

**Veröffentlichungsreihe der Arbeitsgruppe Wissenschaftstransformation  
des Wissenschaftszentrums Berlin für Sozialforschung**

P 99-402

**Jochen Gläser/ Grit Laudel**

**Where do the Actants/ Mangles Come From?**

**Paper presented at the conference "Sociality/  
Materiality: The Status of the Object in Social  
Science", Brunel University, 9-11 September 1999**

**Berlin, September 1999**

**Wissenschaftszentrum Berlin für Sozialforschung gGmbH**

**Reichpietschufer 50**

**10785 Berlin**

Tel.: 030/ 25491-591

Fax: 030/ 25491-684



## **Zusammenfassung**

Gegenstand dieses Aufsatzes ist das methodologische Problem der Einbeziehung materieller Einflüsse in die vergleichende Untersuchung von Forschungsprozessen. Daß solche Einflüsse berücksichtigt werden müssen kann angesichts der neueren Befunde des Konstruktivismus (Actor-Network-Theory und Mangle of Practice) kaum in Zweifel gezogen werden. Weitgehend offengeblieben ist aber bisher, wie eine systematische vergleichende Einbeziehung von Materialität erfolgen kann. In dem Paper werden anhand empirischer Beispiele aus vergleichenden institutionalistischen Studien die Schwierigkeiten diskutiert, die in einer vergleichenden Analyse entstehen. Dabei zeigt sich, daß weder Actor-Network-Theory noch 'Mangle' vergleichende Analysen materieller Einflüsse unterstützen. Als Ursachen werden die Behandlung materieller Einflüsse als rein situative Faktoren, das Fehlen einer Methodologie und der Abstraktionsgrad der theoretischen Modelle diskutiert. Als Ansatz für einen methodologischen Rahmen, der die systematische vergleichende Einbeziehung materieller Einflußfaktoren ermöglicht, wird deren Konzeptualisierung als kognitive Handlungsbedingungen vorgeschlagen. Dadurch kann die Verbindung zur Handlungstheorie und zu auf Handlungstheorien beruhenden institutionalistischen Ansätzen hergestellt werden.

## **Abstract**

This paper deals with the methodological problem of how to include material influences in comparative studies of research processes. Both Actor-Network-Theory and 'Mangle of Practice' confirm convincingly enough that materiality must be taken into account in empirical investigations of research processes. However, it is not clear how material factors can be included systematically in comparative studies. In this paper, we use empirical examples from comparative institutionalist studies of research processes to discuss the difficulties that hinder comparative analyses. It turns out that neither Actor-Network-Theory nor 'Mangle' support comparative analyses of material influences. As causes for this deficiency, we discuss the treatment of materiality as situationally emergent phenomenon, the absence of methodology and the theoretical models' levels of abstraction. A methodological framework is proposed that should support systematic comparative analyses. This framework rests on an understanding of materiality as a cognitive condition of action. With the concept of cognitive conditions of action, materiality can be introduced into theories of action and into institutionalist approaches.



**Content**

**1. The problem of comparison .....1**

**2. Where do the actants/ mangles come from?.....2**

**3. Comparing different actants/ mangles .....6**

**4. Including materiality in social studies.....8**

**5. From material constraints towards cognitive structures.....10**

**References .....13**



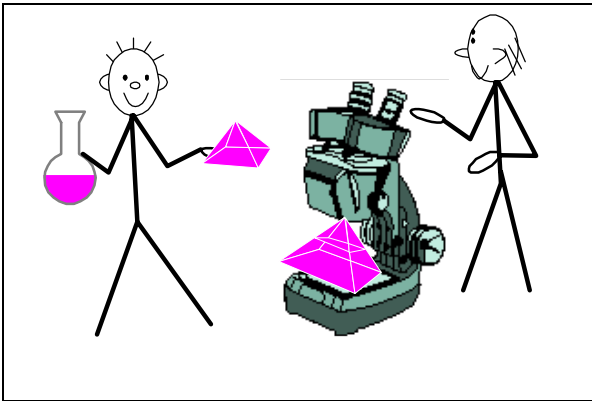
## 1. The problem of comparison

Though the (re)turn to studies of materiality and its interference with research processes is a major achievement of science studies, it is merely a point of departure. From the point of view of empirical science studies, the question is how materiality should be dealt with, rather than whether it should be taken into account at all. The latter question is answered explicitly with "yes" by Actor-Network-Theory (ANT, e.g. Callon 1986, Latour 1988) and Pickering's Mangle (Pickering 1995a). On the most general level, both approaches confirm that materiality must be included in explanations of research processes as an independent factor that cannot be reduced to scientists accounts. This premise is in accordance with our own results: We have conducted comparative institutionalist studies of research processes in several fields and in these studies experienced the necessity of accounting for material influences. This observation immediately raised the question as to how this can be done. Thus, our perspective on the materiality - sociality problem is methodological and pragmatic rather than philosophical. It is formed by the serious problems that emerged when we tried to include material influences systematically in our studies. To do so, we firstly must look for them, i.e. find them in written descriptions and ask scientists about them. Thereafter, it was necessary to compare material influences in different research processes. This is the problem we are addressing in our paper: If we accept material influences on social processes as relevant for the latter's explanation, then we must treat them systematically in a way that enables us to compare them. Unfortunately, both ANT and Mangle offer little support for these crucial tasks.

We are discussing the problems related to comparative treatments of materiality in the context of the sociology of science. However, we think that other social sciences face similar difficulties. Our attempts to compare material influences revealed three problems that we will discuss in this paper. Firstly, we felt the necessity to ask whether and how material influences in different research processes are related to each other. In other words, we asked where the different actants or mangles come from. Secondly, we had to find a way to compare material influences in quite different research processes. Thirdly, we had to include material agency as one explanatory variable among others. In other words, we had to introduce material agency into existing theoretical frameworks. Neither ANT nor Mangle contribute much to this conceptual work. We will hint at causes for this reluctance and explain why we regard reference to standard theories of action the better solution for including materiality.

## 2. Where do the actants/ mangles come from?

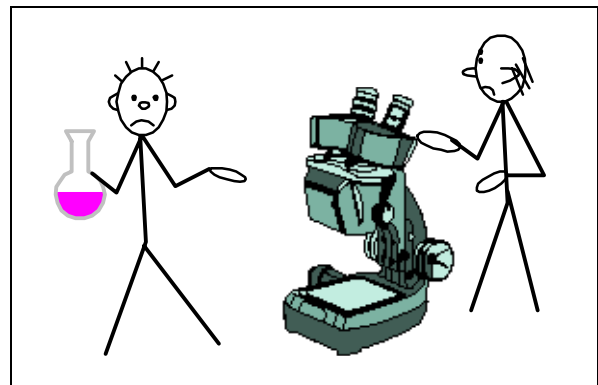
We begin with an empirical example. In an empirical study on the institutional conditions of research collaboration (Laudel 1999a,b), it could be observed that some collaborations between



biochemists and physicists failed and others were successful. In biochemistry, one important task connected with the identification of new proteins is to clarify their spatial structure. Today this is mainly done by physicists with X-Ray crystallography. Application of this method requires having the protein as a crystal. Thus, collaborations occur between

biochemists, who synthesise the protein, clean it and crystallise it, and physicists, who apply X-Ray crystallography to the crystallised protein and produce pictures. These pictures are interpreted by both partners together.

But, of course, it is not that easy. The crucial problem for biochemists is that proteins crystallise only under very specific physical and chemical conditions that cannot be concluded from a general theory. That is why biochemists start a long procedure of trial and error in order to determine the conditions for crystallisation. They know these conditions only when the protein has actually crystallised.



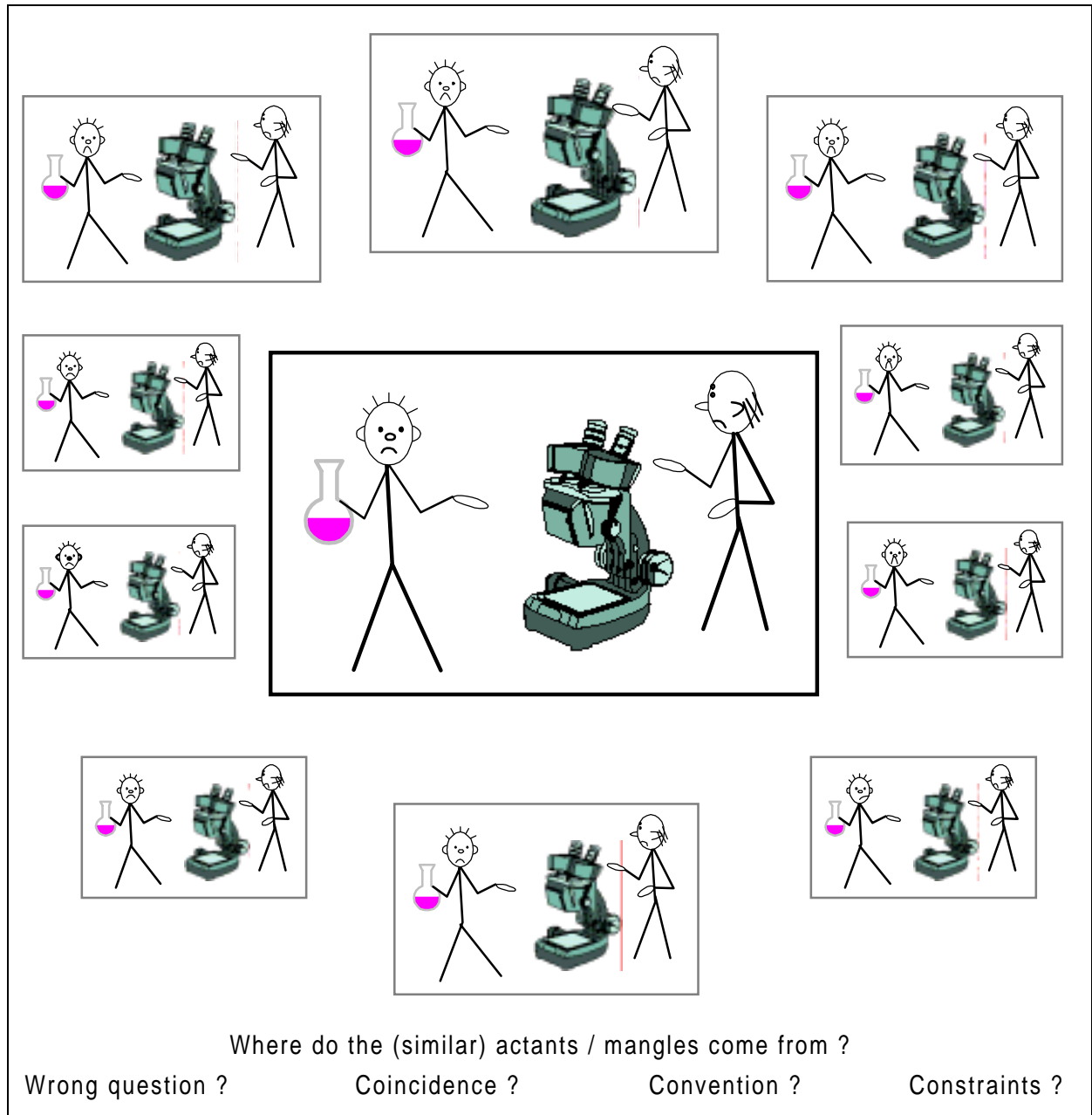
Naturally, these conditions are found only seldom, and many collaborations fail.

I cannot say why this [collaboration] is not progressing. Presumably, it is very difficult to synthesise this protein in particular in a larger scale. We always need quite a lot. Firstly, it must be extremely pure, secondly it must be stable, and thirdly it must be a certain amount. These three prerequisites cannot always be fulfilled. It is possible that it simply does not work. (a physicist/ crystallographer)

Since a protein's structure is a very important contribution to biochemical knowledge, this task is regarded as very important by the specialty of protein biochemists and is attempted all over the world. In several cases, a Nobel prize was awarded to those who uncovered the structure of large, biologically-significant organic molecules. Since several groups usually compete to be the first to uncover the structure of a protein, many similar research processes take place in different labora-



tories. Similar substances are synthesised, similar methods are applied, similar results are produced, and similar resistance is faced by the groups.<sup>1</sup> We can describe this resistance either with actants 'resisting their enrolment' or as initial resistance of material agency that starts the mangle. Despite their conceptual and philosophical differences, both models could be applied, a fact that hints at their fundamental similarities. But how can we explain very similar material resistance in different situations that were separated by time and space?



<sup>1</sup> In the cases included in the empirical study, the similarities were not limited to material influences. The research groups' institutional and economical conditions were equal, and the collaborators had similar interests.

Four different explanations could be applied. Firstly, one could state that we asked the wrong question because the situations were not similar but in fact incommensurable (Pickering 1995a: 185-190). The research situations did indeed differ with regard to many characteristics, such as local knowledge, machines and group size. However, the incommensurability argument is at least not very convincing because both Actor-Network-Theory and Mangle claim nearly universal applicability. Thus, even all the incommensurable research situations must have something in common that enables these general models to be applied. More specifically, Knorr-Cetina's (1999) description of "epistemic cultures" hints at the fundamental similarities of a field's research processes. From a methodological perspective, the incommensurability of research processes seems to be a problem of suitable research strategies and levels of abstraction rather than a principal feature of research situations.<sup>2</sup>

A second explanation could be that similar situations emerge by pure coincidence. There are no trans-situational regularities in local conditions of research processes, and if they seemingly occur, then by chance. Though this explanation cannot be rejected, it is hardly very satisfying because it strongly limits our opportunities to explain scientists' behaviour.

A third possible explanation is that the similarity is caused by social rather than material commonalities. Since researchers share their specialty's paradigm, it is quite natural that they approach material objects and explain failures in similar ways. However, the reference to shared paradigms alone requires us to attribute them a strong institutional power producing uniform perceptions, uniform interpretations and uniform reactions. This is the type of explanation the old institutionalism has been criticised for: Actors become puppets here that can do nothing but follow institutional rules.

A fourth possible explanation is that similar parts of the material world interfere with research processes in a similar way, independently of time and place. In other words, they produce constraints on research. The specific conditions for a protein's crystallisation are an attribute that shows up every time crystallisation is attempted. This attribute can be understood as a material constraint on all investigations of protein structures. Because of the local knowledge about

---

<sup>2</sup> Since the problem of incommensurability seems to be the crucial point for many epistemological and methodological debates, we would like to add here that in our opinion there is no such thing like an incomplete incommensurability, as Pickering suggests (Pickering 1995: 191). 'Incommensurability' is a dichotomic term: The different entities either have common ground or they do not. To establish such a common ground for comparison depends on the level of abstraction. For example, it is very difficult to read Pickering's (1995: 210) comparison of "similar" hunts for quarks by Morpurgo and Fairbank as an argument for incommensurability.

---

conditions for crystallisation, scientists respond to these constraints in different ways and treat their proteins differently. Consequently they face different constraints in the course of their research. Thus, the unique histories of resistance and accommodation can be explained by the fact that scientists' different actions confront them with different constraints.

The idea of material constraints presupposes, firstly, that "*how the material world is* leaks into and infects our representations of it in a nontrivial and consequential fashion" (Pickering 1995a: 183). Secondly, this idea rests on the assumption that there are regular patterns in the material world that show up in research processes in a reproducible way and thus can be explored. From these presuppositions one can conclude, thirdly, that it is these regularities that are theoretically reconstructed by scientists as 'natural laws'. There is no principal contradiction between this view and the observation that all scientific knowledge is constructed. But since the constructions must be brought into accordance with both former constructions and material influences in the lab, they reflect in one way or another both former and current material constraints. What the scientists interviewed by us do is struggle for better approximations of their constructions to the patterns of the real world they observe in their experiments. From this perspective, the dialectics of resistance and accommodation described by Pickering for single research processes can also be applied to scientific research in general. From this perspective, the dialectics of resistance and accommodation describes the way in which researchers' ideas become approximated to the material world's patterns in an endless series of construction processes.<sup>3</sup>

With the concept of real-world constraints it is possible to explain both similarities and differences in material interferences with research processes and to compare them. For these reasons we included it in our empirical approach as well as in our explanatory strategy.<sup>4</sup> As a consequence, we faced new difficulties because we had to compare material influences in different research processes.

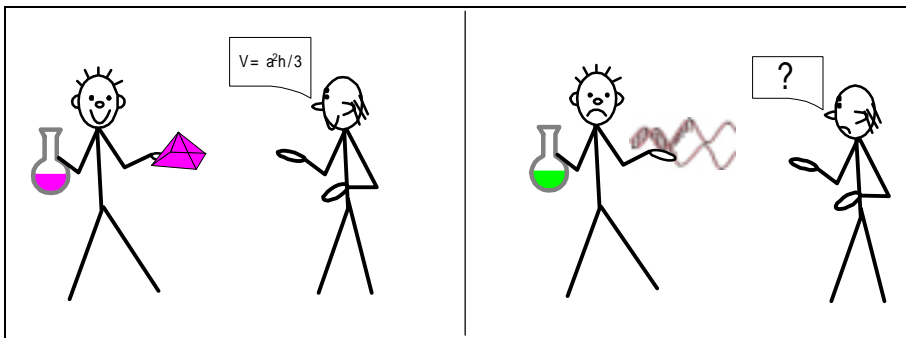
---

<sup>3</sup> This way, Pickering's "pragmatic realism" could be used to justify "correspondence realism" (Pickering 1995: 185). Pickering argues against this conclusion by stating "that nothing in my analysis points to such an erasure of situatedness and path dependence" (ibid.). However, the only logical argument that supports his position is incommensurability. If the assumption of incommensurability is given up (a step that seems unavoidable to us, see footnote 2), there is not much left to defend realism against correspondence. We hasten to add that the "tuning" of researchers' ideas (and, as we claim, specialties' knowledges as well) to materiality never can result in an absolute truth that mirrors materiality. Instead, tuning should produce better fitting reconstructions that are permanently challenged by new occurrences of materiality. For the concept of "tuning", see Pickering (1995: 13-17).

<sup>4</sup> The discussion between Galison (1987: 243-260, 1995) and Pickering (1995a, b) about constraints is difficult to follow through because both authors are very vague about their notion of constraints. Our concept of real-world constraints seems to differ from Galison's understanding of constraints which implies that constraints are a specific form of knowledge. Since the concept of constraints is too imprecise and inflexible to catch the various aspects of materiality's influences, we will substitute it later by 'cognitive conditions of action' (see section 5).

### 3. Comparing different actants/ mangles

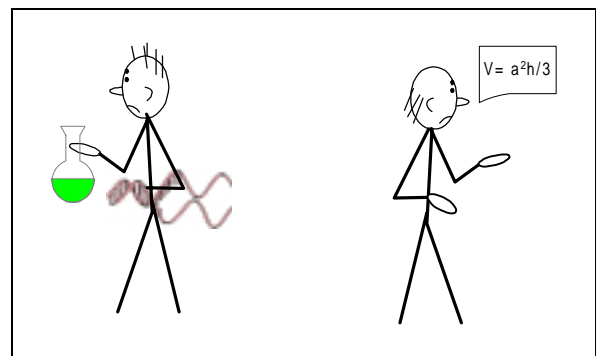
Again, we begin with an example. Both experimentalists and theorists apply methods to objects which must be appropriate to some degree. The fit between research methods and research objects is often endangered by the latter's complexity, that is, by the number of different attributes and relations between attributes that must be dealt with. In our studies we found two basic types



of disparities between methods and objects. In experimental research, some methods can only be applied to simplified model objects be-

cause otherwise observations would be blurred. In theoretical research, some methods or models are not applicable to experimental data because the data describe more simultaneous processes than could be integrated in theoretical models. In this case, theoretical models can only be applied to objects of reduced complexity, that is, to theoretically constructed objects and data.

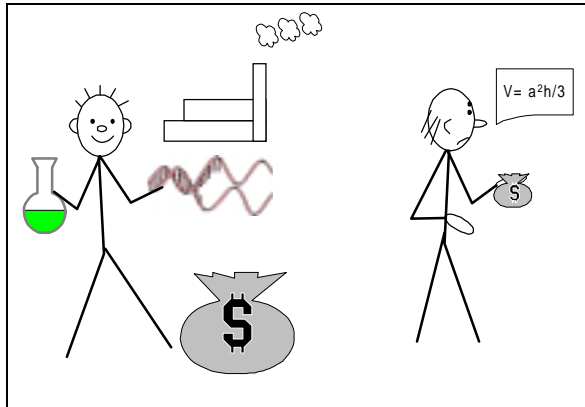
The disparities between objects and methods influenced researchers' opportunities to respond to institutional settings. In the investigation of collaborations it was observed that several planned collaborations never actually eventuated. Other collaborations began but could not be successfully accomplished. Some of these failures were explained by scientists by referring to a disparity between one collaborator's object and the other collaborator's method.



Well, in principle one could look at it with our models, but I believe it is first necessary to understand it a bit better. Thus, we must first understand the simple questions better ... that is why there has been no opportunity to do something together up to now. (a theoretical physicist)

Since there was a strong institutional pressure towards collaboration and scientists invested both time and resources in these collaborations, it can be assumed that the scientists actually tried to collaborate and faced resistance (or, again, 'the actants' refusal to co-operate') that prevented collaboration.

Another empirical investigation was conducted to study how East German basic researchers responded to the institutional changes brought about by German unification (Gläser 1998). Most basic researchers perceived an institutionalised pressure to conduct research that is, although basic, nevertheless somehow 'useful'. This pressure is institutionalised in general societal expectations,



organisations' mission statements and earmarked funding. The researchers' opportunities to respond to this pressure depended partly on the investigated objects and the applied methods. Researchers conducting experimental research with objects representing practically applied systems could easily prove that their basic research simultaneously contributed

knowledge that is useful for applications. Researchers who did theoretical research unconnected to experimental data and researchers who did experimental research with model objects could not adapt to the institutional pressures. Consequently, the latter type of research was found only in institutionally shielded niches.

With these examples, we tried to show that comparative institutionalist studies must include comparisons of material influences in order to judge the effects of institutions. Unfortunately, constructivist studies are not very supportive here. Both ANT and Mangle rest on single-case-studies that are combined on a highly abstract theoretical level but not compared in detail. Therefore, nothing is offered that could guide a comparison of material influences in different research processes.<sup>5</sup> Comparisons of one actant with another, one mangle with another, etc. are not supported. The lack of intermediate levels of abstraction seriously hinders comparative

<sup>5</sup> Interestingly enough, even Knorr-Cetina's latest book aiming to compare "epistemic cultures" (Knorr-Cetina 1999) reveals this pattern. It provides detailed but idiosyncratic descriptions of high energy physics' and molecular biology's epistemic cultures, but the theoretical language of the comparison is highly abstract (loss of the empirical, care for the self, etc.) and does not support comparisons of single research processes. This follows from the strategy chosen by Knorr-Cetina: "Using a comparative optics as a framework for seeing, one may look at one science through the lens of the other. This 'visibilizes' the invisible; each pattern detailed in one science serves as a sensor for identifying and mapping (equivalent, analog, conflicting) patterns in the other. A comparative optics brings out not the essential features of each field but differences between the fields." (Knorr-Cetina 1999: 4) Thus, the comparison is undertaken as a 'grounded-theory strategy' by switching between the two optics provided by the observed fields. The framework is built by a bottom-up strategy. Such an approach is consistent with constructivism's rejection of theoretically informed empirical strategies. It is, however, limited because it produces only what is shown by the "lenses", i.e. by the investigated fields and does not control for the level of abstraction that emerges in the comparison.

studies. Because they lack an analytical framework, these approaches seem to be complex languages that support narratives rather than theories.

#### **4. Including materiality in social studies**

The 'resistance' of ANT and Mangle<sup>6</sup> approaches against comparative research can be traced back to the problem of how to include something non-social in sociological explanations. Sociology of Science faces a principal dilemma here that has been formulated in the 'chicken debate' (Collins and Yearley 1992a, b; Callon and Latour 1992). Pickering described this dilemma in the following way:

As analysts, Collins and Yearley suggest, we have just two alternatives. We can see scientists as producing accounts of material agency, in which case these accounts fall into the domain of scientific knowledge and should be analyzed sociologically as the products of human agents. This is the standard SSK position that Collins and Yearley want to defend. Or we can try to take material agency seriously, on its own terms - but then we yield up our analytic authority to the scientists themselves. Scientists, not sociologists, have the instruments and conceptual apparatus required to tell us what material agency really is. (Pickering 1995a: 12)

Callon and Latour as well as Pickering reject the presupposition that there are only two alternatives. Callon and Latour propose a semiotic approach that shall enable us to think symmetrically about human and non-human agents. Pickering criticises this reply as a "retreat, a return to the world of texts and representations that one does not wish to make" (Pickering 1995a: 13). Moreover, he doubts that ANT is consistently engaged only with signs of materiality (ibid.). His own solution is to take material agency as temporally emergent in practice:

Thus, if we agree that, as already stipulated, we are interested in achieving a real-time understanding of scientific practice, then it is clear that the scientist is in no better a position than the sociologist when it comes to material agency. No one knows in advance the shape of future machines and what they will do, but we can track the process of establishing that shape without returning to the SSK position that only human agency is involved in it. (Pickering 1995a: 14-15)

With this approach to materiality, Pickering apparently solves the problem posed by Collins and Yearley and avoids the retreat to texts.

---

<sup>6</sup> Since it is not explicitly concerned with materiality as a distinct subject matter, we exclude Knorr-Cetina's work from the following discussion.

---

The problem laid out by Pickering and the solutions offered refer to the problem of how to include something non-social into sociological explanations. The three solutions offered in the debate are

- (1) to include only scientists' socially constructed accounts and to treat them as social facts (the first alternative preferred by Collins and Yearley),
- (2) to include scientists' socially constructed accounts as accounts of materiality (the alternative rejected by Collins and Yearly), and
- (3) to include materiality in a specific sociological way by using a specific language to describe materiality (the third approach proposed by Callon and Latour as well as Pickering).

The first solution must be rejected because it has become evident that materiality interferes in research processes. Consequently it must be included in explanations. Thus, the observations presented by ANT and Mangle changed the status of materiality: Materiality has been identified as an intervening variable in the sociology of science's explanations. The second solution can be rejected because it implies to rely on scientists' accounts of 'truth', but there are more methodological arguments than that. To use scientists' accounts of materiality would transform these accounts from a subject matter of science studies into an instrument of science studies. However, it is methodologically impossible to include statements of the natural sciences into sociological explanations. These statements are constructed in a completely different scientific context. To use them, they must always be translated into a language (and, thus, into a context) sociology can work with.

This is essentially the 'third way' proposed by Callon, Latour and Pickering: If we do not want to neglect materiality and do not want (or are not able) to rely in natural sciences' accounts, then we must develop our own language for describing materiality and including it into sociological analyses. ANT and Mangle offer different solutions, that is, different concepts that can be used for describing material influences and including them in sociological explanations. This is not only a matter of different languages. The problem of describing materiality in a way that is compatible to social studies is solved differently: Callon and Latour give materiality an actor-like status and in this way make it possible to describe material influences as actions. Pickering focuses on materiality as resistance to goal-directed human action and this way makes it possible to describe materiality as conditions of human action.

Thus, the core of both approaches dealing with materiality is a translation of the observed material influences from the fields' language (scientists' accounts of materiality) used for describing

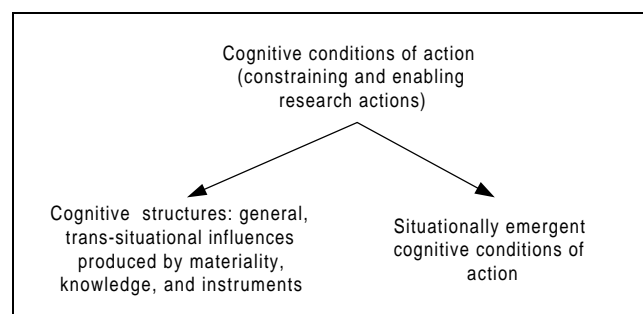
empirical observations into a theoretical language. These translations come as a jump. Because they at least partially use the fields' language, empirical descriptions are idiosyncratic. These descriptions are intertwined in theoretical statements based on the respective models, which are formulated in a highly abstract theoretical language. Abstraction is certainly necessary in order to reduce materiality's complexity. But the level of abstraction adopted by both approaches results in a very poor language for a sociological description of materiality (actants, inscription devices, enrolment, or, respectively, resistance, accommodation, tuning) that is insensitive to variations of materiality. Moreover, neither the path that lead from observations to the models nor the reverse path that leads from the models to an empirical investigation is made explicit. The phenomenology of scientific practice is directly reformulated as a theoretical model without detailed theoretical accounts of how materiality works.

Because of their insensitive account for materiality and their lack of methodology, neither ANT nor Mangle support comparative analyses. That is why we prefer attempts to include materiality into traditional theories of action. This can be achieved by treating materiality as one of the cognitive structures that influence research processes.

## 5. From material constraints towards cognitive structures

To include materiality in our comparative studies, we were forced to develop a conceptual framework that enables us to systematically seek material constraints, to interpret their influence on the observed research processes, and to compare these influences. Since we are mainly interested in institutional influences, we must conceptualise material influences as intervening variables that influence relations between assumed causes and outcomes of the processes under investigation.

Institutionalist studies basically rest on theories of action. That is why it appeared appropriate to include materiality's, knowledge's and instruments' influences as cognitive conditions of action.<sup>7</sup> The concept 'conditions of action' is more precise than the concept 'constraints'



<sup>7</sup> The meaning of the term 'cognitive' is reduced here to the research action only, that is to the production of new scientific knowledge. Thus, the term 'cognitive structures' does not refer to all cognitive processes that accompany human action, but describes only influences on knowledge production that stem from materiality, knowledge and instruments.



---

because it emphasises that materiality, knowledge and instruments not only constrain actions but enable them as well. Since the notion of conditions of action refers to more general, trans-situational influences as well as to situationally emergent conditions of specific actions, we use the term 'cognitive structures' to denote solely the general, trans-situational patterns that influence research processes.

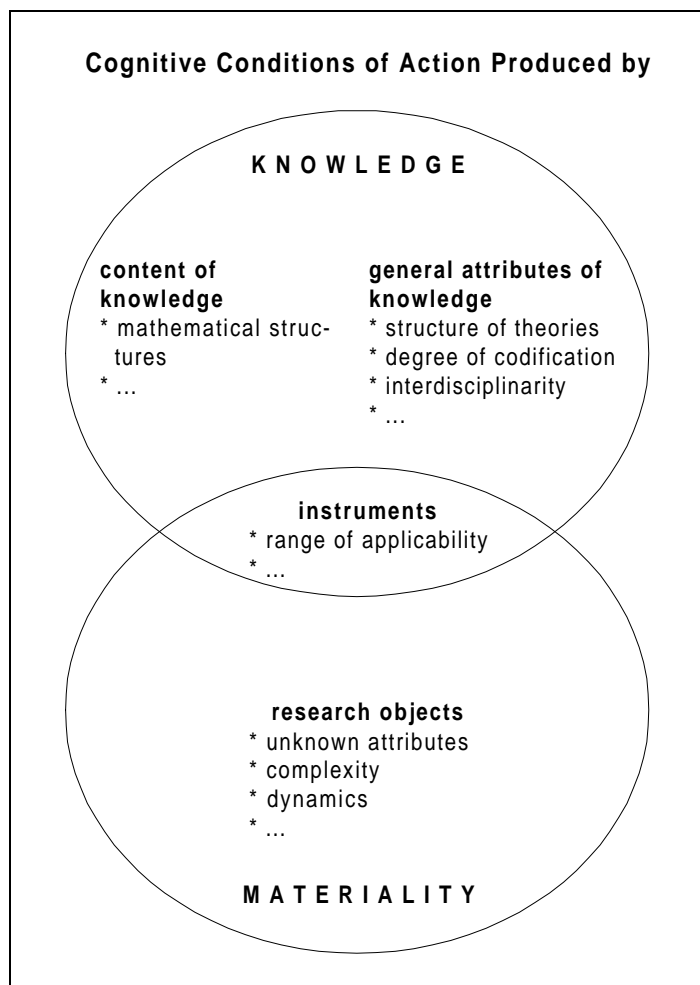
With the concept of cognitive conditions of action, materiality's influences can be integrated into studies of researcher's actions. Our approach falls in the same category as ANT and Mangle: We seek a framework that enables the translation of scientists' accounts of materiality into sociologically usable categories. Thus, the description of cognitive structures faces the same problem as the other approaches: Materiality, scientific knowledge and instruments must be described not as such, but with regard to their sociological relevance. We understand this task as a challenge for the sociology of science that will take at least some decades of "fine tuning".<sup>8</sup> In the following, we sketch some of our experiences in order to outline how such a framework might look.

A systematic account of cognitive structures cannot be reduced to materiality. Beside materiality, influences exerted by the existing knowledge and instruments (which combine material and knowledge influences) must be included in a similar way. Thus, three different elements in a researcher's cognitive conditions of action exist that provide cognitive structures.

Although it is not our primary concern here, knowledge provides very interesting cognitive structures because it is both a product of social constructions and a 'hard' condition of action. Knowledge is subject to a process of institutionalisation that turns it into an 'objective reality' that cannot be wished away (Sismondo 1993). In the words of Berger and Luckmann (1967: 57): "The paradox is that man is capable of producing a world that he then experiences as something other than a human product." That is why we included knowledge: It may appear as hard as materiality and therefore influence research processes in the same way. For example, the structures of mathematical theory restrict researchers' choices between mathematical techniques not only in mathematics (Pickering and Stephanides 1992) but also in theoretical physics (Merz and Knorr-Cetina 1997). Of equal importance are cognitive structures that are produced by general attributes of knowledge. Important examples that have been discussed in the literature so far are the structure of theories, the degree of codification of knowledge, and interdisciplinarity

---

<sup>8</sup> As is also the case for natural sciences, there is no absolute truth here. Scientific knowledge and observed materiality will permanently change.



or, more generally, the variety of different knowledge systems that must be integrated in the course of a research process. These cognitive structures were already used to describe scientific fields twenty years ago. However, the discussion of 'restrictedness' and other cognitive structures was not grounded on empirical investigations and was therefore speculative to a great extent.<sup>9</sup>

The most important cognitive structures provided by materiality are, of course, the research objects' unknown attributes. These unknown attributes partly constitute the research's subject matter, that is they must be 'produced' in empirical research and theoretically

reconstructed. Because they are unknown, these attributes cause resistances (as described by Pickering 1995a), respectively, anomalies in research processes (Star and Gerson 1987). Beside these specific attributes related to a research's subject matter, research objects have general attributes that influence conditions of action. In our investigations, a research object's complexity (we already dealt with this attribute in one example above) and its internal dynamics have played a role. A research object's dynamics influences the time needed for research processes. For example, some elementary particles exist for only fractions of a second, some micro-organisms reproduce themselves in about 20 minutes, and a cloned sheep needs several months to grow.

Material influences on research processes are also produced by instruments. Thus, it is a combination of material factors and knowledge that produces constraining and enabling characteristics of research methods. One of these characteristics is a method's range of applicability. Depending on the effects built into an instrument, the method that is based upon that instrument can be applied to a narrower or wider range of different objects. For example, electron

<sup>9</sup> For the most prominent account, see Whitley 1984

---

microscopy is successfully used in biology, physics and chemistry because the interaction of electrons with matter that is built into the instrument applies to many research objects. Other methods, such as immunoassays, are very specific because they can only be used to identify one substance.

How are these general cognitive structures related to situationally emergent cognitive conditions of action? We agree with Pickering in that what he describes as resistances is situationally emergent. However, the emergence of situationally unique cognitive conditions of actions does not imply that there are no general cognitive structures. The overlap of different cognitive structures and the researcher's individually specific knowledge, perceptions and strategies create a unique combination of cognitive conditions of action. With our approach, we try to identify important similarities as well as differences within these cognitive conditions of actions, trace them back to general cognitive structures and thus to provide a basis for comparative analyses.

By treating materiality as one of the cognitive conditions of action, we were able to include it in our comparative studies. The factors described by our framework influence social phenomena such as researchers' decisions, success and the outcome of their actions, the resources needed for research, the emergence and success of collaborations, etc. This implies, in turn, that it is useful to look for these cognitive conditions of action in investigations that are concerned with the respective social phenomena.

The examples we listed above are the first elements of a framework we attempt to use to compare research processes in different fields. We think that such a framework is necessary for institutionalists who try to avoid institutionalism's traditional failure of 'black boxism' (Whitley 1972) by including the micro-level of research processes in their investigations. However, treating material influences as one cognitive structure among others and as intervening variables forces us to depart from Actor-Network-Theory and Mangle and deal with materiality in a way that does not replace old theories but is compatible with them.

## References

- Berger, Peter L./ Thomas Luckmann, 1967: *The Social Construction of Reality*, Harmondsworth: Penguin.
- Callon, Michel, 1986: Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In: Law, John (ed.): *Power, Action and Belief*. London: *The Sociological Review*, 196-233.
- Callon, Michel/ Bruno Latour, 1992: Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley. In: Pickering, Andrew (ed.): *Science as Practice and Culture*. Chicago: The University of Chicago Press, 343-368.
- Collins, H. M./ Steven Yearley, 1992a: Epistemological Chicken. In: Pickering, Andrew (ed.): *Science as Practice and Culture*. Chicago: The University of Chicago Press, 301-326.
- Collins, H. M./ Steven Yearley, 1992b: Journey Into Space. In: Pickering, Andrew (ed.): *Science as Practice and Culture*. Chicago: The University of Chicago Press, 369-389.
- Galison, Peter L., 1987: *How Experiments End*. Chicago and London: The University of Chicago Press.
- Galison, Peter L., 1995: Contexts and Constraints. In: Jed Z. Buchwald (ed.): *Scientific Practice: Theories and Stories of Doing Physics*, Chicago and London: The University of Chicago Press, 13 - 41.
- Gläser, Jochen, 1998: Kognitive Neuorientierung der ostdeutschen außeruniversitären Grundlagenforschung als Folge des Institutionentransfers. *WZB discussion paper* 98-402. Berlin: Wissenschaftszentrum Berlin.
- Knorr-Cetina, Karin, 1999: *Epistemic Cultures: How the Sciences Make Knowledge*. Harvard: Harvard Univ Press.
- Latour, Bruno, 1988: *The Pasteurization of France*: Cambridge, Mass.: Harvard.
- Laudel, Grit, 1999a: Interdisziplinäre Forschungskoooperation. Erfolgsbedingungen der Institution 'Sonderforschungsbereich'. Berlin: edition sigma.
- Laudel, Grit, 1999b: Collaboration, Creativity and Rewards: Why and How Scientists Collaborate. In: *Individual Careers and collective Research: Is It a Paradox? Special Issue of the International Journal of Technology Management* (forthcoming).
- Merz, Martina/ Karin Knorr-Cetina, 1997: Deconstruction in a "Thinking" Science: Theoretical Physicists at Work. In: *Social Studies of Science* 27, 73-111.
- Pickering, Andrew, 1995a: *The Mangle of Practice. Time, Agency and Science*. Chicago and London: The University of Chicago Press.
- Pickering, Andrew, 1995b: Beyond Constraint: The Temporality of Practice and the History of Knowledge. In: Jed Z. Buchwald (ed.): *Scientific Practice: Theories and Stories of Doing Physics*, Chicago and London: The University of Chicago Press, 42 - 55.
- Pickering, Andrew/ Adam Stephanides, 1992: Constructing Quaternions: On the Analysis of Conceptual Practice. In: Andrew Pickering (ed.): *Science as Practice and Culture*. Chicago: University of Chicago Press, 139-167.
- Sismondo, Sergio, 1993: Some Social Constructions. *Social Studies of Science* 23, 515-553.
- Star, Susan Leigh/ Elihu M. Gerson, 1987: The management and dynamics of anomalies in scientific work. *Sociological Quarterly* 28: 147-169.

- Whitley, Richard D., 1972: Black Boxism and the Sociology of Science: A Discussion of the Major Developments in the Field. In: P. Halmos (ed.), *Sociology of Science*, Sociological Review Monograph 18, Keele, Staffs.: University of Keele, 61-92.
- Whitley, Richard, 1984: *The Intellectual and Social Organization of the Sciences*. Oxford: Clarendon Press.



---

**Bisher erschienene Hefte der Veröffentlichungsreihe der Arbeitsgruppe Wissenschaftstransformation:**

P 93-401

**Werner Meske**

Die Umgestaltung des ostdeutschen  
Forschungssystems - eine Zwischenbilanz

P 93-402

**Hansgünter Meyer**

Neugestaltung der Hochschulen in Ostdeutschland -  
Szenarien - Friktionen - Optionen - Statistik

P 93-403

**Werner Meske und Werner Rammert (Hg.)**

Ein Blick auf die neue Wissenschaftslandschaft  
Zur Lage der sozialwissenschaftlichen  
Wissenschafts- und Technikforschung in  
Ostdeutschland

P 94-401

**Alexander Nadiraschwili**

Die Transformation der Wissenschaft in den  
Ländern der ehemaligen UdSSR - Angaben zum  
Ressourceneinsatz als eine Ausgangsbedingung für  
die Transformation

P 94-402

**Wener Meske**

Veränderungen in den Verbindungen zwischen  
Wissenschaft und Produktion in Ostdeutschland

P 94-403

**Marion Höppner**

Problems of Integration of Newly Established  
Research Institutes in East Germany

P 94-404

**Werner Meske**

Science in East and West: Transformation and  
Integration of the East German Science System

P 95-401

**Hansgünter Meyer**

Die Paradoxien der Hochschulforschung und das  
Neugestaltungs-Syndrom

P 95-402

**Annett Fedorko**

Finanzierung der Wissenschaft in Osteuropa Ende  
der 80er, Anfang der 90er Jahre

P 95-403

**Jochen Gläser, Charles Melis, Klaus Puls**

Durch ostdeutsche WissenschaftlerInnen gegründete  
kleine und mittlere Unternehmen

P 95-404

**Jochen Gläser, Gabriele Groß, Marion Höppner,  
Charles Melis, Werner Meske**

Die aufgeschobene Integration - Erste Befunde zur  
Integration neugegründeter Blaue-Liste-Institute in  
die deutsche Wissenschaftslandschaft

P 96-401

**Werner Meske, Dang Duy Thinh (Hg.)**

Zur Situation und Veränderungen des FuE-Systems  
in Vietnam, unter besonderer Berücksichtigung der  
Schwerindustrie.

P 97-401

**Jochen Gläser**

How do research institutes learn? Paper prepared for  
the 13<sup>th</sup> EGOS Colloquium »Organisational  
Responses to Radical Environmental Changes«,  
Budapest, July 3-5, 1997

P 98-401

**Grit Laudel, Jochen Gläser**

What are Institutional Boundaries and how can They  
be Overcome? Germany's Collaborative Research  
Centres as Boundary-Spanning Networks. Paper  
presented at the EASST'98 Conference »Cultures of  
Science and Technology. Europe and the Global  
Context«, Lisbon, 1st October – 3rd October 1998

P 98-402

**Jochen Gläser**

Kognitive Neuorientierung der ostdeutschen  
außeruniversitären Grundlagenforschung als Folge  
des Institutionentransfers

P 98-403

**Werner Meske**

Institutional Transformation of S&T Systems in the  
European Economies in Transition- Comparative  
Analysis

P99-401

**Jochen Gläser, Grit Laudel**

Theoriegeleitete Textanalyse? Das Potential einer  
variablenorientierten qualitativen Inhaltsanalyse





**BESTELLSCHEIN**

Wissenschaftszentrum Berlin  
für Sozialforschung  
Presse- und Informationsreferat  
Reichpietschufer 50  
**D - 10785 Berlin**

**Absender:**


---



---



---



---

Bitte schicken Sie mir folgende Veröffentlichungen des WZB:

Please send me the following WZB-Papers:

Paper-Nr.:	Autor:

**Paper-Bestellungen: Briefmarken erbeten**

Wir erbitten von allen Bestellern, die papers vom WZB anfordern, eine **1 DM-Briefmarke pro paper** als pauschalen Beitrag zu den anfallenden Versandkosten. Besteller aus dem **Ausland** werden gebeten, für jedes bestellte paper einen »Coupon-Réponse International« (internationalen Antwortschein), der auf Postämtern erhältlich ist, beizufügen.

Aus diesem Grund ist es auch nicht mehr möglich, Bestellungen von papers **per Telefon oder Fax** an das WZB zu richten. Schicken Sie ihre Bestellungen nur noch schriftlich an die WZB-Pressestelle, und legen Sie neben der entsprechenden Anzahl von Briefmarken weiterhin einen mit ihrer eigenen Adresse versehenen Aufkleber bei.

Die in letzter Zeit erheblich gestiegene Anzahl von Bestellungen sowie die Mittelkürzungen, die öffentlich finanzierten Institutionen - wie auch dem WZB - auferlegt wurden, machen diese Maßnahmen unumgänglich. Wir bitten um Verständnis und darum, unbedingt wie beschrieben zu verfahren.

**Stamps for papers**

We ask for a 1 DM-postage stamp per paper from all those who wish to order WZB-papers, and who live in Germany. These stamps contribute to the shipment costs incurred. All persons interested in WZB-papers from abroad are asked to send one »Coupon-Réponse International« (international reply coupon) for each ordered paper. The coupons can be obtained at your local post office.

Because of this, it is no longer possible to order papers over the phone or by telefax. Please send your orders only by letter to the WZB-Press and Information Office, and add to the postal stamps a sticker with your own address written on it.

The reasons for these measures are the high increase in the number of ordered papers during the last months as well as the cut in funds imposed on publicly financed institutions like the WZB. We do ask for your understanding and hope that you will comply with the above mentioned procedure.