vary within Brazil: the far south, for example, is very “white,” while the northeast is rather “black.”

Brazilian social taxonomies are particularly heterogeneous. Classificatory systems based on race, color, and descent coexist, and the same category can be part of multiple systems (Fry 2000; R. V. Santos et al. 2009). There is a tension between bipolar principles of classification—white versus nonwhite—and systems with multiple intermediate categories. Telles (2004: 87) identifies three overlapping systems: the census categories, which are in popular use; everyday categories, which make extensive use of the term “*moreno*”; and state and black social movement practices, which tend to oppose white and black. The latter are related to multiculturalist reforms, which have extended rights for indigenous groups and implemented affirmative action programs in the

form of racial quotas in university admissions for self-identified black students (which may include pretos and pardos).

In ideologies of Colombian nationality, blackness is more important than in Mexico, but less so than in Brazil.<sup>12</sup> There is a small indigenous population (3.4 percent), but, as in Brazil, it figures large in ideas about the nation and its history—and in multiculturalist reforms. Indigenous groups are spread across various parts of the country, not concentrated only in the Amazon region. The idea of internal difference is a powerful trope in images of the Colombian nation, which is often talked of as a “country of regions,” each with a supposedly particular identity. Whiteness and mestizness are often associated with each other and located stereotypically in the highlands, whereas blackness is stereotypically associated with the Pacific and Caribbean lowland coastal regions; indigenosity is seen as both highland (Andean) and lowland (Amazonian) and is stereotyped as rural. In contrast to Brazil, mestizos are more likely to be assimilated to whiteness than to blackness.

These multiple *mestizajes* and taxonomic practices are important. While all three countries share a great deal in terms of underlying ideologies of mixture as the foundational substance of the national body, there is no single discourse or process here. The way genomics operates with racial and national categories reflects this, although not in a simple methodologically nationalist way; there is no straightforward homology between nation and scientific practice.

### The Concept of Race in Latin America

In ideologies and practices of *mestizaje*, the term and concept “race” have been ambiguous in these three countries. In the early decades of the twentieth century, the term was widely used by Latin American writers to refer to entities as varied as *la raza argentina*; *la raza blanca, negra, and india*; and *la raza iberoamericana* (Graham 1990). It was also used more generically, for example, in the book *Los problemas de la raza en Colombia* (Jiménez López et al. 1920). The range of reference of the term indicates its ill-defined character, but the concept behind such usages—which date back to the nineteenth century—was similar to the widely accepted understanding of race in contemporary racial science and eugenics, as a natural-cultural category. Faced with highly mixed populations, Latin American thinkers tended to avoid the more biologically determinist approach to race of some Anglo-Saxon theorists, which condemned mixed peoples to inferiority, and instead took a more eclectic approach, inflected by Lamarckian views, which left greater room for improvement through social hygiene (Restrepo 2007; Schwarcz 1993; Stepan 1991).

This approach fed into an early tendency to avoid the term “race”—even if racialized thinking was arguably still present. While scholars have noted a general postwar trend in Europe and the United States toward a “neoracism” or “cultural racism,” in which an explicit discourse of biology recedes, to be replaced by a discourse about culture (Balibar 1991; Stolcke 1995), it is important to recognize that, in general, culture and biology—or culture and nature—are always intertwined in racial thinking, so it is misleading to think in terms of a simple temporal transition from one to the other (Gotkowitz 2011b; Wade 2002b). Still, there are changes in emphases, and in Latin America a shift toward a more explicit reference to culture occurred earlier than in Europe or the United States. In Mexico in the 1920s and 1930s, eugenicists often referred to mestizos without explicit reference to race or racial groups: the “unraced subject or the generic mestizo” was discussed (Stern 2009: 163); an explicit discourse of race was absent, even though it was evoked by the very term “mestizo,” which fused ideas of racial and cultural mixture (Hartigan 2013b). A culturalist approach to race was evident in Peru from the 1920s, in references to the “soul” or “spirit” of a given group (De la Cadena 2000: 19, 140)—as was also the case in Colombia, alongside use of the word “raza” (Restrepo 2007: 53). In Brazil too, Gilberto Freyre, strongly influenced by Franz Boas, separated race from culture, emphasized the role of the environment in shaping people, and downplayed “purely genetic” (i.e., racial) effects (Freyre 1946 [1933]: 18; see also Pallares-Burke 2005; Benzaquen de Araújo 1994; Maio 1999). Although it was not until after World War II that the explicit terminology of race was “largely abandoned” (Appelbaum, Macpherson, and Rosemblatt 2003a: 8)—at least in public political discourse and even then with certain exceptions in Brazil—important tendencies in that direction date from some decades earlier. This was allied to the ideas, noted above, that race and racism were not significant social issues.

Challenges to ideologies of racial democracy were made from early on and recently have gained ground in countries such as Brazil and Colombia, where the state has admitted that racism is an issue. This has led to an increase in public debates about race and racial disparities. In Brazil the census question about color changed in 1991 to one asking about color or race, while in 2010 Congress passed a statute on racial equality (after ten years of debate). Debates about public health and educational policies have openly talked about race as a factor influencing health, educational, and social inequalities and have targeted the black population as in need of special attention (Fry 2005b; Guimarães 1997; Maio and Monteiro 2005; Maio and Santos 2010). In Colombia, the 2005 census, although it used the word “ethnicity” and did not mention

race, effectively lumped together all “Afro-Colombians” and all “indígenas”: the statistics it generated have been used to address issues of “race and rights” (Rodríguez Garavito, Alfonso Sierra, and Cavalier Adarve 2009).

Despite its greater public presence in recent years, the use of the concept of race to talk about identity and social differences can still be contentious (Restrepo 2012: 181). In Latin America, saying that one is doing research on something called race—whether in relation to social mobility or genomics—may produce denials from a range of people that race is an appropriate object of attention. In Mexico, differences are rarely discussed in terms of race, whether in popular or political discourse, while ethnicity is seen as a term applying mainly to indigenous groups and usually combining notions of linguistic and cultural difference with economic poverty. In Brazil, the heated debates about the appropriateness of race-based affirmative actions in health policy and university admission are phrased not only in terms of whether they contravene principles of meritocracy, but whether they derive from an imposition of foreign racial categories (such as U.S. ones) and also threaten to strengthen racial identities and differences seen as having traditionally played a minor role: “It is not just social policy that is at stake, but the country’s understanding and portrayal of itself” (Htun 2004: 61).<sup>13</sup> On the other hand, in Colombia, some recent *vox populi* journalism showed people in the streets of Bogotá confidently asserting that different races existed, in terms of biological differences, and in many cases claiming to belong to one of them.<sup>14</sup> In short, the term and the concept are both present and absent, invoked and denied, at the same time. Although multiculturalism has given the term and the concept greater currency, above all in Brazil, race still provokes ambivalent reactions. This is an important context for understanding the way racialized categories circulate in genomic science practices in Latin America.

### Gender and Mestizaje

Mestizaje is a sexualized and gendered practice and ideology: it refers to sexual relations and reproduction between men and women perceived as belonging to different races, colors, or ethnicities (however those words are understood in the Latin American contexts). As noted earlier, genomic research often finds evidence in today’s populations that reflects early colonial matings between European men and indigenous or African women, but it is important to grasp some of the cultural meanings that attach to this encounter and its historical developments.<sup>15</sup>

Relations of power obviously structured early sexual relationships, whether these were consensual, constrained by circumstances, or forced (i.e., rape).

Although white men initially had relationships with indigenous and African slave women, as time went on they more likely had sex with the growing population of free black and the dark-skinned, plebeian mestizo women, although where slavery persisted, slave women also would have been present. There is no doubt that sex ratios were skewed among Europeans, early on, but European women gradually formed an important part of elite society. White men protected the (sexual) honor of wives, sisters, and daughters, and the legitimacy of their offspring, while also having relationships and children with lower-class dark-skinned women, deemed to be without honor—being mestizo was considered tantamount to being illegitimate in colonial Iberian America (Johnson and Lipsett-Rivera 1998; Stolcke 1994). Male honor was not besmirched by these relationships. This so-called dual marriage system was common across Latin America and the Caribbean and is found today in patterns of men having official households alongside unofficial families *en la calle* (in the street) (Smith 1997).

For darker-skinned plebeian women, having a relationship with a richer, whiter man could present possibilities of upward mobility. For darker-skinned plebeian men, such hypergamic relationships were much less likely, but still occurred, especially if such men became upwardly mobile first. Interracial sexual relationships were, and still are today, charged with meanings lent by these hierarchies of power and wealth (Caulfield 2000). In Mexico, writer Octavio Paz (1950) has pondered how the Mexican nation was founded on an original act of sexual violence or domination (*la chingada*), symbolized by the encounter between conquistador Hernán Cortés and the *india* La Malinche. The latter is seen both as traitor to her indigenous roots and heroic mother of the mestizo nation. In Brazil, the black man who “marries up” in color terms is generally assumed to be obeying motives of social climbing (Moutinho 2004).

Genomic research that highlights Amerindian markers in mtDNA and European markers in Y chromosome DNA and infers patterns of “asymmetrical mating” (Bortolini et al. 1999) or “sex-biased genetic blending” (Gonçalves et al. 2007) evokes this history and its cultural baggage, yet at the same time tends to telescope the history and gloss over the hierarchical meanings still in play today. This point is discussed in more detail in the conclusion.

### Science Studies

As well as being a contribution to research on race, nation, and gender in Latin America, our book is an intervention in the field of science studies: our research involved lab-based ethnographies, interviews with scientists, analysis

of their published work, and attention to how their work circulated beyond the institutional networks of genetic science, into the public sphere. We were interested in how ideas about race, ethnicity, nation, and gender entered into the work of genetics laboratories, which raised questions about the relationships between science and society in the production of knowledge.

For social studies of science, it is a commonplace that the social and scientific registers are not separate and that science is a social and cultural practice, albeit one of a particular kind (Fausto-Sterling 2000; Haraway 1989; Jasanoff 2004b; Latour 1993, 2005; Latour and Woolgar 1986). Latour (2005) argues that it is wrong to conceive of society or the social as a separate sphere or context that shapes or influences science: chains of associations link things (objects, people, words), which are not compartmentalized into such spheres, creating natural-social hybrids. Yet the science laboratory and scientific methodologies are specifically set up to exclude the influence of social and cultural assumptions that are perceived as potentially distorting the reliability of results; and scientists (and many nonscientists) generally have confidence that their methods can in principle lead to reliable and veracious findings. Specific findings may prove to be wrong, because of faulty assumptions, poor practice, or inadequate techniques, but science itself is assumed by scientists (and many nonscientists) to have the self-critical power to uncover such failures and achieve more truthful results. Scientists often recognize that the categories they use to organize their work, the assumptions they start with, may be derived from commonsensical understandings from outside the laboratory. But these are generally taken as a pragmatic starting point, a way into the nebulous world of cause and effect.<sup>16</sup> If different categories and assumptions can be shown to lead to a more useful result, scientists are likely to relinquish the old ones. Scientists may also explicitly hold to particular moral positions and political objectives that guide the overall direction of their work—for example, anti-racism, social justice, equality of representation, or ecological sustainability (Bliss 2011; Bustamante, De La Vega, and Burchard 2011; Fullwiley 2008). But such positions are not held to shape the actual results that emerge from the practice of science in the laboratory. In that sense, nature and society are held apart by scientists.

Latour (1993) identifies this as a characteristic of “modernity”—that nature and society are separated by acts of “purification,” while such separations are continuously dismantled by the actual practice of constructing associations and networks that assemble together things supposedly divided between nature and society. This does not mean that science simply produces false findings—the unveiling of processes of assembling is not a “debunking”

(1993: 43) or showing that things scientists call facts are merely social fabrications (Latour 2004). Rather it means that science should be seen as a process of the revealing of truths, through the labor of putting together complex assemblages of people, money, objects, facts, and words—things that are not separable into discrete categories of natural and social. Such assembling can be disputed among scientists, indicating that there may be more than one way to reveal truth and that some truths get more airtime than others; some assemblages may become stable, standardized, and taken for granted.

Social studies of science thus aim to show that the purified separations of nature and society and the teleologies of the progressive overcoming of bias and error are not so simple; that the detailed practice of science is continuously mixing nature and culture into natural-cultural combinations; that social and scientific things are combined, by the labor of diverse human actors and the affordances of diverse nonhuman things, into material-semiotic assemblages that cohere (or not) depending on how well and convincingly they speak to different audiences and do useful work for them (Latour 2005; Law 2008; Rardon 2008). This is not a simple matter of social categories—such as those of race, population, or region—penetrating the laboratory and shaping scientific practice, because the point is that these categories are already natural-cultural combinations, which have themselves been formed historically in a complex set of moving associations between scientists (natural historians, physical anthropologists, demographers, etc.) and politicians, engineers, administrators, writers, entrepreneurs, and all kinds of ordinary people. Social categories enter the laboratory, sure enough, but not as an extraneous social contaminant; they are already part and parcel of the assemblages that genetic scientists are putting together. The idiom of coproduction captures this insofar as it avoids giving primacy to either the social or the science and instead sees them as mutually constitutive, even as a boundary between them is continually reinscribed (Jasanoff 2004a: 21).

One way of showing this process of mixing and assemblage is to exploit the differences within science itself—something the comparative scope of our project is well suited to doing. When everything is stable and agreed upon, it becomes harder to see how things could have been different. The way natural-social categories enter into the practice of science can be revealed by demonstrating that a given scientific version of events could have been otherwise; and this can be achieved by showing that scientists disagree or, even more so, use the same or similar data to arrive at different conclusions. This internal variation is expected within—indeed is integral to—science: it can be seen as part of the progressive teleology by which truth, in time, triumphs over falsity. But

social studies of science can also explore this variation to reveal the way natural categories are also natural-social assemblages, which may operate outside the laboratory too.

For example, looping back to the previous discussion on how race works in genomics, we can look again at the notion of population. There is debate in the study of human genetic diversity about whether to sample existing populations, which are usually defined by cultural criteria, such as language, identity, residence, history, and so on—or biogeographical ancestry, as we have seen—or whether instead to spread a homogeneous grid across a given geography and sample randomly within it, as might be done with, say, fruit flies (Nash 2012b; Pálsson 2007: ch. 7; Reardon 2008: 309; Serre and Pääbo 2004). Both methods can produce a picture of how human genetic diversity varies across space. In one sense, this is a technical issue about which method best represents the variation that might exist and any structuring of it. But social studies of science show that complex natural-cultural ideas about populations are deeply embedded in the practice of science (Fujimura and Rajagopalan 2011; M'charek 2005a; Reardon 2005). Populations are considered to have evolved and reproduced within a particular geographical niche. This is reflected in the fact that genetic research on diversity often samples only individuals whose grandparents were born in the population locality, thus effectively imposing a definition of what the population is. As well, specific populations, defined by social criteria, are generally accessed for scientific purposes via gatekeepers of various kinds, including local doctors, anthropologists, or community leaders, who can negotiate collective or individual agreements that samples may be taken (Reardon 2008). These practical but also profoundly ethical issues are based on fundamental notions of human social organization and cultural diversity, notions that do not apply to fruit flies. The grid method is not as easy to work with, as it does not assume particular social units that can be defined in terms of their internal coherence and their gatekeepers.

Starting with populations and producing genetic profiles of them tends to reproduce a model of more or less bounded populations (often the ones that you started with, thus creating an overlap between socially and genetically defined populations). Starting with a grid tends to produce gradients or clines of gradual variation and reduces the impression of located genetic populations; the absence of boundaries suggests the continuous movement and biological mixture of people between populations.

Thus the natural-cultural concept of population—a Latourian hybrid if ever there was one, circulating historically through government, administration, animal breeding, statistics, demography, genetics, and so on—shapes project

design and sampling procedures, which in turn produce results that tend to reaffirm the concept of population, now in a genetic idiom. This might look unexceptional, even banal, except that a different point of departure—the grid—produces different results. One might be tempted to see the grid starting point as acultural: it is based on a seemingly purely scientific notion of random samples. But it is also a natural-cultural category, based on ideas about human homogeneity: it starts with a concept of humans as not segmented into groups, but as mobile and interchangeable, constantly moving and exchanging things, such as ideas, things, gametes.

In short, population is a stable device in human diversity studies; it is widely used and provides entry points and affordances that make it practical and powerful. It is something of an “immutable mobile” (Latour 1987) or a “boundary object” (Bowker and Star 1999: 296; Star and Griesemer 1989): it works between different scientific communities—social scientists, doctors, geneticists—and elicits common understandings, while also performing specific roles for each community and producing different objects—a located cultural grouping, a demographic set, a category of patients or potential patients, a genetically distinct group—which may, however, be translated into each other.

Diversity in scientific practice helps reveal the way natural-cultural categories such as population, race, ethnic group, nation, or region operate in the practice and productions of science and how science reproduces but also changes them. Studies of genetic science indicate how categories such as Mexican, Mexican American, African American, Puerto Rican, European, African, Dutch, and Turkish act as starting points for sampling human diversity and pursuing projects linked to the search for disease-causing genetic variants or forensic DNA matching (see, e.g., Fullwiley 2007a, 2008; M'charek 2005a; Montoya 2011). In the process, these categories, which are already natural-cultural or biosocial constructs, often become increasingly biologized and geneticized, a process that may then convert disparities of health to biological differences and pathologize certain ethnoracially defined populations (Montoya 2011: 185; see also Duster 2003a, 2006a; Fausto-Sterling 2004; Kahn 2005). But the same studies also reveal differences and controversies in this process. Some scientists may reject ethnic labeling of their samples but encounter resistance to this from scientific journal editors (Montoya 2011: 166–169); some geneticists may want to establish a link between African ancestry and propensity to suffer from asthma, but have to tussle with their own data when the data contest such a conclusion (Fullwiley 2008); forensic DNA testing can be challenged in court on the grounds that it is using ethnically biased samples to establish the probability of a link between a suspect and crime scene DNA

(M'charek 2000, 2005a: ch. 2). Scientific practice does not therefore simply reproduce existing categories in an automatic fashion; there is unevenness and contestation, which helps reveal how the categories are working in the laboratories, acting and being acted upon.

Diversity is something that arose out of our focus on specific laboratories and particular genomic projects. This highlighted differences in agendas and approaches, even if many geneticists shared some goals (such as seeking out genetic variants underlying complex disorders). Comparative laboratory ethnography is not very common in science studies (although see, e.g., M'charek 2005a; Fullwiley 2007a, 2008): our project suggests it can be a useful way into seeing how certain categories get assembled in multiple ways in localized sets of practices, which form part of extensive transnational networks.

The focus on diversity also sheds light on questions of power: some assemblages and sets of categories achieve dominance over others. If a Colombian research team invents a set of ethnic or ancestral categories for classifying its samples, but ends up using simplified and standardized ones when submitting for publication in the United States, without, at first, really questioning why, this is because the standard categories have a taken-for-granted status (see chapter 5). If an overriding focus on the mestizo emerges out of current genomic research in Colombia, compared to earlier interests in Afro-Colombian and Amerindian populations, this may well be related to a recentering of the image of mixedness in the context of multiculturalism's focus on black and indigenous minorities (see conclusion).

### Comparative Approaches

The business of isolating units of comparison tends to gloss over interconnections and interactions between the units that might locate them as part of a common network rather than contrasting instances (Gingrich and Fox 2002). Recent work in the history of science has emphasized the need for “connected histories”—in contradistinction to comparative histories—which argues for connecting stories between empires and geographical regions” (Safier 2010: 138). Following critiques of “methodological nationalism” (Wimmer and Glick Schiller 2002), which challenge the taken-for-granted status of the nation as the unit of study and comparison, there has been growing attention to transnational flows, showing how what may appear as a self-contained cultural context has been formed through transnational exchanges (Matory 2006; Seigel 2009). In South America, for example, “creole elites forged nationalist accounts of the land and its historical remains.” But “the political movements

of nationalist science were in fact transnational. . . . Discourses of nationalist science crossed different states in South America” (Sivasundaram 2010: 156).

Our project makes use of a comparative framework by focusing on three nation-states, yet we try to avoid methodological nationalism by emphasizing the transnational flows of scientific knowledge that connect the three nations among themselves and with international genomic science, bringing scientists across Latin America, North America, Europe, and Asia into collaboration. We also show how some Latin American scientists evince postcolonial concerns about their position within hierarchies of international genomic science. And we highlight the internal diversity of science within each nation.

It is important to recall that we chose a small number of labs in each country. In all three countries, and especially in such a large one as Brazil, research on human genetic diversity was carried out in many labs and covered contemporary populations as well as ancient DNA, with questions arising from the fields of evolutionary genetics, demographic history, anthropological genetics, and medical genomics. The labs we worked with were chosen strategically to fit with our particular interest in issues of race, ethnicity, and nation. Our ethnographic focus meant more time was spent on one or two labs or projects than on others. Thus we necessarily have to be cautious in generalizing about the state of genomics in general in a given country, above all when we found different approaches even within the small number of labs that we observed. In that sense, we were alert to the problems of methodological nationalism, which might have drawn us to make broad national comparisons (see conclusion). On the other hand, it was tempting to see national contexts as providing an important frame for understanding specific labs and projects. This could not be ignored, of course, yet it would be easy to overstate the significance of, say, the debates about race-based affirmative action in Brazil as setting the context for genomic human diversity research in general. These debates were undoubtedly a factor in some research, but the transnational world of genomic science formed a rather different context, which also powerfully defined the agendas by which geneticists worked.

### Structure of the Book

The book is divided into two parts. The first has three chapters that provide historical and contextual background to the study of human biological and, within that, genetic diversity in each country. In chapter 1, Santos, Kent, and Gaspar Neto give an analysis of the trajectory of studies in the fields of physical

anthropology and population genetics on race, miscegenation, and human biological diversity in Brazil from the end of the nineteenth century to the present. The argument is that, although there have been profound theoretical and methodological transformations in the past 150 years from the point of view of scientific thought, the question of miscegenation has been a key driving point in the study of the biological diversity of the Brazilian population.

Chapter 2, by Restrepo, Schwartz-Marín, and Cárdenas, analyzes the historical background to studies of human diversity and racial difference in Colombia, highlighting the changing meanings attached to constructs such as “black” and the way the country has been seen as strongly regionally differentiated. Particular attention is paid to the Expedición Humana, an early (1988–1994) attempt to map, in genetic and cultural terms, the diversity of Colombia, along lines rather similar to nineteenth-century expeditions.

The Mexican team—López Beltrán, García Deister, and Rios Sandoval—focuses in chapter 3 on the Mexican National Institute of Genomic Medicine (INMEGEN), its emergence, and early initiatives to sample different populations in the country and create a map of Mexican genomic diversity. This is put into the context of concerns with the mestizo as a scientific object, which go back to the nineteenth century and traverse admixture studies done in the twentieth century by such as León de Garay and Rubén Lisker. The way INMEGEN presents its public face is then analyzed before tracing recent changes in the institute’s priorities, after the publication of the milestone article “Analysis of Genomic Diversity in Mexican Mestizo Populations” (Silva-Zolezzi et al. 2009).

Part II contains three case studies drawn from the lab ethnographies and interviews with scientists carried out mainly by the project’s three postdoctoral researchers, Kent, Olarte Sierra, and García Deister, in collaboration with three project research assistants, Gaspar Neto, Díaz del Castillo, and Rios Sandoval. Each study gives a detailed and focused insight into scientific practice in this field of genomic research. In chapter 4, Kent and Santos look at a research project, which started with the possibility of a genetic continuity between the extinct Charrua indigenous people and the contemporary Gaúcho population of the state of Rio Grande do Sul, a group seen as distinct both culturally and, it was hypothesized, genetically. The authors argue that, throughout the different phases of the research process, there was significant continuity in the central idea of a genetic association between the Charrua and the Gaúchos. Over time, this idea took on different incarnations and was affirmed with differing levels of certainty. This chapter reconstructs the road traveled by this

central idea from initial hypothesis to final scientific conclusion, showing how the distinctiveness of the Gaúchos and the idea of genetic continuity appear through the data and their interpretation.

Olarte Sierra and Díaz del Castillo H.'s case study (chapter 5) concerns a Bogotá university genetics laboratory that undertook a project in the north-east of Colombia. The authors observed that, in this project, the population categories used to classify samples resulted from a highly dynamic negotiating process, in which the struggle to account for diversity and to reflect on the consequences of the scientists' own practice was pervasive. The scientists produced innovative classifications of populations, which differed from those commonly used in genetics research (typically the categories of mestizo, Amerindian, and Afro-Colombian). However, there came a point at which their discourses and practices were flattened and simplified. The categories not only became discrete and static but also returned to their typical form in order to interact with national and international peers. This process was then the subject of self-reflexive debate among the geneticists, who became more intent on reestablishing their own categories. This chapter highlights the often contradictory processes of innovation and transnational standardization.

In chapter 6, García Deister explores the laboratory life of the Mexican mestizo. Her chapter deals with the inner workings of the INMEGEN project to map the genomic diversity of Mexicans. She traces the voyage of the Mexican mestizo from the public domain, through the genetics labs, to bioinformatic databases. García Deister focuses on the transformations by which the Mexican mestizo, who started as a blood sample, is materially reconfigured into bytes (information in a repository or in a cloud). Neither the blood nor the DNA nor the data sets are proxies for the Mexican mestizo; rather, the mestizo is present in each and every configuration in a multiplicity of ways. The laboratory life of the Mexican mestizo extends beyond laboratory walls and into society. Once inhabiting the information cloud, the mestizo takes part in negotiations of belonging that may blur national boundaries and encourage broader ethnic affiliations, therefore debilitating the protective screen of genomic patrimony.

Part II ends with a synthetic chapter that draws together material from the three case studies and other primary and secondary data. Chapter 7 addresses the difficult question of how categories of human diversity operate in the practice of genomic science in the laboratory, from agenda setting through interpretation and publication of results. The chapter explores the way natural-social categories enter into the practice of science by demonstrating that a given scientific version of events could have been otherwise; and this can be

achieved by showing that scientists disagree or, even more so, use the same or similar data to arrive at different conclusions. The focus here is quite specific, exploring the research process in the laboratory, from setting research agendas through sampling procedures to the interpretation of data.

The conclusion reflects on the big questions addressed by our research, assessing the extent to which categories of race, ethnicity, nation, region, and gender are challenged, reproduced, and transformed by the kind of genomic research we have explored. Wade addresses how genomic research relates to changing regimes of the imagination and governance of cultural diversity in these countries, including recent multiculturalist regimes. He assesses the implications of the imagined genetic communities that emerge from the genomic research for notions of citizenship and inclusion or exclusion. Finally he returns to the question of comparison to reflect on our own practice, drawing out the major findings from our research and relating them to ongoing debates in the field.

## Notes

- 1 A decolonial view from the south does take racism as fundamental to colonialism and modernity (Restrepo and Rojas 2010), but the analysis of race need not take North American experiences as paradigmatic.
- 2 The etymology of the word is contested, but it probably derives from terms related to horse breeding (Contini 1959; Liberman 2009; López Beltrán 2004: 182).
- 3 Noncoding DNA (sometimes known as “junk DNA”) is DNA that does not directly encode for proteins and thus was thought to have no direct influence on the organism’s phenotype. A large proportion of an organism’s total genome is made up of noncoding DNA. Recent research indicates that this supposedly junk DNA may have complex indirect but vital roles to play in gene expression (Skipper, Dhand, and Campbell 2012).
- 4 In addition to the sources cited, see Franklin (2001), Goodman, Heath, and Lindee (2003), Pálsson (2007), Strathern (1992), and Wade (2007a).
- 5 Examples include the use of DNA testing to allow entry only to genetically authentic children of immigrants and genetic testing to identify children of disappeared parents in Argentina. See the website DNA and Immigration (<http://www.immigene.eu/>) and Penchaszadeh (2011).
- 6 Montoya, for example, argues that biology and genetics in particular are “reductive and deterministic” and that racial determinism fits right into these patterns (Montoya 2011: 28).
- 7 On geneticization, see the literature cited above and in note 4. See also Latour (1993, 2005).
- 8 For a discussion and references, see Nagel (2003), Wade (2009).

- 9 We are grateful to Joanne Rappaport for directing us to some of these references.
- 10 On Mexico, see Basave Benítez (1992), Bonfil Batalla (1996), De la Peña (2006), Hoffmann (2006), Hoffmann and Rodríguez (2007), Lomnitz-Adler (1992), and Mallon (1995).
- 11 On Brazil, see French (2009), Fry (2000, 2005a), Guimarães (1999), Maio and Santos (1996, 2010), Ramos (1998), and Telles (2004).
- 12 On Colombia, see Gros (1991), Leal León (2010), Mosquera and León Díaz (2010), Rappaport (2005), Restrepo and Rojas (2004), Uribe and Restrepo (1997), and Wade (1993, 2002a).
- 13 See Maio and Santos (2005), and the debates in the same issue of the journal *Horizontes Antropológicos*. See also Fry (2000), Guimarães (1999), Maio and Santos (2010), and Telles (2004).
- 14 A Colombian state TV channel, Canal Capital, aired these programs about race and racism in Colombia on 14 February 2011 (see *Procesocensales* 2011).
- 15 There is a large literature on this topic. For a guide, see Wade (2009). See also Martínez-Alier [Stolcke] (1989 [1974]).
- 16 As Montoya says of the U.S. geneticists he studied who use ethnically labeled population categories, these are starting points for exploring biological differences: “theirs is a pragmatic claim” (Montoya 2011: 162).