THE PALGRAVE HANDBOOK OF BIOLOGY AND SOCIETY

Edited by Maurizio Meloni, John Cromby,
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Introducing the New Biosocial Landscape

Maurizio Meloni, John Cromby, Des Fitzgerald, and Stephanie Lloyd

For many decades, the study of society and the study of biology have been estranged from one another. There are complex reasons for this estrangement. Those reasons are rooted partly in the ways that, for a long time, biologists configured the relationship between their epistemic objects (particularly genes) and those objects' environmental influences; they are also partly rooted in the way that social scientists insisted, for an equally long period, on a strict division of labour between the sciences of society and the sciences of life. Yet many social scientists have now shown that a neat demarcation between the social and the biological has been largely illusory given the intense proliferation of objects, practices, and cultures that have persisted along a supposedly rigid biology/society border (Haraway 1991; Kroenfeldner 2009; Meloni 2016, reprinted here as Chap. 3). Nevertheless, the distinction between the biological and the social has become part of our everyday conceptual fabric—an inescapable metaphysics to which, to various degrees, all of us have more or less succumbed.

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When considered from an historical perspective, the estrangement between knowledge of biological life and knowledge of social processes has arguably been a necessary step. Richard Lewontin famously pointed out that Darwin had to propose an impoverished model of the relationship between organism and environment in order to overcome 'an obscurantist holism that merged the organic and the inorganic into an unanalyzable whole' (2000, 47). However, as Lewontin further noticed, often the epistemological presumptions 'that are necessary for progress at one stage in history become bars to further progress at another' (ibid.). The model suggested by Darwin is in fact nowadays enriched by models (for instance, niche-construction, Odling-Smee et al. 2003) that point to a more complex relationship between organism and *milieu*.

A similar development has occurred in the relationship between knowledge of life processes and knowledge of society, where an initial estrangement may have been, *inter alia*, a productive process. If we compare the holism of nineteenth-century sociologists like Herbert Spencer, for whom there is no social advancement without corresponding biological growth, to the rejection of biological explanations proposed by turn-of-the-century social scientists such as Émile Durkheim or Alfred Kroeber, it is arguable that this rejection was an important step on the way to a more potent understanding of social life. Today, however, that well-known self-sufficient entity, the social fact, has become an obstacle for a broader comprehension of the world in which we live, in all its inextricably biosocial or biocultural dimensions. This *Handbook* is an attempt to wedge us across that obstacle. It is motivated by an intuition (and it is hardly alone in this) that the time has come to reposition this historical legacy and to move beyond the acrimonious controversies that have characterized twentieth-century thought as it traversed the biology/society border.

This *Handbook* provides the first comprehensive overview of the extent to which, and how quickly, we are moving beyond the charged debates that characterized much 'biosocial' thought in the twentieth century. Bringing together a compelling array of truly interdisciplinary contributions, the *Handbook* shows how nuanced attention to *both* the biological sciences *and* the social sciences opens up novel perspectives on some of the most significant sociological, anthropological, philosophical, and biological questions of our era. Our central assertion is that the life sciences, broadly conceived, are currently moving toward a more social view of biological processes, just as the social sciences are beginning to reincorporate notions of the biological body into their investigations.

We are perfectly aware that others have mapped this terrain before us (Fox Keller 2011; Lock 2015; Rose 1997, 2013). Nonetheless, there is work to be done to bring together the burgeoning but too often fragmented work that has powerfully emerged within that terrain. That work, in turn, has rested on some striking developments across a range of intellectual domains. We think here of work in social neuroscience, which shows not simply that the capacity for interaction is instantiated in the brain, but that brain structure and function are themselves part-produced through particular sets of environmental and social relations (see e.g., Cacioppo 2002); we think also of the discovery of adult neurogenesis in humans, the realization that parts of the adult brain continue to produce new cells through the lifetime, that these cells may have functional significance, and that they may be affected by developmental and environmental impacts (see e.g., Gould et al. 1999); and we think of the renewed emphasis on neuroplasticity, which suggests that the brain continues to change and develop as a person ages and lives (see e.g., Draganski et al. 2004). Similar developments occur in what, in molecular biology, is called the postgenomic moment—the increasing awareness of a profound malleability of genomic functioning and a recognition of its dependence on time and place, biography and milieu, social institutions and experiences, with profound implications for the notion of biological heredity that we have received from the century of the gene (Lappé and Landecker 2015; Stallins et al. 2016; Meloni 2016). Today, we know that DNA expression is influenced by factors including toxins, work stress, nutrition, socio-economic status, early childhood care, perhaps even the lifestyle of one's mother, father, or grandparents—all factors that at least partially exceed the traditionally biological. This new understanding, with DNA always ready to respond to environmental cues, is, somewhat paradoxically, a product of scientific advances that were expected to deepen and confirm pre-existing theories of the fixed gene.

These developments have come at a propitious time for the social sciences, and especially for social theory. As Nikolas Rose points out, 'over the last decade a number of social theorists and feminist philosophers have come to realize that it is not reactionary to recognize the reality of our fleshly nature, and to examine the possibilities and constraints that flow from it' (2007, 4). We have thus seen, in feminist theory especially, in related trends such as the 'affective turn' and, more recently, in a body of work going under the sign of a 'new materialism' (Coole and Frost 2010), a growing and often contested assemblage of turns to materialities, affects, ontologies, and bodies—all of which have contributed to a corpus of theoretical work that no longer accounts for itself in terms of its distance from biology—and, indeed, sometimes moves

in quite the opposite direction (Wilson 2004, 2015; see Pedwell and Whitehead 2012, for an important overview of some of these developments). Scholars such as Donna Haraway (1997) and Karen Barad (2007), for example, have edged social scientists away from taking the natural sciences in general, and the biological sciences in particular, as mere objects or resources—as only practises that might be looked *at*, rather than *with*. At the risk of flattening out important distinctions between diverse perspectives, these trends undo binary oppositions between biological influences and social forces, and so have begun to legitimate social research that unpicks the separation between natural and social science.

Given the forms of erasure often built into claims to novelty (see Ahmed 2008), we are reluctant to hail only the newness of such developments. Nevertheless, it does seem, today, that there are many opportunities to do deeply consequential sociological and anthropological work with, and through, bioscientific knowledge and practice. And perhaps this should not be surprising. No matter the hyperspecialization of contemporary scholarship, with its sharp policing of disciplinary boundaries (an actuality partly concealed by rhetorics of 'interdisciplinarity'), human life remains stubbornly biosocial through and through. Whether it is the disproportionate distribution of certain diseases in lower socio-economic groups (Marmot 2010), or the visceral reactions that hate speech may provoke (Zembylas 2007); whether it is the way in which socio-economic and scientific activity modifies bacterial life (Landecker 2016) or gets physically recorded into the outer environment, or in genomic expression; whether it is the way in which normative views of gender, class, and race imbue the materiality of scientific findings with meaning and thereby transform them (Haraway 1989); or the way in which political forms and institutions affect how bacterial diseases take form and circulate (Nading 2012), few central objects of either the social *or* biological sciences today can be understood other than with complex biosocial, biocultural, or biohistorical rubrics.

The aims of this *Handbook* are twofold. First, to demarcate an epistemic space in the relationship between the life sciences and the social sciences. This space stands orthogonally to previous sociobiology-biosociety debates, especially those that took shape in the last quarter of the last century. Thus, we were exhorted either to pit the biological *against and before* the social (sociobiology, evolutionary psychology), or to promote the social *against and above* the biological. This *Handbook* aims to undermine this symmetrical hostility. In so doing, we don't want to oversimplify the complex and disparate (if interdependent) matrices of method, theory, and knowledge at stake on both sides of these divides—nor indeed to gloss the dense networks of power and status

in which they are enmeshed. While perhaps these contributions are only first steps, the biosocial that emerges from this assemblage of 38 chapters, at least, no longer depends upon an original separation of biological and social forces, organism and environment, agent and milieu, that have then to be awkwardly recomposed in a secondary, additional moment (see Fitzgerald and Callard 2015, reprinted here as Chap. 19).

This has clear implications for knowledge production. In part, this is because the entanglements our contributors identify challenge the neat separation between content and context that favours 'entrenched ways of conceiving causation and agency' (Alder 2013, 97) wherein humans are conceived largely independently of their circumstances. But it is also because these entanglements go well beyond now-established social constructionist claims that biological knowledge is shaped by meaning, power, and norms. Rather, biological matter itself, be it genomes, brains, diseases, or viruses, is simultaneously irremediably social, not only in its form but also in its content. And vice versa: the very fabric of sociality is always enabled, mediated, and modulated by fleshy substrates—be they genetic or epigenetic, nutritional, metabolic, hormonal, behavioral, or toxicological. At all levels, the biological and the social are *in* one another.

Our second aim is to avoid dissipating this knowledge through the too-many rivers and trickles of the contemporary academy. The very gesture of bringing together research that is otherwise largely fragmented and isolated is part of a performative gesture of creating new spaces. In so doing, this *Handbook* offers a relatively stable research platform, and functions as a teaching tool to help foster a new generation of scholars who are more capable of thinking in complex, critical ways: about the nuances of our irreducibly hybrid, entangled, biosocial world, and about the benefits and costs of the prevailing metaphysics that drives a wedge between biology and society, and which still primordially structures much academic work.

Overview of the Chapters

Handbooks, we suggest, are epistemic things of a sort—they are contingent, hard-to-grasp, generative objects; they are set out into the world, and worked upon; they unfold, under examination, in multiple ways; and if they never achieve their final definition, still it is only later we come to realize that the always-in-process work of *defining*, and of *being defined*, is where the epistemic and ontological magic happens (Rheinberger 2010). Perhaps it would be better to say that handbooking is an epistemic practice (Knorr Cetina

2001)—which is to say that it is a dynamic activity of nudging, moving, and sometimes disrupting the objects and practices of knowledge that it comes into contact with. This volume, perhaps more than most, is generated, assembled, worked on, and distributed as a dynamic intervention into an emerging space: the six sections are conceived precisely in the spirit of intervening in key hotspots of the biology/society debate. Two additional notes before we describe the chapters: (1) While this volume is for (indeed, founds its contribution on) a certain kind of comprehensiveness, such a goal always, and of necessity, remains in the distance; we would not have it otherwise, and do not wish to exert any totalizing force here. Nonetheless, more prosaically, there are gaps in what follows, some of which we are aware of (although we will not compound the error by naming them!); other gaps will have to wait for our readers to gently point them out. Such gaps can be variously attributed to the exigencies of time and space, bad fortune, or the blindnesses and prejudices of the editors. Without wishing to disavow responsibility for our own omissions, we truly hope to see, in future years, other volumes, from other authors and editors, making good where we have erred. (2) There are authors who write both from 'inside' and 'outside' different practices in what follows. Which is to say: there are those describing some elements (either in hope or in concern) of their own practice here, and there are those (both encouragingly and critically) accounting for the practice of some *other*. (And there are more, probably the majority, awkwardly straddling such logics of inside and outside.) In any event, we have chosen not to mark these distinctions; where disciplinary and other divisions are bureaucratically real enough already, we have no desire to make them more so. If this strategy will occasionally confuse the reader, we are nonetheless convinced that the convivial intentions of the volume are not well served by marking, in advance, who wishes to be in and who out.

A final note: in this time of ascendant protectionist nationalisms and racisms, we also wish to highlight the *Handbook*'s pluralism, not only of approaches and disciplines but also of places. With nearly 50 contributors representing a wide diversity of cultures and geographical regions, from Israel to Brazil, from Australia to Europe, from South Africa to North America, the *Handbook* is an invitation to think biology and society always in the plural, as *biologies* and *societies* (and perhaps this should have been a more appropriate title for this endeavour). After all, among the strongest legacies of the social studies of science is the reminder that 'all scientific knowledge-claims have a provenance: they originate at some place, and come from there' (Gieryn 2002). This *Handbook*, albeit in its own minor way, is deeply committed to caring for scenes that foster a plurality of ways of being-there, of coming-from-there, of going-there.

Outline of the *Handbook*

We start with a historical section ('History of the Biology/Society Relationship'), since we believe that history (if not historicism) is an obligatory passage point for anyone who wants to take seriously the notion that the estrangement between the social and the biological is less a fact of nature, and more a sedimented effect of long-term strategies and decisions involving various disciplinary bodies, authors, institutional settings, and other agencies. In the two first chapters, Snait Gissis and Maurizio Meloni cover a similar historical period, examining the transactions between biology and sociology in the second half of the nineteenth century, including the impact of those transactions in terms of debate on fixedness and plasticity, individuals and social groups, heredity and wider notions of inheritance and tradition. These two chapters, while sharing an historical period, focus on different reverberations of biological knowledge on the making of a modern social science. Gissis looks at the significance of a Lamarckian framework in the work of Spencer and Durkheim, whereas Meloni points to the subtle influence of the German founder of the modern hard view of heredity—August Weismann—on Durkheim's writings in the 1890s as a foundational step toward erecting a neat separation between the social and the biological.

In the next chapter, Chris Renwick focuses on one of the key terms at the crossroads of the social and biological—population. The chapter explains how the emergence of population thinking in biology and social science in late-nineteenth-century and early-twentieth-century Britain were related, with research at the intersection of the two fields helping to construct shared ideas and practices. As the chapter shows, eugenics played a major part in this story 'featuring a space that some researchers considered to be a genuine third sphere between biological and social science'. In the fifth chapter, Antonine Nicoglou focuses on another of the key concepts in twenty-first-century biology—plasticity. She provides an historical account of the role of this concept as a key means of navigating the space between nature and nurture. Nicoglou argues that a comprehensive understanding of the concept of plasticity will assist us in divesting ourselves of this dichotomous opposition.

In Chap. 6, Jonathan Marks traces the transformation of the field of biological anthropology from a science of race to a science of human spatiotemporal variation. He focuses on two major misconceptions in anthropology, each with a long historical legacy: that the human species is composed of zoologically meaningful taxonomic entities, and that human groups think differently in ways that are significantly innate. As Marks writes: 'both of these propositions have been falsified about as thoroughly as young-earth

creationism, but their political value is sufficient to continually resurrect them'. Marks then investigates the complex moral and political dimension associated with these epistemic questions and the inescapable moral side of debates on race and racism. In the next chapter, Will Viney focuses these debates into one epistemic object: the culture of twinning as it emerged between history, biology, and literature. As a sort of 'natural experiment', twin research has been used to think through the divisions between biology and environment, and its history has lessons for our understanding of how human groups interact with scientific endeavours. Viney outlines a history of the conceptualization of twins in an account that is concerned less with the validity of findings generated by twin studies, and more with the ways that this research exemplifies the interweaving of different assumptions (medical, sociological, psychological, ideological, methodological) vis-à-vis the possibility of neatly separating genes from environment. This, argues Viney, is what captures the imaginations of medical researchers and the general public alike in relating to twin studies.

Finally in this section, in Chap. 8, Tatjana Buklijas sketches one of the very first histories of the rise to public prominence of epigenetics, which is among the most rapidly expanding fields in the life sciences, and increasingly seen by many as a potential bridge between the social and the natural sciences. Buklijas looks at competing interpretations of epigenetics as paradigm-shifting, or as just a scientific-cultural trend reinforcing genetics, contrasting views that, she claims, 'go along with opposing historical narratives and understandings of future promise of epigenetics'.

The second section 'Genetics, Postgenomics, Epigenetics, and Society' focuses on some key changes in contemporary molecular biology that have shifted our view of the gene as an autonomous master of development to the 'reactive genome' of molecular epigenetics—now unfolding in specific social and historical *milieux* (Gilbert 2003; Griffiths and Stotz 2013; Keller 2011, 2014). In their chapter, Maurizio Meloni and Giuseppe Testa critically analyse the 'epigenetics revolution', with its claims to herald a new epoch both for gene-based epistemology and for the wider discourse on life that pervades knowledge-intensive societies of the 'molecular age'. Meloni and Testa scrutinize the fundamentals of this revolution, highlighting in particular how the very contours of what counts as 'epigenetic' are often blurred, something that crucially contributes to its success.

In the next chapter, Frances Champagne focuses on the potential of environmental epigenetics research for understanding risk of health and illness, as well as its role in documenting the effects of life experiences. As an epigenetics researcher, Champagne provides insight into how 'hard' scientists might be

both concerned and eager to see how environmental epigenetics research—including Champagne's own—will be translated into new understandings of animals (including humans) and their environments, and eventually into new clinical approaches and interventions. Amy Hinterberger, in her chapter on "Molecular Multicultures", examines what has happened to the politics of multiculturalism in light of the molecularization of biology. Hinterberger argues that a conceptual framework of 'molecular multicultures' may be helpful to highlight how the cultural politics of heredity in bioscience draws together the classificatory practices of the nation-state, the naming practices of identity-based social movements, and the segmenting techniques of genome science.

In her chapter on 'The First Thousand Days', Michelle Pentecost provides an introduction to a movement that is taking an increasingly important space within public health, namely, studies of the first thousand days of life. Pentecost documents this understanding of child development, from conception to two years of age, which suggests that experiences during this period of life set children on paths for the rest of their lives. Using a South African case study of the global 'first thousand days' initiative, Pentecost examines how the DOHaD (Developmental Origins of Health and Disease) paradigm and epigenetic knowledge, as 'biosocial' objects of enquiry, are embedded in global discourses that come to bear on the everyday.

In the next chapter, which takes an educational focus, Deborah Youdell proposes a biosocial understanding that conceives of learning as the folding together of multiple intra-acting forces and processes within which possibilities for social justice are mediated biologically, physiologically, and neurally, as well as affectively, intellectually, and interpersonally. To make this argument, the chapter foregrounds developments in epigenetics and the entanglement of the social and the biological, and Youdell makes a case for thinking about socially just education in a biosocial way. Through an engagement with research in education and the biosciences, she argues that biosocial education research can bring into view 'molecular, neuronal, metabolic, biochemical, social, cultural, affective, psychic, and relational processes operating across multiple scales and temporalities'. Any contemporary ambition for socially just education, Youdell claims, must now attend to this complexity and to its biosocial character.

Finally, in her chapter on the challenge of assembling biomedical big data, Sabina Leonelli examines the issues involved in disseminating, integrating, and analysing large datasets collected on human subjects and non-human experimental organisms, and within both clinical and research settings. Leonelli highlights some of the technical, ethical, and epistemic concerns

underlying current attempts to portray and use 'Big Data' as a revolutionary tool for producing biomedical knowledge and related interventions. When bringing together data collected on human subjects with data collected from other organisms, significant differences in the experimental cultures of biologists and clinicians emerge which, if left unnoticed, risk compromising the quality and validity of large-scale, cross-species data integration. Leonelli highlights the complex conjunctions of biological and clinical practice, model organisms and human subjects, and material and virtual sources of evidence, emphasizing the fragmented, localized, and inherently translational nature of biomedical research.

The third section, 'Neuroscience: Brain, Culture, and Social Relations', is devoted to neuroscience, including the intersections of the diverse practices that term now implies with/in psychiatry and psychology. If we were producing a handbook on relations between the biological and social sciences as little as 15 or 20 years ago, it is difficult to imagine there being much to be said about the neurosciences. Today, the situation is quite different: for many now working in the neurosciences, what makes this area so appealing is precisely the fact that so much of the social and cultural world in which our brains develop *cannot* be reduced to bare neurological material. Authors in this section explore that realization and seek new ways to develop it. But the section leads with two chapters that urge continuing caution about naïve celebration.

We begin with Jan Slaby and Suparna Choudhury's 'Proposal for a Critical Neuroscience'—one of a suite of papers published in the mid-2000s, in which these authors, with their colleagues and interlocutors, set out a compelling vision for how new relations between the neurosciences and critical social sciences might take shape. In this programmatic contribution, Slaby and Choudhury account for their own attempt to 'respond to the impressive and at times troublesome surge of the neurosciences, without either celebrating them uncritically or condemning them wholesale'. The chapter seeks to show what, precisely, an ethos of 'critique' can offer to the neurosciences and how it can help to open out the range of practices and intuitions through which neuroscientific facts are made.

In a complementary chapter, Fernando Vidal and Francisco Ortega zero in on the neuroscience of culture, where they argue that 'in spite of an emphasis on the two-way processes that turn brain into culture and culture into brain, a common feature of the neurodisciplines of culture is their belief in the ontological primacy of the brain'. Working through some of the key techniques and approaches through which neuroscientists have tried to get at culture, Ortega and Vidal show how the field relies on quite traditional neuroscientific

methods and tropes. The chapter pays special attention to the way that cultures of 'individualism' and 'collectivism' are conjured in this field, and how the image of culture that emerges around it, for all the methodological novelty, turns on a surprisingly conventional image of discrete and bounded 'cultural' entities.

The chapter that follows is in quite a different mode. Here, Christian von Scheve takes seriously the notion of a 'neurosociology', proposing that 'many neuroscience studies and paradigms as well as their hypotheses and results are directly adaptable to and relevant for the processes and mechanisms traditionally studied by sociologists'. To consider this potential, von Scheve focuses on the paradigmatic case of affective neuroscience, a field that concerns itself with the processing of emotions. Offering a thick account of how neuroscientific work might then help to hook emotional processes into social situations, von Scheve proposes that a neurobiological perspective on emotion could help sociologists to move away from accounts of instrumental reason when they consider moments of decision-making and thus help us to understand, in a much more fine-grained way, the deeply embodied nature of such social scenes.

The next chapter, by anthropologist Rebecca Seligman, joins that of von Scheve in her intuition that there is something important to be gained from running neurobiological and social scientific problems through one another. This time, the argument focuses on the relationship between physiological and cultural states, through a study of religious devotion in Brazil. Focusing on the phenomena of spirit possession in Brazilian Candomblé, Seligman uses ethnographic and psychophysiological interventions to explore this religious practice, and to show how religious states recruit particular forms of psychophysiological regulation. Drawing on the concept of bio-looping, Seligman's chapter 'draw[s] attention to the ways in which embodied processes, including biological ones, are implicated in the continuous and mutually reinforcing relationships among meaning, practice, and experience'. For Seligman, such an attention has the capacity to tell us something very new about the concept of embodiment—and allows us to get a grasp of moments in which psychological, cultural, and physical states seem strikingly inseparable from one another.

The next chapter, by Des Fitzgerald and Felicity Callard, tries to take a metaperspective on the space between neuroscience and social science. Fitzgerald and Callard argue that there is much scope, now, for reanimating collaborative relationships between the social sciences and neurosciences, but that this potential is squandered by arguments (both for and against such a development) that significantly misunderstand what is at stake. Setting themselves

against what they call 'the regime of the inter-', a space of thought that insists on understanding neuroscience and social science as very different kinds of thing, whether in service of 'integrating' them or keeping them apart, Fitzgerald and Callard instead call for thicker attention to, and situation of researchers in, *experiments*, as sites of novel exchange and practice.

The final two chapters in this section expand these debates through attention to two very specific sites. First, in his chapter on neuroscience and schizophrenia, John Cromby uses the development of the diagnostic category of schizophrenia to show, in its past, present, and future, how schizophrenia has been developed through symbiotic relationships to the brain and neuroscience. Beginning with the foundational work of Kraepelin and Bleuler, and tracing this work into contemporary neuroscience, Cromby shows how 'conceptualisations of mental health and illness, concepts and images of brains, their parts and their functions, practices of treatment and intervention, and the somewhat disparate interests of multiple professions … are continuously circulated and exchanged, and mutually, dynamically and contingently related'. Sketching out a range of possible futures for the scientific study of schizophrenia, the chapter shows, for example, a renewed interest in social and relational approaches; through this and related attentions, argues Cromby, committed and serious neuroscientific work need not be wedded to the traditional rubrics of biological psychiatry.

In the final chapter in this section, Stephanie Lloyd and Eugene Raikhel examine the emergence of a style of thought that connects work in environmental epigenetics to the 'suicidal brain'. Lloyd and Raikhel propose that epigenetics be analysed as a 'style of reasoning', a particular mode of biologically construing both the environment and time in a way that, for some, has 'led to a new vision of the relationship between society and biology, while for others they have bolstered long-held ideas about biosocial complexity'. They draw on epigenetic research on suicide as a way of showing how, in this space, social contexts can get molecularized, drawing connections, for example, between early social and environmental experience and suicide risk. The (often explicitly) political ramifications of such a thought-style become apparent in the case of aboriginal suicide in Canada, where a blanket insistence on 'early adversity' often occludes the complexities of structural violence, as well as 'highly specific social, political and economic contexts'. Perhaps returning us, then, to where we began this section, Lloyd and Raikhel conclude that mere 'engagement' cannot simply override the deep epistemological differences between social scientists and neuroscientists.

Section IV is devoted to *social epidemiology*, a discipline that began to emerge in the 1960s, and which has, since then, gained considerable stature

and reach generating evidence for, and interest in, the social causation of illness and health. Social epidemiology's concern with the societal determinants of patterns of disease points to a quintessentially biosocial dimension. Nevertheless, the mere existence of a subdiscipline called *social* epidemiology is already suggestive of the various epistemic tensions along the biology/society border. As Nancy Krieger (e.g. 2011) in particular has repeatedly highlighted, what is at stake in the separate constitution of social epidemiology is the tendency of epidemiology to fall prey to a taken-for-granted 'just biological' presumption, according to which attempts to identify social determinants of illness and health tend to be seen as somewhat additional, optional, adjunctive, or marginal. From different angles, the five contributions in this section all challenge this established way of thinking.

First, Michelle Kelly-Irving and Cyrille Delpierre consider embodiment in relation to social epidemiology, focusing on the incidence of cancer. Their chapter traces some of the intertwined conceptual and methodological issues with which coherent empirical research into embodiment and epidemiology must contend. A life course approach is suggested whereby DNA mutations in cancer are at least partially initiated by immune and inflammatory system processes, processes, that are in turn open to social influence. Finally, evidence is presented from a prospective study suggesting that, at least among women, an accumulation of 'ACEs'—adverse childhood experiences—is associated with a subsequently increased incidence of cancer.

In the next chapter, Silvia Stringhini and Paolo Vineis outline some of the evidence regarding the connections between socio-economic status (SES) and health, before presenting candidate processes, most notably epigenetic ones, that might mediate these connections. Stringhini and Vineis describe a conceptual framework within which epigenetic processes in relation to health and SES might be understood, summarize some of their own research exploring the connections between epigenetic changes and SES, and then draw out some policy implications of their studies (including those that flow from the potential reversibility of some epigenetic changes).

From a different angle, Jonathan Wells and Akanksha Marphatia consider how maternal capital could mediate the associations between health and social inequality. Drawing on evidence for both plasticity and critical periods in development (periods during which environmental influences might have more marked or enduring consequences), the concept of 'maternal capital' describes how offspring are differentially enabled to thrive during development by (largely unintentional) variations in the somatic or behavioral 'investments' of mothers. While maternal interventions designed to benefit offspring might seem to treat mothers as little more than passive vehicles, Wells and

Marphatia suggest that this problem might be avoided if the chosen interventions are ones that also benefit mothers themselves.

In Chap. 25, Mike Kelly and Rachel Kelly provide a narrative overview of the character of, and synergies between, the new 'omic' biological subfields. They suggest that these projects can be integrated with sociological accounts of the dynamism that characterizes structure–agency relationships, in order to more precisely answer questions about the relationships between disease and environmental stressors. Kelly and Kelly draw on Giddens's structuration theory to understand how the repetitive, recursive character of much human activity gets realized within socioculturally normative practices with both social and biological aspects. Hence, practices constituting activities such as eating, drinking, loving, working, and child-rearing have societal origins and, simultaneously, 'drive' the human interactome.

Finally, in the last chapter of this section, some of the intricate associations between socio-economic variables and health inequalities are explored empirically by Rasmus Hoffmann, Hannes Kröger, and Eduwin Pakpahan. Life expectancy differentials of 5–10 years between the most and the least wealthy (and differences in healthy life expectancy of up to 20 years) starkly illustrate the force of social influence, as do related differentials associated with gender and ethnicity. Nevertheless, as this analysis demonstrates, empirical studies that compare social causation models of these inequalities with social selection models (i.e. models presuming that health inequalities drive socioeconomic status) produce a more complex picture where different influences predominate at different stages of the life course.

In the fifth section of the book, 'Medicine and Society', attention turns to the institutions and people affected by, and shaping, emerging knowledge and practices in the postgenomic era, as life, risk, and vitality are measured and interpreted in new ways. Conceptually, these movements attempt to reach into and beyond individual bodies, producing data that aims to quantify individual profiles whilst also situating bodies in specific environments. These practices embed specific goals and values in emerging forms of surveillance in the ongoing reconception of human bodies and biosocial spaces. Assumptions are made about what forms of data can be compared, and what forms of data count—with 'the environment', interior or exterior to the body, often reduced to one or two key factors, commonly measured with brief questionnaires or checklists to be linked to biomarkers. This represents what social scientists have referred to as 'pragmatic' or 'methodological reductionism', conceptualizing environments as a set of molecular inputs. This logic requires the abstraction of inputs, with distinctions in content or derivation flattened and rendered incidental. Amongst other concerns, observers worry that the

reduction and flattening of environmental contexts to molecular mechanisms will make it more likely that potential interventions are solely conceived on this scale.

Opportunities for collaborations between bio-scientists and social scientists are opened by these conceptualizations of humans, environments, health, and disease, yet questions remain over how multiple forms of data might be brought into conversation with one another. Potential studies raise questions about how research might be carried out in such a way that it avoids beginning with 'the social', 'the psychological', and 'the biological' as distinct domains. Beyond largely rhetorical invocations of 'the' biopsychosocial model (which in fact was never developed coherently as such) lies a clear need instead to view these processes, and the data produced about them, as symmetrical, with no branch of evidence considered more 'real' or foundational than another.

In Chap. 27, Patrick Bieler and Jörg Niewöhner provide a portrait of the ways in which the relationships between the human material body and social practices are currently being explored. In their account, Bieler and Niewöhner argue that the epistemological space opened by these interests and molecular understandings of humans provides an opportunity for social scientists to engage with social differentiation as a complex biosocial phenomenon, rather than as measurable variables. They propose a study of the 'body-in-action' as a boundary object in emerging research in both biological and social sciences. This body-in-action 'implies that it must be ethnographically accounted for in its complex entanglements with the assembled environment instead of trying to measure clearly defined, decontextualized variables'. An understanding of context nevertheless remains a significant challenge in studies of individual biomedical and molecular profiles, and Nadine Levin explores this challenge in Chap. 28. Levin explicates some of the issues raised by making, and making sense of, 'big data' in biomedicine, as scientists attempt to construct molecularized, personalized accounts of situated risk. Proposing an 'anthropology of data', Levin aims to question the norms, politics, and values that get wrapped up in data.

In Chap. 29, Barbara Prainsack provides an historical overview of personalized medicine, tracing it from its original focus on matching drug therapies to patients' specific genetic profiles, to its current instantiation which is concerned more broadly with a consideration of patients' profiles—molecular and otherwise—in order to improve medical care and research. Within this historical shift, Prainsack focuses most particularly on the implications of one of the central goals of this research in its current form of 'precision medicine'—comprehensive individual data capture. This data capture seeks to

produce the most detailed profile possible of individuals' lives, bodies, and environments in order to reach 'personalization', a point that would putatively permit improved patient care as well as continue to inform biomedical researchers' future interventions. Yet, as has often been the case in the history of medical research, patients who contribute information, time, and self-monitoring ultimately have little influence on how their bodies and lives are represented and 'datafied' in this process.

In Chap. 30, Megan Warin and Aryn Martin explore the construction of the uterus as a social space in epigenetics research. Warin and Martin situate this process within the broader reconsideration of the environment within epigenetics. Through case studies of reproduction (fetal origins and microchimerism), they explore the rearticulation of environments, not only in terms of the limits of binaries (nature/nurture; self/other; time and space) but also in terms of postgenomic capacities to reduce the environment to individual risk in gendered and sexed bodies—rather than open research agendas to a consideration of the complexity of biosocial spaces. In Chap. 31, Ayo Wahlberg then considers the growth of interest in biomedical research in the study and management of morbid living. Through this research, 'quality of life' becomes the focus of data collection as disease-specific clinical trials are carried out, and patients and caregivers are taught to 'live with' sickness as optimally as possible. The result is a 'novel analytics' of what Wahlberg refers to as the 'vitality of disease'.

In Chap. 32, Elizabeth F. S. Roberts and Camilo Sanz provide a methodological intervention, describing their efforts to develop a new research platform that combines ethnographic and biological data—'bioethnography'. Bioethnography is a response to the criticisms of big data, in which the potential wealth of 'comprehensive profiles' is often lost in reductive forms of data collection, management, and analysis. By contrast, bioethnography aims to 'arrive at a better understanding of the larger histories and life circumstances that shape health and inequality'. These authors' approach emerged from collaborations with environmental health scientists involved in a longitudinal pregnancy birth cohort and chemical exposure study in Mexico City. Now in a phase of analysis, Roberts and Sanz reflect on the process that entails the 'epistemic, temporal, and logistical coordination of disparate, and differently positioned intellectual research ecologies', in order to provide a preliminary guide for social scientists engaged in biosocial collaborations.

The *Handbook* ends with a section on 'Contested Sites/Future Perspectives', of which there are many that the emerging biosocial world is likely to provoke or is already provoking. Of the many dangers to be circumvented in a volume like this, perhaps most urgent is to avoid covering over the many pressing

political, conceptual, methodological, and evidential objections (each intertwined with, and sometimes masquerading as, the other) that have dogged the history of 'biosocial' approaches. We think here not only of critiques launched at such crass endeavours as sociobiology and evolutionary psychology, but also more recent critical approaches taken to social neuroscience, socio-genomics, epigenetics, and so on. We take very seriously the responsibility of a handbook of biology and society to not only 'memorialize' these contests, but to contribute in whatever minor way it can to keeping them in view—to insist, indeed, that it will have no truck with any 'biosocial' space wherein this history of contestation around biosocial approaches is rendered invisible. While the deep historical and political debates that have structured the division between the biological and the social are present, in some way, in all of the contributions in this section, we nonetheless here explicitly foreground discussions of how the biosocial intercedes—and not always in welcome or happy ways—at the intersections of race, gender, class, science, and justice (Reardon 2013).

We begin with a chapter from Catherine Bliss that, drawing on interviews with leading figures in genomic science, foregrounds discussions on racial politics in the postgenomic age. The chapter shows how 'struggles over the characterization of race, and the amelioration of racial inequality, have come to be drivers of large-scale global research programs'. Bliss focuses in particular on the relationship between 'science activism' and 'mass activism', to highlight how some genomic scientists actually take on the mantle of racial activism. While this mobilization has similarities to the kinds of mobilization we are more familiar with in the political mainstream, it ultimately fails to support a politics of mass movement around racial inequality. In the postgenomic age, Bliss argues, the political mobilizations of scientists in fact results in a reinforcement of a deterministic understanding of race.

In the following chapter, Kenney and Müller turn their attention to environmental epigenetics research on maternal care, arguing that while, on the one hand, this research is exciting and offers possible opportunities for collaboration between molecular biology and the social sciences, it is also necessary to consider its political dimensions. Through their research, they underscore how common-sense assumptions about sex, gender, sexuality, and class are present in the design, interpretation, and dissemination of experiments on the epigenetic effects of maternal care. As these experiments come to support claims about human motherhood through a dense speculative cross-traffic between epigenetic studies in rodents and psychological and epidemiological studies in humans, Kenney and Müller argue that current research trends work to illustrate, rather than interrogate, existing stereotypes about maternal agency and responsibility. Through their work they aim to