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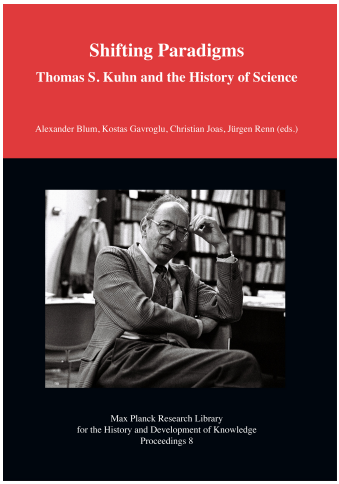


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# Chapter 22
# Experimental Turnaround, 360°: The Essential Kuhn Circle

*Carsten Reinhardt*

Kuhn uses quite a few examples of experiments in his 1962 *Structure of Scientific Revolutions* (Kuhn 2012). They relate, among other things, to the pitfalls of standard experimental procedures when facing uranium fission (pp. 60–1), to the intertwinement of "factual and theoretical novelty" in the "discovery" of oxygen (p. 53), to the failure of precision apparatus in detecting ether drift (p. 73). In all these cases, however, Kuhn gave prominence to the theoretical side of the scientific enterprise. But he also emphasized the puzzle-solving activities of normal, everyday science and the crucial role of acknowledged experimental methods when he developed the various meanings of paradigm. In doing so, he conceived of scientific communities as carriers of paradigms and understood the paradigm as being the constitutive parameter of a community. Kuhn later recognized the circularity of this argument, pointing to empirical sociological analysis for the determination of scientific communities. However, when it came to the question of explaining the binding forces of such social groups, he kept referring to paradigms, or to the disciplinary matrix.[1]

During the 1970s and 1980s, historians, sociologists and philosophers of science began to move experimentation into the center of their works. At first sight, in an anti-Kuhnian stance, the 'New Experimentalism' put the theoretical, experimental and instrumental dimensions of science on an equal footing.[2] Although these dimensions are interrelated, they are supposed to have a life of their own, according to Ian Hacking's often quoted phrase. Among the more famous, if disputed, claims of the adherents of the 'experimental turn' are the following: Experimentation is largely independent from theory because it is based on the interplay of theory, material things and data. Thus, the autonomy is constructed by reliance on many conditions, not just one. Moreover, at least in modern science, facts are the products of a complex laboratory technology, leading to the "self-vindication of the laboratory sciences" (Hacking 1992). In addition, even if we accept the impact of theory, interpretation of data mainly rests on low-level

[1] Kuhn (1974), see Hacking (2012, xxiv).

[2] One crucial text in this regard is Galison (1997).

concepts, and not on high-level theory. This proclaimed autonomy of the laboratory sciences constituted the discourses of quite a bit of the work done on the history of experimentation, focusing on the "inner laboratory" (Galison 1997, 4), and therefore underlining the inherent momentum of experimental practice.

It would be unjust to reduce the experimental turn to a kind of 'new internalism' in the history of science. Just by citing Hacking's phrase in full ("Experimentation has a life of its own, interacting with speculation, calculation, model building, invention and technology in numerous ways") (Hacking 1983, xiii), one recognizes that the 'new experimentalists' from the beginning took seriously influences from beyond the laboratory walls. This understanding is strengthened when we consider works of an STS bent, focusing on the social construction of scientific knowledge, and the tradition of ethnographic laboratory studies, laying open the multitude of epistemic cultures and their interplay. The history and philosophy of experiment and the STS direction clashed more often than not, especially when it came to questions of scientific (entity) realism or of Actor-Network-Theory. They share, however, an attitude that emphasizes the role of practice and gives particular attention to the interactions of epistemic cultures in building up Kuhn's "scientific communities."

So far, we may get the impression that both HPS and STS, Kuhn's most powerful heirs, parted company with the fundamental argument in *Structure*, according to which it is the accepted, "unprecedented" and "open-ended" achievement of scientific practice (the paradigm) that creates at the same time both a coherent research tradition and the corresponding scientific community.[3] However, this is not the case.

For example, Hans-Jörg Rheinberger recognizes the drive behind scientific research in a dialectic interplay of epistemic things and technical objects (Rheinberger 1997). The latter constitute the established methods and instruments of an experimental system, and they serve to stabilize the epistemic things, understood as yet unknown entities, in the investigative process. Rheinberger clearly positions his work in a "post-Kuhnian move away from the hegemony of theory" (p. 1). However, he also resists a Heideggerian dominance of technology, as would be smuggled in by terms such as "technoscience." It is the interaction of imagination and technical skill that constitutes the experiment: "Experimental reasoning […] transcends its technical conditions and creates an open reading frame for the emergence of unprecedented events" (p. 31). In explicitly connecting to Kuhn, Rheinberger introduces the notion of experimental cultures, sharing "styles of experimental reasoning" and circumscribing the "informal communities of researchers" (p. 138). Hacking, with his notion of laboratory style, also holds a similar argument. Moreover, both approaches enclose the scientific en-

[3] For Kuhn's argument see Hacking (2012, xxiii).

terprise inside the laboratory walls and thereby shield it from external (mainly technical, but also economic and implicitly political) repercussions.

Even if we accept that the laboratory is not an enshrined space, we have difficulties escaping the Kuhnian circle. Terry Shinn's notion of research technology, for example, explicitly addresses the hybridity, or interstitiality, of the careers of his subjects[4]. Being part of a transversal regime, research technologists move endlessly between the spheres of industry, government and academia. There is no place for an encapsulated scientific community in Shinn's system. The products of research technologists, viz., the instruments and apparatus of modern science, are not only based on advanced technology but have generic qualities as well. Thus, they can be applied in and adapted to many different niches in science (and technology) at the same time, being disembedded and re-embedded in various contexts. Moreover, the appeal of genericity creates an autonomy of research technology, in making it independent from direct pressure toward application and giving rise to an epistemic standing in its own right. Research technology not only answers research questions, but also creates its own research problems. In doing so, it forms its own standardized language, its metrology. It is this latter property that allows research technologists form their own communities, including journals and institutions of their own.

I have just listed the tip of the iceberg of works that can be included under the rubric of new experimentalism. It is evident that their main difference from the Kuhnian picture is their emphasis on the material dimension of science, and their rejection of theoretical hegemony. Most of the approaches underline the stabilization of technical craft, experimental practice and theoretical knowledge during the research process. Only if this was achieved, could the apparatus be trusted, transferred and appropriated, giving rise to a certain style, or mode, of experimental thinking. Many studies focus on standardization and teaching. While this approach embraces the textbook problems of Kuhn's *Structure*, it goes beyond them by including hands-on seminars, the standardization of data, and their interpretation and representation. Some tackle the new social and institutional forms that came with the reliance of science on expensive, high-tech instrumentation. These include laboratories concentrating on the development and dissemination of new methods, and the forming of close alliances between academic scientists and instrument manufacturers. Normal science, in Kuhn's diction a puzzle-solving activity, has been supplemented by the generation of methods for their own sake, which is essentially a puzzle-seeking activity. In my understanding, methods are pathways of research, routinized experiments that both define and enable scientists to solve research problems at hand. Their size and scope can range from technical gadgetry to whole knowledge domains. Methods do

[4]See the contributions in Shinn and Joerges (2001).

structure the inner economy of science, and they serve as connections to technology, economy and politics. In the mid-twentieth century, so my thesis, a novel type of scientists emerged in a triangle of academic science, instrument industry and governmental science funding: the method makers. Method makers focus on "Methods for Methods' Sake" (N.N. 2004, 1), as they develop research techniques for use by other scientists. In doing so, they change the inner economy of science, introducing a certain division of labor, and they affect the prevalent epistemology, turning methods into potential end-products of scientific activity (Reinhardt 2006).

The experimental turn has produced many achievements that have changed our understanding of science in fundamental terms. In analyzing scientific research, it has created a sound balance of theory, experiment and instrument. It has led to the partial break-down of the laboratory walls as a metaphor of the autonomy of the epistemic core. It has even opened the way to a possible alliance of the sociology of knowledge and the philosophy of science. However, I would argue, we have not escaped the Kuhnian trap that connects paradigm and community with a circular argument. Even if we take into account different functions, heuristics and social roles, we stick to this circle. Stressing the simultaneous co-creation of both community and paradigm is perhaps the only thing we should do, as this creates the self-referring system that David Bloor explains so vividly in his contribution. Thus, for scholars of scientific communities and institutions, the "Kuhn circle" described here offers a particular opportunity. It constitutes the link between epistemic activities and social order, and gives rise to studies of institutions that put the epistemic side on an equal footing with the social part. In the case of studies of experiment, this has led to a plethora of types of experimental communities and cultures, enriching the "zoo" of scientific institutions, and especially connecting it to practical, craft-like activities. Moreover, works on archives, libraries, fieldwork, museums and exhibitions have enriched and substantially expanded our view with regard to the classifying, collecting and exhibiting of "scientific" entities. It needs to be seen, however, what can be done in the frame of this thinking when we consider the more general or universal institutions of science, such as the university or research organizations of various kinds. Are they more than containers for the epistemic activities just mentioned? What are their constitutive socio-epistemic norms and values? Certainly, the co-construction of cognitive and social order is at work there, too.

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