Science as Culture
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713444970

Species of Biocapital

Stefan Helmreich [a]
[a] Massachusetts Institute of Technology, Cambridge, USA

Online Publication Date: 01 December 2008

To cite this Article Helmreich, Stefan(2008)'Species of Biocapital',Science as Culture,17:4,463 — 478
To link to this Article: DOI: 10.1080/09505430802519256
URL: http://dx.doi.org/10.1080/09505430802519256

Science as Culture
Vol. 17, No. 4, 463–478, December 2008

Species of Biocapital

STEFAN HELMREICH

Massachusetts Institute of Technology, Cambridge, USA

ABSTRACT *Several scholars in science studies have lately sought to theorize the contemporary join of capitalism and biotechnology. A variety of terms have been forwarded to name how 'life' in the age of genomics, stem cell research, and reproductive technology has become enmeshed in market dynamics, and no term has become as prominent as* biocapital. *This article offers a classification of articulations of this concept, arguing that definitions of biocapital centre (with varying emphasis) on two transformations: in biotic substance and in economic speculation and sentiment. Experimenting with ways of representing diverse species of* biocapital*, this essay offers a timeline of intellectual history, a genealogy of scholarship, and a theory worksheet, which last the reader is invited to use to generate their own accounting of the bioeconomy.*

KEY WORDS: Biocapital, biotechnology, production and reproduction, speculation, economic anthropology

The store of science studies work theorizing the conjuncture of economic action and contemporary biotechnology is now well stocked. Scholars in anthropology, sociology, history, and literary theory have generated a variety of concepts: biovalue, genetic capital, the biotech mode of (re)production, the organic phase of capitalism, genomic capital, life as surplus, the bioeconomy, and, perhaps most prominently, *biocapital*, which term is becoming the prevailing coin in academic exchanges about contemporary unions of biological science with profit-oriented enterprise. Articulations of biocapital and its kin are various enough that a taxonomy of *species of biocapital* may be in order.

The word *species*, of course, refers not just to durable, though mutable, life forms, but also to 'a particular kind or sort of coin or money' (OED), so that a classification of kinds of biocapital may take the form of an intellectual phylogeny or of an accounting, or both. Following Pierre Bourdieu (1991 [1982]), who first defined four 'species of capital' (economic, cultural, social, and symbolic) and showed how they might be convertible into one another, such a classification could also manifest as a table of exchanges between different coinages. I consider all these possibilities here.

What is biocapital? Scholarship in the social and cultural study of biology has suggested that in the age of biotechnology, when the substances and promises of biological materials,

Correspondence Address: Stefan Helmreich, Anthropology Program, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, USA. Email: sgh2@mit.edu

0950-5431 Print/1470-1189 Online/08/040463-16 © 2008 Process Press
DOI: 10.1080/09505430802519256

particularly stem cells and genomes, are increasingly inserted into projects of product-making and profit-seeking, we are witnessing the rise of a novel kind of capital: biocapital. The term, paging back to Marx, fixes attention on the dynamics of labour and commoditization that characterize the making and marketing of such entities as industrial and pharmaceutical bioproducts. It gives a fresh name to a phenomenon that Edward Yoxen, writing at the dawn of the biotech revolution in 'Life as a productive force: capitalizing upon research in molecular biology', described as 'not simply a way of using living things that can be traced back to the Neolithic origins of fermentation and agriculture', but 'a technology controlled by capital, ... a specific mode of the appropriation of living nature—literally capitalizing life' (1981, p. 112). Biocapital also extends Foucault's concept of *biopolitics*, that practice of governance that brought 'life and its mechanisms into the realm of explicit calculations' (Foucault, 1978, p. 143). Theorists of biocapital posit that such calculations no longer organize only state, national, or colonial governance, but also increasingly format economic enterprises that take as their object the creation, from biotic material and information, of value, markets, wealth, and profit. The biological entities that inhabit this landscape are also no longer only individuals and populations—the twin poles of Foucault's biopower—but also cells, molecules, genomes, and genes.

Stem cells, the objects in discussion in this special issue, have been particularly potent objects on this landscape because of their, well, ... potency—or better, their potential potency, their capacity, under finely tuned circumstances, to grow into diverse sorts of cells, cells that might be employed as resources for regenerative medicine. One might argue that stem cells are animated by a double fetishism—infused with vitality because of the erasure of the labour and regulation that allow them to appear 'in themselves' in such places as laboratories and simultaneously imbued with life because of their origin in living things. Whether such fetishism dovetails with commodity fetishism is a complicated question—certainly stem cells' relation to market, gift, and national economics and imaginaries is multiple, as articles in this issue illustrate—but one of the more general claims of the present essay will be that biological potency as such, in biocommerce, is often (mis)taken to be a primordial ontology upon which biocapitalism merely elaborates.

This essay began as a review of two books that make biocapitalism central to their purpose. Kaushik Sunder Rajan's 2006 *Biocapital: The Constitution of Postgenomic Life* and Nikolas Rose's 2007 *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* each propose a broad diagnosis of scientific, ethical, and cultural transformations in the way we think of life—biological and social—in the era of capitalized molecular biology, biotechnology, and stem cell and genomic medicine. A quick appraisal of each book sets the stage for my larger classificatory enterprise.

Kaushik Sunder Rajan's *Biocapital* argues that new life science commodities—e.g. therapeutic molecules, genome sequences, and pharmaceuticals that promise future health—require a reinvigorated analysis of capitalist practices as well as of the correlated kinds of citizen, corporate, and scientific subjectivities that are materializing alongside such activities. New capitalist practices see university and corporate biosciences becoming porous to one another, with the circulation of biomaterials between labs governed by novel regimes of buying and selling—regimes set in place by regulatory transformations, primarily in the United States, that permit the holding of intellectual property in biological matter and knowledge. Contouring this landscape, too, are infusions into genomics of money from venture capital. Speculative finance, for Sunder Rajan, often motivates and mirrors the speculations of biotechnology. The

subjectivities in the making—for scientists, doctors, and patient advocacy groups—meanwhile, also tune to future-looking financescapes.

The biocapitalist ethos, urges Sunder Rajan, takes nationally particular forms. *Biocapital* offers an ethnographically informed comparison between genomics in the United States and India. Through interviewing scientists and business people and visiting them at their conferences and in their labs, Sunder Rajan finds that US rhetoric is organized around sentiments of *salvation*, sentiments that see the promise of genetic medicine in near millennial terms, often powered by a language of hope and hype (cf. Kitzinger, this issue, on hope and hype in stem cell research). Sunder Rajan theorizes this ethos through Weber's *The Protestant Ethic and the Spirit of Capitalism* (1905). Value in the market sense and value in the ethical sense co-constitute one another in biocapital. There is a heavy dose of Foucault here, too, since the claim that new subjectivities are in the making depends on the claim that biopower operates through conjuring new common sense around what will count as the truth of the biological. In India, meanwhile, a narrative that highlights the importance to the nation of biotechnology prevails; bioproducts promise to make India as a nation a 'global player'. Sunder Rajan here illustrates how new genres of biocapital also depend on older, often colonial, structures of subordination. For example, he shows how unemployed textile workers in a marginal neighbourhood in Bombay become enlisted as 'volunteers' for pharmaceutical clinical trials outsourced from the United States. What Sunder Rajan locates as the 'upstream' world of genomic science and the 'downstream' world of pharmaceuticals are connected not only through the idealized flowcharts of biotech companies, but are also realized through historically carved channels of inequality. In both the Indian and the US case, such realizations are often located in a promised future; the speculative character of biotechnology is foundational for what Sunder Rajan names as 'the constitution of postgenomic life'.

Biocapital may be read as itself a kind of speculative enterprise, a provocative testing out of new assemblages of theory to understand what might be novel in the era of highly capitalized biotechnology. This testing, in the end, works less on the *bio* side of things than the *capital* side. Sunder Rajan takes on board the notion that in the days of genomics, 'biology increasingly becomes an information science', a framing that leads him to ask 'where value resides as biology becomes an information science' (p. 41). The informatic angle affords him a fruitful way to focus on how the codes of genomic potentiality and scientific truth combine with and, in some cases, enable rhetorics of market promise and cycles of capitalist credibility. Fastening on informatic logics also permits Sunder Rajan's discussion to track permutations in the kinds of 'explicit calculations' about 'life and its mechanisms' that Foucault saw as key to biopower. Sunder Rajan's use of the information frame sees him paying less attention to how the materialities of genetic substance, DNA chips, or stem cells are transubstantiated in the bioeconomy. He is, to be sure, careful always to put biological materiality into his accountings, but does not train attention on how this materiality is itself remade in the laboratory practices called forth by biocapitalism. For my money (or taste?), Nikolas Rose (and others, as we will see below) provides more on the *bio* side of the balance sheet.

In *The Politics of Life Itself*, sociologist Rose, through a synthetic reading of existing literature in the social sciences, explores how novel forms of personhood, citizenship, race, brain/mind, and crime are under construction as people diversely position themselves in relation to technologies of genetic mapping, genetic diagnosis, genetic counselling,

genetic therapy, and genetic profiling. The sweep of stuff Rose takes in is impressive: from couples wrestling with the ethical dilemmas produced through amniocentesis, to patient rights organizations banding together around genetic polymorphisms, to medical professionals redefining race in the age of haplotype mapping, to criminologists looking to the brain sciences for new classifications of the pathological.

Strongly inflected by Foucault as well as Foucault interpreter Paul Rabinow, Rose's thesis is that contemporary biopolitics operates at the level of the *molecular* and from that seat organizes new landscapes of risk and genres of ethical subjectification. Rose writes that 'molecularization strips tissues, proteins, molecules and drugs of their specific affinities—to a disease, to an organ, to an individual—and enables them to be regarded, in many respects, as manipulable, and transferable elements or units, which can be delocalized' (2007, p. 36). The objects and subjects of biopolitics are transforming. What Foucault called 'life itself' has a new, molecularized profile. Family, personhood, race, crime are all refigured as the stuff of biology is made increasingly miniature and malleable. For Rose, the effects of this molecular re-scaling appear in such dispersed practices as genetic counselling and insurance law, and he argues that such practices draw persons into new kinds of 'ethopolitics' (politics of ethics) that demand new genres of reasoning across micro and macro scales. Rose concludes *The Politics of Life Itself* with a Weberian meditation on 'The spirit of biocapitalism', detecting an 'elective affinity' between the new molecular bioeconomics of 'life itself' and the modes through which, for example, doctors and patients work on and through human corporeal being, a corporeal being that is increasingly fungible and multiple. Rose is more interested in this corporeality than is Sunder Rajan, and he makes it the centre of what he calls 'somatic ethics'. Because he is curious about the varieties of bodily experience called forth by the new biology, he resists a reading of somatic ethics as the simple emanation of new kinds of biopolitical bondage, offering a more open-ended, even occasionally optimistic, assessment of the manifold futures of the politics of life itself, which, for him, turn out to prepare new *moral economies of life and self*. If Sunder Rajan speculates on speculation, Rose speculates on possible substantiations, including those pluripotent possibilities that issue from stem cell research.

Sunder Rajan and Rose are not alone in their attempts to theorize biopolitics in an age when biology is commoditized at the molecular level and increasingly worked upon by public–private hybrids of university and industry science. Several scholarly works have been and are operating in similar terrain. To make sense of the genesis of discussions of biocapital it may be useful to collect a timeline of publications, starting with Marx (see Table 1).

The table below does not take in as many vectors of origin for biocapital as it might. Missing are chronicles of molecular biology (especially as it formed in late-twentieth century grids of calculation and regulation: e.g. Kay, 1993; Wright, 1994; Keller, 1995; de Chadarevian, 2002), histories of modernist agricultural technique (e.g. Fitzgerald, 1990; Boyd, 2003), studies of colonial and postcolonial enterprise (e.g. Sidney Mintz's classic 1985 analysis of the plantation as a fusion of farm and factory in *Sweetness and Power*), anthropologies of organ donation and trafficking (e.g. Hogle, 1999; Scheper-Hughes, 2001), and social analyses tracking the rise of markets in racialized genomics (e.g. Fullwiley, 2007; Montoya, 2007; TallBear, 2008). Also absent are works theorizing recent transformations in capitalism and governance more generally (e.g. Harvey, 1989; Comaroff & Comaroff, 2000; Maurer, 2000; Jasanoff, 2005).

Table 1. Concepts of biocapital

1867	Karl Marx in *Capital* defines *use-value* and *exchange-value* as, respectively, the value of things in use and the value that things acquire when set against one another as commodities. For Marx (who inherited these terms from Aristotle, Luther, and Smith), use-value could be natural or conventional, though Marx sometimes described 'nature'—materialized in such substances as cultivated soil or the human body—as containing 'means of production already produced' [quoted in Franklin (2007, p. 106)]. This framing posits generativity (or reproductivity) as an elemental property of the natural.[a]
1884	Frederick Engels in *The Origin of the Family, Private Property, and the State* theorizes a distinction between means of production and means of reproduction, suggesting that women's subjection in marriage is aided by their domination as a class of unpaid workers responsible for the material reproduction of persons in households.
1904	Max Weber in *The Protestant Ethic and the Spirit of Capitalism* suggests that in post-Reformation Europe, Calvinist ethics of hard work and rationality underwrote the assignation of moral meaning to capital accumulation, which could be read by believers as a secular sign of a salvation for which they were already predestined.
1976	Michel Foucault in *The History of Sexuality, Vol. 1*, theorizes *biopower* as that which made it possible for nation-states to bring 'life and its mechanisms into the realm of explicit calculations'; that is, to summon forth the bodies of individuals and populations as elements to be governed and managed in the service of such social imperatives as nation-building and colonial expansion.
1981	Feminist scholars Olivia Harris and Kate Young, commenting on Engels in 'Engendered structures: some problems in the analysis of reproduction', argue against naturalizing—i.e. locating in the ground of the biological—a distinction between reproduction and production.
1981	Marxist scholar Edward Yoxen publishes 'Life as a productive force: capitalizing upon research in molecular biology', in which he argues that a shift in the 'appropriation of living nature' takes place when capital begins to operate on biotic stuff at the molecular level.
1987	Literary critic Hortense Spillers in 'Mama's baby, papa's maybe' examines how the reproductive capacity of slaves under chattel slavery in the antebellum American South was conscripted by slaveholders into producing more slaves as property and as potential capital.
1988	Rural sociologist Jack Kloppenburg, in *First the Seed: The Political Economy of Plant Biotechnology, 1492–2000*, offers a history of the capitalization of plant matter.
1992	Anthropologist Paul Rabinow in 'Artificiality and enlightenment' coins the term *biosociality*, arguing that genetics, immunology, and environmentalism are 'leading vehicles for the infiltration of technoscience, capitalism, and culture into what the moderns called "nature"'(p. 245).
1992	Anthropologist Marilyn Strathern in *After Nature* and *Reproducing the Future* describes biological substance modified and capitalized as 'nature, enterprised-up'.
1993	Ecologist Walter V. Reid publishes 'Bioprospecting: a force for sustainable development' in *Environmental Science and Technology*. The term, a compression of 'biodiversity prospecting' refers to scouting in 'natural' settings (e.g. rainforests) for biological material (e.g. from plants) or information (e.g. traditional or indigenous knowledge) that may provide leads for natural products that can be industrialized or commercialized.
1995	Historian Harriet Ritvo in 'Possessing Mother Nature' offers a history of the remaking of livestock breeding in eighteenth-century Britain, when curated pedigrees emerged as tools to establish markets in what she terms *genetic capital* [see also Derry (2003) on the profit motive in breeding cattle, dogs, and horses beginning in 1800].
1997	In *Modest_Witness@Second_Millennium*, historian of biology Donna Haraway discusses a shift 'from kind to brand' in the taxonomy of living things in the days of biotechnology. OncoMouse™ is an exemplar of the new branded biology.

(*Continued*)

Table 1. Continued

1997	Physicist and critic of development Vandana Shiva publishes *Biopiracy: The Plunder of Nature and Knowledge*, building on then recent activist analyses of bioprospecting that construe the activity as a neocolonial practice of resource extraction, in which wealthy nations or companies dispossess poorer nations or people of their territorial, organic, or ethnobotanical inheritances, often at profit.
2000	Historian Hannah Landecker, in 'Immortality, in vitro', examines the case of the immortalized cancer cells of Henrietta Lacks, showing how they were serially imagined as valuable as the gift to science of an unknown woman, as the property of science, and, when they were discovered to originate in the body of a black woman, as two things: by some scientists, in line with racist visions of black sexuality, as hyperfecund, and by Lacks's family and advocates as a sign of an historical and continuing dispossession in the United States of black women from their bodies as property. Landecker made early versions of this argument in 'Between beneficence and chattel: the human biological in law and science' in 1999.
2000	Medical sociologist Catherine Waldby coins the term *biovalue*, 'generated wherever the generative and transformative productivity of living entities can be instrumentalized along lines which make them useful for human projects' (p. 33) (See also Waldby and Mitchell (2006)).
2001	Anthropologist Chaia Heller in 'McDonalds, MTV, and Monsanto: resisting biotechnology in the age of informational capital' theorizes 'biotechnology as a mode of production', and argues that scholars might name a new moment in capitalism, *the organic phase of capitalism*, in which 'capital targets the reproductive dimensions of cultural and biological life as loci for intensified production and commodification'.
2001	Science studies scholar Mike Fortun in 'Mediated speculations in the genomics futures markets' suggests that understanding the business of genomics requires attention to its speculative logic, which he examines by demonstrating the role of 'forward-looking statements' in generating investment and profit. This work elaborates his earlier interest in the rhetoric of speed in genomics (1999) and sets the stage for his 2002 argument that genomics operates in the 'future anterior', the *what-will-have-been*—the promise—an argument he will elaborate in 2008 in *Promising Genomics: Iceland and deCODE Genetics in a World of Speculation*.
2001	Anthropologist Margaret Lock's 'The alienation of body tissue and the biopolitics of immortalized cell lines' fuses political economic analysis with Foucauldian attention to body politics.
2001	Sociologist Nikolas Rose argues that new markets in health create a circumstance in which 'biopolitics becomes bioeconomics' (p. 15).
2003	Anthropologists Sarah Franklin and Margaret Lock define *biocapital* as a kind of wealth that depends upon a 'form of extraction that involves isolating and mobilizing the primary reproductive agency of specific body parts, particularly cells, in a manner not dissimilar to that by which, as Marx described it, soil plays the "principal" role in agriculture' (p. 8). Franklin and Lock understand this biocapital to be underwritten not only by production, but also by reproduction. Their thinking emerges from a May 2000 conference at the School of American Research, which they recall thus: 'Imagining ourselves (re)writing volume 1 of (bio)*Capital*, we attempted to specify as precisely as possible the range of forces at work in the transformation of life and death into means to (re)production and, in turn, into component parts that together compose an emergent global biological economy' (p. 13). Franklin's contribution to *Remaking Life and Death: Toward an Anthropology of the Biosciences*, the volume that emerged from this workshop, was entitled 'Ethical biocapital'.
2003	Sociologist Charis Thompson argues that the *biotech mode of (re)production* operates with 'promissory capital', 'capital raised for speculative ventures on the strength of promised future returns' (quoted in Franklin & Lock, 2003, pp. 6–7). In her 2005 book, *Making Parents: The Ontological Choreography of Reproductive Technologies*, Thompson turns her attention to what she calls the 'biomedical mode of reproduction'.
2003	Science studies scholar Kaushik Sunder Rajan in 'Genomic capital: public cultures and market logics of corporate biotechnology' defines 'biocapitalism' as that which asks, 'how "life" gets redefined through the contradictory processes of commodification' (p. 87). His biocapitalism has five features: a rhetoric of speed, corporate/university connections, porosity between commodity and gift economies in labs, excessive production, and biosocialities tuned to market logics.

2003 Anthropologist Cori Hayden in *When Nature Goes Public: The Making and Unmaking of Bioprospecting in Mexico* shows how bioprospectors often seek to create capital through channelling biodiversity through 'slightly choppy' (p. 10) networks that mix economies of purchase, benefit-sharing, dispossession, profit, and promise, many of which turn out to be situated in larger frames of North–South political economic inequality.

2005 Literary theorist Eugene Thacker in *The Global Genome* fixes on how the fluidity of genetic information as data permits it to be used as a currency in globalization. Thacker draws on the Marx of the *Grundrisse* as well as on Foucault to develop a theory of 'biological exchange' that aligns information management with moments in the movement of capital: encoding/production, recoding/circulation, decoding/consumption. Thacker thinks through the excess of bio-information using the work of Georges Bataille (1967) in *The Accursed Share*, which argues that the accumulation of surplus is not always fed back into production, but is often spectacularly spent on lavish wastage.

2006 Kaushik Sunder Rajan in *Biocapital: The Constitution of Postgenomic Life* follows Marx in parsing *biocapital* into industrial, commodity capital (such as therapeutic molecules) and speculative, commercial capital (such as stocks), which latter are often underwritten by quasi-religious sentiment, in the way Weber argued that the rise of merchant capital was motored by the Protestant ethic. Sunder Rajan uses Bataille to think about how speculation underwrites and permits practices of excess, particularly in the over-the-top expenditures of biotechnology start-ups in the United States.

2006 Anthropologists Adriana Petryna, Andrew Lakoff, and Arthur Kleinman in *Global Pharmaceuticals: Ethics, Markets, Practices* (2006) examine the inequalities that organize world distribution and markets in pharmaceuticals, a global economy in which access and excess are often inversely related. They draw on Bourdieu's notion of capital to locate pharmaceutical economies—of patents, products, and promises—in regimes of economic, cultural, material, and symbolic capital. They do not put the package together as *biocapital*—though Lakoff argues in 2005 that in pharmacogenomics, 'Biopolitics and the market were to be brought together through the application of genomic knowledge' (p. 171).

2007 Nikolas Rose extends earlier arguments of his that a 'mutation' from *biopolitics* to *bioeconomics* characterizes the dominant social order in at least the United States and Europe, writing that 'vitality has been decomposed into a series of distinct and discrete objects, that can be stabilized, frozen, banked, stored, accumulated, exchanged, traded across time, across space, across organs and species, across diverse contexts and enterprises, in the service of bioeconomic objectives' (p. 67). Rose notes that *BioCapital* is already a phrase circulating in the world of pharmaceuticals, frequently as a company name or service.

2007 Sarah Franklin in *Dolly Mixtures* looks at the history of 'stock' in livestock to think about the braided logic of breeding and wealth creation, from pre-capitalist to capitalist modes of accumulation, writing that 'capital in the older sense of stock derives out of a combination of genealogy, property and instrumentality' (p. 57).

2007 Science studies scholar Joseph Dumit theorizes *surplus health* as that which pharmaceutical companies conjure in order to 'add medications to our life through lowering the level of risk required to be "at risk"'(quoted in Sunder Rajan, 2007, p. 81). Dumit's Biomarks (or, sometimes, BioMarx) Experiment operates by substituting 'health' for 'labor' in *Capital* (consult Dumit, forthcoming).

2007 Political theorist Melinda Cooper in 'Life, autopoiesis, debt: inventing the bioeconomy', argues that capitalist culture operates through 'delirium', in which the drive of capital to overcome its own material limitations not only finds new resources, but also constantly redefines the 'nature' of resources (e.g. through turning debt or other crisis moments into value) in order to create surplus. Her later *Life as Surplus* (2008) elaborates this argument.

Note: [a] For Aristotle, *generativity* was such a essential property of nature that he saw the application of its logic to the artifice of exchange as an ethical problem. In his *Politics*, he wrote, 'Currency was intended to be a means of exchange, whereas interest represents an increase in the currency itself. Hence its name [*Tokos* ("offspring")] for each animal produces its like, and interest is currency born of currency. And so of all types of business this is the most contrary to nature' (I x 1258a27). Martin Luther in 1520 had a similar view: 'I do not understand how a hundred guilders can make twenty profit in a single year, or even one guilder make another. Nothing like this takes place by cultivating the soil, or by raising cattle, where the increase does not depend on human wits, but on God's blessing' (1961, p. 482). Note that if there is a generative biological inside Marx (via Aristotle and Luther), there is surely an economism inside Darwin: that of Malthus.

My timeline, though organized stratigraphically, also does not immediately indicate which writers relied upon which others to develop their arguments—which information could help trace how the concept of biocapital has developed and diversified. Co-citation or co-word analysis might make common links clear (see Cambrosio *et al.*, 1993), though a search for 'biocapital' in Thomson Scientific's Web of Science database yields only five journal articles, a teeny sample size. Plugging 'biocapital' into Google Scholar picks out Franklin and Sunder Rajan as key exponents of the concept, showing 24 citations to Sarah Franklin's 2003 articulation and 28 to Sunder Rajan's 2006 book and, strikingly, since both publish in anthropological venues, no cross-citations between the two, suggesting that there may be two scholarly conversations in motion here. A simple scientometric approach, of course, would be difficult to cash out as a full tracing of influence. Different scholars cast more and less finely meshed citation nets. As do different search algorithms.

These caveats in mind, Figure 1 below is a tentative genealogy, full, as all genealogies are, of repetitions, omissions, mistakes, surprises. Its nodes are the names of authors of peer-reviewed, published works that contribute to discussions of biocapital. Names are keyed to years and each scholar appears only once (in connection with either their first articulation of a concept important to biocapital or their most significant statement on the matter; usually, but not always, these are the same thing). The lines represent direct, more-than-in-passing citation. Turning away from the automatic information gathering

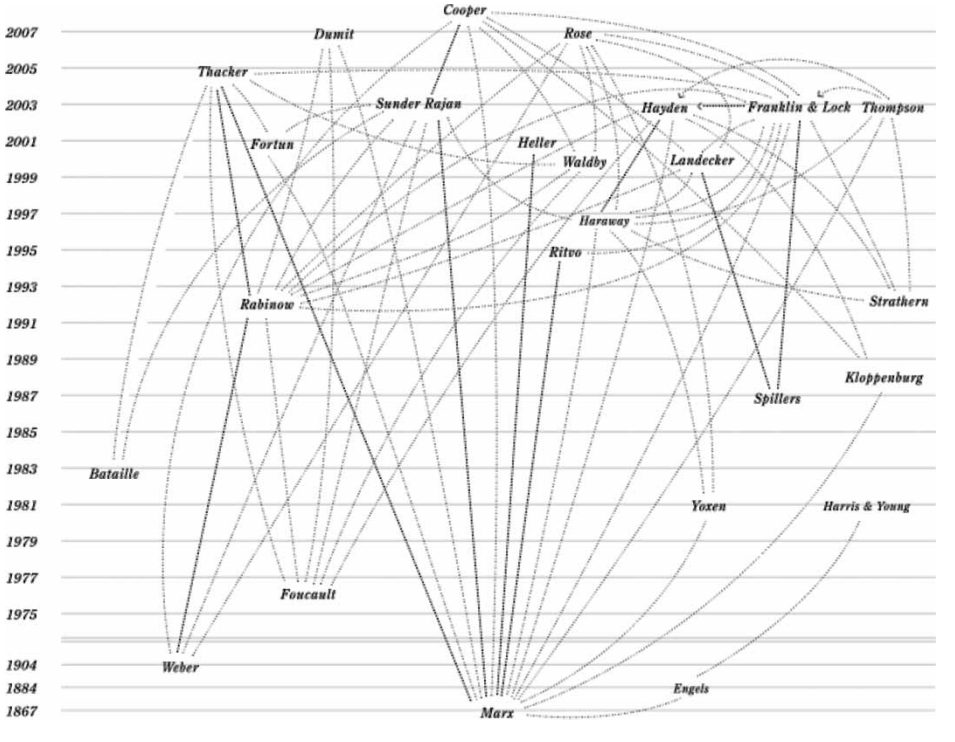

Figure 1. With apologies to Charles Darwin, a diagram of the divergence and convergence of taxa of biocapital. Rendered by Michael Rossi.

of citation analysis, I sought to locate authors' developments of concepts central to biocapital by using an antique method: reading.

Gillian Beer has suggested that Darwin's forking figure in the final pages of *Origin* 'could as well be interpreted by the eye as a shrub, branching coral, or seaweed' (2000, p. 86). The figure above is even weedier than Darwin's, but even within this thicket, two clusters of writing on biocapital can be discerned.

One cluster—loosely around Sarah Franklin, Margaret Lock, and Charis Thompson, and drawing significantly on Marilyn Strathern, Donna Haraway, and Paul Rabinow—might be called Marxist feminist. Here the binary of *production* versus *reproduction* is key, as are questions to do with sex/gender and race (particularly in work about reproductive technology). The remaking of boundaries between *nature* and *culture* is a central concern—one reason that attention to the changing substances and generativities of biology, emblematized by Hannah Landecker's work on the history of tissue culture, is also a signature feature of this scholarship.

A second cluster—around Kaushik Sunder Rajan, Eugene Thacker, and Michael Fortun, and drawing in diverse measure on Haraway and Rabinow—pays close attention to questions of meaning, though less to biomatter as such. Focusing on questions of information management and speculation, this scholarship has a Weberian flavour. Call it Weberian Marxist; relations of production are described alongside accountings of ethical subjectivity.

Of course, strains of each line are present in the other. And Marx's political economy and Foucault's biopolitics operate as crucial conditions of possibility for each. Melinda Cooper's work marks a recent fusion of the lines. Haraway's 2007 *When Species Meet*, not mapped here, also trellises the traditions together.[1]

Another feature of the discussion that leaps out—in both the list and genealogical representation—is the acceleration of the discussion in the late twentieth century. For those scholars interested in new kinds of financial speculation of genomics, biocapital tracks biotechnological innovation (recombinant DNA, PCR) as well as the history of legal agreements between universities and companies about the commercialization of university property, which begins in 1980 with the passage in the US Congress of the Bayh–Dole Act, which permitted universities and their employees to retain rights in patented inventions developed with federal monies and, if desired, to license or sell those inventions to private business. Academic–industrial biotech hybrids became common in the US after the Supreme Court in 1980 permitted the patenting of modified organisms in *Diamond v. Chakrabarty*. For those theorists of biocapital interested in the intercalation of reproductive technologies (IVF, cloning, pre-implantation genetic diagnosis) with new kinds of relations of commoditization (of women's reproductive labour, most notably), biocapital is entangled with changing relations of reproduction and kinship. It should be no surprise that discussions of biocapital mark a social moment.

I think the two schools of thinking on biocapital also have distinct orientations: they represent two sides of what, once upon a time, was called the *substantivist* position in economic anthropology. Against *formalist* economic anthropologists who believed that a common rational logic animated all exchange, *substantivists* sought to examine logics of exchange with respect to the cultural values that motivated them—values to do, for example, with kinship or prestige [for a review of the formalist versus substantivist debate, see Isaac (1993)].

The cluster of which Franklin, Landecker, Lock, Thompson, and Hayden are a part, I suggest, represents a substantivism keenly interested in the changing substances of

biology. Associates of this cluster attend directly to matters of generativity and reproduction. But they are careful not to take generativity and reproduction as 'natural laws' (as Marx did). In earlier work, Franklin, writing with Helena Ragoné (1998, p. 2), cautioned against 'the relegation of "reproduction" to a domain of "natural" or biological facts ... considered prior to, and separate from, sociality'—an argument that echoes an earlier position in Marxist feminist anthropology, in a 1981 piece by Olivia Harris and Kate Young, entitled 'Engendered structures: some problems in the analysis of reproduction', in which the authors argue against positing, as did Engels in *The Origin of the Family, Private Property, and the State*, a fundamental difference between reproduction and production.

A scholar like Sunder Rajan, meanwhile (and to return to the book review charge of this essay), may be read as a substantivist who looks at moral and ethical economies, joining Marxist political economy with a Weberian attention to meaning. Though he offers clear analyses of molecular biology lab practices, he is less interested in the substances of the biological, calling attention instead to the constructedness of biological facts upon which speculative exchange-value is predicated.[2] In *Biocapital*, he takes care not to impute any particular ontology to biological material—though by not engaging the earlier arguments of writers like Franklin and Lock about the new substances of 'life itself' which (via such materials as stem cells) contain and morph histories of sex/gender, race, colony, and nation, he misses a chance to dig into the politics of generation and reproduction that are in-the-remaking in biotechnology.[3] Together, however, Sunder Rajan's and Franklin and Lock's attention to the making of facts and the remaking of generativity can complicate such analyses as Eugene Thacker's, which argues that bioengineering relies on a '"molecular species being", a species being in which labor power is cellular, enzymatic, and genetic' (2005, p. 40). That formulation is a molecular rewrite of Engels' famous 1876 reflection on 'The part played by labor in the transition from ape to man', in which Engels naturalized labour, via evolutionary theory, as that process at the heart of anthropoid organisms' self-making (see Engels, 1884).

But let me cut across these substantivisms, and offer a less nit-picky classification. Taking a cue from evolutionary biology, I'll pick an analogous structure that operates in the bodies of all the work I've discussed: the very concept of *biocapital* (and its similars). Comparing how the concept fares in different bodies of work may permit us to set up a series of exchanges among them.

What is biocapital? My sense is this:

In *Capital*, Marx describes the circulation of money as capital—in which 'More money is finally withdrawn from circulation than was thrown into it at the beginning' (1867, p. 251)—using the formula $M–C–M'$, where M stands for money, C for commodity, $'$ for the surplus value gained in a profitable exchange of a commodity for money, and M' for the total capital produced by that exchange. For the biotech imagination, I suggest an analogous formula to describe the making of biology into capital: $B–C–B'$, where B stands for biomaterial, C for its fashioning into a commodity through laboratory and legal instruments, and B' for the biocapital produced at the end of this process, with $'$ the value added through the instrumentalization of the initial biomaterial.

What does $B–C–B'$ look like for the theorists discussed above? How do different species of biocapital organize the metabolic pathway that makes B into B'? What 'primes' biology? Table 2 is an unfinished chart. The reader is invited to treat it as a worksheet, working through the quibbles and quarrels that have surely been percolating in his or her head while reading my accounting.

Table 2. Unfinished worksheet

	B	*C*	*B′*
Marx	'means of production already produced'		
Engels	means of reproduction		
Spillers	reproductive capacity	chattel slavery	humans born into chattel slavery
Harris & Young			
Rabinow	nature known and remade through technique		
Ritvo			labour accumulated in the bodies of reproducing animals
Shiva			labour appropriated from organic nature
Landecker	flux	laboratory instruments	
Waldby	generative and transformatively productive	biovalue as exchange-value	biovalue in the context of profit
Heller	reproductive		commoditization
Fortun		forward-looking statements	speculation
Franklin & Lock	'the primary reproductive agency of specific body parts, particularly cells'		
Thompson		'promissory capital'	
Thacker	'molecular species being', 'a species being in which labor power is cellular, enzymatic, and genetic'	exchange-value as material and informatic	
Sunder Rajan	biology as constructed scientific fact	commoditization via Weberian ethics	industrial, commodity capital and speculative, commercial capital
Rose	'vitality . . . a series of distinct and discrete objects, that can be stabilized, frozen, banked, stored, accumulated, exchanged, traded across time, across space, across organs and species, across diverse contexts and enterprises'		
Cooper		'delirium' as a mode of refashioning rather than merely interpreting value	
Reader			

In recent work, I have suggested that the sentiment of many biotech boosters has them imagining B' already to be latent in B—to believe that biological process itself already constitutes a form of surplus value and profit production (Helmreich, 2007).[4] This logic naturalizes biotech. Biological generativity is configured as accumulated labour power, the products of which can be harnessed to create productive futures. This belief is based, it bears emphasizing, on a metaphor: that organisms are labourers [an equivalence declared even by Marx, who saw the natural consumption of eating entailing production of the body (1857–58, p. 228)]. The negative image of biocapital then becomes *necrocapital*, dead matter, like fossil fuel, put to unregenerative, zombie-like work. But we must be careful not to imagine reproduction as a transparently 'natural' process, as though organisms' coming-into-being straightforwardly designates them as what Marx would have called 'means of production already produced', as though their productivity is the essence of their *species being*. To see matters this way is to see organisms as natural factories or assembly lines, when in fact they only become so in certain relations. As Hannah Landecker argues, contemporary biology has become expert at stopping, starting, suspending, and accelerating cellular processes, wedging these dynamics into processes that look like a molecular version of industrial agribusiness. But biotech geese cannot lay golden eggs without daily tending.

What does lining up the various formulae for $B–C–B'$ in this chart permit us to do? To begin, this accounting points back to Bourdieu—a figure mostly absent from theories of biocapital—and allows us to name how each B' corresponds to economic, cultural, social, and symbolic species of capital (also, in the bargain, making explicit the Darwinian, Marxist, Weberian, and Foucauldian ancestries in play in different theorists' formulations). It can allow us to draw up a table of exchanges between different B primes, species of biocapital.

But—to draw upon the evolutionary biology idiom once again—such a classification assumes the neatness of the species concept, which is, after all, these days newly in crisis; recent stem cell research has seen the creation of trans-specific hybrids, contemporary molecular biology has discerned thick lateral gene transfer tangling up taxonomic boundaries almost everywhere. But more, sorting biocapital into species has the effect of holding stable the item against which different species of biocapital exist at all—namely, *capital* itself. What if we asked not what happens to biology when it is capitalized, but asked rather whether capital must be the sign under which all of today's encounters of the economic with the biological must travel? It is certainly the case, as medical anthropologists such as Margaret Lock (2002), Lawrence Cohen (2005) and Leslie Sharp (2006) have shown, that the circulation of organs is not in every instance overdetermined by capitalism (the fraught language of donation and trafficking is a give-away here). Cathy Waldby's *biovalue*, Sarah Franklin's *breedwealth* [1997; see also Franklin (2006) on *biowealth*], and Donna Haraway's 2007 *encounter value* (a term she suggests might join use-value and exchange-value to make clear that exchange is always the result of encounter) are germs of theory that undo the capitalocentrism of so much writing on biocapitalism—and also, perhaps, the emphasis in such writing on the commodity form. Emerging social histories of 'bioeconomy'—looking back to early population sciences to think through political economy—might be another place to look for analyses that include, but reach beyond capitalism (see Larsen, 2005). What if we imagined biovalue and bioeconomy through J. K. Gibson-Graham's *The End of Capitalism (As We Knew It): A Feminist Critique of Political Economy* (1996), which seeks to break away from the delirious

reinscription of capital that happens even in its Marxist critique? What if, refusing to make capital into the coin of exchange across these concepts—and, more, refusing to trust that exchange as such can permit the adequation of different values—we found that capital itself, like the species concept, was unstable, was not so easily reproduced, or so generative, or omnipresent, after all?

Acknowledgements

Thanks to Samer Alatout, Kean Birch, Joseph Dumit, Sarah Franklin, Hannah Landecker, Vincent Lépinay, Bill Maurer, Heather Paxson, Ramya Rajagopalan, Sophia Roosth, and Michael Rossi for comments.

Notes

[1]The tree representation overlooks important mechanisms and vehicles for the travel of concepts [see Ingold (2007) on the functions of lines as connectors, threads, and traces]. It leaves out the lateral transfections and endosymbiotic fusions consequent on classes taken, conference papers heard, drafts circulated, readers reports rendered (Rabinow started giving a biosociality talk in 1990; Fortun was speaking on 'Projecting Speed Genomics' as early as 1994; Thompson's notion of the promissory circulated at a 2000 conference; Sunder Rajan's dissertation, with the same title as his book, was finished in 2002, etc.). Perhaps most damagingly, it leaves out the fact that authors' positions change over time. As with corroborating phylogenies created through bioinformatics, interpreting and querying the tree requires cracking questions of meaning, translation, and transcription: knowing who read (and understood and cared about) *what*, *when*. These lines are surely tied to particular academic departments and to the composition of dissertation committees [see Hess (1995, p. 138) for a diagram of 'Hiring Patterns Among American Anthropology Departments']. A representation like that of the 'Neurotree' (http://neurotree.org/neurotree/) project, in which advisors in the neurosciences are named as 'Parents' to their students, who are called 'Children', would be intriguing—though a look at committees and conference conversations would likely reveal each scholar to have several daddies and mommies. Any model of the inheritance of properties would also map out a story of the transmission of what Bourdieu called *academic capital* [with credit and credibility not far behind—see Latour and Woolgar's (1986, p. 201) circle diagram of cycles of conversion between types of capital, in which recognition → grant → money → equipment → data → arguments → articles → recognition → and so on . . .]. And—to stay with the monetary metaphor—such a tracking of the accumulation of academic capital could either confirm or undo George Marcus's worry (which he articulated for ethnography) about the establishment of an 'inflationary sphere of pedagogy and anticipatory reception' (2007, p. 1129).

What about another representation? How about those admixture analyses so popular these days among producers and consumers of genetic genealogies? The ones that deliver results like: you are 57% German, 23% Irish, and 20% Choctaw? That could have us figuring out which percent each scholar's concept of biocapital is, say, Marx, Foucault, or Weber.

[2]Compare social theorists of finance as far back as Gabriel Tarde, who in 1902 looked to organic metaphors to think through capital as a relationship between potentialities of invention and accumulation. Tarde developed the metaphors of *germ capital* and *cotyledon capital* to account for the origin and maintenance of capital not exclusively in accumulated labour, but in ratios of difference and repetition realized in reproduction and production imagined as contingent collaborations of human, machine, and nature [Lépinay (2007b); imagining the biotic as machinic, even factory-like, is another basis for imagining biocapital, one that it would take another essay to dissect]. While Tarde often came close to naturalizing reproduction as an energy potential latent in nature, his view of germ capital and cotyledon capital as only legible in retrospect complicates this view.

Complicating another biological metaphor in social studies of money, the work of Vincent-Antonin Lépinay (2007a) critiques the notion that financial formula packages such as Capital Guarantee Products are 'parasitic' on the industrial goods to which they putatively refer, arguing that such products circulate in the same sphere of valuation as the 'organisms' to which they are calibrated. Such a critique of how

'parasitism' is employed to describe derivative financial instruments could be extended to direct attention to the parasite metaphor's anti-Semitic resonances in the history of finance in the West (particularly in characterizations of lending money at interest) (see Raffles, 2007).

[3]Sunder Rajan's use of the concept of 'lively capital' in his forthcoming edited volume (collecting essays from a pair of conferences he organized under that heading at UC Irvine in 2004 and 2005) will be interesting to watch for how it extends or complicates his earlier conception of biocapital—and also, particularly for my analysis here, for how 'liveliness' is theorized. See also Haraway (2007) on lively capital.

[4]Autocitation analysis: I cite Fortun, Franklin and Lock, Harris and Young, Heller, Landecker, Marx, Strathern, Sunder Rajan, Thacker, Thompson, and Waldby. Mortifying omissions include Kloppenburg and Yoxen. Foucault and Haraway, whom I see I do not explicitly cite, are in the inking water . . .

References

Aristotle (1981) *The Politics* (Harmondsworth: Penguin).

Bataille, G. (1967) *The Accursed Share, Volume I: Consumption* (New York: Zone).

Beer, G. (2000) *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot and Nineteenth-Century Fiction,* , 2nd edition edn. (Cambridge: Cambridge University Press).

Bourdieu, P. (1991 [1982]) *Language and Symbolic Power* (Cambridge: Harvard University Press).

Boyd, W. (2003) Wonderful potencies? Deep structure and the problem of monopoly in agricultural biotechnology, in: R. A. Schurman and D. D. T. Kelso (Eds) *Engineering Trouble: Biotechnology and Its Discontents*, pp. 24–62 (Berkeley: University of California Press).

Cambrosio, A., Limoges, C., Courtial, J. P. and Laville, F. (1993) Historical scientometrics? Mapping over 70 years of biological safety research with coword analysis, *Scientometrics*, 27(2), pp. 119–143.

Cohen, L. (2005) Operability, bioavailability, and exception, in: A. Ong and S. Collier (Eds) *Global Assemblages: Technology, Politics, and Ethics as Anthropological Problems*, pp. 124–143 (Malden, MA: Blackwell).

Comaroff, J. and Comaroff, J. L. (2000) Millennial capitalism: first thoughts on a second coming, *Public Culture*, 12(2), pp. 291–343.

Cooper, M. (2007) Life, autopoiesis, debt: inventing the bioeconomy, *Distinktion*, 14, pp. 25–43.

Cooper, M. (2008) *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era* (Seattle: University of Washington Press).

de Chadarevian, S. (2002) *Designs for Life: Molecular Biology after World War II* (Cambridge: Cambridge University Press).

Derry, M. (2003) *Bred for Perfection: Shorthorn Cattle, Collies, and Arabian Horses since 1800* (Baltimore: The Johns Hopkins University Press).

Dumit, J. (forthcoming) Prescription maximization and the accumulation of surplus health in the pharmaceutical industry: the_biomarx_experiment, in: K. Sunder Rajan (Ed.) *Lively Capital* (Durham: Duke University Press).

Engels, F. (1884) *The Origin of the Family, Private Property, and the State in the Light of the Researches of Lewis Henry Morgan* (New York: International Publishers, 1972).

Fitzgerald, D. (1990) *The Business of Breeding: Hybrid Corn in Illinois, 1890–1940* (Ithaca: Cornell University Press).

Fortun, M. (1999) Projecting speed genomics, in: M. Fortun and E. Mendelsohn (Eds) *The Practices of Human Genetics. Sociology of the Sciences Yearbook 21*, pp. 25–48 (Dordrecht: Kluwer).

Fortun, M. (2001) Mediated speculations in the genomics futures markets, *New Genetics and Society*, 20(2), pp. 139–156.

Fortun, M. (2002) The human genome project: past, present, and future anterior, in: E. A. Garland and R. M. MacLeod (Eds) *Science, History, and Social Activism: A Tribute to Everett Mendelsohn*, pp. 339–362 (Dordrecht: Kluwer).

Fortun, M. (2008) *Promising Genomics: Iceland and deCODE Genetics in a World of Speculation* (Berkeley: University of California Press).

Foucault, M. (1978) *The History of Sexuality Volume 1* (New York: Vintage).

Franklin, S. (1997) Dolly: a new form of genetic breedwealth, *Environmental Values*, 6, pp. 427–437.

Franklin, S. (2003) Ethical biocapital, in: S. Franklin and M. Lock (Eds) *Remaking Life and Death: Toward an Anthropology of the Biosciences*, pp. 97–127 (Santa Fe: SAR Press).

Franklin, S. (2006) Bio-economies: biowealth from the inside out, *Development*, 49(4), pp. 97–101.

Franklin, S. (2007) *Dolly Mixtures: The Remaking of Genealogy* (Durham: Duke University Press).
Franklin, S. and Lock, M. (Eds) (2003) Animation and cessation, *Remaking Life and Death: Toward an Anthropology of the Biosciences*, pp. 3–22 (Santa Fe: SAR Press).
Franklin, S. and Ragoné, H. (Eds) (1998) Introduction, *Reproducing Reproduction: Kinship, Power, and Technological Innovation*, pp. 1–14 (Philadelphia: University of Pennsylvania Press).
Fullwiley, D. (2007) The molecularization of race: institutionalizing human difference in pharmacogenetics research, *Science as Culture*, 16(1), pp. 1–30.
Gibson-Graham, J. K. (1996) *The End of Capitalism (As We Knew It): A Feminist Critique of Political Economy* (Oxford: Blackwell).
Haraway, D. (1997) *Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse™: Feminism and Technoscience* (New York: Routledge).
Haraway, D. (2007) *When Species Meet* (Minneapolis: University of Minnesota Press).
Harris, O. and Young, K. (1981) Engendered structures: some problems in the analysis of reproduction, in: J. S. Kahn and J. R. Llobera (Eds) *The Anthropology of Pre-capitalist Societies*, pp. 109–147 (London: Macmillian).
Harvey, D. (1989) *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Cambridge, MA: Blackwell).
Hayden, C. (2003) *When Nature Goes Public: The Making and Unmaking of Bioprospecting in Mexico* (Princeton: Princeton University Press).
Heller, C. (2001) McDonalds, MTV, and Monsanto: resisting biotechnology in the age of informational capital, in: B. Tokar (Ed.) *Redesigning Life? The Worldwide Challenge to Genetic Engineering*, pp. 405–419 (London: Zed Books), Available at: http://www.social-ecology.org/article.php?story=20031028150738895.
Helmreich, S. (2007) Blue-green capital, biotechnological circulation and an oceanic imaginary: a critique of biopolitical economy, *BioSocieties*, 2(3), pp. 287–302.
Hess, D. (1995) *Science and Technology in a Multicultural World: The Cultural Politics of Facts and Artifacts* (New York: Columbia University Press).
Hogle, L. (1999) *Recovering the Nation's Body: Cultural Memory, Medicine, and the Politics of Redemption* (New Brunswick: Rutgers University Press).
Ingold, T. (2007) *Lines: A Brief History* (London: Routledge).
Isaac, B. (Ed.). (1993) Retrospective on the formalist–substantivist debate, *Research in Economic Anthropology*, pp. 213–233 (Greenwich, CT: JAI Press).
Jasanoff, S. (2005) *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton: Princeton University Press).
Kay, L. (1993) *The Molecular Vision of Life: Caltech, the Rockefeller Foundation, and the Rise of the New Biology* (Oxford: Oxford University Press).
Keller, E. F. (1995) *Refiguring Life: Changing Metaphors of Twentieth-century Biology* (New York: Columbia University Press).
Kloppenburg, J. R. (1988) *First the Seed: The Political Economy of Plant Biotechnology, 1492–2000* (Cambridge: Cambridge University Press).
Lakoff, A. (2005) *Pharmaceutical Reason: Knowledge and Value in Global Psychiatry* (Cambridge: Cambridge University Press).
Landecker, H. (1999) Between beneficence and chattel: the human biological in law and science, *Science in Context*, 12(1), pp. 203–225.
Landecker, H. (2005) Living differently in time: plasticity, temporality and cellular biotechnologies, *Culture Machine*, 7, an e-journal at culturemachine.tees.ac.uk/Articles/landecker.htm.
Larsen, L. T. (2005) Speaking truth to biopower: on the genealogy of bioeconomy, *Distinktion*, 14, pp. 9–24.
Latour, B. and Woolgar, S. (1986) *Laboratory Life: The Construction of Scientific Facts*, 2nd edn. (Princeton: Princeton University Press; first edition: Beverly Hills: Sage, 1979).
Lépinay, V.-A. (2007a) Parasitic formulae: the case of capital guarantee products, *Sociological Review*, 55(Supplement 2), pp. 261–283.
Lépinay, V.-A. (2007b) Economy of the germ: capital, accumulation and vibration, *Economics and Society*, 36(4), pp. 526–548.
Lock, M. (2001) The alienation of body tissue and the biopolitics of immortalized cell lines, *Body & Society*, 7(2–3), pp. 63–91.
Lock, M. (2002) *Twice Dead: Organ Transplants and the Reinvention of Death* (Berkeley: University of California Press).

Luther, M. (1520) An appeal to the ruling class of German nationality as to the amelioration of the state of Christendom, in: J. Dillenberger (Ed.) *Martin Luther: Selections from His Writings*, pp. 403–488 (Garden City, NY: Anchor Books).

Marcus, G. (2007) Ethnography two decades after *Writing Culture*: from the experimental to the baroque, *Anthropological Quarterly*, 80(4), pp. 1127–1145.

Marx, K. (1857–58) *The Grundrisse*. Excerpted in: R. C. Tucker (Eds) *The Marx–Engels Reader* 2nd edition, 221–293 (New York: W. W. Norton & Company, 1978).

Marx, K. (1867) *Capital Volume 1* (London: Penguin).

Maurer, B. (2000) A fish story: rethinking globalization on Virgin Gorda, British Virgin Islands, *American Ethnologist*, 27(3), pp. 670–701.

Mintz, S (1985) *Sweetness and Power: The Place of Sugar in Modern History* (New York: Penguin Books).

Montoya, M. (2007) Bioethnic conscription: genes, race, and Mexicana/o ethnicity in diabetes research, *Cultural Anthropology*, 22(1), pp. 94–128.

Petryna, A., Lakoff, A. and Kleinman, A. (2006) *Global Pharmaceuticals: Ethics, Markets, Practices* (Durham: Duke University Press).

Rabinow, P. (1992) Artificiality and enlightenment: from sociobiology to biosociality, in: J. Crary and S. Kwinter (Eds) *Incorporations*, pp. 234–252 (New York: Zone).

Raffles, H. (2007) Jews, lice, and history, *Public Culture*, 19(3), pp. 521–566.

Reid, W. V. (1993) Bioprospecting: a force for sustainable development, *Environmental Science Technology*, 27(9), p. 1730.

Ritvo, H. (1995) Possessing mother nature: genetic capital in eighteenth-century Britain, in: J. Brewer and S. Staves (Eds) *Early Modern Conceptions of Property*, pp. 413–426 (London: Routledge).

Rose, N. (2001) The politics of life itself, *Theory, Culture & Society*, 18(6), pp. 1–30.

Rose, N. (2007) *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* (Princeton: Princeton University Press).

Scheper-Hughes, N. (2001) Commodity fetishism in organs trafficking, *Body and Society*, 7(2–3), pp. 31–62.

Sharp, L. (2006) *Strange Harvest: Organ Transplants, Denatured Bodies, and the Transformed Self* (Berkeley: University of California Press).

Shiva, V. (1997) *Biopiracy: The Plunder of Nature and Knowledge* (New York: Zed Books).

Spillers, H. (1987) Mama's baby, papa's maybe: an American grammar book, *Diacritics*, 17(2), pp. 65–81.

Strathern, M. (1992a) *After Nature: English Kinship in the Late Twentieth Century* (Cambridge: Cambridge University Press).

Strathern, M. (1992b) *Reproducing the Future: Anthropology, Kinship, and the New Reproductive Technologies* (New York: Routledge).

Sunder Rajan, K. (2003) Genomic capital: public cultures and market logics of corporate biotechnology, *Science as Culture*, 12(1), pp. 87–121.

Sunder Rajan, K. (2006) *Biocapital: The Constitution of Postgenomic Life* (Durham: Duke University Press).

Sunder Rajan, K. (2007) Experimental values: Indian clinical trials and surplus health, *New Left Review*, 45, pp. 67–88.

Sunder Rajan, K. (forthcoming) *Lively Capital* (Durham: Duke University Press).

TallBear, K. (2008) Native-American-DNA.com: in search of Native American race and tribe, in: B. Koenig, S. S-J. Lee and S. Richardson (Eds) *Revisiting Race in a Genomic Age* (New Brunswick: Rutgers University Press).

Thacker, E. (2005) *The Global Genome: Biotechnology, Politics, and Culture* (Cambridge: MIT Press).

Thompson, C. (2005) *Making Parents: The Ontological Choreography of Reproductive Technologies* (Cambridge: MIT Press).

Waldby, C. (2000) *The Visible Human Project: Informatic Bodies and Posthuman Medicine* (London: Routledge).

Waldby, C. and Mitchell, R. (2006) *Tissue Economies: Blood, Organs, and Cell Lines in Late Capitalism* (Durham: Duke University Press).

Weber, M. (1905) *The Protestant Ethic and the Spirit of Capitalism* (New York: Routledge), 2001.

Wright, S. (1994) *Molecular Politics: Developing American and British Regulatory Policy for Genetic Engineering, 1972–1982* (Chicago: University of Chicago Press).

Yoxen, E. (1981) Life as a productive force: capitalizing upon research in molecular biology, in: L. Levidow and R. Young (Eds) *Science, Technology, and the Labour Process*, pp. 66–122 (London: Blackrose Press).