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Stephen Hilgartner, *Reordering Life: Knowledge and Control in the Genomics Revolution*

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If the "genomics revolution," emblematized by the Human Genome Project (HGP), has revolutionized biomedical sciences, it is not only in the sense that it has fundamentally shifted the ways biological life is defined and valorized, but also in the sense that it has transformed how biomedical knowledges are produced, circulated, and controlled in and beyond laboratories. The figure of high-throughput genome centers contrasted with ordinary "cottage industry" molecular laboratories, for instance, exemplifies a significant change in the material infrastructure and modes of knowledge production and collaboration in biomedical sciences. The genome center is not simply about taking advantage of economies of scale, as it entails a different mode of producing, sharing, and controlling knowledge.

Stephen Hilgartner's *Reordering Life* traces the changes in the "knowledge-control regimes" during the HGP. The knowledge-control regime refers to "a sociotechnical arrangement that constitutes categories of agents, spaces, objects, and relationships among them in a manner that allocates entitlements and burdens pertaining to knowledge" (9). Focusing on the strategic activities of the sociotechnical vanguards committed to the HGP, he draws attention to the dynamic process through which extant knowledge-control regimes are reordered during periods of transformative change in knowledge production. And, the process is not an arbitrary one. The sociotechnical vanguards make use of available cultural resources and practices that are already in place, and work with generic schemata that govern their interpretations and actions. The "organized set of schemata that provides a template that actors employ to guide action and interpretation" (12) is termed as a "governing frame." The governing frame works like the modern state's constitution by defining its elements and mapping the relationships among them in a generic manner, while leaving ambiguities when being applied to specific circumstances. Hilgarnter walks readers through how the sociotechnical vanguards, "a bit like a constitutional lawyer" (226), actively interpret, engage with, and reformulate extant categories, reasoning, and regimes of governance, as they seek not only to achieve a new paradigm in biology, but also to transform the existing

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scientific practices and institutions to realize the goal. Instead of looking at the conduct of scientists being controlled by the existing norms, Hilgartner directs readers' attention to the agency of scientists and their strategic maneuvering within and around the constitution-like governing frames.

Hilgartner's long-term ethnographic engagement with the genomics research community was sustained from 1988, two years before the launch of the genome project, to 2003, the official completion of the HGP. It offers a unique opportunity to observe the dynamic processes of stabilization and destabilization of knowledge-control regimes, as well as the transformations in the epistemic and strategic value of knowledge objects.

In chapter 2, readers are introduced not only to the vanguard vision of the HGP leaders, but also to the changes in the material practices and organizational structures of the laboratories from 1988 to 2000. Whereas the vanguard outlook envisioned unprecedented sharing of data and materials for the genomics research community, it could not survive without friction. The HGP leaders anticipated and promoted "sharing" of data and materials to accelerate the speed and increase the efficiency of the genome project. Databases became a matter of particular importance, and it necessitated a new knowledge-control regime. The traditional molecular biology laboratory saw data and materials as its holdings that could be transferred only within its perimeter.

Furthermore, scientific knowledge production, for individual researchers, is not only a matter of scholarly contribution to the scientific community at large, but also a matter of individual career and living, for which one should strategize how to invest one's time and efforts to build a competitive research profile. Hence, the strategic actions of genomics researchers that are examined in this book concern not only the larger objective of the HGP, to complete the project in an efficient manner and to generate what they envision as knowledge to revolutionize life sciences. They also include strategic actions related to more mundane yet undeniably significant concerns of individual researchers and laboratories that are involved in the HGP for their career trajectories, research profiles, and laboratory holdings. While they are partly linked to molecular biology's highly individuated epistemic culture, the concerns and problems are also related to the academic credit system that scientists, like most of us, are living with. And, when overt commercial interests and trade secrets came into the scene, the matters became more complicated, as seen in the debates on the proprietary databases and patenting of expressed sequence tags in chapter 5.

From the outset, the HGP had to deal with the highly individuated epistemic culture of molecular biology that the HGP leaders saw as challenges to the enterprise, and the efforts to build databases for "sharing" needed to be articulated with the already established regimes of the journal and the laboratory. During the HGP, with its emphasis on the efficient and accelerated production (and sharing) of data, the high-throughput data-producing facilities have been established as the main "producers" of data, distinct from "ordinary biology" laboratories that are rather seen as the "users" of data.

In chapter 6, Hilgartner traces the stabilization and destabilization of the database regimes during the HGP. Here, readers learn that "sharing" data is in no way straightforward. It is not simply a matter of the "ownership" regarding data and materials. Even when data and materials are "shared" through databases, there are many more practical issues that actually matter: how they should be collected and made available in a timely manner, when they can be released without impinging on the rights of the producers,

how the producers and users of data and materials are entitled to credit, and so forth. By analyzing the dynamic process of database regime changes in relation to the "adjacent" regimes of the journal and the laboratory, Hilgartner invites readers to attend to the practicalities of data management that should have broader implications in the era of "big data."

While the ethnographic research is primarily based in the United States and focuses on the HGP, Hilgartner has done some field research in other European countries in which different regimes have emerged around the vision of genomics research. Chapter 4 offers a comparative analysis of the US regime that was built at the outset of the HGP and the Reference Library System (RLS) that took shape in the UK funded by a London-based charity. Despite the differences in their fates and scales, the comparative analysis reveals the specific structural and normative choices that were embedded in the HGP regime. With the advent of the HGP, it is easy to take for granted that the well-funded genome centers that produce data and distribute them to everyone (independent and autonomous laboratories) were the most efficient way to go. However, the comparison with the RLS regime, which configured the central library and participating laboratories as a producer/user network, makes it clear that the US regime was not the only obvious choice. Two contrasting views of the "scientific community" were embedded in the two regimes, and the HGP regime's wider acceptance and success could be, Hilgartner notes, attributed to the existing culture and practices of molecular biology heavily leaning toward individual autonomy. If the RLS envisioned a more collective research system, which may have revolutionized the existing culture and practices of molecular biology, the HGP took a route that preserved the existing culture. Hilgartner once again makes a point of taking seriously the existing culture, practices, and systems that can often be missed when focusing on the dramatic shift brought by the genomics "revolution": "New regimes proved easier to constitute when they did not attempt to change the control relationships operative in established jurisdictions. Rather than attempting to impose new burdens and entitlements on molecular biology laboratories, the US genome program distinguished the HGP from 'ordinary biology,' constituting a governing frame focused on controlling the new agents it sought to bring into being (genome centers) without disrupting the existing ones (ordinary laboratories)" (227–28).

The main question that guides *Reordering Life* is how *existing* social orders integrate genomics into their practices. The author's long-term ethnographic engagement, taking seriously what was happening in real time, allows readers to observe both the endurance of existing social orders and reformulation of them in the advent of the genomics revolution. And in this process, the mundane workings of academic credit and ranking systems, disciplinary epistemic cultures, researchers' own concerns about their future, and national technoscientific imaginaries are all at work. One important methodological lesson that Hilgartner brings to us is to get (back) into the laboratories to attend to "activities" of the scientific community. In order to understand the mutual coproduction of science and society, one may start from regulatory agencies, courts, and ethics commissions where the "social" implications of science are discussed. However, it is equally important, Hilgartner shows, to look into the process through which specific visions take shape and others not, informing and being informed by the discourses on "society." And, it includes not only scientists' grandiose visions, public performances, and groundbreaking achievements but also the practicalities of their

scientific life with which the visions and regimes are articulated. This approach may offer a promising avenue for the scholars working on STS in each locale. Taking seriously the mundane concerns of scientists that are shaped not only in the epistemic culture of a specific discipline, but also in tandem with the local political economy and changing academic/commercial environment, richer accounts of local science and technology and further comparative opportunities may emerge.

The genomics "vanguards," or self-consciously revolutionary scientists that Hilgartner followed over time, saw themselves as responsible not only for the making of new knowledge but also for building more infrastructure and novel scientific culture and practices than before. Hilgartner points out the importance of this revolutionary identity that provided the sense of urgency and energy to the genomics scientists involved in the HGP. The figure of genomics vanguards fits nicely into the technoscientific imaginary that is at work in the United States. One might wonder then how the scientists in East Asia in the emerging field of science and technology identify themselves as both local and global actors, how they strategically act to create room for their own scientific enterprises, and perhaps how they employ the model cases from other countries in their strategic actions.

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