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THE GEOGRAPHY OF SCIENTIFIC COLLABORATION

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Introduction

In 1980, Stanley Presser opened a paper in *Social Studies of Science* with a somewhat alarming phrase: “The dramatic growth of collaborative research over the last few decades has been clearly documented” (p. 95). Since Presser published his article, the average number of co-authors of scientific papers has doubled, the percentage of international collaborative publications has increased fivefold, and the mean distance between collaborating scholars is no longer measured in hundreds, but in thousands of kilometres. If 40 years ago the growth of scientific collaboration was dramatic, what adjective should we use today? Yes, science has always been a collective activity—a social system within which the intersubjective understanding of the world has been crafted and negotiated. But today’s science is saturated with collaboration on an unprecedented scale. Multilevel and multimodal networks increasingly condition and shape the contemporary cognitive enterprise. This collaborative turn not only alters the ways science is organised, managed, and performed but also enables new research objectives, accelerates knowledge production, and challenges practices of establishing the epistemic validity of science.

At the same time, in the contemporary technology-dependent and innovation-obsessed world, science occupies an emphasised place. And this is not only a symbolic zone in our imagination. Scientific inquiry takes place at very tangible coordinates: public and private laboratories, university campuses, research libraries, and remote research facilities, to name but a few. The spatial location of scientific activity may seem trivial in contrast to the universal validity of science. But make no mistake, geography matters. On the one hand, the specific conditions of places influence the quantity and quality of scientific activity and its outputs and impacts. On the other hand, the presence of the science sector affects the economic and social development of neighbourhoods, towns, cities, regions, and whole nations.

The juxtaposition of these two broad topics laid the foundation of our study. We started with straightforward questions of how geography conditions scientific collaboration and how collaboration affects the spatiality of science. As we explored the subject, more intriguing questions emerged. Specifically, there is a tension between the seemingly disruptive capacity of the collaborative turn and the persistence of social, economic, and spatial structures of science. Even though scientific enterprise has become increasingly collaborative,

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networked, and internationalised, it also remains substantially hierarchical. Those hierarchies largely reflect organisational, national, and international disparities ingrained in the pre-collaborative-turn era. At the same time, the rise of new scientific hubs cannot be fully understood without accounting for collaborative networks. In this entangled system, scientific collaboration seems to play a disruptive—as defined by Schumpeter (1942) and Christensen (1997)—and simultaneously a stabilising role.

The other intriguing tension is between proximity and distance. Despite the development of transportation and communication technologies that have overhauled traditional time-space limits and greatly facilitated scientific collaboration on a global scale, proximate collaborative links tend to outnumber distant relations. Spatial closeness constantly matters for the formation of research collaboration. Meanwhile, distant collaborations bring the promise of bolder results and impacts. The combination of diverse capacities—more likely in broader networks—seems to promote the expansion of the knowledge frontier. What, then, is the role of spatial proximity and distance in scientific collaboration? How should science policy respond to the proximity-distance dilemma?

Challenges imposed on science policy by the massive growth of research collaboration go well beyond the above-stated problem. Traditionally, collaboration-oriented science policy was aimed at intensifying collaboration. But since research collaboration has become semi-ubiquitous, the traditional approach is no longer adequate. The key issue is not how to increase collaboration, but rather how collaborative networks should be managed, how to evaluate their benefits and costs, and how to respond to the direct and indirect consequences of collaboration. The increasingly central role of collaboration in scientific enterprise implies the gradual amalgamation of science policy and scientific collaboration policies. Thus, understanding the processes and patterns of scientific collaboration becomes indispensable for crafting science policies in the collaborative-turn era.

Before proceeding, it is essential to distinguish between the geography of scientific collaboration—the research domain that we outline in this volume—and the geography of science. The relation between the two can be seen through the lens of the concept of knowledge stocks and flows (Machlup, 1979). While the geography of science is preoccupied with the location of research activities, the geography of scientific collaboration focuses on flows between those places. Certainly, the two approaches cannot be separated. On the one hand, the localisation of research centres forms a playing field for scientific flows: after all, links do not exist without nodes. On the other hand, flows in the form of scholarly collaboration constitute a significant factor for the progress and impact of scientific places. In a certain sense, “these places are not meaningful in themselves but only as nodes of these networks” (Castells & Ince, 2003, p. 57). Ultimately, spatial hubs of research collaboration fundamentally overlap with centres of scientific production and excellence.

In what follows, we deliberately seek a balance between broad and narrow approaches. First of all, we use a broad, open definition of scientific

collaboration: the act of working together to achieve common scientific objectives. This tactic allows us to capture the phenomena in all its complexity and to avoid futile definitional considerations. Simultaneously, we limit our focus to relations among scientists and within science. As a result, we almost entirely pass by the issue of science–industry and science–business relations (already discussed at length by many great authors). Lastly, our theoretical approach is broad. Because there is no definite theory of scientific collaboration from a territorial perspective, we had wide latitude in testing a great variety of concepts, ideas, and frameworks developed within various intellectual schools, scientific fields, and research paradigms. In doing so, we were able to map the emerging theory of the geography of scientific collaboration.

Our journey through the places and spaces of scientific collaboration has seven stages. The first two chapters pave the way for the remaining parts of the volume. To discuss the spatial aspects of research collaboration we need to understand the driving forces of the geography of science (Chapter 1) and the processes that govern collaboration on the level of individuals, teams, and organisations, as well as the historical developments that led to the contemporary collaborative turn in science (Chapter 2). In Chapter 3 we overview data sources, measures, and methodological considerations for spatial studies of research collaboration. Chapter 4 depicts and scrutinises the spatial patterns of scientific collaboration at several territorial levels. We focus on the internationalisation of science, the evolution of global scientific networks, the geographical patterns of collaboration–performance nexus, and the centre–periphery logic of the geography of scientific collaboration. Chapter 5 provides explanations of the driving forces and processes that condition research collaboration in space. Here we outline the theoretical framework for the geography of scientific collaboration. Chapter 6 reviews research collaboration policies. It consists of policy case studies—set in Europe, the United States, and China—as well as a comprehensive catalogue of tools for scientific collaboration policy. The book closes with conclusions that summarise our key insights, reflect on possible future trajectories of the geography of scientific collaboration, and discuss challenges for science policy in the collaborative–turn era.