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**Biomedical Trans-actions:
Translational research, post-genomics and Knowledge / Value¹**

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Abstract

This paper examines the notion of “translational research”, which has become a dominant form of the institutionalization and practice of contemporary biomedicine, as an entry point into theorizing questions of knowledge, value and their articulations. We are interested in locating translational research in a conjuncture that is marked, on the one hand, by a “post-genomic” moment in the life sciences, and on the other hand, by the capitalization and globalization of biomedicine. We undertake this through reference to the historical trajectory of these movements. In the process, we argue for a consideration of knowledge in terms of its mobility, rather than simply in terms of its ability to produce “truth”. These concerns with mobility, we suggest, articulate knowledge to and through value, whose own meanings and stakes come to matter in the process. We conclude that translational research in itself is just a signifier of a contemporary biomedicine that operates “in the trans”, under the sign and context of various movements across domains that see the production, articulation and problematization of knowledge and value. This argument serves as an introduction and framing for the three essays in this Dossier.

¹ Both authors have benefited greatly from discussions with Gail Davies, who also provided insightful comments and suggestions on a preliminary draft of this essay. Warm thanks also to Kaushik’s Chicago colleagues and our collaborators in the K/V project (especially Judith Farquhar and John Kelly, who have provided a commentary for this Folio section). The Knowledge / Value workshop was supported by the Lichstern Fund of the Department of Anthropology, University of Chicago; the Division of Social Sciences, University of Chicago; The Chicago Center for Contemporary Theory, and The Franke Institute for the Humanities, University of Chicago. Sabina Leonelli’s research was funded by the UK Economic and Social Research Council, as part of the ESRC Centre for Genomics in Society.

Translational research has become an important institutional component of the life sciences over the past decade. At its simplest, it is encapsulated by the formula “bench-to-bedside”, which was introduced by the US National Institutes of Health (NIH) in the early 1990s with specific reference to biomedical research of relevance to the treatment of cancer.² Since then, the importance of translational research has become powerfully established, particularly in Anglo-American biomedical audit and funding cultures. The bench-to-bedside formulation assumes that too much research in the life sciences has failed to advance human health, either because it is esoteric in nature or, more commonly, because the institutional structures within which research is conducted do not facilitate its transformation into health outcomes. This latter concern distinguishes translational research from earlier notions of “applied” research. Translational research is not necessarily a critique of fundamental research. It is, rather, an attempt to facilitate the “downstreaming” of fundamental research – its use by stakeholders other than the scientists engaged in developing that knowledge – in ways that can positively impact human health. How this vision for translational research is concretized varies considerably in practice, for instance between biologists and clinicians, across different disciplinary spaces and funding contexts, and in different parts of the world.

This collection is not about translational research as an object in itself. Indeed, translational research is not a singular object, even though it is often framed and portrayed as such within the rendering of biomedical funding bodies. We are not even interested in tracing the multiple forms and processes of translational research, though a sense of this multiplicity might emerge when reading across the essays in the collection. Our concern, rather, is with the sites and contexts of the materialization of translational research in its myriad meanings in contemporary landscapes of biomedicine. In other words: what does the importance of something(s) called “translational research” tell us

² This linear approach is exemplified by the following definition established in 2005 by the National Cancer Institute Translational Research Working Group: ‘translational research transforms scientific discoveries arising from laboratory, clinical, or population studies into clinical applications to reduce cancer incidence, morbidity, and mortality’ (Keating and Cambrosio 2012, 347).

about biomedicine today? And what do the configurations of biomedicine today tell us about knowledge, value and their relationships?

In this regard, one set of relevant contexts relates to the increased bureaucratization of the research university (Radder 2010) and the influence of audit cultures in structuring research (Strathern 2000), which in turn must be understood in terms of the increased capitalization and globalization of the life sciences. A second set of contexts concerns shifts within the epistemologies and practices of the life sciences themselves. We aim to show that the co-production of macro-structural transformations in the institutionalization of the life sciences alongside epistemic transformations within the life sciences leads to a necessary recalibration of some of the analytic categories and institutional frames through which scientific knowledge is legitimated and used. What kinds of science are actually being imagined, created and performed within translational research regimes? And, inversely, what kinds of epistemic emergence within the biological sciences provide the conditions of possibility for such regimes in the first place? The essays in this collection ask such questions across multiple institutional spaces, ranging from laboratory to clinic to society, in different national contexts.

Biomedicine “in the trans”

The term ‘biomedicine’ indicates the set of practices which brings biological and clinical knowledge, norms, tools and procedures to bear upon each other. While the specific nature of the boundaries between biology and medicine has been a matter of contestation and debate, their “bringing together” has never been easy.³ Moving across domains in biomedicine is complicated by factors such as disciplinary and sub-disciplinary alignments. Further, there are differences in the aims of medicine and of biology (e.g. understanding the causes of disease versus treating patients), as well as in funding structures, pedagogical styles and emphases, and temperaments and aesthetics towards biomedical problems (e.g. Fleck 1927 and Canguilhem 1991 [1966]). Layered on to this lab / clinic interface is the shifting interface between academe and industry, which

³ See for example: Loewy, 1986; Keating and Cambrosio 2003; Quirke and Gaudillière, 2008.

emerges in distinct ways, and is often negotiated differently within, scientific as opposed to clinical environments.

Technoscientific emergence over the past few decades, especially in the information and life sciences, has therefore put questions of knowledge and value in need of fresh conceptualization. The question of Knowledge / Value is not, and cannot be, simply one that asks “what is knowledge?” or “what is value?” Indeed, we recognize the very polyvalence of these categories at the outset. For instance, value could refer simultaneously to dimensions of the ethical and the normative, as it could to questions of market value. “Knowledge” as well could have multiple resonances, some of which we will develop subsequently in this essay. Hence, the series attempts less to pin down the definitions of its animating categories than to conceptualize the very intersection of Knowledge/Value: how are knowledge and value related when the meanings of both terms are at stake?

We believe that translational research is a critical site at which Knowledge / Value problematics emerge and can be theorized. On the one hand, translational research explicates value considerations of all sorts within its remit: the monetizable / fungible / tradable kinds of value that speak to the construction of a stronger commercial infrastructure for the life sciences; the accountability value of bureaucratic audit cultures; and the ethical value enshrined in projects that emphasize the “advancement of human health” as their goal, oftentimes with explicit community-outreach mandates and aspirations. On the other hand, translational research also forces us to ask what contemporary biomedical “knowledge” might mean, and to whom, given the variety of domains and circumstances under which it is produced, circulated and used.

In this regard, it is useful for us to think both with and against Michel Foucault’s problematic of Power / Knowledge, which attends to the ways in which discursive formations and their materialization in institutional structures in European modernity lead to the possibility, both, of the ability of certain kinds of statements to operate as “truth”, and to the consequent emergence of new regimes of power (Foucault 1980). This

problematic, and its mode of explication by Foucault across his oeuvre, is of direct inspiration to the Knowledge / Value project because of the way in which, through the coupling of knowledge with power, new theorizations of power emerged.

And yet, we perceive three limitations in Foucault's framing of the problem. First, Foucault's notion of power is more limited than our conception of value, which is meant to embrace all the rationales, norms and activities through which individuals, groups, institutions and governments assess aspects of the world and determine courses of future action. Political and economic power is an important component of these evaluative processes, but does not encompass them all. Second, the relationship between power and knowledge is posed in too unidirectional a manner: Foucault's problem is, ultimately, to understand how new modes of knowing *lead* to new modes of exercising power. Regimes of knowledge are a means to understanding regimes of power. We are more concerned with knowledge and value as *co-produced* – we are interested in understanding how new articulations of knowledge lead to specific forms of value and, at the same time, new articulations of value lead to specific forms and conceptions of knowledge.⁴

Third, the Foucauldian notion of knowledge remains straightforwardly epistemic: what is at stake is the nature of truth, discernible through regimes of what counts as truth that emerge at particular historical moments in liberalism. While epistemic concerns do not go away in considerations of Knowledge / Value, we wish to argue that is what is at stake in these emergent formations is not only the question of truth but also the *movements* of knowledge. Truth cannot be straightforwardly assigned to any assertion or claim about the world independently of its unfolding history, present status and projected use. Indeed, the transformations that define what counts as knowledge in any given domain can only be identified and traced by looking at knowledge 'in transit', as different communities select and attribute meaning to various knowledge forms through a complex nexus of commitments, frames and material engagements with the world. In our view, the question of knowledge thus concerns itself principally with *movement across domains*, and what counts as knowledge in those movements and domains. The domains could be

⁴ For the notion of co-production, see Jasanoff 2004.

institutional and disciplinary – from laboratory to clinic, biology to medicine or academe to industry; spatial – from an animal facility to a lab bench; geographical and transnational, as in the globalization of the life sciences to different parts of the world; or conceptual, such as from “upstream” research to “downstream” application or from “bench” to “community”.

Mobility is therefore central to the idea (and ideal) of knowledge that animates translational research. In order to act toward the aspiration of “improving human health”, biomedical claims, objects and practices have necessarily to move across boundaries. In such movements, the question of what counts as true knowledge comes to matter only alongside a host of other concerns, such as the commensurability, exchangeability, fungibility or accountability of knowledge-making practices and their outcomes.⁵ Enabling and managing such mobility requires extensive efforts, and indeed requires us to think about that key concept embedded in the very name “translational research”, which is translation.

The theorization of translation in Science and Technology Studies (STS) has been relatively limited compared to the long history of concerns with the term in linguistics and literary studies. The most prominent and elaborate deployment of the concept in STS has been in actor-network theory (Callon 1986, Latour 1987). For scholars such as Michel Callon and Bruno Latour, translation is an analytical category, used to describe scientific activity in terms of enrollments of actants and movements of inscriptions (in Latour’s terms, ‘immutable and combinable mobiles’; 1987, 227). For us, the problematic of translation is coded in different terms. We are interested in how something like translation emerges as an *actor’s* category in biomedicine, most recently in the guise of translational research. In this regard, it is worth asking whether translational research, in fact, is concerned with translation at all. More generally, we kinds of trans-formations or trans-actions (including, but also other than translation) does translational research point

⁵ See also Mary Morgan’s introduction to the volume *How Well Do Facts Travel* (Morgan 2010). Our concerns with mobility as articulated here take inspiration from and build upon Morgan’s.

to?⁶ We locate our concern with translational research, then, not in an analytic that is confined to translation, but one that is more broadly concerned with a biomedicine “in the trans” – what might be called, following Sarah Franklin, “transbiology” (Franklin 2006).⁷ We wish to situate this concern in a conjuncture of globalizing, post-genomic biocapital.

Biomedicine today: translational research in the post-genomic era

The past two decades have witnessed the emergence of a set of practices, tools and technologies in biomedicine which, on the one hand, facilitates the integration of biological and medical practice; and, on the other hand, reconfigures biomedicine as a body of knowledge by bringing new salience to certain features of experimental and clinical research. We shall briefly characterize this reconfiguration of biomedicine through two sets of conjunctures, one structural (questions of capital and the global) and the other epistemic (questions of “post-genomic” life sciences). Both have deep connections to the institutionalization of translational research.

Structural conjunctures: capitalization and globalization

Over the past forty years, the life sciences have become increasingly incorporated into market logics and regimes (Cooper 2008, Sunder Rajan 2006, 2012). We are not suggesting a seamless trajectory whereby the life sciences become a “capitalist” enterprise in any simple sense. Indeed, this trajectory is striated and contingent in all sorts of ways. Yet, over the past four decades there has been a profound transformation in the location and practice of the life sciences that suggest their appropriation into systems and regimes of capital at multiple registers.⁸ This institutional movement, which is particularly marked in the Anglo-American context, has seen the university itself become a more entrepreneurial institutional space, one that explicitly encourages the commercialization of research conducted within its confines. The corporatization of the life sciences can be

⁶ See Silverstein 2003 for a seminal essay on the notion of translation in relation to other trans-categories in linguistics.

⁷ Franklin’s conceptualization of the term draws upon Donna Haraway, who has been concerned with biology “in the trans” throughout her work (but see especially her political development of that concern in relation to questions of knowledge and objectivity in her seminal essay “Situated Knowledges”, Haraway 1991). It has been subsequently developed by Gail Davies (Davies 2012), who, as one of the co-organizers of the Knowledge / Value series, has most directly brought concerns of transbiology into our conversations.

⁸ See the Introduction to *Lively Capital* for an elaboration of this argument (Sunder Rajan 2012).

traced back to the beginnings of the biotechnology industry in the mid-1970s, which was marked by the concomitant emergence of new types of science and technology – especially recombinant DNA technology (RDT) - with changes in the legal, regulatory and market structures and social imaginaries that shaped how that technoscience was developed. A host of changes in the United States in the 1980s, having to do with legislation facilitating technology transfer, a supportive legal climate for the patenting of life forms, the openness of financial markets to betting on biotechnology, and an ideological embrace of innovation as a policy principle, led to the further capitalization of the life sciences (Sunder Rajan 2012). Alongside these movements in research context, one saw ways in which clinical practice, especially in relation to therapeutic development, was becoming progressively commercialized. This capitalization is not simply an institutional movement; it is also an epistemic one. Melinda Cooper has traced the co-production of the epistemology of the life sciences over the past four decades alongside that of neo-liberal economics, to show how closely the two feed off each other (Cooper 2008). This is not to deny the very specific histories and contingencies within which such capitalization takes place, or to suggest that capital “shapes” biomedicine in any determinist manner, but rather to highlight the importance of understanding the entrenchment of market structures within contemporary life science research programmes and institutions.

The question of capital is only one side of the structural coin. The other side is the globalization of biomedicine. In spite of important and occasional exceptions, we believe that there is not yet a body of work that is speaking in a consistent manner to questions of the globalization of the life sciences or biomedicine. This is ironic, given how central questions of globalization have been to social theory over the past three decades. This is perhaps reflective of the extent to which science and technology studies (STS) and the history and philosophy of science remain, in the main, parochially Euro-American in their focus. Indeed, while we mark globalization as an essential structural conjuncture in which to understand translational research, the three essays in this folio are themselves not concerned with this question in any explicit way. We mark this as a lack and as a site

where further work needs to be done, and allude below to some trajectories of scholarship that open up a space of analysis which requires fuller development.

One strand of such scholarship concerns work on the governance of the life sciences within advanced liberalism, such as Sheila Jasanoff's which demonstrates that even within Euro-American representative democracies, there is large variability in how biotechnologies interact with, and are produced alongside, social norms and forms, governance regimes, modes of public reasoning, and civic epistemologies (Jasanoff 2005). A second relevant strand of research concerns the movement of "Western" science to the "developing world", or the establishment of new centers of research excellence in parts of the world that might be regarded as "emerging economies", especially in South, East and South-East Asia. This is not simply a question of more people or places doing cutting-edge science – it involves reconfiguring what constitutes global relationality in technoscientific capability, and asking whether and how typical colonial relationships of metropole to periphery might be under transformation (Redfield 2000, Lakoff 2006, Sunder Rajan 2006, Fischer 2012). A third strand is found in anthropological studies of traditional medicines, not just as "indigenous" systems alone, but also as globalizing epistemes and practices that appropriate, or are appropriated by, "Western" knowledge and value systems in various ways (Farquhar and Lai 2012, Langwick 2011, Gaudilliere and Pordie 2012). A fourth strand focuses on concerns of space, scale and location in the production and dissemination of biological knowledge. This includes questions regarding the multiple scales created and worked within the life sciences; the kinds of segregation and collaboration facilitated by the spaces in which research is carried out; and the extent to which the spatialization of research facilities contains within itself conceptualizations of ethics, infrastructure, expertise and division of labor (Davies 2012; Davies, Frow and Leonelli forthcoming). It is also worth thinking of the re-conscription of new kinds of peripheries in relation to research "centers" within advanced liberal societies as a particular form of the dispersions and dislocations of biomedical research. This last concern is represented in this collection by Jennifer Karlin's essay on the recruitment of poor, minority communities into clinical research in the United States. Though this is not specifically about "global" biomedicine, it is not irrelevant to such a problematic.

Hence, “the global” can be parsed at the level of national-state differences, of the spatializations and scale-making involved in building global research projects and collaborations, of emerging centers of research excellence in the Global South, of the biomedicalization of traditional epistemologies and medical practices, and of the emergent relationships of biomedicine to spaces of marginality around the world, including the “First World”. All these registers of the global are at stake in the conceptualization of translational research in the content of regimes of knowledge and value; and all of them are subject (and often consequent) to processes of capitalization that enable the movement of knowledge, materials and resources (including human capital) across the world.

Epistemic conjunctures: the post-genomic era

In parallel to the institutional movements described above, the knowledge produced through research and experimentation in labs across the globe has undergone significant developments over the last forty years. Following the discovery of DNA in the late 1950s, biology entered a ‘molecular bandwagon’. Throughout the 1960s, 1970s and 1980s, biochemistry and genetics have absorbed the vast majority of resources and public attention allocated to biology, culminating in the international funding of sequencing projects in the 1990s, which were ostensibly aimed at ‘deciphering the code of life’ (Kay 1993, 2000). Such was the attention to biochemistry as holding the key to understanding life, that the whole of the 20th century has been dubbed the ‘century of the gene’ (Keller 2000). Several scientists, philosophers, historians and sociologists have accused this approach of reductionism, resulting in a skewed understanding of life in terms of the individual molecular components of cells rather than the complex and dynamic relationships between biological components – molecules, cells, organs, organisms – and their environments (e.g. Morange 1998, Oyama 2000). These arguments found new strength towards the end of the Human Genome Project, whose results confirmed the long-held suspicion, particularly by some of the very instigators of the sequencing projects themselves, that sequencing data need to be integrated with studies of other biological components, processes and levels of organization in order to yield an improved

understanding of life – and particularly one that could inform clinical research (Barnes and Dupré 2008; Ankeny and Leonelli 2011; Müller-Wille and Rheinberger 2012).

We use the term ‘post-genomics’ as a way to signpost the most recent period in the history of the life sciences, where several key developments (discussed below) have coincided with the completion of the first genome sequencing projects in the late 1990s and early 2000s. We do not mean to assert that the completion of these projects has had a direct causal influence on those developments, though their existence certainly helped to enhance existing key technologies for data production and reinforce key ideas such as epigenetics. We also do not wish to dismiss the extent to which genomics continues to grip contemporary biomedicine. Rather, we use the notion of ‘post-genomics’ as a historical marker for an era where the results of genomics is being brought together with biological and medical insights gathered throughout the 20th century, in order to reach integrated, systemic understandings of organisms and their environments.

The reductionist strategy underlying genome sequencing projects has actually fostered a renewed appreciation of disciplines and approaches that had momentarily moved to the backstage of the life sciences in the second half of the twentieth century, such as epigenetics, immunology, physiology, cell biology and ecology. This attention to integration is due partly to the intrinsic relationality of biological objects and processes. It is impossible to even identify what counts as a biological individual without appeal to its environment and to its relations with other organisms. Identity, lineage and stability in organisms are results of complex and ever-unfolding relations among a rich ensemble of components, whose constant interaction defines what counts as a ‘live’ organism and demarcates animate from inanimate matter (Dupré and O’Malley 2009). A second reason for the crucial role of integration in the post-genomic era is its importance towards understanding the complex temporality of organisms. Change is an essential feature of life and studying the rate at which change occurs is as important to understanding organisms as are the mechanisms that generate change - a point brought to life by Hannah Landecker's essay on metabolism in this issue. However, there are several different time-scales at work within organisms, ranging from the seconds necessary to enact molecular

processes within the cell to the days, months or years used to measure developmental stages (e.g. the growth of a human embryo into an adult) and the much longer periods involved in evolutionary shifts (e.g. from *Homo habilis* to *Homo sapiens*). These different time-scales jointly determine the features of the processes that produce and maintain life, and biological understanding thus needs to find ways to integrate them (Dupré 2011). Consideration of scales brings us to a third reason for the focus on integration in contemporary biomedicine: a renewed attention to systems and to processes of synthesis aimed to create life, as evident from the current prioritization of funding devoted to systems and synthetic biology across the globe.

Through all of these features, what we are calling the ‘post-genomic moment’ is challenging some of the most deeply entrenched dichotomies within biology, such as that between organisms and environments (Dupré and O’Malley 2009) and between nature and nurture (Keller 2010). The essay by Hans-Jörg Rheinberger in this collection points to the distinction between genotype and phenotype as one such dichotomy that played a crucial structuring role in 20th century life science. Landecker’s essay shows how this dichotomy is being replaced by concepts such as epigenetics, speaking to relationships between gene and environment where both the gene and the environment are unstable epistemic things, partly as a consequence of such investigations themselves. Together, these two essays provide us with a window on the history and contemporary practice of biomedicine, and on the shifts in the crucial role played by genetics and genomics in structuring current reconfigurations of biomedical knowledge and practice.

Translational research and Knowledge/Value

The various essays in this collection locate and analyze see Knowledge / Value articulations of biomedicine “in the trans” through different exemplary entry-points. Karlin’s essay focuses on community outreach as a practice of translational research; and Rheinberger and Landecker point to concepts (heredity and metabolism respectively) that structure 20th (and now 21st) century biology. This introductory essay has set forth a theoretical framework in which these concerns, and the underlying realities from which they emerge, can be made sense of. The use of the term ‘translational research’ in

biomedicine is polyvalent and may signify radically different things. We are not interested here in settling upon its “real” definition or its “true” meaning. Rather, we wish to argue that the *stakes* of translational research take many more forms and interpretations than the simple linear definitional mantra of “bench-to-bedside” suggests. In all of its guises, translational research confronts the social as something to be conceptualized as much as the biological, with important theoretical and practical consequences. Translational efforts could foster reduction as well as pluralism, polyphony as well as appropriation.⁹ The essays in this folio collection individually and collectively map domains of trans-action and trans-formation that put our understandings of knowledge, value and contemporary biomedicine at stake.

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⁹ This point about the janus-faced politics of a “trans”-biology was anticipated by Donna Haraway years before “translational research” became an actor’s category in biomedicine (Haraway 1991).

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