



## Introduction

This book is a contribution to the study of the social dimensions of contemporary science and technology. It is part of the tradition of sociology of science begun in the last century by Robert K. Merton and developed in subsequent years in many directions. If the problems that are discussed here are clearly identified from the viewpoint of their centrality for the speciality—for instance, those of the conditions for the emergence of scientific collectives—the solutions that are used for these problems diverge deliberately from the routes more usually taken in a large part of the sociology of science. These “post-Kuhnian” routes of the area have been analysed in great detail in previous work.<sup>1</sup> It has not been considered worthwhile to reproduce a demonstration of their merits here—a concern about empiricism or of a science “in the process of being produced”, or of their drawbacks—for example, the obliviousness to what escapes immediate observation, a great capacity for overinterpretation, etc. The objective is not to re-stage methodological and epistemological analyses already undertaken.

The general idea behind this work is that the sociology of science has come to the end of a cycle. In general terms, it has, since the end of the 1990s, been in a period of reconfiguration analogous to the one it underwent in the mid-1970s. The active researchers in this field during that period—and who, in the meantime, made the greatest contribution to its theoretical renewal, to the growth in its institutional visibility

but also its theoretical fragmentation—have given way gradually to a new group with different aspirations. This process of renewal is both a generational and thematic one, and is evident at both a national and international level in the scientific bodies of the sociology of science. It is accompanied by a gradual and beneficial dismantling of the boundaries between research groups.

To go with, and if possible strengthen this development, this book has three main themes that are discussed as the chapters unfold: 1) to define the principles of a coherent sociological approach concerned with the dynamic of the sciences; 2) to establish sociologically the reality of the disciplinary reconfiguration noted above; 3) to provide a sociological investigation of some aspects of contemporary biomedical research in order to develop case studies that demonstrate the usefulness of the theoretical framework defined above.

Readers most interested in the first two themes, will find chapters 1, 4 and 5 of most interest. The first chapter, “Science and Social Action”, thus offers a general discussion of the modes of production of empirical knowledge as well as more widely still the issue of sociological intelligibility in the domain of the study of science. It starts from an *a priori* acknowledgement that might be surprising to someone unfamiliar with this area—the difficulty that many of its exponents have in getting beyond a narrowly descriptive use of the category of “action”. The general argument of the first chapter is that in order to give a central emphasis to the theme of action, it is not enough, 1: to indicate the limits of a narrowly descriptive approach to the micro-contexts of research practice, and 2: neither is it sufficient to substitute for it an analysis of the general determinants, either real or supposed, of this practice. It is necessary to take account of the way in which actions—whatever their determinants might be—interact and aggregate with each other to generate collective results that are sometimes predictable and sometimes, on the contrary, unexpected or unwanted. The first section of the first chapter is thus intended to clarify some aspects of this strategy of what are known as “aggregation processes” applied to the study of scientific phenomena, by specifying the articulation of concepts of “level”, “sequence” and “emergence”. Such a property of a given research collective<sup>2</sup> will in general terms be described as emergent if it fulfils four basic conditions: 1) it must be capable of being described as the result of a sequence made up of accumulation—independence—and/or mutual adjustment—interdependence—of individual actions; 2) it should be capable of being identified by changes of scale or level

in terms of sociological discourse; 3) it should be capable of being sufficiently stable and constant to be detectable as such by one of the measuring devices developed specifically for this level; 4) it should be capable of directing the sociologist to employ categories that are partially or entirely distinct from those that he would use to account for local actions and interactions registered independently of their consequences. The second part of the chapter offers the opportunity to emphasise the significance of this research strategy through a new reading of the classical and contemporary literature. By crossing the differentiated nature of the objects that are proper to the sociology of science with the basic characteristics of aggregation processes, it becomes possible to identify a theoretical potential of processes associated with the study of phenomena as varied as the macrostructure of science, the growth and distribution of the scientific population, the development of institutional agendas and their influence on the emergence of a research collective, the communicational networks at work in an area of interdisciplinary research, and the innovative capacities of researchers, or even the creation of inequalities and of scientific elites.

This work on sociological theorisation applied to the study of scientific phenomena also has meaning in relation both to a certain view of the general development of the sociology of science (Chapter 4), as much as it does to a more specific relation with the limits and/or blind spots of other approaches that are well known in the field (Chapter 5). Chapter 4, "Merton and the Self-Exemplification of the Sociology of Science", is thus an exercise in the reflexive sociology that leads to some key conclusions concerning the current state of the speciality. The first concerns the predictive error made by J. Cole and H. Zuckerman in a famous article<sup>3</sup> about its future. In their 1975 study the latter present the data on indicators of citational cohesion in the sociology of science as proof of an established structure it would demonstrate in the future. Against all expectations these indicators did not show the expected trend development and rather than the speciality showing increased internal cohesion, it became fragmented to the point of becoming a succession of research perspectives that were entirely independent of each other. Such fragmentation of the speciality is clearly identified by the citation analysis of publications in the five leading journals of the sociology of science. It is demonstrated even more decisively by co-citation analysis. The comparison of co-citational networks between 1985 and 2005 shows that in the recent period there was a net loss of cohesion between

the main research groups which in aggregate make up the global network of sociology science. This chapter is also the opportunity to reflect upon the renewed influence of the Mertonian literature. This renewal is demonstrated by careful study of the citational uses of Merton's work. The study shows among other things the renewed importance of two Mertonian concerns: study of the generative mechanisms of inequality, and study of the norms of the scientific community. The contemporaneity of the two Mertonian concerns counterbalances to some degree a rather pessimistic feature of the disunity of the speciality. Moreover, in Chapter 5, "Rhetorical Construction of the Collective: Implicit Aspects of Constructivist Ideas and Actor Network Theory"—deals with the extent to which the research strategy described in chapter 1 can be distinguished from other theoretical approaches—and especially that of actor–network theory (ANT). Beyond the analysis of the theoretical consequences of the constructivist metaphor, the study of a recent version of ANT is the opportunity to look at the problems of the theoretical conditions of how the sociology of science can take effective account of the specificity of the "collective" and the forms of its emergence.

The third general concern of the book—how to deal sociologically with certain aspects of contemporary biomedical research—is the central concern of chapters 2 and 3 of this book. These chapters make use of scientific publications as the culminating points of the collaborative processes in which scientific actors are involved.

In these chapters the *Web of Science* [WOS] (Institute for Scientific Information, Thomson Scientific) is used as a form of sociological database. The latter is often thought of now as a merely instrumental tool for the exclusive use of research management. And it does of course make it possible, at relatively low cost, to produce measures of productivity, visibility, etc., so that a more generalised "benchmarking" of scientific collectives can be done. This secondary use of bibliometric data, sometimes both questionable and questioned, should not let us forget their primary purpose, one well-defined much earlier by E. Garfield, D. Price and H. Small: to contribute directly or indirectly to the production of knowledge on the state and future of scientific disciplines and specialities.<sup>4</sup> Coming back to this first intention, I have therefore chosen to combine the bibliometric data extracted from WOS with the tools and theoretical language of social network analysis (SNA) in order to understand change within two sectors of biomedical research.

Of course, biomedical research has been widely examined by the history of science.<sup>5</sup> But in contemporary France it has become the focus

of contradictory assessments and statements.<sup>6</sup> The biomedical research sector is often presented by the public authority as an area of strategic importance. A sector in which public and private investment cannot be over-encouraged on a number of issues, some well and some less clearly defined. At the same time, researchers are worried: not merely about how easy it is in fact to obtain financial support for their work, but as much about the creation of new systems of supervision and bureaucratic structuring of their research. The ambivalent nature of biomedical research in France is examined in chapters 2 and 3. The first part of chapter 2, “Science by ‘Special Dispensation’: Modelling Scientific Collaboration: The Stem Cell Research Network”, deals with the specifically French form of the systems of supervision and bureaucratic structuring of human embryo research brought in by the law on bioethics of 2004 which was reconducted in 2011. This law provides a unique status for research, that of a “*science by special dispensation*”. Specific attention is focused on how the Agence Française de la Biomédecine (ABM) functions. This agency plays a part in the more general transformation of the role and nature of scientific expertise. The second part of the chapter is a study of change in scientific collaboration in this research area. As a first stage it develops a general perspective on the area by examining all research collaborations by French scientists in the period 1995–2009, in order to then focus on a sub-set of this domain: that of human embryonic stem cell research (hESC). These hESC are a paradigmatic form of genericity that is potentially a boost to scientific collaboration between researchers from different specialities. It is matter of creating a specific profile for these collaborations—especially in relation to the general area of stem cell research—and to assess the results for the cohesion of this research area of the social regulation orchestrated, in part, by the ABM. The third part of this chapter is a contribution to the assessment of the methods of evaluation and simulation in the domain of the sociology of science. The use of data on the network of scientific collaboration in stem cell research has made it possible to identify in a methodical way the different stages of conception and modelisation that are specific to SIENA application. This is an approach of an “actor-based modelling” type that appears to be quite innovative for analysing the dynamics of relational structures. Moreover, this tool has an obvious compatibility with the general principles of the sociological analysis of science that are defined in chapter 1. However, its use requires the sociologist to be clearly aware, both of the problems of interpretation

associated with the results of evaluations produced by the application, and more basic still, certain limits of the model of social actor that it involves.

The second research sector discussed in chapter 3, "Prion Disease: Scientific Marginality and Health Scares", concerns the research conducted in France into prion diseases. These diseases have high visibility because of an international health scare linked to the possible transmission to humans of the infection agent responsible for bovine spongiform encephalopathy (BSE). Although it has been shown that the alarmist predictions made in 1996 about the accumulation of human forms of prion disease were mistaken, such forecasts had a distinct effect on the overhaul of national and international research networks and more generally still on the general dynamic of this research domain. Using the differentiation of phases in the development of research groups proposed in the past by N. Mullins, this chapter describes both modalities of the emergence of the collective (the paradigm group and communicational network stages) and its structural and institutional establishment (cluster and speciality stages). In addition, it makes it possible to specify the modalities for the entry of the research domain into scientific policy. Study of the role and the impact of institutional operators of research programming is thus an occasion to ask questions about the workings of the opportunity structures in science through which scientists reason and act, but also about the expected or unexpected consequences produced by the aggregation of these forms of reasoning, and the individual behaviours to which they are related.

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intellectual exchanges that have taken place over a number of years in various contexts. And finally I want to thank those closest to me, my family, for their comprehensive support and have a special thought for MA, once partner in sociological studies.

## NOTES

1. Cf. Dubois, M., *Introduction à la sociologie des sciences*, Paris, Presses Universitaires de France, 1999 (Arabic trs., 2008); Dubois, M., *La nouvelle sociologie des sciences*, Paris, Presses Universitaires de France, 2001.
2. We use the term, “collective” to refer to one basic unit of our sociological analysis. Sociologists of science have developed a voluminous repertoire of these basic units. The Mertonian tradition was mainly interested in the scientific community conceived as a homogenous collectivity of norms and values. Post-Kuhnian sociologists of science have chosen to substitute for these macro units a list of more narrowed and delimited sociological units: members of the same scientific discipline, of the same speciality, of the same laboratory, of the same collaborative network, etc. The use of the term “collective” is very common since the elaboration and diffusion of the actor–network theory at the beginning of the nineties. If we choose to retain the term here, we try to develop its sociological use in another theoretical framework (cf. Chapter 1).
3. Cole, J., Zuckerman, H., “The emergence of a scientific specialty: the self exemplifying case of the sociology of science”, in Coser, L. (ed.), *The Idea of Social Structure*, New York, Harcourt Brace Jovanovich, 1975, pp. 139–174.
4. For a reminder of the wide range of uses of these databases, cf. Cronin, B., Atkins, H.B. (eds), *The Web of Knowledge: A Festschrift in Honor of Eugene Garfield*, ASIS&T Monograph Series, 2000.
5. To give only one example the approach taken by the social history of science developed by Gaudillière, J.P., *Inventer la biomédecine. La France, l'Amérique et la production des savoirs du vivant (1945–1965)*, Paris, La Découverte, 2002.
6. For a quantitative assessment, cf. Lesourne, J. (ed.), *La recherche publique dans le domaine biomédical en France. Analyse quantitative et éléments de diagnostic*, Etude FutuRIS, May 2008.