1.3

Anthropology of Biomedicine and Bioscience

Sarah Franklin

Two key transitions have led to the emergence and rapid growth of an anthropology of the biosciences and biomedicine in the latter half of the twentieth century. One is a change in the relationship between the disciplines of anthropology and biology, so that, as part of a broad post-war redefinition of anthropology's engagement with the 'culture' concept, biology is no longer seen as prior to culture, but as a domain of phenomena that is shaped by historical and cultural forces, such as religion and politics, as well as social identities, including gender, class, ethnicity and nationality. The life sciences have increasingly come to be seen as culturally specific institutions, and 'biology' as a cultural product. This is manifest in the terms 'biomedicine' and 'bioscience', which refer to the manipulation of life as a means of both understanding it, and remaking it (Franklin and Lock 2003, Rabinow 1996).

These terms also demonstrate the second significant major transition, which has occurred *within* the biological sciences, also in the post-war period, overturning previous certainties about what biology 'is', or how humans 'are' biological. This shift has variously been described as the molecularization, re-engineering, or redesign of life itself, and is associated with the genetic revolution, cloning, organ transplantation, assisted conception, stem cells, synthetic biology, and other areas of 'high tech' biomedicine and bioscience (Keller 2000, Landecker 2006). In sum, bioscience and biomedicine refer to significant post-war changes in how life is understood, and new mechanisms through which it can be produced and controlled, which are seen to have implications for understandings of both biology and culture (Gibbon and Novas 2008, Kaufman and Morgan 2005).

These changes are also linked to a growing concern with the social, ethical and political implications of increasing biological control over life itself (Good 2001, Rose 2006). For some scientists, such as the British biologist Ian Wilmut, creator of Dolly the sheep, 'the age of biological control' provides a straightforward intellectual, political and ethical imperative to establish the limits biology 'itself' no longer provides. He writes,

> As the decades and centuries pass, the science of cloning and the technologies that may flow from it will affect all aspects of human life – the things that people can do, the way we live, even, if we choose, the kinds of people we are. Those future technologies will offer our successors a degree of control over life's processes that will come effectively to seem absolute. Until the birth of Dolly, scientists were apt to declare that this or that procedure would be "biologically impossible" – but now that expression, biologically impossible, seems to have lost all meaning. In the twenty-first century and beyond, human ambition will be bound only by the laws of physics, the rules of logic, and our descendants' own sense of right and wrong. (Wilmut et al. 2000: 5)

For the anthropologist, such a statement presents complex challenges. We must, for example, ask not only what kinds of cultures (e.g. professional cultures, national cultures, historical cultures) shape biological innovation, and the organization of research priorities in the life sciences, but also

the reverse: How are non-scientific cultural contexts shaped by scientific ideas, applications, assumptions and aspirations? This dilemma is epitomized by the very idea of a 'scientific fact'. Since we know scientific facts do not emerge out of nowhere, fully formed, entering our stratosphere like meteors from another planet, but instead are carefully hewn and refined through a continual historical process of human labour, we cannot accord them absolute, permanent, objective status as asocial or precultural 'facts' that are simply 'true', or even necessarily here to stay (Fleck 1979, Latour 1993, Latour and Woolgar 1986). Science is an essentially sceptical practice. All of the most important contemporary scientific facts, equations, terms, experimental procedures, laws and principles have withstood relentless questioning and continuous interrogation (Kuhn 1970). This means that scientific facts tell us 'who we really are' in two rather different senses: on the one hand, they convey information such as how many chromosomes are present in a normal human genome; on the other hand, even such a basic empirical 'fact' reveals that we have come to understand ourselves through the language of the genes. This chapter is organized to show how the anthropology of bioscience and biomedicine emerges both as a result of, and in response to, the difference between these two different ways of interpreting scientific facts.

Like other branches of anthropology, the anthropology of bioscience and biomedicine, which studies the cultural significance of changes in the modern life sciences, can be unsettling because it challenges taken-for-granted ideas not only about who we are but also about how we came to understand ourselves through some categories rather than others. In the following sections of this chapter, this contrast is explored through five sequential frames of reference. First we examine early ideas about reproduction in anthropology, asking how these 'conception models' shaped the kinds of research undertaken by anthropologists in the late nineteenth and early twentieth centuries, and, in turn, how these ideas developed and changed. In the following section, we turn to the late-twentieth century anthropological study of new reproductive technologies and the work of Marilyn Strathern, to ask how older anthropological questions about reproduction and biology were reworked in the context of bioscience and biomedicine, and what this reveals about reflexivity as a modern form of anthropological comparison. In the third section, we consider the work of Paul Rabinow and Donna Haraway to examine how some of the broad changes giving rise to what some have called 'the biosociety' have been conceptualized as a change in the relationship of nature to culture. This is followed by an ethnographic example concerning kinship, drawn from the work of Rayna Rapp, illustrating in finer detail how 'biosociality' is experienced in the context of prenatal genetic testing. Finally, we conclude with an overview of current topics in the anthropology of bioscience and biomedicine, including organ donation, stem cells, and cloning, demonstrating how the study of biomedicine and bioscience continues to generate anthropological innovation.

EARLY REPRODUCTIVE MODELS

The discipline of anthropology was 'born' in the late nineteenth century out of many of the same questions that are being asked today about the relationship between human biology and the origin of social structures such as the family and kinship (Coward 1983, Franklin 1997). For the sake of historical perspective, it is worth reviewing briefly some of the ways in which 'the biological facts of human reproduction' were seen to determine human social organization, as well as how these views were challenged by the view that human biology is highly culturally plastic, or malleable. Much of this early contestation and debate was focused on questions of how to interpret the social or cultural significance of the natural facts of biological reproduction – also known as 'the facts of life'.

Following an essentially Rousseauian model of human emergence out of a state of nature, through which 'man' both retained, but also separated himself from, his original natural condition, many early anthropologists looked to so-called primitive societies for answers to questions such as how the human family emerged, whether marriage is universal, and to what extent social structure is determined by the need to satisfy certain fundamental biological needs? For many late nineteenth century thinkers, a key to the puzzle of how the 'natural facts' of sexual reproduction formed the base, or prehistory, to the early human family was the question of knowledge of physical paternity. Frederich Engels (1884 [1986]) and Lewis Henry (1887), for example, postulated that the origin of private property (as well as the family and the state) arose as a logical progressive evolution from the 'discovery' of physical paternity: e.g. the male role in the generation of offspring. Such theories were criticized, however, for proposing a narrow, unilinear path of human development based more on speculation than close observation. The early twentieth-century anthropologist Bronislaw Malinowski, one of the founders of the British school of structural functionalism, was among many who argued for a

less deterministic model of human social organization and a more plastic view of biology. He used the case of the Trobriand Islanders to argue that there was no direct correlation between either knowledge or ignorance of paternity and social structure. Since the Trobrianders claimed to be ignorant of physical paternity, but had complex and sophisticated societies, Malinowski claimed this correlation was false, and based on a misguided view of knowledge, as well as of the importance of 'the facts of life'. As Malinowski observed in his classic monograph *Argonauts of the Western Pacific:*

> Modern science shows…that their social institutions have a very definite organisation, that they are governed by authority, law and order in their public and personal relations, while the latter are, besides, under the control of extremely complex ties of kinship and clanship. (Malinowski 1961 [1922]: 10)

In *The Sexual Life of Savages* he added that:

> It is rather inconsistent to get excited about the faulty knowledge of the Trobrianders when it comes to processes of sexual fertilisation when we are perfectly satisfied that they posses no real knowledge as to processes of nutrition, or metabolism, the causes of disease or health, or any other subject of natural history. (1932: ii)

From these observations Malinowski generalized that 'The ideas and institutions which control conception, pregnancy and birth show that these cannot be regarded by the anthropologist as mere physiological facts, but [must be seen as] facts deeply modified by culture and social organisation' (Malinowski, 1962: 140).

In his rejection of the idea that the 'discovery' of the biological facts of paternity could, in and of itself, determine any particular form of social structure, Malinowski introduced three key themes that would continue to reshape anthropology throughout the twentieth century. First, he argued that the nineteenth-century over-emphasis on the biological facts of sexual reproduction was a Western, or even more specifically a Victorian, obsession that was not universally either shared or relevant for the ethnographer. He thus also introduced the idea that scientific knowledge is at least in part culturally determined, and that it is important for the scientist to take this into account – and to be self-conscious about his or her own belief system. Second, he introduced the model of biological plasticity – arguing that beliefs about procreation can be adapted, adjusted and altered as part of a wider social process of creating individual and group identities. There is nothing transparent or obvious about 'being biological', he insisted. Finally, he introduced the idea of reflexive comparison – that another culture's use of 'scientific' knowledge might shed some light on the particularities of how it is used 'at home'.

As we shall see, all of Malinowski's observations have gained added significance in the contexts of assisted conception, organ donation, genetic screening and stem cells – in which the plasticity of both biology and biological identities have become increasingly prominent and explicit, and greater reflexivity about anthropological certainties has been required. Not only are such contemporary debates consequently continuous with the origins of anthropology but also this continuity offsets the common overemphasis on novelty that is a feature of many contemporary discussions of bioscience and biomedicine. Thus, as we shall see, although some of these more recent areas of enquiry may be new in a historical sense, they raise questions that are often very familiar to anthropologists.

Malinowski's critique of the overemphasis on 'accurate' knowledge of the 'scientific facts' of biological reproduction in accounts of the origins of social structure has been returned to repeatedly by other anthropologists over the course of the twentieth century. The American kinship theorist David Schneider, for example, took Malinowski's argument to its logical conclusion in the 1960s, arguing that all Western anthropological theories of kinship shared a crucial false assumption in presuming that the biogenetic basis of kinship and reproduction is logically prior to its social construction. In contrast, Schneider argued that the logic of kinship was essentially symbolic, and that 'natural facts' were consequently *symbols*. He argued that the American 'kin universe' was not based on nature, but on the symbolic natural acts of reproduction and parenting, through which children came to symbolize conjugality and the closeness of the family, linked through ties of shared genetic substance, and thus by 'diffuse, enduring solidarity'. Like Malinowski, Schneider argued against an overly literal reading of 'the biological facts' and insisted they have no determining role in social life (Schneider 1980 [1968]).

These claims were taken further by feminist anthropologists in the 1980s, following Sylvia Yanagisako's influential response to David Schneider's *Critique of the Study of Kinship*, published in 1984. In 1985, Yanagisako delivered a paper to the annual conference of the American Anthropological Association in San Francisco, in which she argued that Schneider had overlooked the most important logical consequences of his own argument. She pointed out that the same naturalized model of sexual reproduction that Schneider saw as limiting kinship study also

defined the study of gender – and that as a consequence the study of kinship, gender and reproduction were all essentially the same field: 'Our model of the natural differences in the roles of men and women in sexual reproduction lies at the core of our studies of the cultural organisation of gender, at the same time it constitutes the core of the genealogical grid that has defined kinship for us' (1985: 1).

This insight proved crucial to a new synthesis in anthropology in the 1980s and 1990s, not only between the study of gender, kinship and reproduction but alsoconcerning the role of 'natural facts' in Western knowledge production more widely. In essence, the long-standing implicit biologism of anthropologists – even of those, such as Schneider, who only partially critiqued it – became the focus of a profound and thoroughgoing re-examination. This took the form of critiquing gender roles and the sexual division of labour, but more broadly the corresponding divisions between nature and culture, or biology and society (Collier and Yanagisako 1987, MacCormack and Strathern 1980, Yanagisako and Delaney 1995).

NEW REPRODUCTIVE TECHNOLOGIES

To understand the full implications of this shift, it is useful to turn to the literature on new reproductive technologies, which began to be published in the mid-1980s, following the birth of the world's first test-tube baby, Louise Brown, in 1978. Marilyn Strathern played a key role in the emergence of feminist anthropology, and her 1980 anthology, co-edited with Carol MacCormack, entitled *Nature, Culture and Gender*, had set the stage for an entirely new approach to both gender and kinship. In the same way Schneider had argued that biology was a symbolic, not literal, resource in the formation of American kinship, so Strathern (1980) argued that the nature–culture dichotomy, and Western categories of the natural more broadly, had similarly been taken too much for granted as one of the foundational frameworks for social theory. Rather than being a universal and primordial distinction, or one that was either self-evident or 'factual', Strathern analysed anthropology's over-reliance on its own indigenous knowledge categories of 'nature' and the 'natural' as a form of ethnocentrism. She further demonstrated that the model through which gender categories such as 'male' or 'female' were understood to be 'based on' an underlying natural or biological order, (so that 'sex' became the biological base to which 'gender' was the social addition, or 'social construction'), could not explain either sex or gender in other societies where no such naturalized ontology exists. This insight represented a significant advance within anthropology, both by introducing a more radically reflexive approach to 'natural facts', and by diagnosing the crucial link between models of nature and biology, and models of gender and sex (Franklin 2001a).

Strathern's argument about the cultural specificity of the Western model of biological sex gained additional significance as technological assistance to human reproduction became increasingly widespread from the 1980s onwards in the form of *in vitro* fertilization (IVF), artificial insemination, surrogacy, and a host of other procedures designed to *re-engineer* the 'natural' reproductive capacities of humans, animals, plants and microorganisms. In the context of IVF, during which the basic processes of ovulation induction, removal of ova, fertilization, embryo culture, embryo selection and embryo transfer were conducted under the close supervision of technical experts, and thus surrendered into the helping hands of science, it could be said that biological reproduction had, in a sense, become fully domesticated. This did not make them entirely non-natural: indeed, a common representation of IVF in patient information leaflets is of 'giving nature a helping hand'. However, the idea of technologically assisted nature was, according to Strathern's analysis, a revealing hybrid: it showed that reproduction was now 'after nature' in two important senses – post the 'unassisted' nature that had come before, but also differently *modelled after* nature, in the sense of being a new kind of natural-technical phenomena.

A key consequence, in Strathern's view, of the rise of new reproductive technologies, and the prominent public and parliamentary debates which accompanied their regulation (such as the UK's Human Fertilization and Embryology Act), was of *displacement*. Having been supplemented by technology, to provide live human offspring, the former view of sexual reproduction being a consequence of natural facts that 'stood for themselves' was displaced by a new conception model according to which nature could be redesigned – or literally *reconstructed*. New 'miracle babies' born of IVF thus embodied a new origin – one that was both essentially and explicitly 'man-made'.

Thus, new reproductive technologies not only inaugurated a new age of reproductive control but also made explicit a new conception model, based on new 'facts of life' (Franklin 1997). At one level, these differed substantially from previous conception models which took nature as the ground for social action, by reversing this process, and making choice, technology and human aspiration the ground for 'artificial' reproduction.

Significantly, the new reproductive technologies also introduced new uncertainties into the process of conception. These took a wide variety of forms. For example, although it might be said that it is a basic fact of life that it takes a sperm and an egg to make a baby (hence the old paternity debate), it turns out that a sperm and an egg are not enough, and this 'causal' explanation is only ever valid retrospectively – *after* a baby has been born. As IVF still demonstrates today, the presence of a sperm and an egg in a Petri dish does not guarantee either an embryo or a pregnancy will result. For all that successful human IVF did to confirm the benefits of scientific progress, and the fruits of modern biomedicine, it also, somewhat paradoxically, confirmed how much remains unknown and mysterious about the precise mechanisms leading to conception. This kind of uncertainty has proven to be characteristic of many areas of bioscientific and biomedical innovation, and has even been described by some social theorists, such as Ulrich Beck, as a defining condition of late modernity.

As we shall see in the next section, anthropological study of new reproductive technologies identified many of the basic dilemmas characteristic of the hope of *embodying progress* in the contemporary era of high-tech biomedical and bioscientific innovation – described by Ian Wilmut earlier as the 'age of biological control'. By symbolizing hope, progress, choice and control, new reproductive technologies opened new paths of human aspiration, fuelling what Mary Del Vecchio Good has described as 'the biotechnical embrace'. By making human scientific innovation the mechanism for an unprecedented form of 'artificial procreation', IVF established a new reproductive model. New kinds of offspring could be born, such as 'twins' conceived in the same Petri dish, but born years apart with the aid of cryopreservation. Egg donors could become genetic parents to offspring gestated in their birth mother's womb. And similarly, new models of parenthood could be forged, through what IVF ethnographer Charis Thompson (2005) has called 'strategic naturalisation', describing the complex ways that multiparty conception arrangements are aligned with preferred conjugal and kinship patterns.

However, these new reproductive models also had much in common with pre-existing kinship structures and practices. And while it is correct to emphasize the novelty of techniques such as IVF, it is equally important to acknowledge that their emergence extends a well-established legacy of 'biological control' through livestock domestication, agriculture and medicine (Clarke 1998). Similarly, although an undoubted confirmation of bioscientific ingenuity and progress, IVF continues to raise new uncertainties, and is the site of difficult choices and obligations that generate ambivalence, suspicion and doubt. Thus, although novel, and often described as 'racing ahead' of society, in new fields such as stem cells and cloning, the science of reproductive biology can be studied by anthropologists using many of the same techniques through which the discipline of anthropology came into being more than a century ago (Franklin 2001b, Franklin and Lock 2003).

BIOSOCIALITY AND NATURECULTURES

Published in the same year, 1992, as Strathern's two path-breaking monographs (1992a & b) on new reproductive technologies were two of the early contributions to social theory which have had the most enduring influence on the anthropology of biomedicine and bioscience. Anthropologist Paul Rabinow's concept of 'biosociality' was introduced in the context of early efforts to map the human genome, and his own efforts to forge an ethnography of bioscience. Writing from a Foucauldian perspective, Rabinow proposed a shift similar to that described by Strathern in the context of new reproductive technologies. As early as the 1960s, the French historian and philosopher Michel Foucault described the emergence of modern biology as a consequence of Darwin's theory of evolution, which Foucault argued formed the basis for modern biology.

> Historians want to write histories of biology in the eighteenth century; but they do not realise that biology did not exist then, and that the pattern of knowledge that has been familiar to us for a hundred and fifty years is not valid for a previous period. And that, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through a grid of knowledge constituted by natural history. (Foucault 1973: 127–128)

Darwin's theory was revolutionary for many reasons, not only because he claimed that man descended from animals but also because he argued the same 'helping hands' of evolution that continued to shape animal nature also shaped human nature. An important implication of this principle, from an anthropological point of view, is that humans are subject to the same biological 'laws' as every other living thing. The disciplines that have developed this comparison most fully are evolutionary biology and socio-biology, through which, for example, human societies are studied not only in terms of animal behaviour but even in terms of the 'laws' that govern insect communities, such as ants. In the second half of the

twentieth century, following the discovery of the structure of the DNA double helix by Watson and Crick in 1953, the modern biological model of inherited genetic 'programming' began to become more influential in studies of behaviour. The idea, for example, that humans and other animals are 'hardwired' for certain behaviours, which are beneficial in evolutionary terms, gained influence. A paradigmatic example is the work of E.O. Wilson, the Harvard entomologist, who coined the term 'sociobiology' to describe how certain social patterns, such as altruism, reflect an inherited biogenetic script that is not necessarily available to the conscious mind (Wilson 1975).

The effort to unlock the secrets to the human genome that began to gain momentum in the 1980s was initially imagined to offer access to the molecular alphabet of this hardwiring, both structurally and conceptually. An enormously expensive and technically daunting initiative, the Human Genome Project was based on the same engineering model as IVF: by taking apart the genome and analyzing its components, it would be possible both to understand it better, and to intervene in its structure – and eventually to redesign it. To one of the earliest anthropologists of bioscience, Paul Rabinow, this project represented a remaking of the very idea of 'man'. Whereas socio-biology had understood the human as a product of its biological 'hardwiring', Rabinow proposed a reverse scenario, for which he also proposed a new term, 'biosociality':

> If socio-biology is culture constructed on the basis of a metaphor of nature, then in biosociality, nature will be modelled on culture understood as practice. Nature will be known and remade through technique and will finally become artificial, just as culture becomes natural. (1992: 241–2)

According to Rabinow, the flow through which 'culture is constructed on the metaphor of nature' will be reversed: 'nature will be modelled on culture'. The primal scene for this reversal, the new genetics (itself 'a biological metaphor for modern society'), would be revealed, he predicted, through the development of new scientific techniques. In his view, the techniques of the Human Genome Project would 'move' existing social aspirations into our biology – much as the techniques of IVF had already accomplished by enabling intervention into the very earliest stages of life to create new offspring. Rabinow predicted that a consequence of the new genetics would be what he called a 'truly new form of autoproduction' accompanied and enabled by new social groups, such as genetic patient support groups: 'groups formed around the chromosome 17, locus 16,256, site 654,376 allele variant with a guanine substitution … [which] have medical specialists, laboratories, narratives, traditions and a heavy panoply of pastoral keepers to help them experience, share, intervene in, and "understand" their fate' (1992: 244). Thus, according to Rabinow's prediction, biosociality would involve 'the formation of new group and individual identities and practices arising out of…. new truths' (i.e. the new truths of the Human Genome Project). The change, as he noted, would involve a reversal of the presiding cultural logic – from nature to culture – so it flows backwards – from culture to nature.

Writing in the same issue of the anthology *Incorporations* in 1992, science studies scholar Donna Haraway addressed a somewhat different, but related, shift in the context of new animal models containing human genes. Produced in partnership with Harvard scientists in the 1980s, DuPont's transgenic OncoMouse® was the world's first patented mammal. At once a tool for cancer research, a commodity, and an animal model containing human genes, OncoMouse® embodied, in Haraway's terms, a new kind of 'traffic' between nature and culture. Whereas Rabinow proposed a 'reversal' in the 'flow' between nature and culture, Haraway proposed an 'implosion'. OncoMouse®, she argued, was 'many things simultaneously': 'A kind of machine tool for manufacturing other knowledge-building instruments in technoscience, the useful little rodent with the talent for mammary cancer is a scientific instrument for sale like many other laboratory devices' (1997: 79).

Significantly, both Haraway and Rabinow used the idiom of kinship to interpret the significance of what Haraway calls 'naturecultures' produced in the context of technoscience (Franklin, Lury and Stacey 2000). For Rabinow, new biosocial groupings, such as genetic disease patient support groups, would be differently based on 'biogenetic substance', through 'family ties' established on the basis of biomedical intervention and bioscientific innovation. These ties would affirm the importance of interventions into the very 'stuff of life' in order to alleviate the suffering caused by hereditary pathology. A new kind of kinship universe would thus reflect a different idea of 'man', or *anthropos*. This kinship universe would not simply follow the paths of genealogical descent, but would reverse this relation – making genealogical relatedness an object of technological 'rewiring'.

A somewhat different set of kinship implications are explored by Haraway in the context of OncoMouse®. Because she has human genes, and has been both born and made out of her intimate associations with human illness, she is a 'sibling' species, in Haraway's terms, to which a complex human debt is owed:

> The techniques of genetic engineering developed since the early 1970s are like the reactors and

> particle accelerators of nuclear physics: Their products are "trans." They themselves cross a culturally salient line between nature and artifice, and they greatly increase the density of all kinds of other traffic on the bridge between what counts as nature and culture for my people. … Like the transuranic elements, transgenic creatures, which carry genes from "unrelated" organisms, simultaneously fit into well-established taxonomic and evolutionary discourses and also blast widely understood senses of natural limit. What was distant and unrelated becomes intimate. By the 1990s, genes are us: and we seem to include some curious new family members at every level of the onion of biological, personal, national and transnational life. What could be more natural by the 1990s than worldwide commercial, familial, biotechnical, and cinematic genetic traffic? (1997: 56–57)

Here, as in early anthropology, the relation between 'biological' facts of life – in this case the 'new' naturalcultural facts of transgenic reproduction – and emergent categories of identity are theorized by Haraway using kinship models. As for both Rabinow and Strathern, it is the new forms of 'traffic on the bridge between what counts as nature and culture' and the 'culturally salient line between nature and artifice' that concerns Haraway. Anthropologically, what is significant in all three theorists' work is their shared emphasis on the shared, biological embodiment of technological progress, and their use of kinship as a means of charting its effects.

NEW BIOGENETIC CONNECTIONS

The changing social meanings of biogenetic substance in the context of new genetic technologies has, like the earlier field of studies of kinship in the context of assisted conception described above, become one of the core sub-fields of the anthropology of biomedicine and bioscience. Confirming Rabinow's prediction of emergent 'biosocialities', numerous studies by anthropologists have examined the challenges of genetic choice in the context of increasing genetic information provided through new forms of genetic screening and diagnosis (Finkler 2000, Franklin and Roberts 2006, Gibbon 2006, Palsson 2007). In one of the most influential of these studies, US anthropologist Rayna Rapp introduced the term 'moral pioneers' (1999: 306) to describe the often philosophical, as well as practical, issues faced by women undergoing routine amniocentesis during their pregnancy. In attempting to provide a 'topography' of amniocentesis through a multi-sited account of personal and professional encounters with prenatal chromosomal analysis, Rapp analyses how her informants negotiate the gap between biogenetic information – which is often highly technical but incomplete – and meaningful knowledge, which, by definition, is socially, not medically, defined, evaluated, and acted upon. She shows how 'alternative and sometimes competing rationales' (Rapp 1999: 10) must be weighed up and evaluated, often in complicated marital or family settings that can generate what she describes as 'kinship friction' (153) – a situation Rapp attributes to 'the gap between statistical risk figures and phenomenological experience' (175).

This 'kinship friction' is worth examining in some depth, as it demonstrates the value of fine-grained ethnographic studies of bioscience and biomedicine such as Rapp's in the effort to characterize the subjective experience of 'the age of biological control'. The following case offers a typical example of how different logics of genetic interpretation produce what Rapp describes as a diagnostic 'stand-off' (1999: 188). The background to the case is the discovery of 'something ambiguous on the #9 chromosome of the sample' and a provisional diagnosis of '#9+'. The closest condition to which this could be assimilated is 'some clinical reports on trisomy 9', resulting in physical anomalies and mental retardation. After counselling, the mother decides to keep the pregnancy, and gives birth in early June. A month later the genetics laboratory requests a consultation via the mother's obstetrician, and she agrees to attend with her baby son.

> He was a six-week-old Haitian boy named Etienne St-Croix. His mother, Veronique, spoke reasonably good English and good French. His grandmother, Marie-Lucie, who carried the child, spoke Creole and some French. The two geneticists spoke English, Polish, Hebrew and Chinese between them. I translated into French, ostensibly for the grandmother and mother... . The geneticist was gracious with Veronique but after a moment's chit-chat asked to examine the baby. She never spoke again to the mother during the examination. Instead, she and a second geneticist, both trained in pediatrics, handled the newborn with confidence and interest. The counselor took notes as the geneticists measured and discussed the baby. "Note the oblique palpebral fissure and micrognathia," one called out. "Yes," answered Veronique in perfect time to the conversation, "he has the nose of my uncle Herve and the ears of Aunt Mathilde." As the geneticists pathologized, the mother genealogized, the genetic counselor remained silent, furiously taking notes, and the anthropologist tried to keep score. (Rapp 1999: 187)

This episode, from Rapp's chapter on 'Refusing', illustrates the multiple languages of genetic translation and the difficulty of aligning these into a single narrative. The geneticists are working from known precedents to increase their scientific understanding by comparing a new case with previous cases through physical examination of the newborn 'trisomy 9'. However, these 'natural facts', despite being based on objective scientific analysis, do not resolve into a single shared genetic diagnosis, but instead generate conflict. As Rapp observes:

> While the geneticists are confident that this child will share the developmental pattern reported in the literature for other children with very similar chromosomal patterns, the mother was quite aware of the idiosyncratic nature of the case, its lack of a clear-cut label and known syndrome. She therefore decided that the contest for interpretation was still an open one (Rapp 1999: 188).

Veronique's rejection of a medicalized version of genealogical connection is underscored by her decision to have the child – more or less against the medical advice. Asked about her decision after the examination is over, on the way to the subway, Veronique explains that 'more' genetic information had not increased her confidence in expert medical advice. To the contrary, it had reinforced her sense of the limits of abstract scientific knowledge in relation to something as personal and intimate as her own pregnancy:

> But when they told me this, who knows? I was so scared, but the more they talked, the less they said. They do not know what this is. And I do not know either. So now, it's my baby. We'll just have to wait and see what happens. And so will they. (Rapp 1999: 188)

For Rapp, what is important about this outcome is not only that it is made up of 'alternative and competing rationales' (10), but that it involves a direct rejection of biomedical expertise. Using Paul Rabinow's concept of 'biosociality' discussed above, Rapp argues that:

> Biomedicine provides discourses with hegemonic claims ... encouraging enrolment in the categories of biosociality. Yet these claims do not go uncontested, nor are these new categories of identity used untransformed. Religious orientations and practices, informal folk beliefs, class-based and ethnic traditions as well as scientifically-inflected counterdiscourses also lay claim to the interpretation of extra chromosom[al material]. (Rapp 1999: 302)

Rapp's ethnographic account of the new genetics emphasizes the plurality of meanings that accompany 'scientific facts', and the wide range of cultural knowledges that come into play as these new 'facts of life' are negotiated by various social actors, who have divergent interpretations of their significance. She thus shows how much picking and choosing is going on at the level of which information is accepted as useful knowledge, what kinds of authority are relied upon, and how individual decisions are reached amidst often conflicting individual, marital and familial priorities. The central paradox of prenatal testing is that it is primarily sought as a form of reassurance that everything is 'normal', when it is designed to detect exactly the reverse. Moreover, it is only when a test returns a 'positive' outcome that there are difficult decisions to be made. The most difficult decisions of all occur when normality is no longer a predicted outcome, which is, ironically, after the test has been 'successful' in detecting genetic disease.

As Rapp notes, because genetic information is always partial, 'in some sense, all positive diagnoses appear ambiguous to pregnant women' (Rapp 1999: 188). Even when a chromosomal analysis is known with all possible certainty, it will not reveal how serious the disease will be, when its onset will occur, or how it may affect a child's life span. Even in the very rare cases of single gene disorders where the outcome can be predicted with tragically accurate clinical precision, such as Tay–Sachs disease, spinal muscular atrophy, or Duchenne muscular dystrophy, the potential offspring is never fully reducible to a potential syndrome, even if it is terminal. Hence, the assumption that genes make us who we are is both too true to ignore, and too partial to be enough truth by itself.

AMBIVALENT BIOLOGIES

The 'partial' nature of genetic information in the context of biomedicine returns us to the intersection between biology as a science and biological identity in a manner that illustrates a fundamental ambivalence toward both the embodiment of scientific progress and the meaning of the expression 'biological control'. This ambivalence is a key theme in other studies of bioscience and biomedicine, including research on organ transplantation, cloning and stem cells. In her study of organ transplant, for example, anthropologist Sharon Kaufman describes the 'moral confusion' that 'results in the creation of new kinds of persons, a new category of life itself, new relationships of care and familial burden, and new cultural narratives about life and death' (2000: 70). These new

categories and narratives challenge existing meanings of nature and natural facts, producing new hybrid entities 'born' of medical intervention, such as brain-dead cadavers that become organ donors after being removed from life support. As Margaret Lock notes, such transitional contexts create 'uneasiness' in part because of the difficult choices they require of families, professionals and patients alike. The determination of death for some patients has become 'primarily a moral and not a medical matter, and the fulfilment of medical criteria, albeit often clouded by uncertainty, is a necessary but not sufficient reason to declare death' (2003: 189). As Lock notes, these choices are difficult in part because they are more explicitly arbitrary: 'widely debated and socially recognised assessments of what constitutes a morally acceptable social death must take place' (2003: 191). Thus, they are also challenging because such difficult choices *are themselves chosen*: 'These are the shifting sands we have created for ourselves in late modernity as a result of our intrusions into the "natural" world' (2003: 191).

As Sharon Kaufman and Lynn Morgan note in their discussion of emergent forms of life and death in the context of bioscience and biomedicine, there are both a cause and a symptom of more 'ambiguous boundaries' affecting the beginnings and endings of life. Drawing on Foucault's notion of 'biopolitics' they observe that:

> The stem cell, "orphaned" embryo, fetus, fetal specimen (the dead unborn), sperm and egg donors and recipients, comatose, demented, neomort, and "cadaveric" organ donor – all can be seen as biopolitical subjects, brought into being through the workings of biomedical regimes of power. Their emergence into social subjecthood creates new relationships and obligations (among strangers and kin, between doctors and patients, and between individual and institutions), new forms of knowledge, and new kinds of normalising practices at the same time as they foster tensions about political, ethical, and medical responsibility. (2005: 329)

Here, then, are the conditions of biosociality that continue to be analysed by anthropologists and other social theorists, who seek to depict the texture of lived experience in the context of the often-difficult choices presented by contexts such as organ donation, assisted conception, or genetic screening. Such studies also aim to address the overarching question of embodying progress in 'the age of biological control'.

Three of the most important overarching themes recurring across the anthropology of bioscience and biomedicine are progress, ambivalence and choice (Franklin and Roberts 2006). The pattern by which technology is developed to enable new choices, thus producing new obligations, new uncertainties and new risks, has become a prominent concern in the social sciences in the late twentieth century. Medical technologies, with their potent mix of open-ended promises, heroic achievements, ambivalent hopes and often impossible choices, epitomize a set of dilemmas alternatively associated with postmodernism or posthumanism. For example, the German sociologist Ulrich Beck used the 'progress' of medical technology, and in particular IVF, as a paradigmatic case his influential study *Risk Society* (1992). Beck's argument centrally concerned 'the logic of "progress"' that informed the decision to attempt IVF in humans:

> In the sub-politics of medicine…the possibilities for thoughtless and unplanned exceeding of limits lie in the logic of "progress". Even in vitro fertilization was first tested in animal experiments. One can very well argue over whether that should be permitted. But an essential barrier was crossed in applying this technology to people. This risk… is after all not a risk for medicine, but for the next generation of people, for all of us… (209–210)

Like Ian Wilmut, Beck points to the challenge of limiting the application of medical technology, in particular at the point when it can be life-saving (or, in the case of IVF, life-creating). Referring to the logic of progress, or what has been described above as the embodiment of progress, he describes how new risks are created not only for individuals but also for the population, when 'essential' barriers are crossed. For Beck, this problem of the 'risk society' – whereby it is progress itself that generates new risks – encapsulates a defining feature of late modernity.

As Lock, Kaufman, Morgan and others have shown, organ donation offers a case in point of the 'shifting sands we have created for ourselves', as Lock describes them. These risks are not only ethical or political but also are embodied, and in the context of assisted conception they are implicated in a mode of human reproduction. While being the focus of often desperate hope, new technologies such as cloning, stem cells, tissue engineering and regenerative medicine are thus, conversely, also at risk of creating systemic biological risks for future populations – risks that are 'man-made' in the name of progress and the moral obligation to alleviate human suffering. This is why, for example, Beck claims that 'public debate on the potential for politics to exert influence over technological transformation is pervaded by a peculiar ambivalence' (Beck 1992: 187). A similar pattern is confirmed by much anthropology of bioscience and biomedicine, suggesting that

Wilmut's proscription to limit the application of new means of biological control is sociologically more complex than it might seem.

CONCLUSION

At the outset of this chapter it was argued that while scientific facts may provide increasing information about the human condition, the reverse may also be true. Indeed, as projects such as the Human Genome Initiative have revealed, there are fewer human genes than scientists expected, and they tell us less about ourselves than hoped (Keller 2000), while projects such as the cloning of Dolly the sheep may reveal more about human culture than biology (Franklin 2007). At the same time, the expectation that answers to the human condition might be found in the genetic code confirms something else about contemporary global scientific culture, which is that science and technology continue to be viewed as crucial components of human emergence and human progress. That a reflexive, critical understanding of progress, and in particular the embodiment of progress, is also a feature of 'the age of biological control' is a finding that is repeatedly affirmed in the field of what has come to be known variously as biosocial studies, social studies of the life sciences, or the anthropology of bioscience and biomedicine (Lock and Nguyen 2010).

As a growing number of groundbreaking ethnographic studies confirm, bioscience and biomedicine are important contexts in which the meaning of the human is being remade, often by being rebuilt. As we have seen in this chapter, this effort is highly consistent with the origins of anthropology as a discipline, and continues to extend many of its founding insights and concerns. Thus, while 'new', and in many ways transformative of the category of the human on which anthropology is based, bioscience and biomedicine are also fields that can be analysed using some of the oldest methods and analytical models to which the discipline has given rise. It is thus both the importance of biomedicine and bioscience to society, and their increasing prominence within the discipline of anthropology, that ensure questions in this rapidly expanding subfield will continue to generate innovative contributions to social science.

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