8. Conclusion – Biomedicine as Discipline and Integrational Category

In my book, I set out to recover the lost disciplinary identity of medicine. In the process, I tried to give historical explanations of the complicated relationships between institutions like the laboratory, the clinic, the natural, the medical and the clinical sciences as well as medical practice. In short, I wanted to provide a historical picture of academic medicine from the vantage point of *scientific*, rather than clinical practice. I was able to show that medicine is more than just a science-based profession; that it rather constitutes an autonomous academic discipline, next to others like physics, chemistry or biology. For this purpose, it was important to realize that reference to an epistemic object or a shared set of practices is only one aspect of a scientific discipline. The theoretical approach of disciplinary cultures helped me elucidate this fact. The concept constitutes sort of a middle ground between sociological notions of disciplinarity and the idea of research cultures popular in STS. It is meant to go beyond the formal understanding of disciplines, defined by such features as paradigms, canons, recruitment structures or the institutionalization in departments; and complement it with a perspective on the more individual and local conditions in which disciplines are formed and changed.

Although the structures defining the scientific system have been shown to be not as orderly as the sociologies of science suggest, my study presents a strong case for not so readily discarding the analytical concept of disciplines. As I have demonstrated through a concentration on the discursive identity-formation of research communities, the concept is compatible with the messier view of science that is characteristic of STS and their emphasis on research practices and cultures. However, a concentration on only the quotidian features of science fails to account for the structural relationships that transcend the micro-social and material conditions of research. Though my study revealed how the institutions of medicine have over the past roughly two-hundred and twenty years fragmented into several different ones – some with closer proximity to the everyday realities of clinical practice than others – it also showed that they are all held together by overarching narratives and ideals, such as those contained in the supercategories scientific medicine and biomedicine. In this respect, despite the different methods of research, various understandings of science and

conflicting languages of practice, investigating how professional actors articulate their common identity nevertheless enables mediation between the level of the everyday realities experienced by them and the level of the larger structural context of boundaries, relationships and institutions that define the system in which they operate.

The idea of disciplinary identity was used to suggest a connection of local cultures of research with global narratives of science. The observed identity work by actors in the medical science sector, moreover, makes clear how discipline formation – strictly speaking – is a dynamic and permanent process. Actors continuously adapted the identity of their discipline to the changing settings of research policy and societal expectations. Protagonists who defined medicine's disciplinary identity all aimed at conserving or promoting a certain medical research culture. This meant securing the social, political and cultural legitimation of their research trajectories as well as facilitating recruitment into the ranks of their scientific profession. The analytical framework combining the notion of disciplinary cultures with an approach to studying discursive identity work proved rewarding in examining the disciplinary dynamics of medical science and therefore makes a fruitful addition to the social and cultural study of science. I could show how the disciplinary identity work of historical actors fulfilled the function of securing the persistence of their research trajectories and autonomous scientific pursuits by equipping their autonomous discipline with promises of utility. This ranged from the more abstract and cultural idea of providing a certain form of education but could also manifest itself in more concrete "services", such as understanding the nature of disease or contributing to health care practices. It became obvious that an adherence to overarching scientific narratives played an important role for structuring the medical discipline as well as its relation to other sciences and society more broadly.

The classification of medicine as *Wissenschaft* in early-nineteenth-century Germany, which connected it to the pure science ideal of Romanticism, for instance, first enabled the development of an autonomous discipline of medical science. As actors began refraining from practicing medicine to pursue scientific work, they could legitimize their new form of medical occupation with the argument that exposure of medical students to their science would equip them with the appropriate cognitive and moral qualities to become good physicians (and able medical scientists). Had my focus been only on the prevailing research cultures at the time, this area of occupation would have fallen to the field of what now is academic biology – which is precisely the sort of classification that many historical accounts

undertake when examining these actors and their work. Similarly, had only formal structures been of interest, medicine would have become visible only as a profession and would not have been seen to emerge as a full-blown academic discipline in the modern research university.

Keeping the local circumstances and the overarching narratives of science in view, was crucial also in other instances, for example, when clinical medicine began to be framed as a pure science at the start of the twentieth century in the USA. American protagonists imported European ideals and interests of science (particularly those who had studied and worked at German institutions) and adapted them to the academic system in the United States. A view to formal structures would have only revealed the distinction between medical science and clinical medicine, on the one side, and biology and medicine on the other. Taking the pure science vocabulary into view, however, enabled a perspective on how the methods and ideals of experimental work also spread to clinical medicine. This helped understanding how under the umbrella of scientific medicine a new discipline, detached from the research practice of medical laboratory science, was beginning to form. At the same time, this transfer not only complicated the relationship of medical science and clinical practice. It also became obvious how biological and medical science research cultures moved closer together.

Biomedical science inherited its disciplinary identity from the distinction of medical science and clinical medicine as well as from the convergence of biological and medical research cultures after World War II. Contextualizing these developments in the post-war narrative of basic science helped comprehend how the previous spread of experimental work in medicine also to the natural sciences departments caused serious ambiguities with respect to their institutional affiliation and to actors' professional work. Regarding the national science policy after World War II, the adjective "biomedical" emerged as a shorthand for collectively grouping research activities in medical and biological institutions in order to correct the ambiguity. But since the concept of the life sciences already defined this large group of work with a view to methodology and subject, the primary identification of biomedical science no longer is a specific method or a clearly demarcated subject area, but instead what I have called a linear legacy – the rather remote promise that basic laboratory investigations will pay off in health care benefits in the future. However, following the crises in clinical research towards the end of the twentieth century, new concepts emerged. While EBM contains the idea of biomedicine as an independent

academic discipline, TR preserves the linear legacy, which determines our overall understanding of the modern enterprise.

I have further suggested that "biomedicine" today acts as both the name for a vast academic meta-discipline *and* as an integrational supercategory. This distinction becomes apparent when we see how the label is enlisted to signify the system of research-based medicine as a whole, as opposed to only the part that frames basic laboratory research as contributing to public health care. In contrast to the discipline, therefore, which is defined by the above-mentioned distinction and convergence, the supercategory sees only integration: purely biological research with no clinical implications as well clearly clinical work have become subsumed under the label of biomedicine. This analytical perspective – name for a discipline vs. supercategory – can help us make sense of the current ambiguities and conflicts, which appear to burden the health care system. As I have shown, the actors defining, reorienting and refining the role of the scientific discipline of medicine with respect to the world of academia and the requirements of medical practice and training, simultaneously also contributed to the supercategorical function of describing the modern enterprise globally. A crucial point in this respect is to clearly spell out what distinguishes the scientific discipline from the global understanding and the social promises attached to it. To wrap up my investigation, I want to give examples that will help elucidate this analytical advantage.

The problem at hand appears to be that we cannot distinguish between the legitimate and unjustified demands that can be brought to the discipline of biomedical science. Our image of the field seems tainted by overburdened expectations in public discourses. What does biomedical science offer as viable services to medicine, other fields and society more broadly? One way to sociologically assess the roles and expectations associated with the term biomedicine is to distinguish more clearly between self-depictions of the discipline and more general narratives of science and medical progress. In the case of today's biomedicine, the discipline is not primarily characterized by its research subject, nor only by an ostensible outlook to the improvement of health care, but much more narrowly by specialized job opportunities and very concrete services to other social realms.

The Life & Medical Sciences Institute of the University of Bonn, for example, currently offers an elite three-year Bachelor's course in "Molecular

Biomedicine".[85] The curriculum is composed of general physics, chemistry and biochemistry, immunology, microbiology, genetics, developmental biology, anatomy, cell biology, neurobiology and physiology, molecular medicine, pharmacology, pathology – a classic list of subjects in the hybrid curriculum that will deliver proficiency in the research culture of biomedicine. The course's core description references the hybridity and alludes to the linear legacy, as I have explicated it:

> "The Bachelor's course in Molecular Biomedicine combines methods and the molecular understanding of the natural sciences with current contents of medicine. The goal is to obtain a molecular understanding of the mechanisms and functions of complex life processes and to understand the pathophysiology of human diseases. This is also the basis for the development of new diagnostics and therapy approaches, which are intended to combat human diseases".[86]

The discipline thus adheres to its identity of the linear legacy, asserting that its work is basic to the future improvement of public health. Moreover, the course of Molecular Biomedicine is offered at the medical faculty in Bonn and much of the training takes place in university hospital facilities. One would therefore be inclined to see the proximity to clinical medicine and hospital work. However, the description of services and job prospects removed from clinical interests confirms my thesis that biomedical science has grown into an autonomous academic discipline. Looking at the professed service roles, the discipline appears in a much humbler light. In their advertisement of the bachelor's course, the university lists the following as possible occupational fields for graduates: "basic biomedical research (institutes of the Max-Planck-Society, major research institutions etc.), development/production/marketing (industry), molecular diagnostic (for medical, biotechnical, environment-related, forensic issues; in clinical disciplines – e.g. pediatrics, human genetics, internal medicine), science (teaching/research at universities, research institutes etc.)."[87]

Consequently, next to the prospect of a traditional academic career, the subject is thus directed towards two large areas of services: one is the

85 See https://limes-institut-bonn.de/studium-lehre/bsc-molekulare-biomedizin/ (accessed August 17, 2020).

86 https: //limes-institut-bonn.de/en/education-training/bsc-molecular-biomedicine/ (accessed August 17, 2020).

87 https://www.uni-bonn.de/studium/vor-dem-studium/faecher/molekulare-biomedizin/molekulare-biomedizin-bachelor-of-science/molekulare-biomedizin-bachelor-of-science-ein-fach?set_language=de (accessed August 17, 2020).

employment of expertise in various settings of research and development; the other is the application to diagnostic problems. There is no explicit mention of discoveries of disease and curing the sick. Graduates of Molecular Biomedicine are neither oriented specifically towards the solution of clinical problems nor do they any longer seem necessarily responsible for medicine in a large sense. Where their work is directed to medical issues, and not to subjects like the environment or forensics, it appears that their work and training is almost directed towards those areas, which Ahrens and others felt were threatening the integrity of clinical research in the last decades of the twentieth century.

Abstracting again to the general level, this means that, although formally housed in a medical institution, the discipline developed independently from its epistemic and practical requirements. Furthermore, it becomes apparent how it is a direct descendant of the culture that emerged after 1800 and which was interested only in the pure science of organic nature. In other words, recognizing biomedical science as an autonomous discipline helps to better categorize the field into the general system of science and academia, seeing how it relates to societal expectations and to prospects for advancing science and the treatment of disease.

This analytical perspective can reveal some of the far-reaching consequences that have resulted from regarding biomedicine, in a supercategorical fashion, as the general name for the academic health care system. In 2009, Iain Chalmers and Paul Glasziou, both towering figures in EBM, for instance, published an alarming evaluation of the research-based health care system's current state in *The Lancet*. Their revelation was that large parts of research outcomes were going to waste because they proved unusable for clinical purposes. Chalmers and Glasziou identified that globally "over US$100 billion is invested every year in supporting biomedical research", which leads to "an estimated 1 million research publications" annually (2009: 86). The authors refer to biomedicine as a supercategory, and not a discipline, since they speak of how the largest part of this money goes to "basic research", with only a fraction devoted to "treatment evaluation" – their own area of expertise (ibid.). Just as became clear with other commentators, the authors are thereby implying that biomedicine comprises more than only a laboratory research culture. Nonetheless, Chalmers and Glasziou warn the academic medical community, and the public more generally, that the high investments in the academic health care system

"should be protected from avoidable waste of inadequately producing and reporting research" (ibid.).[88]

Chalmers' and Galsziou's study is based mostly on data that reveals research waste coming from the conduction of and reporting on clinical trials, but they "believe it is reasonable to assume that problems also apply to other types of research", which – in accordance with the supercategorical understanding – suggests extrapolating their findings to the biomedical research system as a whole (ibid: 88). The authors identify four stages in the research process in which losses can occur: research question, research design and methods, access to publications and the usability of reported findings. Out of theses stages, therefore, two pertain to the production and two to the publication of research. The various biases plaguing scientific publication processes are an enduring theme that has been dealt with in a row of analyses in science studies (Leng/Leng 2020: 199–226). I want to confine my argument only to the first two aspects concerning knowledge production, since it is highly relevant to the issue of the relationship between science and medicine, which I have pursued in my book.

The complaints brought forth specifically by Chalmers and Glasziou concerning research production are, on the one hand, that researchers can address "the wrong questions for research" or, on the other, pursue "studies that are unnecessary, or poorly designed" (2009: 86f.). But what are the *right* questions? And how is their "correctness" determined? It must be understood that such questions are predetermined by the scientific narratives to which a discipline adheres and consequently also by the societal expectations it is connected to. Very simply, for example, it would be spurious to expect concrete outcomes from research that qualifies itself as basic research or to expect material gains or products from the social sciences and humanities (although, sadly, this seems to be the measuring stick for some research policies). For evaluations of the research process this means keeping the two dimensions in mind. Stated differently, the waste problem in biomedical research turns out to pose itself in light of specific imperatives that justify the production of scientific knowledge in front of the background of a sense of urgency: namely, the need to heal disease. With respect to the first complaint, therefore, the imperative is that an "efficient system of research should address health problems of importance to populations"; "However," Chalmers and Glasziou observe, "public funding of research is correlated only modestly with disease burden, if at all" (ibid). The second imperative concerns the pursuit of "new

88 Glasziou and Chalmers (2018) renewed their warning recently.

research", which the authors see only justified if, "at the time it is initiated, the question it proposes to address cannot be answered satisfactorily with existing evidence" (ibid: 87).

From a social and ethical perspective, Chalmers and Glasziou are making very reasonable demands to better understand and improve the processes of research production and reporting. Even on a modest scale, this would promise "to yield substantially increased dividends for patients and the public" (ibid.). However, they are making these demands without a clear view of the actual promises of biomedicine. The generality with which these demands are expressed reveals the confusion that exists over whether all of the different research operations bearing the name of the supercategory biomedicine actually pursue the explicit end of improving the healing of disease. I was able to show that the academic health care system is characterized by fragmentation into heterogenous research cultures with actors pursuing vastly different aims and very particular interests. In fact, many can apply the label biomedicine to describe their research work without any direct intention of improving health care. Again, my investigation revealed that the key concept of biomedicine, which is the dominant term in the present science and policy discourses, is at the same time a supercategory subsuming a variety of different activities and transporting a linear legacy that connects improvements in public health with research work; but, as biomedical science, also the name of an autonomous scientific discipline, largely removed from issues of clinical medicine. It is no trivial matter that Chalmers and Glasziou, key actors in academic medicine with a great deal of influence, fail to see – or at least clearly express – this difference in their text, since thereby their ostensibly reasonable demands, in fact, turn out to be founded on false expectations. In short, Chalmers and Glasziou seem to demand from individual research fields what only the supercategory of biomedicine promises.

More, my focus on the use of medicine's conceptual language allowed contrasting the idea of modern medicine as a discipline with our common understanding of medicine as a profession and can also open up a valuable analytical vantage point with respect to current issues. For instance, those works dealing with the historical category of scientific medicine were characterized by the sharp analytical distinction between the clinic and the laboratory, while the social and historical studies of biomedicine seem to have been constructed more from the background of how innovations in research practices have somehow also enabled better practical abilities of medicine. Both have in common, though, that they underplay the identity of medicine as a scientific discipline and inflate its understanding as a

profession. In the majority of social and historical studies of medicine, the enterprise is thus presented as constituted by the application of scientific knowledge.

As a result, medicine has been conceptualized in terms of its conflicting scientific and practical identity. This biased understanding of medicine might also help explain why Chalmers and Glasziou make such generalizing demands of a highly complex and differentiated system. Regularly, questions arise to whether scientific prescriptions or the practical experience of the physician should govern clinical decision making (as in debates around EBM, for example). But if we see medicine in the light of a scientific discipline, contemporary conflicts over how much science should guide the actions of practicing physicians can be viewed more in the light of boundary disputes between proponents of medicine as science and as a profession, respectively, and about ambiguous formulations of what to expect of the discipline's services. Moreover, if we distinguish between the overall expectations attached to the supercategory, which are also reflected in our view of the profession's abilities, and the concrete services of the discipline, it will become easier to differentiate between which research outputs constitute waste and which simply address questions that do not relate to the general issue of clinical practice (notwithstanding that problems of research quality exist). This view should inspire the assessment of future research policies regarding the relationship between input and outcome and to whether the current policies might be fueling the perceived crises by investing in unrealistic expectations of what research-based medicine can and cannot do.