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Book review

Supersizing science. On building large-scale research projects in biology, by Niki Vermeulen, Maastricht: Universitaire Pers Maastricht [Maastricht University Press]

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Walking into a McDonald's restaurant and ordering a Big Mac meal, one used inevitably to be asked whether to 'supersize' the meal, resulting in a larger portion of fries and a larger soda to accompany a Big Mac burger. The burger itself would be left unchanged. The key feature of *supersizing according to McDonalds* is to provide a supersized periphery to an unaltered core. *Supersizing according to Vermeulen* displays strikingly different features from the version made famous by McDonalds and its competitors.

Although the title of her book suggests that Vermeulen is interested in understanding how science got big, she mainly focuses on the role of collaboration in this process. Vermeulen summarises these features in two concepts, which she slowly but steadily develops into the theoretical frame of her book. These are the notions of *big biology* and *the projectification of science* which together contribute to the supersizing of science. The book is divided into three parts, entitled 'Big biology', 'Life science live' and 'Supersizing science', of which the first two present a mixture of theoretical and empirical analyses, whereas the last provides the theoretical integration.

The book starts with an historical overview of big science. However, this overview quickly turns into a theoretical exercise centring on the question whether big biology is in fact big science. The author answers that question affirmatively, but not without adding a rather substantial *nota bene*. Big biology, she argues, is a very specific version of big science. While big physics is characterised by its big instruments and centralised organisation, big biology is characterised by its networked character: scattered sites of inquiry and decentralised modes of organisation and institutionalisation. In this big biology network, all the nodes are tied together by various sorts of bioinformation and data. To Vermeulen, the infrastructure of big biology is a structure dominated by large, international databases: huge and omnipresent, requiring growing resources to build, standardise and maintain. These sociotechnical arrangements have even led to the formation of a new professional: the computational biologists, or bioinformatician. Furthermore, the bigness of biology is to be seen in a different societal context as the bigness of, for example, physics. Different from physics, biology's bigness is contingent upon its ability to be relevant, socially and economically. Connected to this requirement is the trend that big biology is accompanied by large studies of (unintended) social, ethical and legal consequences. Growing collaborations, fuelled by the advances in information and communication technologies, as well as increased ties with society and social science, have made biology truly big.
Vermeulen defines big biology by its key ingredients: collaboration, information and societal relevance. This makes big biology a very heterogeneous entity. Vermeulen

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has taken up the challenge to provide empirical accounts of three very different big biologies: the Census of Marine Life ("big natural history"), the Silicon Cell Initiative ("big laboratory/information biology") and the VIRGO Consortium ("applied big biology"). These diverse empirical landscapes are exposed to three equally diverse theoretical *bagages*, resulting in an historical, sociological and innovation analysis respectively.

The Census of Marine Life (CoML) has no lack of ambition or size: it is attempting to catalogue all life in all of the world's oceans and involves 2000 researchers from 80 countries, spending more than $1 billion in 10 years. Vermeulen traces the history of the CoML to learn about the history of collaboration in biology, and especially in ecology. Collaboration in natural history is, argues Vermeulen, influenced by the digital revolution. For instance, amassing collections of specimens is replaced by collecting data about the oceans. Technologies such as submarines, cameras and data storage and retrieval systems have provided new opportunities to venture deeper under water, amass larger catalogues of more diverse forms of life. Simultaneously, however, technology adds to the disconnecting of researcher and research subject, for example through unmanned submarines and especially through genetic taxonomy: invisible and without the need actually to witness life. Furthermore, global collaboration has exponentially increased scale and ambition, but decentralised, local funding has fragmented that ambition and continues to complicate alignment and integration.

Vermeulen shows that despite the CoML's ambition to create a global map, the decentralised census in fact provides a map with a large *terra incognito*, overlapping with the areas expected to have the largest and most surprising biodiversity. Vermeulen argues that while natural history is still mapping the living world, both the *mapping* and the resulting *map* have undergone radical changes. (Information) technology has changed research practices, research agendas and research outcomes. Subsequent modelling efforts have even enabled natural history to extend the reach of its claims about the world from the past into the present and even into the future. Simultaneously, Vermeulen continues, natural history is contextualised: popular books and movies accompany its research output. Vermeulen convincingly argues that the CoML is an example of *new natural history*: highly technological and highly social, yet part of an 'old' way of knowing.

Subsequently, Vermeulen zooms in from the grand scale of the world's oceans to the minute scale of the individual cell. Natural history is exchanged for laboratory biology and submarines for supercomputers and, most importantly, a successful case-study is exchanged for a not-so-successful one. The Silicon Cell Initiative (SCI) is virtual in nearly all the meanings of the word. Vermeulen traces how and why the SCI never coalesced into a real collaboration, guided by the question 'why is it so hard to make biology big?' She takes up a dramaturgical perspective and stages the (failed) formation as a story with a sad ending, starring the interaction of science and its organisation in every stage of collaboration, showing how scientific disputes, contextualisation and public mobilisation of knowledge shape this interaction.

Vermeulen shows that while the bigness of the ambition of the SCI is legitimised both scientifically and politically, its scientific reality lags behind. The SCI was performed

Genomics, Society and Policy, Vol.5, No.1 (2009) ISSN: 1746-5354

as 'big science' on the public stage, while its backstage character remained small. This performance did not secure resources to make the move from small to big backstage and the SCI's leading scientists embarked on a different path: to promote systems biology, a scientific context able to support the bigness of the SCI. Vermeulen argues that the roles of the scientists in the proto-collaboration changed, moving from constructing a programme to constructing a 'new world of biology': from researcher, though collaborator and lobbyist to policymaker and negotiator. Apparently, building big biology out of small cells requires grand and multiple roles for those who do so and, Vermeulen argues, for many of these roles, no scripts are available. While the SCI remains a collaboration-in-the-making, its systems biology context is rapidly solidifying. This, in turn, slowly enables backstage bigness for SCI.

The final empirical domain visited by Vermeulen has made her book especially timely: the quest for a vaccine to prevent a flu pandemic. *Supersizing Science* positions the making of such a vaccine as big biology at the intersection of academia, industry and government. She discusses this quest in the light of contemporary life sciences innovation policy in the Netherlands: the stimulation of academic-industrial collaboration in 'tribrid' consortia, such as VIRGO (Viral Genomics Consortium). Her focus lies on the boundaries between the three cultural realms and the collaboration work that bridges them, resulting in a political history of collaboration in innovation.

Vermeulen describes the birth of VIRGO in its sociopolitical context, which is characterised by moves towards capitalisation, valorisation, implementation and application. Given that the initiators for the consortium are from academia, all of the above had to be built into a new 'innovative cluster'. As VIRGO moved from being an academic collaboration into a public-private collaboration, its research and innovation goals diversified to encompass all interests. This interweaving of goals, priorities, structures and stories was facilitated by the project format, structuring and guiding the process. Multiple work packages allow for diversity, while the project structure ensures uniformity and centralised orchestration of, for example, accountability and evaluation. The project-format of VIRGO and other consortia, Vermeulen argues, enables the alignment of various elements such as funding, time, location and much more. To do so, however, it requires hybrid scientists: virologist-managers or virologist-entrepreneurs, a scientific identity Vermeulen compares to the public image of J. Craig Venter. Bridging boundaries is done through the creation of hybrid structures, under the auspices of the project format, a political innovation in the scientific landscape.

Supersizing Science takes up these various threads and integrates them into a theoretical exposé of collaboration in biology. It highlights defining features such as the networked character of big biology in which structure, infrastructure and size are as important as content. Vermeulen maps her cases studies along axes of bureaucratisation, hierarchy and interdependency and argues that a 'loose' organisation of collaboration will result in troublesome integration of research results. Furthermore, *Supersizing Science* presents three ways to be big: "aspirational, material and policy-imposed bigness" (p. 184). Each of the collaborations Vermeulen studied is big in all three ways, although in dissimilar ratios, and although the CoML continues to grow and SCI has the potential to continue growing, VIRGO is restricted in its scale by a policy-imposed boundary on collaboration: the Dutch national border.

Genomics, Society and Policy, Vol.5, No.1 (2009) ISSN: 1746-5354

Vermeulen positions aspirational and material bigness as enablers to the supersizing of science while policy-imposed bigness both enables and restricts this process. This is odd, given that in the analysis of her case studies, she hints at a number of restrictive elements in the aspirational and material sphere.

Near the end of the book, the notion of *styles of collaboration* is introduced. Vermeulen argues that the three case studies, CoML, SCI and VIRGO, exemplify three styles of collaboration: 'sorting things out', 'transforming knowledge' and 'applying knowledge', respectively. Vermeulen draws the notion of style from authors such as Fleck, Kwa and Pickstone ('ways' instead of 'styles' in the case of the latter). She develops her styles of collaboration in their image, most notably as non-exclusive and dynamic. Regrettably, although Vermeulen explains the differences between the various styles of collaborating, she neglects to discuss how a 'way of knowing' or a 'style of thinking' relates to a 'style of collaborating'.

Supersizing Science ends by linking the key theoretical notions in the book: big biology and the projectification of science. Contingent upon the exact style of collaboration, crafting a budding collaboration into big biology requires the formation of a network, the building of connections and the maintenance of bigness once it exists. Big biology is often prepackaged in projects containing strategies, roadmaps, problems, solutions and deliverables. Even then, big biology may seem bigger than it actually is, due to a misfit between ambition and reality. Projectification is thought to increase the feasibility and effectiveness of big biology. However, Vermeulen convincingly shows that "project work often does not work" (p.196). The projectification of science strictly confines thought and inquiry. This enables detailed control, yet leaves little room for gradual improvement and thrusts new roles upon scientists: lobbyist, manager, coordinator and project leader.

Is big biology a new biology after all? Vermeulen concludes that supersizing science is a process that affects all levels of scientific organisation and many types of inquiry in the life sciences. It is about changing the conditions under which science takes place, the way it is organised and the knowledge it produces. It is about the individual scientists and their work as much as it is about social and material connections. 'Supersizing', according to Vermeulen, penetrates all layers of science and correspondingly leaves 'supersizing according to McDonalds' in the dust. In the epilogue, after recognising her own position in big biology, Vermeulen even hints at an expansion of her study into the supersizing of social science.

While the title suggests prepackaged thinking about collaborative big biology, the book presents a careful analysis respecting the diversity which defines working together. This diversity, captured on the empirical level in a variety of case studies and on the theoretical level in a variety of positions, prevents the book from diving deep into any specific problem or issue surrounding collaboration or big science. Instead, Vermeulen presents a broad overview. Nevertheless, while she leaves room for a variety of contingencies, a small number of her conclusions are overly general, for instance that building big biology "does not leave room for reflection of uncertainty" (p.195). Furthermore, while Vermeulen does not mask her normative position, the book itself remains largely descriptive. As a result, it offers plenty of food for thought to scholars of science, yet does not offer any advice, suggestions or

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recommendations directed at science policy circles. Because of a number of such loose ends, *Supersizing Science* leaves a slightly unfinished impression. It is best read as a travel guide: pointing out the hotspots and the dodgy areas in the landscape of collaboration. Like every travel guide, it is never complete, it is never perfectly up to date, and its value depends on one's knowledge of the area. Nonetheless, it is of great value to those on their first visit to town.

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