non-Weaver notion and that could be legitimately used in the biological context. He argues that the only things that genes can be said to really encode are proteins for which they are templates. The route from these proteins to phenotypic traits is too messy and complicated to be understood in terms of coding or transfer of information.

The final debate deals with a hot topic in evolutionary psychology. The question is whether the hypothesis of massive modularity of human mind makes sense. Peter Carruthers thinks that it does and James Woodward and Fiona Cowie provide arguments for the opposing view. In his paper Carruthers tries to clarify the notion of module and to argue that this notion is indispensable in understanding human cognition and its evolution. For their part, Woodward and Cowie present a skeptical case against the claims of massive modularity. They show that the notion of module used by the evolutionary psychologists is vague and plagued by difficult methodological problems.

As a whole, this anthology provides a good sample of contemporary philosophy of science. Naturally many important topics are not covered, but the volume gives a real taste of current philosophical debate. The debated issues are real and well-defined, and not obscure conflicts of various -isms whose philosophical relevance is only understood by the participants.

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Daniel Lee Kleinman:
Impure Cultures – University Biology and the World of Commerce.
The University of Wisconsin Press, 2003. 205 pages.

"Universities are threatened by commercialisation." These are the sorts of claims that have often inspired traditional research into university-industry relations. In his book *Impure Cultures – University Biology and the World of Commerce* Daniel Lee Kleinman explores the influence of the world of commerce on academic biology by studying one specific laboratory called the Handelsman lab. Without making a normative judgement about the role of commercialisation, he focuses on the indirect effects of commercialisation, rather than on the direct (funding-related) relations between science-based firms and academic scientists, which concernes the "traditional" literature on university-industry relations. Kleinman argues that there is a *commercial culture*, which indirectly and pervasively influences academia.

By following the researchers and research practices in the Handelsman lab as a participant observer, Kleinman started to distinguish some of the commercial factors that influence the every-

day practices of this particular (plant pathology) lab. In order to study these influences, however, Kleinman could not adopt a "classical" laboratory studies approach. In a detailed analysis of the laboratory studies literature, he sets out his reasons for adopting a structural approach. At a particular moment in time structures and power relations – that were once constructed – exist and may constrain certain practices. These structures have been neglected or missed in studies that focused on agency and construction processes. In chapters 3, 4, 5 and partly 6 (the book consists of six chapters), Kleinman explores the effects of already existing structures on laboratory science-in-action. In doing this, he often takes the historical developments of these structures into account.

Chapter 3 discusses how the agrichemical industry became the dominant actor in defining pest-control strategies and has affected the scientific practices of labs engaged in biological control research. According to Kleinman World War II was a decisive factor in shaping modern pest control in agriculture. The U.S. government promoted pesticides in order to increase the food production. Methods of biological control received far less attention and funding. To understand how this development affected biological control research, Kleinman demonstrates that the Handelsman lab always needs to justify its academic papers and applications for grants in relation to chemical disease control. To develop a particular micro-organism (UW85) commercial justifications are needed; Handelsman needs to suggest that this micro-organism would have a market advantage over existing chemicals. The efficacy of field tests is similarly measured against the efficacy of a commercially produced chemical. Kleinman discusses another case where the world of commerce affects biocontrol research. After the citrus industry promoted cosmetic standards for the fruit, biological control scientists needed to find insects that would control pests and would make sure that ripe fruit would meet the industry's standards. Kleinman suggests that these guidelines indirectly shaped scientist's practices. The cosmetic standards defined what was considered adequate biological control: "standards of research success were indirectly established by measures of commercial success" (79).

Chapter 4 examines issues of power relations and resource dependency by investigating the standardisation of research tools in biology. Kleinman describes how the Handelsman lab relies on certain technologies that the lab cannot afford. The lab therefore depends on companies to analyse samples. If the company and the lab do not agree about a particular result, the lab can try to resolve the disagreement within a scientific discourse (with help of evidence and argument). The company, however, may instead threaten to sue the lab for accusing it of making a mistake. An academic laboratory will not be able to afford the expenses of a lawsuit. Another case explores the use of kits in laboratory science. The scientist has to trust the efficacy of the kits and in this way relies on the commercial producer who provides the kits. Working with commercially provided kits can influence the work in the laboratory in two ways. Kits can be useful in the sense that they decrease time spent on routine work, however, they can also be so much of a black box that

the user does not realise what is actually going on and therefore draws inaccurate conclusions.

Chapter 5 discusses yet another way in which the world of commerce influences laboratory science. This chapter is concerned with the tendency to regard products of biological research as private property and to patent them. Kleinman demonstrates the consequences this can have for academic science. In fact, he suggests that it is often the common sense assumptions about the efficacy of patent protection – whether they are true or not – that influence the behaviour of both companies and academic scientists. Companies can restrict production, control the price, and set conditions under which these products may be used. Scientists involved in basic research are allowed to use products for research purposes without a license under something called "experimental use exemption". If a product becomes more expensive, a lab may consider developing products in-house to free money for other products. The company that holds the patent, however, can decide to fight the "experimental use exemption" and this threat of legal action often results in the refraining of the lab to produce their own products. Laboratories themselves have to try and patent their inventions to realise the market potential of their work; companies will not work with unpatented products. This resource dependency and the practices around patents are time consuming and restrict laboratory practices.

Impure Cultures – referring to the difficulties in both maintaining a pure bacterial culture in the laboratory and rigid boundaries between science and commerce – is a multi-facetted work. It can be read as a work that explores university-industry relations, as a (reflexive) ethnography of a laboratory placed in a broader context, and as a theoretical work that engages with science and technology studies literature and studies on university-industry relations. The book is very rich in detail. Kleinman has familiarised the reader with the Handelsman lab, its work, and its members in the first chapter of the book and provides many examples from the lab to illustrate the theoretical claims that partly resulted from his ethnographic work. This concreteness and its clear structure are a major attraction of the book.

Kleinman has persuasively shown the influences of wider (social) structures, power relations, and resource dependency on the everyday work in the lab with help of a variety of interesting and sometimes novel cases (the use of kits in a laboratory for example). With regard to his interest in structural factors, it is obvious that Kleinman does not follow the actor – Handelsman in this case – in her distinctions between the world of science and the world of commerce. Whereas Handelsman distinguishes issues like intellectual property from what she refers to as "the science", Kleinman states "the reality of running a university biology lab does not allow her the luxury of separating 'the science' from matters of patenting, funding, and administration that play important parts in her professional life". (158) Here the boundary between science and what he calls the social seems to be blurred. Kleinman argues, however, that although science and the social are intimately connected in the lab, they are not inseparable. If they were, it would not be possible to investigate the ways in which the larger

social world shapes academic science. Kleinman convincingly demonstrates that in some cases the social can have an analytical priority over the technical – one of his central claims – in chapter 6. Yet, I wonder if occasionally the concepts of "science" and "the social" are not confused with the – sometimes equally confusing – terms "micro" and "macro" in which both can be a combination of the social and the technical.

Moreover, I am concerned about the lack of definition of the main concepts (world of commerce, direct influences, indirect influences) in the book. Since Kleinman does not follow the actor's concepts he has to make an *a priori* distinction between university science and the world of commerce. He does not, however, define his primary concepts. Many developments he sketches are in my eyes not necessarily related to the pervasive influence of the world of commerce. At times he recognises this himself. He remarks for instance that barriers to open communication are not always brought about by patenting, as much of the industry-university relations literature suggests; inter-lab competition, laziness, or failure to maintain samples properly can hinder open communication as well. Also, the relation between standardised research tools, laboratory life and commercialisation is not straightforward. Kleinman writes "Handelsman and several of her students pointed out that the problem is in the black-box nature of these technologies, not in the fact that they are commercially produced." (111). The main relation with commercialisation may be that "commercial opportunities often tend to propel standardisation". (112) The confusion about the exact nature of commercialisation and its consequences also leads to other questions. Is it the influence of commercialisation that leads university laboratories to try to develop the best possible product and measure this against what is already there (in the case of biological control research) or has that always been normal academic practice? If investment of money by industry is seen as a sign of commercialisation, how is investment of money by the government regarded? The development of cosmetic standards by the citrus industry shapes the design of biocontrol research and points to the pervasive influence of the world of commerce. When the European Union sets cosmetic standards for fruit, can this be retraced to commercialisation as well?

This also brings me to consider the question of "direct" and "indirect" influences. By "direct influence" Kleinman seems to mean that academic research is directly funded by industry. However, patronage by industry would only have "direct influence" if the industry demands for the research to be undertaken in a specific way or if the industry funds one type of research rather than another. The Handelsman lab for example receives funding from several companies. These companies have nevertheless no control over how the money is spent. "Indirect" can refer to a variety of aspects, amongst which the cosmetic standards set by the citrus industry: "Industry affected scientific practice not directly through research funding, but indirectly through institutionalised standards and tools developed through earlier industry-supported research". (89) Would similar standards set by the European Union be even more indirect? Do levels of indirectness exist or are all

different indirect factors equally important? Kleinman himself acknowledges at several points that "the extent of these indirect influences on academic science is difficult to measure" (89) and that "the indirect effects of the commercial world on the practice of academic science are difficult to see and easier to ignore that the direct factors that have been the focus of the controversy". (162)

Kleinman set himself a difficult task, one that could perhaps have been a little easier if he would have defined the concepts mentioned above from the outset. He has not convinced me it is the world of commerce that has a particular strong indirect influence on laboratory life compared to other structural influences. Whether the distinctiveness of current changes in the U.S. university, which he wanted to investigate with help of the analysis of indirect influences of the world of commerce, is due to the explicit (direct or indirect) commercial character of the structural factors remains a question. Yet, he provides a sound analysis of the ways in which this academic laboratory is influenced and shaped by 'outside factors' -whether these are called "(social) structural factors" or the "new knowledge economy"- something that has indeed not been addressed by many other so-called laboratory studies. He has clearly demonstrated the impacts of power relations and resource dependency on the everyday work in academic laboratories.

To conclude, I am enthusiastic about this book. It really is a pleasure to read due to the richness of the data and the analysis provides the reader with a valuable and welcome contribution to existing work in both science and technology studies and policy literature on university-industry relations. It is a work that addresses a wide range of audiences and that I would recommend to anyone having an interest in laboratory ethnographies, in relations between university and industry, or in science and technology studies.

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