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Front page illustration: Seymour R. Cray with the Control Data Corporation 6600 computer.

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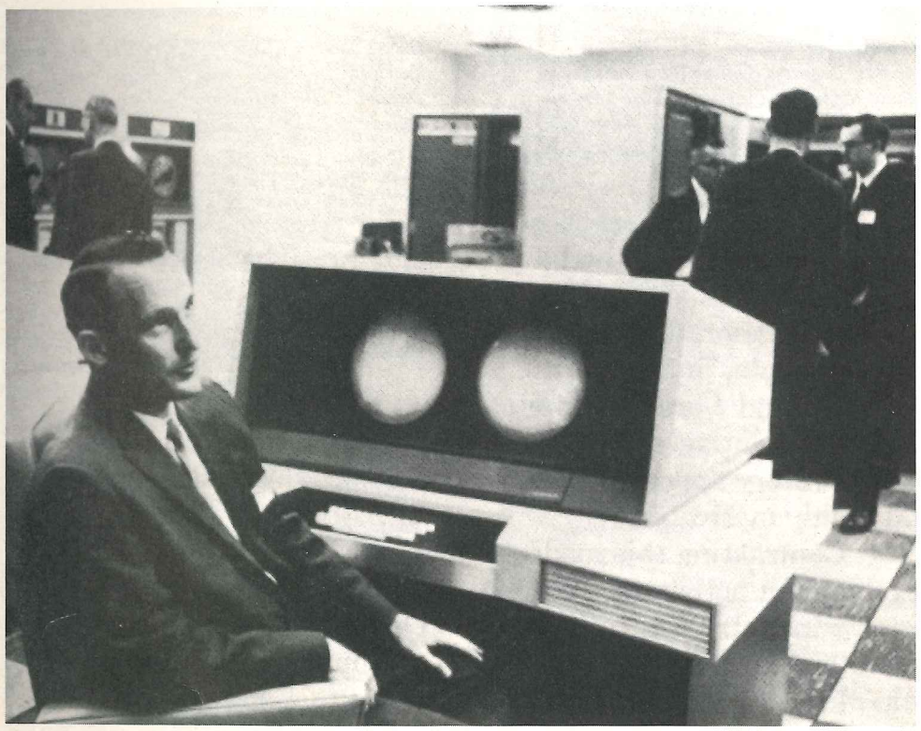

Knowing the Sociology of Technology

by Neil Pollock
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Review of *Knowing Machines: Essays on Technical Change* by Donald MacKenzie, The MIT Press, Cambridge, Mass., 1996.

Donald MacKenzie has produced under the title 'Knowing Machines: Essays on Technical Change' a wide-ranging collection of his (most recent) previously published work. Not only in terms of topics discussed in the collection, is the book diverse, but also in the nature of the approaches that he has decided to adopt. It is clear that MacKenzie finds the various moves in recent sociology of technology towards ever greater symmetries debilitating. This is reflected in his overall approach, where he is at once a relativist 'questioning the underlying knowledge/assumptions' of the building of nuclear weapons (chapter ten -'Tacit Knowledge and Uninvention of Nuclear Weapons'), and at the same, he is a realist 'making knowledge claims' about the prevalence of computer related accidents (chapter nine 'Computer-Related Accidental Death'). This analytical 'skirting around' between approaches provides for a fascinating example of the difficulties of describing just what do we mean when we are talking about the 'sociology of technology'. If this is a recipe for how to do sociology of technology studies, then it is certainly a heterogeneous one. One possible reading (which I think warrants a mention), while implicit in many of the chapters, but more obvious in others, is MacKenzie's view of a sociology of technology which informs design.

We need little reminder of the influence of his early work, and of the sway of the social shaping framework. Straight away in the first chapter, 'Marx and the Machine', he begins to set out his politics. Here he recounts how Marx's work on technology has most often been interpreted as an argument for technological determinism. Many Labour Process studies having fed of such accounts, deployed endless descriptions of the power of machines to displace and deskill labour. In arguing against this well held belief, MacKenzie reminds us of the sophistication of those pictures of the early disciplining of workers through technology, an account that shows just how the machine was able to make stable and durable the conditions of work. Nor was Marx arguing that technology was determinant at one remove, in that it solely embodied the 'interests' of capital. In MacKenzie's hands, Marx appears to be arguing that while technology was shaped by the needs of capital, it remained essentially neutral:

> It took both time and experience before the workers learnt to distinguish between machinery and its employment by capital, and therefore to transfer their attacks from the material instruments of production to the form of society which utilises those instruments (Marx, quoted in MacKenzie, p44).

If Marx confined his studies to how a neutral technology was later 'shaped', then we can rightly ask, 'what relevance does his work have for a sociology of technology which is attempting to inform design?' MacKenzie is clear that this approach 'has relevance' in looking at, what he calls, the 'contingency of design', or, in other words, how the design of technology could have be done 'differently'. He points to examples from Langdon Winner's account of the 'politics' of bridge building, and to David Noble's description of the managerial assumptions embedded in machine tools, as landmark studies of identifying these types of contingencies. Once such contingency is identified, MacKenzie argues, there then exists a need to explain

'why' certain choices were made. And here Marx's work is relevant: "...because it does suggest where to look for such an explanation...(p45)". This is a nice chapter, but, in terms of the sociology of technology, I think that there is little new here. The chapter serves its purpose, which was to correct earlier straightforward technological deterministic interpretations of Marx's, and at the same time, to remind us of the elegance of his writings. Further, although it does sit fairly uncomfortably among the other papers, it might be said to act as some sort of an introduction to MacKenzie's own brand of social 'shaping' studies of technology. The use of 'shaping' as opposed to the 'construction' of technology delineates a (sometimes not recognised) difference in the history of the sociology of technology. This can also be characterised by a use of the 'social' to explain technical change. By pointing this out, I don't mean to detract from the sophistication of the approach, and MacKenzie himself is not unproblematic in his use of the social: "This 'social shaping of technology'... should not be thought of simply as unchanging social relationships causing changes to technology, for heterogeneous engineering involves changes to social relations too." (p14)

In the next chapter, 'Economic and Sociological Explanations of Technological Change', MacKenzie attempts to discover some 'common ground' between social studies and economic studies of technology. Amongst other things, he picks up on the notion of 'natural trajectory' or 'technical trajectory' of technology. The notion, often used by evolutionary economists to explain persistent patterns of technological change, MacKenzie problematises, for the way 'natural' seems to resonate with the idea of the mechanical metaphor of 'trajectory': "The notion of 'technological trajectory' can thus very easily be taken to mean that once technological change is initially set on a given path...its development is then determined by technical forces." (p55) In referencing studies from the social history of technology (shot) and actor network approaches (ant), he asserts that such studies have shown that while technological change does possess a momentum, it is "never momentum of its own (p55)". While I agree with his criticism of the notion of trajectory, one of the problems of this kind of 'outsider looking in' analysis of evolutionary economics, is that the strawman that MacKenzie sets up (the technological trajectory), is one that does not exist unproblematically in evolutionary economics itself (see Van Lente (1993) for a more elaborate criticism).

That said, we are shown the real strength of the collection (and of the potential for crossover) in his discussion of 'self-fulfilling prophecy'. In economics, such a notion comes under the guise of 'expectations'. For example, MacKenzie quotes from the economist Paul David's work on the universal adoption of the QWERTY keyboard: "A particular system could triumph over rivals merely because the purchasers of the software (and/or the hardware) expected that it would do so" (David, 1986 cited in MacKenzie, p57). In a similar way, he uses the notion of self-fulfilling prophecy to add an aspect to the notion of technological trajectory. Namely, that: "[p]ersistent patterns of technological change are persistent in part because technologists and others believe they will be persistent" (p56). In drawing on material form one of the other chapters in the collection, 'Nuclear Weapons Laboratories and the Development of Supercomputing', he points to how designers of supercomputers, having estimated the possible future increases in speed of their rivals computers, would aim to build their machine to match or better the estimated speed of their rivals. Therefore, a continued increase in the speed of supercomputers, resulted (partly) from a belief among designers that faster speeds were possible: "The prophecy of a specific rate of increase has thus been self-fulfilling. It has clearly served as an incentive to technological ambition; it has also...served to limit such ambition" (p56). His use of self-fulfilling prophecy (SFP) is, I think, the most intriguing aspect of the collection of papers, and is not something that has been made much of in the sociology of technology. He carries this theme into several of the other papers, but makes most use of it in the chapter on 'Tacit Knowledge and the Uninvention of Nuclear Weapons'.

This chapter hinges on the argument that the development of nuclear weapons requires both explicit and tacit knowledge for successful construction, and he (tentatively) points to a situation where, in the future, the tacit skills needed to build such weapons may disappear. In his conclusion, he attempts to show how future efforts to build these weapons will be so great (without the tacit skills of the earlier generation of scientists) that it won't be a simple case of re-building from previous designs but a 're-invention' will be required. And the effort to re-invent, he argues, may be more than most countries are willing to sacrifice. This of course raises an interesting question: could the difficulties of re-invention be such that countries are sufficiently deterred from taking this route? MacKenzie, in a way, dismisses his own conclusions when he invokes the following argument "[i]t is hard to imagine belief in the feasibility of atomic or thermonuclear weapons now disappearing, and that fact alone increases the probability of their reinvention" (p249). For MacKenzie, one of the reasons why it has continued is because opponents think its continuation is inevitable and therefore "[t]heir consequent failure to oppose it has been one factor making it possible" (p57). By positing the idea of the "uninvention" of nuclear weapons, through a loss of tacit knowledge is MacKenzie's way of countering this pessimism. In taking his argument further, that we can see a time when these weapons might not exist, may enable us to look beyond what now seems inevitable.

If I were to make a criticism here, it would be this: MacKenzie makes recourse to the notion of SFP to explain the durability of nuclear weapons, without really elaborating on the term. The recent trend in the sociology of technology of unpacking reifications, warns us against using such blanket terms, however interesting or useful they appear to be. But of course, recall the introduction and the point about MacKenzie's aversion to symmetries. Yet I think, his unwillingness to expand on the expression misses out on much of the interesting aspects of what is self-fulfilling about technical change. I am tempted to say that I think he intends a performative use of SFP, rather than the more cognitive (but it is difficult to make this separation without tending towards a dualism). Performative in the sense, that he's interested in how SFP acts to enrol others. For instance, in the chapter 'From the Luminiferous Ether to the Boeing', we hear how firms have to decide whether there is going to be a technological revolution in laser gyroscopes. The risk of being left behind (they believe) is too great not to switch technologies. Therefore many invested heavily, helping the laser gyroscope revolution to become a reality. In the example of nuclear weapons, he might have emphasised just how such SFP's are constructed and maintained. This could be a description of what "interests" or actors had to be brought together under the same roof to effect such a feeling of inevitability. In a way, it is an obvious point, but I think if we're to really make use of the notion of SFP, there is maybe a danger in pretending that this is a characteristic of all technologies. When in actuality, such a notion is better thought of as an achievement, rather than as a property of technologies themselves, and in turn, (to be symmetrical) such effects need to be thoroughly described. For example, I like the way MacKenzie starts to outline the possibility of the uninvention of nuclear weapons. Importantly, he begins to describe the initial crumbling of just 'what' makes the notion of proliferation inevitable: "The military situation has changed, budgetary constraints have tightened, and parts of the nuclear weapons production infrastructure in both the United States and the former Soviet Union are now, either closed or in physically dangerous condition. Add to this a possible ban on testing and it is far from clear that the governments of the major nuclear states will commission new types of nuclear weapons in the foreseeable future" (p257).

In a further chapter entitled, 'The Charismatic Engineer', MacKenzie returns the discussion to a subject more familiar to the sociology of technology. That is, in describing the work of Seymour Cray, the engineer whose name has become associated with the invention of the supercomputer, he seeks to delineate some of the heterogeneous work of one of the worlds most distinguished technologists. From Pasteur's microbes, Bakelite's plastic to Edison's electric light, through to talk of charisma, brilliance, leadership, and of great inventors, others have taught us that such attributes are 'effects'. Invention is the bringing together of many

resources and building of heterogeneous networks. Brilliance, invention or great leadership is in placing oneself at the front of these networks. MacKenzie brings another angle to this in his discussion of Cray's work. Cray, it seems, is a charismatic. He has something special. MacKenzie teaches us of his obsession with control, a fixation that won't even allow him to transfer work to others, for fear that they won't be able to deliver on their promises. We hear about his determination to succeed, to make his computers work, every time with more speed. Often his attempts to overcome problems seem so ludicrous, that nobody, not even his colleagues will take him seriously. After hearing one particular suggestion they 'laughed' and "rolled in the aisles" (151).

MacKenzie tells us of Cray's continuous efforts to build the world's fastest computer, to continually attempt to improve on their speed and, in doing so, he, again and again, places himself at the intersection of what could be described as two contrasting networks. The first is a more stabilised result of previous efforts, where we see the customers of Cray's machines demanding hardware modifications, software and end-user support, for their newly purchased machines. The second is a more perilous journey with much uncertainty, where to reach his goal of increased speed he continually has to rely on his attempts to enrol the technology and the support of his colleagues. Rather than take the safe route of providing services that his customers need, a route that would provide financial security for the company, he forsakes the security offered here and (again and again) pushes for the second route. In envoking the work of Weber, MacKenzie captures just what is different about Cray:

> Just as revelation and the sword were the two extraordinary powers, so were they the two typical innovators. In typical fashion, however, both succumbed to routinization as soon as their work was done...[R]ules in some form always come to govern...The ruler's disciples, apostles, and followers became priests, feudal vassals and, above all, officials... (Weber cited in MacKenzie, p134).

In the hands of MacKenzie, Cray, at every turn, sees his work, his genius, becoming "routinised" for the needs of capital (to gain a return on investment), for the firm (to build market share), for the customers (to receive increased customer support). In building networks, forming alliances and placing oneself at the front of this network, and when the network begins to stabilise, when there is routinisation, or there is little room for movement, the charismatic engineer can play a "...different role in the new network..." (157). Or, as in the case of Cray, he can "...cut loose from it and begin afresh" (157). This is what is different about Cray. At every turn, he tries to shake of the constraints that might hinder his search for an even faster computer. Cray is not a charismatic, but a single minded engineer, who in searching for that ever faster computer, both built and destroyed an empire.

In concluding, this book has much to offer science and technology studies. MacKenzie shows that there is no such thing as a recipe for doing sociology of technology (something hinted at in other recent collections (Bijker, 1995)). For MacKenzie there are only tools to be used for particular jobs. The critique, often directed at the sociology of technology, that our studies tend towards a political and moral indifference is directly challenged in this collection. Though, where I agree with MacKenzie that the absence of some groups, manual workers or women for example, from the design of technologies is an important, often not discussed issue, I feel a little uneasy about the direction in which he takes some of his analysis. For example, while his argues that a loss of tacit knowledge serves to describe the possibility of a nuclear weapons reduction on two levels, a decline in those who are able physically to make such weapons, and as fuel for his SFP argument, there is also the possibility that his own thesis can be taken up in different ways. In other words, and he notes the point himself, those who wish to continue down the weapons proliferation road may enrol such arguments, as evidence for increased investment in weapons building and testing. The problem of intervening in technology design is an important, and not easily resolved, issue for the sociology of technology. See, for example, the May (1996) edition of the journal 'Social Studies of Science' which features a special edition on the 'politics of SSK'. In the collection, MacKenzie does not deal with the problems that such an intervention might bring, an aspect which is slightly disappointing, given that this theme runs implicitly throughout many of the papers.

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Letter from London

(November 96)

by Janet Rachel

Is there a future for the Sociology of Scientific Knowledge? Well, it all depends what you mean by Future, Sociology, Science, and Knowledge. Ho ho. Nearly a hundred and fifty people were drawn together by this question for a conference in London on Saturday 7 September (organised by Sally Wyatt and Tim Jordon here in Innovation Studies and Sociology, UEL), although we didn't take a vote it seems reasonable to tentatively suggest the hypothesis that, given certain conditions, there is. So long as no-one insists on calling it by that name.

This is interesting.

Naming, the passing on of names, the assumption of names, and the attachment we have to those names seems significant. Proper Names are the sign of Property. Property supposes ownership. Belonging supposes a willingness to be owned.

On the top table at the opening of the conference we had the usual suspects as keynote speakers. The unifying theme of all the speeches was their difference from each other. For example, Keynote Lecture number one: Steve Woolgar was against Natural Realism. Keynote Lecture two, Barry Barnes was for Natural Realism, but against Essentialism. Keynote three: Sandra Harding, stressed her surprise at being invited, after all she was an Epistemologist - nothing to do with SSK. And Keynote number four: Wiebe Bijker said, we should pay our respects to our Epistomological roots, but move swiftly on and dedicate ourselves to the real matter at hand - the practical details of the Political dimension - i.e. change society.

Thus we can conclude that this community values difference, and that its members belong to different camps (either positively or negatively) Natural Realists, Epistemologists, Marxists, Not-natural-realists, Not-orthodox-marxists, Not-SSK.

So, the un-named (unnamable?) community values difference, and this value is firmly held, deeply entrenched, and faithfully honoured. Evidence? Each of the speakers and many of the listeners were pushed to the point of perplexity when someone seemed to be agreeing with them: 'No no', they replied, 'you've misunderstood me' etc until the difference was once more established, and disagreement reigned - at least at the level of talk.

And what other level might there be? Well it certainly seems to have some relationship to something in the body. Evidence? Red faces, and blustering fluster, and the calling of

names. One point in a question session had some members hankering for a unity of feeling: they began speaking about past battles that SSK had participated in, they raised the spectre of old (and still active) enemies. Someone (I wouldn't dream of saying who...) seemed-to be suggesting that SSK would be ok if it could win over the likes of Lewis Wolpert to the cause... Tension rose at the prospect of such a union. Suddenly we all knew which side we were on. Evidence? - the gale of laughter that ripped through the room when someone (I wouldn't dream of naming names) located Wolpert in a specific camp: he was a Prat. Well, why not, it unstuck the debate and enabled us to continue talking about how different we were from each other (safe in the knowledge that none of us were THAT different).

Have you, by the way, seen The Usual Suspects? That wonderful film with the wonderful Gabriel Byrne. If you saw it you might have noticed that it was impossible to make any sense of it on traditional who-dunnit kind of lines. Epistemologically speaking it caused confusion. Morally, however, it made sense when you put the cripple in the place of the devil and thought about redemption and god (buy me a beer and I'll explain it to you - in the meantime it all depends upon realising that the Devil is ultimately in the Service of God). I mention it here because god and the good was one way of making sense conhere with reference to that Saturday meeting in September. We were engaged in asking about the right the good and the true, avoiding a mono-theic order.

Names. Now, what is this business about names, the level of talk, the relationship of bodies - be they bodies of knowledge, insitutions, men, or women - Property and ownership? Or put it another way, how do you be part of a community that refuses a common name and a common figure. Is it possible to name oneself (auto-nomie) without reference to ownership and property? (clue: no), or is this a question about the difference between an-archy and poly-archy? (clue: yes). Last night I noticed a programme on telly which showed some anthropologists talking about a society of apes. The focus was on what happens to baby apes when their fatherhood is in question. First of all we were invited to focus on what this means to the perplexed possible father. He seemed to realise that said infant was not a consequence of his productivity, so he killed the offending product. And then we were invited to see it from the perspective of the other female apes in the society. They killed it too. (There are enough of these illegitimate offspring to make it possible for the whole community to join in the ritual.) Oh yes, and then they ate it. Thus we can conclude, that it is impossible to know some pretty important things in the absolute (vis: the patronage of a baby ape), and that the inability to decide this and to attribute a name (a patro-nym) is cause for considerable concern. The implication of the programme (it seemed to me) was that it mattered quite a bit what one did with the concern once it was unleashed.

If we allow the idea of Difference to be the fundamental defining point of our community (and this phrase implies both ownership and belongingness) then it raises some interesting questions about how to belong. The notes I took as Steve Woolgar spoke are peppered with suggestions on this topic: 'SSK is provocation not position'. 'The purpose of reflexivity is modesty'. 'Reflexivity avoids arrogance'. 'We must avoid the dangers of complacency' (cf Ethnomethodology which has been accused of moving out to the suburbs'). So far so good. 'The linear model is deeply entrenched, needs uprooting, exorcising.' I personally have a few problems with this last one.

The conference itself was held at The Tavistock Institute in North London, in a room with glorious views over the vast spread of this great and wonderful city (ok, so my prejudice is on view - better out than in say I). It was great to be in a conference venue that admitted so openly to the outside world, and invited it in so unreservedly. I wonder if this is coincidental to the owner of the place? The Tavistock Insitute is a psychoanalytical clinic, and invites parts of the world in that other institutions prefer to leave outside. I wonder whether we - whatever banner we each choose to rally under - have the technical capacity (and, of course, I am using technical in the new post-SSK sense of the word, that is the pre-modern) to accommodate such differences as there are in the world, or whether we are in grave danger of adopting the more forthright strategy of our friends the apes. Watch this space.

Dissertation Abstracts

Marc Berg, *Rationalizing Medical Work: Decision Support Techniques and Medical Practices*, Ph.D., Maastricht University, The Netherlands 1995. To be published by MIT Press, Cambridge, MA, January 1997.

In response to a perceived 'crisis' in medicine, such as large variations in practice and increasing costs, many authors in medical journals have called for decision support techniques as a means to rationalize medical practice. These tools, including protocols, decision analytic techniques, and expert systems, have generated much debate as to their benefits, threats and (im)possibilities. Advocates see in these tools the optimal means to transform the 'art' of medical work into a 'science': the tools would make medical practice more rational, more uniform, and more efficient. Critics, on the other hand, question both the feasibility and desirability of these tools. Authors within the medical profession, as well as philosophers such as Hubert Dreyfus and science studies scholars such as Harry Collins, have argued that formal tools cannot supplant humans in most real-life tasks.

This book examines what it is these tools do, how such tools work (or not work) in concrete medical practices, and how they are made to work (or not to work). It takes the different positions raised by advocates and critics as points of departure for investigation, rather than as a priori assertions. Drawing on ideas and methodologies from recent science and technology studies, it attempts to understand what 'rationalizing medical practices' means. Its central claim is that getting a decision support technique to work in medical practices entails the creation of niches within these settings. These niches encompass several dimensions: new discourses on medical practice and its problems come into being, medical criteria and disease definitions change, and the heterogeneous elements constituting particular practices are realigned to fit the requirements of particular tools.

In discussing the emergence of the different facets of these niches, the book emphasizes the inevitable divergences between the claimed goals of the toolmakers and their end products. 'Uniformity' is threatened by the continual proliferation of differences between the tools, for example, and the rationality accomplished through their use is unlike any advocates' ideal-typed view. On the other hand, contrary to many critics, the book does not draw the conclusion that the tools are useless and should be discarded. Rather, it shows how practices are transformed in and through the coming of these tools, so that some insight may be acquired into what is gained and what is lost.

In tackling these different questions, the levels of analysis shift between the chapters. Together, the chapters depict the multi-layered processes involved in obtaining and maintaining a place for decision support techniques in medical practices. he first chapter argues that there is no singular, unified call for a more rational medical practice. Through focusing on the medical profession's self-analysis in post-war medical literature, it is demonstrated that several notions exist of what medical practice is, what its problems are, and how these can be solved. Only recently have depictions of medicine's problems arisen where decision support techniques appear as the "perfect" answer.

In the second chapter, the perspective shifts to the tools and their builders. Through an analysis of the ways some typical tools are introduced and discussed, it is demonstrated that 'rationality' means something quite dissimilar for the different techniques. While introducing the tools further, this chapter also

shows that the more recent, diverging views of medical practice and its problems are inextricably tied to the emergence of different tools.

Chapter 3 focuses on the actual construction and implementation of some specific decision support techniques. Analysis centers on the negotiation processes this entails, and on how individual tools and practices are transformed in ways beyond anybody's or anything's grasp. Creating a niche within medical practice for the tool to function implies the disciplining of that practice to the prerequisites of the tool. The nature of this disciplining, and the recurrent means through which this is achieved (reinforcing bureaucratic hierarchies, for example, or materializing the tools' demands) are demonstrated to be directly linked to the formal nature of these tools. In this disciplining, disease definitions change, doctor-nurse relations are altered, and so forth. The tool does not simply do what physicians do 'better': it shapes a new practice.

In Chapter 4 it is demonstrated how in the process of constructing and implementing the technique the latter becomes increasingly bound to a specific place, to a circumscribed scope of action, and to a modus of operation that more often than not is less 'rational' than the builders had hoped originally. In other words: the tool is inevitably localized - either in space, scope, or rationale. This localization reduces the 'homogenizing' and 'universalizing' potential of the tools - but it is a prerequisite for the actual functioning of the technique. The localization of the tool and the disciplining of the practice(s) are closely related: localization can be fought by further disciplining, and failure to discipline results in further localization. Getting a tool to work, thus, is a two way process: the tools and the settings onverge into a coinciding network in which all heterogeneous elements constituting the practice are made to fit. Rather than being a generic characteristic of a type of technology, 'universality' - inevitably incomplete - is the outcome of this process.

Chapter 5 then demonstrates how the creation and maintenance of a niche is not merely the tool-builders doing, but also an accomplishment of the personnel dealing with the tool. Here the focus is on medical personnel at work with the tools. The socially and materially situated nature of medical work is stressed, and cognitivist renderings of medical decision making are thus criticized. The focus is on how the tools figure in that work, and how the tools transform it. They do not simply make the life of medical personnel easier, as they were expected to. Rather, the continuing need to actively create the formal tools' prerequisites creates an additional level of accountability. On the other hand, control is not unequivocally taken back by the health workers, as critics predicted. In the transformed practice, rather, control is distributed over both health workers and the tool: together they form a powerful 'hybrid' whose functioning cannot be reduced to either tool or personnel. The chapter concludes that the critics are right: the work does remain indelibly local. But the advocates of the techniques are right, too. In fundamentally transforming medical work, formal tools can increase efficiency and complexity. Chapter 5 shows, in other words, how the apparently contradictory statements of critics and advocates can both be true.

Finally, Chapter 6 summarizes the key arguments set out in this book by discussing why some decision support tools have been more successful than others. It points to how earlier chapters have cycled through different layers of a repeating theme: the creation of niches for the tools to become possible, and the convergences between tools and settings that characterize these processes. With this theme in mind, and coming back once more to some of the arguments of both advocates and critics, this last chapter formulates the contours of an alternative answer. The success or failure of decision support techniques, it is concluded, is not so much due to the merits of the different tools as such, but the intricate outcome of the processes of constructing and maintaining niches for these tools to work.

Merle L. Jacob, *Sustainable Development: A Reconstructive Critique of the United Nations Debate*, Goteborg University. Department of Theory of Science and Research, Dicksonsgatan 12, 412 98 Goteborg, Sweden. E-mail: biosphere@vest.gu.se

The main objective of this thesis is to provide a reconstructive critique of the United Nations debate on the concept of sustainable development from the disciplinary vantage point of theory of science. This is achieved by focusing on two critical issues: the meaning(s) of the concept of sustainable development and the difference between sustainable and conventional development. The thesis is divided into two main sections. The first section is an introduction which provides a statement of the problem, main objectives and description of the theoretical framework. The second section is further subdivided into five papers which take up different aspects of the argument developed to explore the two main objectives. The thesis concludes that the concept of sustainable development may be visualised as a nascent research framework which contains normative as well as theoretical content. This research framework may be visualised a having a core of values that are constitutive of sustainability surrounded by a more flexible layer of arguments about how sustainability figures in the context of development. It further argues that the concept represents a window of opportunity for the realignment of development theory and practice.

Fiona Q. Wood, *Issues and Problems in the Public Funding of University Basic Research*, PhD 1996, University of New England, Australia. Address: fwood@metz.une.edu.au

This thesis is concerned with issues and problems regarding public support of university basic research. Of particular interest is the role of the research funding agency or council in channelling government funds to the university research community and implementing government research policy regarding these funds. A related concern is the efficacy of the peer review mechanism for the determination of awards, ensuring quality control and providing accountability. On the basis of an extensive literature review, criticisms and limitations concerning the use of peer review are presented. Alternatives and improvements to this form of quality control are also discussed. A further area explored is the project grant as a dominant mechanism of government support for basic research. The interpretive framework developed within the thesis reflects a view that the funding mechanisms used by governments to support basic research are the 'operational embodiments' of policies regarding the government-university research relationship. Moreover, it is argued that strains in the government-university relationship inevitably develop where these funding mechanisms are not properly suited to 'the policies, purposes, and expectations of both parties' or are not sufficiently flexible to adapt to changes in circumstances in the broader socio-eco-geopolitical environment. Background to the development of the government-university relationship is provided and particular attention is directed to the development in the post World War II period of an ethos regarding the purpose and conduct of science. It is suggested that a principal reason for the current re-examination of the principles guiding this relationship lies with a shift in public values regarding the purpose of science. An important consequence of this shift of values is that governments in many western countries now consider the university sector as the supplier rather than the customer of the basic research effort. A core component of the thesis entails a case study of the Australian Research Council's Large Grants Program. The case study was based on first hand observation of the grants cycle during 1992. During 1993 data were collected which would allow a statistical profiling of applications assigned to four of the subdisciplinary panels used to advise on award determinations. The decision making procedures regarding the Large Grants Program are described and an overview provided regarding several recent public inquiries which have levelled criticisms at the operations of the Australian Research Council. A number of issues which would have been expected to be considered in the initial planning regarding the ARC model are also identified. The case study represents one of the first independent examinations of the decision-making processes and outcomes of this funding program and reflects a commitment by the ARC to increasing the transparency of its operations to the academic community.

The Environmental Movement and Science Policy

by Andrew Jamison

At some point in the mid-1980s, the environmental movement ceased to exist as a living source of collective identity for a relatively small number of people and became instead a source of collective inspiration for society as a whole. What had previously been a wide ranging critique of industrial society and its waste and artificiality became a much more delimited and disembodied set of symbols, ideas, slogans and practices that have since been working their way into the the world of science and technology policy. What had earlier been seen by the power elite primarily as a subversive threat to the further expansion of the industrial state has come instead to be seen, by many influential actors in both business and government, as an important contributor to economic recovery and rejuvenation.

From the paradigmatic notions of sustainable development and risk society to the pragmatic techniques of cleaner production and pollution prevention to the new marketing strategies of green consumption and environmental labelling, the political discourse of environmentalism has been reinvented over the past ten years as a policy discourse. What represented in the 1970s an alternative approach to modern science and technology has come to be reconstituted, from the mid 1980s onward, as a partner in a constructive program of science, technology and economic policy. And what were in the 1960s and 1970s protest movements of radical opposition have largely been emptied of their political content, while simultaneously giving rise to new branches of, and approaches to, science and technology. While the more radical, or oppositional, voices have lost much of their influence, the more pragmatic and scientific voices have been given a range of new opportunities. Of course, this is not to say that there is no longer a radical environmental opposition, but I would contend that radicals and reformists have increasingly drifted apart from one another, and in most countries now work in different organizations, with little sense of a common, oppositional movement identity.

There has been, in other words, a fragmentation of what was, for a relatively short time, a social movement into a number of disparate bits and pieces. In the 1970s, environmentalism, throughout the industrialized world, stood for an alternative set of "knowledge interests," involving both a fundamental political critique of modern technoscience's attitude to nature, as well as an alternative organizational ideal - a democratic, or participatory ideal - for the development of knowledge. There was also a distinct form of collective learning that took place in the study circles and information activities of environmental movements, and a kind of grass-roots, or, what Ivan Illich termed a "convivial" form of engineering that went under the name of appropriate, or radical technology. The point is that, as a social movement, environmentalism managed to combine different kinds of interests into a central core identity, what Ron Eyerman and I have termed cognitive praxis, with both cosmological, technological and organizational dimensions.

The cosmology was, to a large extent, the translation of a scientific paradigm into a socio-economic world-view. The holistic concepts of systems ecology were transformed into political philosophies of social ecology; in the writings of the American anarchist Murray Bookchin, for example, ecology was linked to a utopian political tradition, represented by Charles Fourier, Henry David Thoreau, and William Morris to inspire a new kind of liberatory "ecology of freedom". For Bookchin, and for Arne Naess in Norway, and for many other movement intellectuals, ecology was not to be reduced to an instrumental rationality, to a control apparatus. An emancipatory, or deep ecology would rather be one in which scientific knowledge production would be selectively restructured according to an organismic ethic, rather than a mechanical logic.

Technology was to be developed under the general perspective that "small is beautiful", and that large scale, environmentally destructive projects were to be opposed and stopped. At the same time, new contexts for education and experimentation and the diffusion of research were created in the form of movement workshops and, in Holland, for example, in the form of science shops, allowing activist groups to gain access to the scientific expertise at the universities.

I have earlier suggested that one of the key processes at work in the 1980s, which served to decompose, or break apart this integrative movement cognitive praxis into a disparate cluster of organizations and individuals, was a process of professionalization. The knowledge interests of the environmental movement were transformed into various kinds of professional expertise, which made it possible to incorporate parts of the movement into the established political culture, and shift at least some of the members of the movement from outsider to insider status. Some of the alternative technical projects proved commercially viable - biological agriculture, wind energy plants, waste recycling.

Some of the alternative visions were taken up by professional philosophers and politicians (and even Murray Bookchin got a university post), while the alternative contexts for knowledge production and dissemination either cleaned up their act and developed more sophisticated communication and information strategies or they eventually ran out of steam.

There were both internal and external reasons for this professionalization process. In the course of the energy debates of the 1970s, the environmental movement had generated within its own ranks a new range of expert competences in energy planning, energy policy, alternative energy production, and so forth. As the intensity of the public debate over energy futures waned in most of the industrialized countries during the early 1980s, either through over-exposure or some kind of definitive parliamentary decision, these counter-experts thus found themselves in need of new sponsors to support their work. Some became professional consultants, working either in private consulting firms or in relation to the government, and some found jobs at non-governmental organizations, like Greenpeace, or the older, more established conservation societies. Others carved out niches in the media and the universities, creating new professional identities as environmental journalists, environmental and energy researchers. Still others moved into governmental and intergovernmental agencies, like the World Bank and the European Commission, to develop programs in energy efficiency and sustainable technology development.

What began to be noticeable in the mid-1980s, to a significant degree as a result of these professional outgrowths, or spin-offs, from the environmental movement, was a new kind of environmental policy agenda, the so-called global environmental agenda that focused on problems of biodiversity, climate change, and transborder pollution. These problems were, of course, identified by scientists and engineers as serious and urgent, particularly after the hole in the ozone layer was disclosed over Antarctica. It is, however, worth noting that most of these international environmental problems had been discussed at least since the 1940s by concerned scientists and nature-lovers, and, at the 1972 UN Conference on the Human Environment in Stockholm, the global nature of environmental problems had been stressed by many scientific participants.

What had changed in the meantime was the character of the international political economy. By the mid 1980s, production, in many branches, had become increasingly globalized, with research carried out in one part of the world, development in another, and manufacture in still another. Individual firms were increasingly nodes in transnational corporate networks. Economic life had more and more come to be governed by international patterns of production and diffusion, and this globalization trend was further accentuated by developments in telecommunications and information technology. It became possible, and, in a few short years, common practice, to plan industrial operations on a global basis, and to shift operations from country to country

depending on changes in market and financial conditions. There are, of course, many elements to this globalization that are open to dispute, and there is, to say the least, a lively discussion of what all this means. For environmentalism, and environmental science and technology policy, globalization has meant a shift in substantive focus - from the local and national to the global, when it comes to the issues to be dealt with - as well as a shift in location - from national policy-making bodies to intergovernmental and international organs, when it comes to agenda-setting, and, increasingly implementation of research programs, as well. In actual research practice, the new information technologies have meant a great deal, in terms of the kinds of observations that can be simulated, the kinds of models that can be constructed, and the kinds of calculations that can be made. The social construction of scientific facts has been shifted from a more or less direct interaction with the environment and its component parts, to an ever more abstract and aggregate meta-environment of atmospheric, hydrological and geological processes that cannot be directly observed or, for that matter, studied.

It can be suggested that what has made these new issues particularly interesting for the new cadres of environmental professionals that had grown out of the environmental movement, is that their solution requires something more than old fashioned science and technology. They require rather a new kind, or mode of knowledge production that combines various disciplinary perspectives. Most importantly, these new global environmental problems require a new kind of social or political expertise to complement the traditional kinds of scientific-technical expertise that had previously dominated environmental science and technology policy. In particular, there is need for an intermediary expertise between the global and the national, an expertise in the social, or, as it is often called, the human dimensions of global change. What this expertise often involves is a knowledge of particular methods of accounting, assessment, scenario building, forecasting, foresighting, prediction, and the like that seem to be called for in dealing with these extremely abstract and uncertain global problems. But it is also, at various levels and in various ways, an expertise in societal adjustment, environmental management, "life-cycle" analysis, risk assessment. It is what Ulrich Beck calls reflexive knowledge, a kind of knowledge that Beck sees as characteristic for the emerging risk society that, one might contend, the environmental movement first identified. Instead of calling it risk society, which, in essence, implies an acceptance of continuous and ever more serious risks in our complex societies, the environmental movement saw the construction of risks as the problem to be overcome, and those technologies - nuclear energy, automobiles, chemical fertilizers - that were too risky simply had to go. It was science-driven development itself that was the problem, because, as Barry Commoner showed already in 1971, that development favored artificial, synthetic techniques; an ecological society would be one that lived within nature's limits, however difficult it was to define those limits in practicable - and economically profitable - terms. The ecological society - Ernest Callenbach's "ecotopia" - proved to be a vision that could not be made amenable to a capitalist, market-based logic, at least not on a general, global scale. Risk society, on the other hand, can be lived with, and it can be incorporated into a capitalist economic system, but it requires new kinds of expertise in order to become sustainable.

How can we as social scientists continue our analysis of these transformations? Let me briefly present the project that I have just initiated within the program on targeted socio-economic research (TSER) of the European Commission. It might serve to inspire others among us who are culturally and critically minded to respond to the upcoming second call for proposals (deadline in January 1997). We call the project PESTO, since we are green and saucy; it stands for Public Participation and Environmental Science and Technology Policy Options.

What we want to investigate is how the transformation of the environmental movement that I have described above has affected environmental science and technology, both in terms of policy agendas, as well as in terms of project implementation and institutional restructuring. We

conceptualize science policy as a cultural process, by which representatives of the concerned policy domains, or cultures, negotiate decisions, or non-decisions, of various kinds. In this perspective, the environmental movement can be said to represent a civic "policy culture", and its influence can be evaluated by seeing how much its conceptions of policy measures, doctrines, and programs are taken into consideration in policy deliberations with the other policy cultures - economic, bureaucratic and academic. Science policy making can be thought as a field of cultural tensions, where the different actors try to impose their prirorities and policy principles onto the system as a whole.

It is interesting that, by becoming respectable, the environmental movement - renamed "non-governmental organizations" - has been allowed to take a more active part in policy-making. But that participation differs substantially from country to country. In Denmark and the Netherlands, for instance, technology assesssment is an officially established activity, and the general public is involved in a variety of ways in the new programs of sustainable science and technology. In Sweden, on the other hand, science policy remains largely in the hands of the experts, and public participation is much more limited and circumscribed. I would contend that policy makers, activists, and social scientists have a lot to learn from cross-national comparative research.

PESTO is divided into three main phases, or "work packages," as they say in Brussels:

* In the first work package, the project investigates the interface between the public and policy-makers, focusing on issues of representation and legitimation, and on the communication strategies of environmental organizations and relevant authorities.
* The second work package will analyze the evolution of new innovative networks in environmental science and technology in the different countries. We will study the connections, or linkages, that are being established between universities and private companies, and the role that the public is allowed to play, or not play, in these emerging networks.
* In the third work package, we will explore the transnational exchanges that are taking place in environmental science and technology policy. Here, we will examine how the new policy activities and programmes transcend national borders, especially in Europe.

PESTO thus focuses on how the "public", in different countries and in different ways, participates in the new approaches in environmental science and technology policy. The aim of PESTO is to compare the reconstitution of environmental science and technology policy in eight European countries: Britain, Denmark, Iceland, Italy, Lithuania, the Netherlands, Norway, and Sweden. It is our contention that the involvement of the general public is crucial for the successful implementation of environmental science and technology policies, and that, in this regard, the countries of Europe have a great deal to learn from each other's experiences. By systematically comparing what we term the cultural tensions in environmental science and technology policy making in a wide range of different countries, we hope to develop a better understanding of these important policy transformations.

What we hope to achieve in PESTO is an interactive process of social learning, both among the participants, but also with various participants in the networks that we study. We want to provide an opportunity for reflection and for the sharing of experiences across the European countries. We would also like to carve out a new kind of role for social science in the new discourse of sustainability, a more partisan role, in that we believe that the issue of participation is central to the value of the new environmental science and technology policies. And finally, we want to strengthen the comparative understanding of ecological modernization, by identifying, in a systematic manner, the national differences in policy making, network building and public participation.

Note

This paper was presented, in slightly different form, at a conference on Environment and Power, organized by the Center for Technology and Society at the University of Trondheim, October 30-31, 1996. For a more developed version of the argument, see my article in Risk, Environment, Modernity, edited by Scott Lash, Bron Szerzynski and Brian Wynne (Sage 1996).

STS Participation in the Targeted Socio-Economic Research (TSER) Programme[1]

by Terttu Luukkonen
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At its Council Meeting approximately two years ago EASST decided to monitor the rate and experiences of STS[2] centres' participation in European Community Research Programmes. The question had became topical with the launch of the Targeted Socio-Economic Research programme (TSER) early in 1995. This research programme is part of the Fourth Framework Programme for Research (1994-1998) and it is the first specific EU (EC) research programme in the social sciences. Its first research area, 'Evaluation of Science and Technology Policy Options in Europe', is particularly relevant for the field of social studies of science and technology. The research area was initially designed drawing on input from persons active in science and technology studies. In addition to TSER, there are specific research programmes in fields, such as environmental issues or information and telecommunications technology, which include areas and opportunities for social science research, and science and technology studies in particular.

After an EASST Policy Forum meeting in Brussels in February 1995, an EASST Task Force[3] was established to monitor the new developments in the policy environment at the European level, in particular. As a major input to the Task Force activities, Aant Elzinga and the author of this paper organised a survey among major European based centres in science and technology studies about their response to Brussels' call for projects under the auspices of the Fourth Framework Programme and its various European R&D funding initiatives. In the survey, particular attention was given to attitudes towards and experiences of the Targeted Socio-Economic Research Programme (TSER). The questions asked related to whether the centres had applied for funding; if yes, to their experiences of the process; if not, why they or any of their researchers had not applied for funding. This paper reports the major conclusions of this survey.

One of the original concerns of this study was whether more qualitative approaches might be disadvantaged in large networks, the standard model of EU research funding. This was reflected, among other things, in questions about the problems met with in the planning of the proposals, such as those related to the size of the network, a need to co-ordinate a multinational network, and the multidisciplinary nature of the research. The success rates of applications from different types of institutions also have a bearing on this concern. It was assumed that a funding model of large networks will favour more quantitatively oriented and established disciplines, such as economics. It is to be remembered that EU research funding is not intended for any particular disciplinary orientation, but it is highly targeted and mission oriented. It may, however, be the case that particular research orientations are more suitable for the research tasks outlined.

Conclusions based on the study

The number of responses to the EASST survey on EU research programmes was not large, 42 people from 34 institutions. We have, therefore, to be cautious in drawing conclusions on the basis of the data. In the absence of a more comprehensive survey, this study, despite its drawbacks, provides a first approximation about the attitudes and experiences of a sizeable number of major European institutions in the field of science and technology studies.

By and large, the respondents were fairly positive about the EU programmes, STI researchers in particular. The respondents had somewhat critical comments on many aspects of TSER and other EU programmes, but the criticism was scattered. The evaluation of the proposals, in particular, prompted surprisingly little criticism. There is, however, a lack of transparency in the process and alleviating this lack would greatly improve its credibility.

There is one major observation which is related to the researchers' perception of TSER and their active participation in TSER and other EU programmes. There seems to be a divided between those in STI on the one hand and those in STS and 'other' studies[4] on the other hand. The latter group of researchers do not find EU research programmes so complementary to their research agendas and do not even apply for the research money as their colleagues in STI do. The data indicated that these scholars put forward fewer proposals for EU research programmes both now and earlier in spite of their international orientation in general. Consequently, researchers representing these research orientations are a very small minority among the participants in EU sponsored research projects and networks. These researchers indicated mismatch of research interests as a major reason for non-participation. We may surmise that the mismatch does not only mean that the research topics would be widely different. It is also a question of the research approaches and strategies to be pursued. Even though this study did not provide strong evidence of it, the research topics of more qualitatively and exploratively oriented science and technology studies do not seem so well fitted to be pursued in large networks. The traditions of social sciences are fairly individualistic in spite of increasing international exchange and collaboration. The overall goals of TSER are also seen as too technocratic or applied by part of the research community.

Researchers representing STS and orientations other than STI were not only less active in seeking EU research money, they appeared to be less successful in obtaining EU funding. This finding may, however, be an artefact of the small sample, because TSER applications data do not indicate strong bias in favour of any particular orientation.

Limited EU collaboration by social studies of science and approaches other than STI is certainly a loss in two ways. The researchers miss an opportunity, in terms of both funding and organisational framework, for European collaboration. The EU misses research which is carried out within STS and other orientations and which would diversify the analysis of socio-economic changes and the scientific and technological developments at the European level. Economic or quasi-economic approaches and models pursued in STI institutions, even though they are in line with and provide the language of many important EU policy documents, do not provide a comprehensive intellectual framework and tools needed for the analysis of the major science and technology related problems the EU is facing.

Notes

1. Paper prepared for the Joint Meeting of EASST and 4S in Bielefeld, October 10-13, 1996. To obtain the whole report, please contact the author of this summary.

2. Social studies of science and technology; in some cases the scope extended over into STI, i.e., science, technology and innovation studies.

3. The Task Force consists of Aant Elzinga, Peter Healey, and Terttu Luukkonen.

4. Researchers and institutions belonging to STI are active in economics and management studies. There were also institutions and researchers who could not be classified into these classes and who carried out research in fields such as political science, ethics, methods etc. These are called 'other' in this report.

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The Network of European Centres in Science and Technology Studies (NECSTS)

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Mission statement
The Network of European Centres in Science and Technology Studies (NECSTS) began several years ago, initially as a group of universities interested in student exchanges under the ERASMUS student mobility scheme of the European Community, and keen to develop a stronger sense of European identity at the Master's and Doctoral level in this field. In the NECSTS-context the term Science and Technology Studies is used as a generic title for a range of activities that covers such fields as social studies of science, science and technology policy analysis, science dynamics, socio-economic studies of innovation, and sociology of technology; or in terms of the acronyms currently used: STS (science, technology, society), STP (science and technology policy) and STI (science and technology innovation).

The student mobility programme will be continued under the EU's new SOCRATES programme. NECSTS-members have expressed their interest in continuing this activity under this new SOCRATES regime. NECSTS shares an interest with EASST and with other institutions and networks in the field, in establishing science and technology studies as a recognizable and recognized field of academic and policy relevant teaching and research in Europe.

Network membership
The NECSTS-network now comprises 14 centres in 10 countries: Edinburgh and Manchester in the UK, Bielefeld and, as a new member, München in Germany, Goeteborg in Sweden, Trondheim in Norway, Roskilde in Denmark, Wien in Austria, CNAM and Paris VII in Paris, France, La Sapienza in Rome, Italy, Universidad del Pais Vasco in San Sebastian, Spain, and Amsterdam (UvA) and Maastricht in the Netherlands. Membership of NECSTS has been rather stable over the last couple of years, but in anticipation of the EU's new SOCRATES programme NECSTS is interested in expanding the size of the network by recruiting new members. Due to the restrictions some British universities place on incoming students, NECSTS experiences a specific need for new members in Great Britain. We are therefore happy that the Science Policy Research Unit (SPRU) at the University of Sussex has expressed an interest in joining the network in 1997.

Organizational structure
NECSTS is a rather loose network of autonomous research and teaching centres in science and technology studies. Each centre appoints a local coordinator responsible for informing students about the opportunities the network offers and for taking care of the administrative work required for annual applications under the ERASMUS/SOCRATES student mobility programme. The local ERASMUS coordinators meet annually for a business meeting. Among its members the networks selects the network or programme coordinator. Until the academic year 1996/1997 the programme coordinator's home institution is the representing and responsible contract party for the EU. After that student mobility will be based on bilateral agreements under institutional contracts. Funds for the student mobility programme are distributed through national institutions and the universities, whereas the coordinating institution (until 1996/1997) receives a budget to cover expenses for the coordinators' annual business meetings.

Up till the academic year 1994-1995 the University of Amsterdam was NECSTS's coordinating institution, with Loet Leydesdorff as the programme coordinator. At the 1995 Bielefeldmeeting it was decided that, starting with the academic year 1995-1996, Maastricht University would act as coordinating institution with Ger Wackers as programme coordinator.

Activities
1) One of the most important acitivities of the network is exchanging students, most of them being at a masters level, but also PhD students are travelling within the network. Although different in emphasis and profile, all members of the network provide a regular curriculum in science and technology studies, or are in the process of developing such a curriculum. Network members exchange general information about STS courses by updating the NECSTS dossier annually, and more detailed information bilaterally on request.
2) NECSTS has a good record of organizing annual workshops, in conjunction with the annual coordinators' meetings. The 1993 workshop, for example, was held in Vienna on the topic of Science Meets the Public. The 1994 workshop was in Manchester on the History and Sociology of Biomedical Sciences. The 1995 workshop was in Bielefeld on Social Theory and Social Studies of Science. The 1996 workshop was organized in Amsterdam on Quantitative Approaches to Science and Technology Studies. In 1997, from May 27 to June 1, Trondheim will host the workshop on Gender and Technology, whereas the University of Maastricht proposed the Politics of Technology as the topic for the 1998 workshop to be held in Maastricht. Both staff and students of network members are stimulated to participate in the workshops. (See conference announcements.)

EASST, as the professional organization in the field, has been supporting these workshops with financial means and by offering travel grants to students who would like to particpate.
3) Finally, the network provides channels for dissimination of information about ongoing research. The network facilitates collaboration and the search for partners for joint research proposal aiming at EU or other supranational funds.

Waiver of tuition fee, transfer of credits and accomodation support
Membership in the NECSTS-network implies that each centre, or university, waives the tuition fee for incoming, visiting students, traveling within the network. This also means that one's own students who want to study abroad are not required to pay tuition fees for courses they attend at one of NECSTS member institutions. Waiving tuition fees removes an important financial barrier for studying in an international context in another European country.

Membership in the NECSTS-network implies that a centre recognizes courses attended by a students at another NECSTS-centre as (optional) parts of the centre's STS-programme. In other words, credits earned by students at a NECSTS-member institution will be transferred to the student's home university. NECSTS-members support visiting students in finding accommodation for the duration of their visit (from three months up to one year). If a centre or university cannot provide these services, students can be referred to proper local accommodation bureau.

For further information on NECSTS contact Dr. Ger Wackers: tel 31 43 3883372/3319; fax 31 43 3259311; email <g.wackers@tss.unimaas.nl>.

The Future Location of Research:
A Triple Helix of University-Industry-Government Relations II
Theme paper for a Conference in New York City, January 1998

by Loet Leydesdorff & Henry Etzkowitz
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As the university crosses traditional boundaries in developing new linkages to industry, it must devise formats to make its multiple purposes compatible with each other. The primary role of the university in relation to industry is through its educational activities that prepare graduates for industrial employment. The second academic focus of relations with industry builds upon the development of scientific research capabilities and the transfer to industry of economically relevant knowledge. Thirdly, the production of commercially relevant knowledge, either as an extension of basic research or by solving problems presented by industry, has been institutionalized through the creation of a series of boundary-spanning mechanisms (Etzkowitz, Webster, & Healy, 1997).

Within industry, questions are raised about what should be located within the firm, among firms, or between firms and other types of institutions, such as universities and government laboratories. Given market pressures, is there a role for the corporation in supporting basic research, or is this task best left to academia and government? What is the role of government given the perceived need for research in economic and regional development?

Thus, universities and industry are assuming tasks that were formerly the province of the other in the development of new technologies. We argue that a spiral model of innovation in terms of university-industry-government relations is required to capture the evolution of multiple linkages at different stages of the capitalization of knowledge (Leydesdorff & Etzkowitz 1996; Etzkowitz & Leydesdorff 1997). In a knowledge-based economy, the distribution of research locations provides a focus of strategic opportunities for both research and policy-making.

The Triple Helix Model

Three institutional spheres (public, private, and academic) which formerly operated at arms' length are increasingly working together, with a spiral pattern of linkages emerging at various stages of the innovation process, to form a "triple helix." There are four dimensions to the development of the triple helix: the first is internal transformation in each of the helices, such as the development of lateral ties among companies through strategic alliances or changes in the resource base of university systems. The second is the influence of one helix upon another, for example, the role of the U.S. federal government in instituting an indirect industrial policy in the Bayh-Dole Act of 1980 or of state governments in formulating policies and programs to encourage universities to establish industrial ties.

The third dimension is the creation of a new overlay of tri-lateral networks and organizations from the interactions among the three helices, established to generate new ideas and formats for high-tech development. This phenomenon is especially salient at the level of regional industrial clusters which formerly lacked a common organizational structure. These new arrangements typically arise under crisis conditions such as those induced by general economic depression or increased international competition. The fourth dimension of the helix model is a recursive effect of these exchanges among institutional spheres, both on the spirals from which they emerged and on the larger society. One such effect is on science itself, as a result of internal changes within academia, strengthened and diffused by government policy (Gibbons *et al.* 1994).

The incorporation of economic development into the mission of universities and the further integration of the knowledge infrastructure into systems of innovation are shaped differently in various countries. Institutional backgrounds and cultural traditions affect the future location of research. At the global level, however, we are witnessing a Second Academic Revolution: a reconfiguration of institutional boundaries and the introduction of an economic mission into the university system (Etzkowitz 1994).

The First Academic Revolution introduced new roles into academia, transforming professors from teachers of youth, who would not likely remain in academia, into researchers in disciplinary specialties as well (Jencks & Riesman 1968). In some European countries like France and Italy, this revolution began only recently. Research was located in an institute structure apart from the universities, while the latter were largely confined to a teaching mission.

Even in the U.S. the transition through the "Second Academic Revolution" is not complete. As awareness of the significance of research to economic development spreads, schools in less research intensive parts of the country, attempt to restructure themselves into research university, typically by beginning research centres focussing on topics relevant to the local economy. In older schools and at the level of the development of disciplines, we note a shift towards specialties like biotechnology, information sciences, new materials, etc. Corporations are structurally involved in this development of new knowledge (Gibbons *et al.* 1994; Etzkowitz & Leydesdorff 1997). Institutions like Cooperative Research Centers are nowadays the most rapidly increasing sector in the knowledge infrastructure (Turpin & Garrett-Jones 1997).

Nations, regions, and states are able to compete globally for the economic benefits of these new developments by changing their respective infrastructures (Porter 1990). The Triple Helix provides us with a model for mapping these new arrangements across regions, industrial sectors, disciplines, and technologies (Leydesdorff 1995). Under what conditions does collaboration provide new opportunities for strategic alliances, research centers, spin-off firms, and SMEs? What is the role of market forces, government policies, and technological restructuring? What is the potential of these emerging arrangements as new sources of employment?

Code sharing

Beyond intermediary linkages between different institutional spheres is the issue of emergent structures arising across spheres. As Europe moves toward the U.S. entrepreneurial academic model, some U.S. academics, supported by the NSF and state government science and technology programs, are attempting to create institute-based research structures in order to accomplish longer-term projects and multiple goals beyond the compass of individual research groups. Large facilities like Lincoln at MIT or JPL at Cal Tech were traditionally located apart from the university with their own staff, although there was always some connection in training of graduate students, etc. The new labs, often called Centers, are nowadays organized within the main campus (Betz 1996).

No single line of organizational development can be discerned internationally, except for an increasing tendency for R&D to be located in emergent structures that cross-cut traditional institutional spheres such as corporate, governmental, and academic laboratories. The new arrangements can be conceptualized as "code shares," by analogy with the airline practice of sharing equipment, personnel, and routes among companies. Thus, an academic research group and a spin-off firm located outside the university may actually be operating in tandem as a coordinated virtual unit, despite their apparent separation. Note that "code sharing" is different from "cost sharing": the regime of collaboration and differentiation has changed. Knowledge is no longer transferred, but co-developed.

While university-industry relations have been established on the basis of mutual complementarities, this older model assumes that each of the partners will assess the collaboration and negotiation in terms of its own code. For example, a university department has to balance its relations with relevant partners against teaching obligations, high-level publications, and other academic objectives. The industrial partner is interested in the transfer of insights in terms of strategic and operational profits from the perspective of

the business, while government is expected to orchestrate, but not to intervene in this collaboration. Thus, each partner assesses the collaborative efforts in terms of its own institutional codification.

The development of the complex network of univeristy-industry-government relations is driven by a dialectic between functional differentiation of communications and institutional integration. As the institutional code itself becomes increasingly differentiated, each partner has to develop mechanisms for integration at the interfaces. University departments have developed specialized agencies for such transfer, but in the meantime the nature of the research enterprise itself has changed. Computer software can no longer be categorized in terms of "pure" and "applied" research (Kaghan and Barnett 1997); "biotechnology" is not a technology, but a science (McKelvey 1996).

Within academia, puzzle solving has nowadays become as important as truth finding. The quality of the communication and the validity of the knowledge claims is warranted by disciplinary control, while the system opens laterally in terms of the agendas that the various specialties are designed to address. Thus, universities take on some business roles: marketing knowledge, taking research into product development, and assisting in the formation of new firms. The recombination of elements from different sources has become a major challenge, leading to new developments.

This recombination can be computer supported, but the emphasis is on human agency for translating among codes into new arrangements ("puzzle solving"). As the new arrangements become codified in niches, they put pressure on the institutional layer to adapt (Freeman & Perez 1988). The institutional layer is functional for conflict resolution and decision making, but it generates its own bureaucratic pressures. A systematic "dis-organization" of institutional boundaries, however, has prevailed during the "post-modern" 1980s (Turpin & Garrett-Jones 1997). If the overall system is complex enough, institutions are able to innovate gradually toward the "knowledge intensive mode" (Gibbons *et al.* 1994).

In this transition the reflexive dynamics of government at various levels becomes crucial (Van den Belt & Rip 1987). Hierarchically organized institutions like those in the former Soviet Union may suffer catastrophic crises when coping with the uncertainties generated by a regime that flourishes on the basis of knowledgeable reorganizations of previous modes of communication, and at various intermediate levels.

Regime change

In contrast to a biological double helix, a triple helix is by nature unstable. It remains an emerging construct on top of the underlying communications. But as in a nested structure, its global stabilization feeds back onto the underlying communications to solve internal problems of differentiation at the interfaces. This complex system continuously reorganizes itself with reference to its past. Thus, the new regime rests on the bi-lateral and tri-lateral arrangements from which it emerges, and legitimates action in terms of rearranging functions in favour of further developmental possibilities.

These emerging possibilities are by definition not given. The unintended consequences of previous interactions, however, remain initially latent for the actors involved. The economic potentials have to be constructed reflexively, and in this context they are the subject of research options. Expectations can then be specified in the terms of codified, i.e., scientifically controlled, communications. Thus knowledgeable reconstructions drive the knowledge-based economy in terms of expectations. The institutional basis of this system is itself a laboratory for testing expectations in terms of niches. Institutional adaptations are maintained or not, depending on their viability in the relevant environments.

The niches can be of different sizes: some reconstructions can be tested in a single test tube, while others require complex infrastructures like modern cities or specific regional developments. Tong (1996), for example, has pointed to niche management on China's eastern coast aiming at picking up momentum from economic developments in the Pacific region. Thus, the size of research and the locus of an experiment may vary dramatically across disciplines, trades, and

industries, and according to the specific organization of the interface between innovations and markets in a prevailing system of innovations.

Niches are constructs that build on specific complexities. Surplus value is generated in terms of interaction systems among institutions. The emerging code in the interactions feeds back on the underlying differentiations. Of course, this does not mean that the underlying institutions are abolished. Some may be in need of replacement, but in general the system adds complexity to itself in layers. New arrangements supplement the existing ones, so that the creative researcher is able to shift gears and thereby to draw upon existing code or on code that is shared in another context.

The analysis of knowledge-intensive action is contextual: events are generated in a distributed mode in the interaction among contexts. Accordingly, one can no longer analyze "research" in general; one can distinguish among "laboratory research", "economic research", "organizational innovation", etc. As far as an emerging overlay can be (provisionally) stabilized, it is expected to develop its own sharing of code. In this way, different contexts are being created. Some of them will persist, while others will disintegrate. Competition among them is a dynamic function that includes the analysis of evolutionary life cycles (cf. Freeman & Perez 1988).

The Analysis

In summary, the analysis of the future location of research focusses on the contexts of research in terms of university facilities, industrial needs, and government policies. These contexts, however, cannot be considered as given; they are dynamic functions as well. The future location of research is expected to be found in the interaction among the different contexts. Each context selects according to its own codes; the triple helix builds on the negotiations and interactions in terms of reflexive codes that potentially emerge in the communications among the institutional actors.

The traditional selector, of course, is the market. However, price competition is no longer the only dynamic function at work. Thus, the new economics of science (Dasgupta & David 1994) are relevant for the analysis of the triple helix by focussing on product competition and innovation. Other analyses can inform us about historical contingencies in developments, about competitive advantages in strengths and weaknesses of the research potential of a region, a nation, or a corporation, and about deliberate policies to increase the knowledge-intensity of regions and/or their failure.

Contextual analysis is itself a well-known tradition in sociology. The sociology of science, for example, has distinguished between the level of disciplinary developments and the local context of a laboratory group. Scientific literature, for example, is evaluated at the field level, while local contingencies and informal communication prevail at the group level (Gilbert & Mulkay 1984). Research can be considered as the translation of the mixture of resources at the group and at the field level into new configurations, for example, by the publication of scientific results. Successful interactions are those which change the interacting constellations (Latour 1987).

In this conference, we wish to generalize contextual analysis for studying future locations of research. The observable events can be considered as functional to interactions between contexts, like the "code sharing" among aviation corporations. What is being shared? What is linked in an interaction among which contexts, and why? How are the events selected and provided with meaning from different perspectives, and how are these meanings adjusted in processes of negotiation? Can one specify the asymmetries and confluences in the relations, and can one identify the forces that stimulate integration into specific collaborations? How has research changed the institutional contexts from which it was generated? Are options visible along new dimensions of events that were initially unintended, but which allow us to specify a new dimension, i.e., potentially a new layer, using the evolutionary model?

During the past decade, the evolutionary model has pervaded our thinking about technology developments and its co-evolution with relevant contexts (Nelson 1994). We have become aware that developments can be

"locked" into a sub-optimal state (David 1985); that network externalities can reinforce unpredictable developments (Arthur 1989), etc. In our opinion, it is urgent to take the next step: how can one analyze the events that have occurred from a perspective of hindsight, as specific instances of mutual shaping among ranges of events that could have occurred.

The evolutionary perspective requires a shift of focus: we no longer "follow the actors" along the time axis. The contingencies of the positive instances are analyzed in terms of the interacting dynamics among university science, industrial development, and government intervention. These selective contexts have to be specified on theoretical grounds. Then we can ask when the selections have reinforced one another. What can these case studies teach us about policy making and its (lack of) interaction with other social forces?

The central question

This conference focusses on the question of where the locations of research will emerge. The question is obviously relevant for higher education, since teachers wish to qualify students for jobs in the newly emerging configurations. Thus, the theme relates to human resource issues.

In general, human capital is expected to generate variation, since theorizing enables us to understand the translation and recombination among codes. By providing the communications with specific meaning, the codifications can be considered as selections. If the specificity can be stabilized in a niche, the initially latent dimension may gain momentum by repetition. Institutions are expected to adapt in varying degrees (Tong 1996).

Instances of new lines of research enable us to specify the evolutionary selections that have brought about these particular instances. The specification of the relevant codes can provide us with an expectation of future locations of research, since the latter are generated by the interactions among the former.

The Conference

This conference follows a first meeting in Amsterdam at which the Triple Helix model was discussed with a group of researchers from thirty countries (Etzkowitz & Leydesdorff 1997). Now we propose to extend the model to address policy issues, and to discuss its relationship to the relevant theoretical perspectives of economics, engineering, and science studies. The discussion will also include practitioners and policy analysts from these three spheres.

We propose to commission a series of orienting papers as the basis for discussion. These will provide the basis of a volume of proceedings. Additionally, some of the papers submitted will be selected for a more specialized book. The conference itself is composed of plenary sessions, submitted paper sessions, and workshops. Additionally, panels of practitioners will be constituted from organizations like the European Union, state and regional organizations in the U.S., relevant industries, and spin-off companies.

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News from the Association

EASST Elections and Membership Renewal

Enclosed with this December issue of the Review are the biographical sketches of candidates as well as a ballot for the EASST Council and Presidential elections. These are to be returned to the EASST secretariat by January 21, 1997.

Membership renewal forms have been enclosed with all Reviews. If your membership expires at the end of 1996, your address label shows a special reminder above your name. If no such message appears, you are registered as a member for 1997, and may wish to pass on the form to an interested colleague.

EASST Constitution

Adopted in Budapest, 1994, and amended by the EASST General Meeting in Bielefeld, October 1996

1. EASST is the abbreviated name of the European Association for the Study of Science and Technology.
2. The aim of EASST is to foster within Europe the scholarly study of science and technology including their historical development and their role in society. More specific aims include improving scholarly communication and exchange in the field, increasing the visibility of the subject to policy-makers and to the general public, and stimulating and supporting teaching on the subject at all levels.
3. The activities of EASST included thematic and general meetings, organised visits and exchanges, the publication of newsletters, and any other means towards the above aims.
4. Membership of EASST is open to all who share its aims. Those members who are not resident in Europe will not be eligible to vote in the affairs of the Association but will enjoy a lower membership subscription. Discretionary membership subscriptions may also apply to lower income countries either inside or outside Europe. Institutes, scientific societies and other organisations participating in the field are invited to become institutional members of EASST.
5. The activities of EASST are financed from the annual subscriptions of individual members, from the voluntary contributions of institutional members, from gifts, legacies and other donations, and from funds made available by foundations and other organisations for the performance of specific functions consistent with the basic aims of the Association.
6. The affairs of EASST are governed by a Council, consisting of a President, eight regular members and the President-elect subject to clause 7 below.
Members of Council are elected by the individual members of the Association, from among EASST members residing in Europe. No member of the Association shall serve as President for more than 8 years consecutively. The Council shall have a quorum of 5 members. The Council may co-opt up to four members without voting power either to undertake specialist tasks or to gain experience of Council before seeking election to full membership. One such co-opted member will be responsible to the Council as Editor of the Association's Newsletter.
7. Regular members of the Council and the President of EASST shall be elected for four year terms. The President of the Council and Association and the regular members of Council will be elected separately. Every two years at least three and at most five regular members of the Council shall retire. Elections shall be held by postal ballot sent to all members of the Association, on the basis of nominations proposed at a general meeting of the Association. The postal ballot will take place within three months of the general meeting at which nominations are received. Regular members of the new council will take office as soon as results are known. A newly elected President will take office within six months after his or her election. During this period the President-elect is a member of the Council and has the rights and obligations of a regular member of the Council as specified in this constitution. The President of the Association remains in function until the President-elect is installed as President.
8. General meetings of the society will take place every two years, normally at the Association's major conference. Proper and due notice of general meetings will be given to all members. Special general meetings may be called by a resolution of one third of the members delivered to the Secretary of the Association. At the special general meeting, which must follow within two months, a resolution carried by a simple majority can require an immediate fresh postal ballot to replace the whole membership of the Council.
9. The Council designates one of its members as secretary, and another as treasurer. The duties of officers are as follows:
The President shall have general charge of the affairs of the Association. The President or a member of the Council designated by the President shall preside at all meetings of the Association and of the Council. The president shall be responsible for representing EASST to other organisations unless this power is entrusted to another Council member for a specific purpose. The Secretary shall be responsible for the administration of the Association and the safe keeping of its records. The Secretary shall be responsible for communicating the agenda of Council and general meetings of the Association, and for transmitting reports to such meetings and the associated papers to participants at least 20 days before each meeting. The Secretary shall be responsible for keeping the minutes of Council and general meetings.
The Treasurer shall be responsible for the funds of the Association and for reporting on the financial position to Council and general meetings. A statement of the societies accounts shall be submitted as required by the Council, and for general meetings 20 days in advance. Other positions may be created and filled at Council's discretion. Council shall conduct its business by a set of decision rules which will be open to inspection by any member.
10. The provisions of this constitution can be changed at any general meeting by a two thirds majority of those present and voting, provided that at least two months notice of any proposed changes has been given to all members, or by a two thirds mail ballot of the membership, again providing the requirement for two month's notice have been met.
Any disputes over interpretation of this constitution shall be resolved under the laws of the country where the Association has its offices and under European Union law as appropriate.

Science as Culture: Long-term Processes and Local Contingencies

The European Graduate Summer School in STS -Enschede, August 26-30, 1996

A Report by Julia Garritt, Centre for Science Studies & Science Policy (CSSSP), Lancaster University

"So, Ted, where would you like to die?" Well, we knew it was a Summer School on long-term processes, but none of us were quite expecting that kind of time scale! This question was the first one posed by Karin Knorr-Cetina in a dual interview between her and Theodore Porter in the first session of the programme. It was an unusual and interesting start, allowing the two principle lecturers to give some personal context to the ideas they would be proposing over the next few days. In fact, Ted and Karin led all the sessions during Monday, Tuesday and Wednesday, providing detailed explanations of their recent work through a variety of formats - lectures, discussions and roundtables.

The aim of the week was to investigate the contrasts in studying long-term 'macro' phenomena and local 'micro' contingencies, and these three days highlighted not only the differences but also the associations. Taking the notion that 'knowledge is everywhere', the three lectures by Karin - 'Knowledge Structures', 'The Disunity of the Sciences' and 'Inside Objects' - supported the ethnographic study of epistemic practices and forms of alignment in order to realize the knowledge structures which nest within our social structures. The achievement of knowledge can thus be to unfold the world to us, she claimed, rather than looking "backwards to reality".

A different approach to studying local actions within a long-term context was shown by Ted's use of historical study. Ted also gave three lectures - 'Objectivity and Community', 'Quantification and Culture' and 'A Social and Intellectual History of Statistics in the 19th Century'. In these he challenged some of Karin's ideas; for example, he claimed that objectivity can be created through independent thought - it is once the scientific method (or "honesty") fails that the rule-making of society intervenes. Yet he drew parallels with other ideas, such as the increasing role of society and the micro-social order in science.

Seven other lecturers visited on Thursday and Friday to give short presentations of their own research which again highlighted some macro-micro issues in STS.

Kaat Schulte Fishedick recounted her micro-analysis of British and Dutch fieldwork practices in vegetation science in the first half of this century. By looking at specific practices and the historical rendering of them by the scientists involved both at the time and many years later, she found that some histories could be criticized and others confirmed, together pinpointing the progressiveness of science.

Trudy Dehue very much supported the historical research method for looking at science, suggesting that historical sociology - and continued curiosity - rather than STS can raise normative issues and explain the context of social relations.

A kind of compromise was broached by Eddy Houwaart who illustrated the difficulty in researching medical history from an STS perspective. An ethnography of medical practices based on human contacts would be impossible because of the time lapse, so following the careers of instruments and their social patterns of being would have to be done through a critical analysis of records and other historical documents.

As Houwaart talked of medical technologies as representations, so Maarten Hajer suggested that environmental issues were dealt with in the political arena by reference to signs and emblems. To highlight the different approaches to acid-rain politics in the UK and Netherlands, he used discourse-coalition analysis based on (recent) historical documents, with interviews as an informative extra. An interesting conclusion of his work was of an intermediate layer of issues being constructed by institutional actors to fulfil the role of an emblem, thus he undermined any impression of the 'micro' and 'macro' being fixed and polarized entities.

Annemarie Mol took us on a more

philosophical journey to explain her ideas that the 'local' can be looked at as a matter of complexity rather than contingency, and so 'small' and 'large', 'global' and 'local' need not be seen in opposition but as patterns of links which are indifferent to scale.

The final two papers were fitting conclusions to the week. If much of scientific practice and science-politics is about decreasing uncertainty in order to gain trust, then Harro van Lente gave a supporting case study by looking at the 'Tenax' development. The three methods of decreasing uncertainty he found - specific claims, opportunities and scenarios - highlighted once again the interlocking of activities through the micro, meso and macro levels.

Ernst Homburg's study of the Dutch White Lead Industry of the 1800's found this too. Using both historical narrative and a micro-study that he said followed Bijker, the complimentary relationships between the long-tern perspective of society, the specific nature of local contingencies and the intermediate level which was affected by both, could be illuminated and described in a cohesive manner.

On behalf of all the students who attended the Summer School, I would like to warmly thank Rob Hagendijk and Gerard de Vries for creating such an informative and enjoyable programme. You commitment to our welfare lasted even until the time the bar closed each night!

If I may just have a short sentence to step up onto my soapbox, I would like to make an observation and a plea. The only reason that I was able to attend this Summer School was by receiving WTMC and EASST stipends and financial help from the School of Independent Studies, Lancaster University. For all this help I am extremely grateful - the Summer School has helped both my research and my confidence beyond measure. Yet such a programme simply does not exist in the UK. Obviously there are differences in the UK and Dutch graduate education systems, but I can only imagine the benefits that would result from either running even one Graduate School per year in the UK or enabling greater access to the Dutch programme. If there can be any such initiative from EASST and/or a UK STS centre, then I am sure the discipline as a whole simply could not lose.

A Close Encounter Of The Third Kind

Luhmann and Latour in Bielefeld

by Gerald Wagner

"Like Ma Bell, I've got the ill communications"
-The Beastie Boys

In October a joint conference under the title "Signatures of Knowledge Societies" was organized by EASST and 4S in Bielefeld, Germany. The announcement for one of the events sounded especially promising. Niklas Luhmann was supposed to speak about "Social Studies of Science and the Theory of Society", commented upon by Loet Leydesdorff, Wolf Krohn, Bruno Latour and myself. Of course, most people were looking forward to witness the confrontation between Luhmann and Latour. In many eyes this encounter seemed remarkable, not the least because its protagonists missed each other so strikingly.

Luhmann On Air

Luhmann's lecture was exemplary for its clarity and the analytical distinction of its concepts and theoretical claims, but it did not do justice to the topic. Those who had thought that Luhmann would speak about the discipline - Science Studies itself - were disappointed. Science and its sociological observation were mentioned only in a short sentence, where Luhmann laconically said that science is an autopoietic subsystem of the modern society. From the perspective of a theory of society, whose most important empirical element is the theory of functional differentiation, this remark wasn't in any way hurtful to the professional observers of that 'subsystem'. Still, to the spectators this remark seemed less than accommodating and politely distant, classic in a way that could also be described less sympathetically as bygone. The audience pricked their ears to Luhmann's exposition of the operational closedness of social systems, but appeared nevertheless to be waiting for Latour's counterattack, which promptly came.

In Latour's opinion, Luhmann's theory basically could not offer him or the discipline anything at all. A glance in the congress programme, according to Latour, would be sufficient to establish the fact that the empirically obsessed STS-people could not recognize their objects within Luhmann's theory. System theory might label this obsessive empiricism as "flat" sociology. In Latour's opinion, the empirical zoology of STS describes society as it is, not as it might appear from the distance of the icy heights of system theory. Basically, Latour's reply amounted to pointing out that system theory represents all that he and his colleagues in STS literally have been fighting against for the last 20 years. The purification of science as well as the setting of boundaries for the social realm characterized Luhmann's work as the epitome of the "cognitive turn" of epistemology. For Latour these were the old words of provocation, which just miss the characteristics of science, namely its materiality.

In his reply Luhmann used the opportunity once more to distinguish strictly between the realm of things and that of language. Thus, the motley conglomeration of the objects in most science studies belongs to the *Umwelt*. In his view, this is a result of the marriage of communication theory and the theory of society, and that's that. Social differentiation, however, does not prevent talking about these objects; on the contrary, it makes it possible!

Latour Unplugged

All of this did annoy Bruno Latour, yet he did not stop to protest against the theory of differentiation. Following Latour, social differentiation is The evil of system theory. Connecting, forming networks, including and naturalizing the objects into our society, which has always been a commonly shared world, etc. - it was hopeless. Luhmann simply refused to discuss these topics. Perhaps his polite smile hid a certain feeling of puzzledness facing the irritation of the Frenchman behaving strangely.

To be sure, conference confrontations rarely achieve the level of written argumentation. Moreover, confrontations of any kind between Latourian sociology and systems theory rarely if ever take place. Under these circumstances, this 'clash of cultures' pointed up the mutual misconceptions between empirical science studies and the general sociology of modern knowledge societies. Basically, there was nothing to criticize about Luhmann's contribution, but unfortunately he did not take any risks to explore and search the still unknown worlds of communicating material artefacts, as he actually had done in his recent study on art. An approach from that direction certainly also would have aroused the interest of his counterpart from Paris.

On the other hand, abstinence from theory in most of STS stems from a deeply rooted suspicion of unpacking. STS prefers a theoretical transmogrification of its objects into show 'n' tell. As in grammar school, the assignment in STS is to present an object and massage it with words. In the beginning it is simply the object in performance that plays the leading role; later on its description gradually takes over. In the scientific evolution of show 'n' tell the anthropologists of science would like to dwell on things as long as possible, thus bringing the objects back in, not in order to catch them in the butterfly nets of words, but to capture words with things. What matters is not the ostensivity of language, but that of objects. System theory points at the self-referentiality of communication, whereas anthropology of science attempts to lend a voice to everything there is in a situation. This was already apparent when looking at the announced titles of the different events. It was the artifacts themselves which organized these sessions: contraceptives, the human body, fertilization

technologies, machines and musical instruments.

Apparently, this close encounter of Luhmann and Latour was a wasted opportunity. Ironically, Latour's exit from the stage gave the impression of some influential technical actants somehow objecting against this form of 'ill communication'. Obviously displeased, Latour fled the field, inadvertently ripping the microphone cable out of the floor, causing a general communication breakdown. For the chairman, Loet Leydesdorff, there was nothing left to announce to an amused audience except that the show's over.

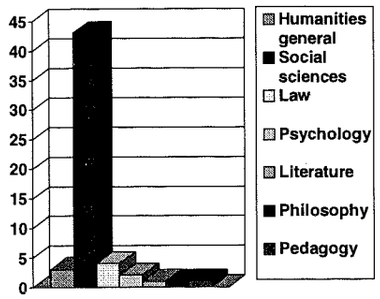
Editorial Note

The editors would like to thank the following Bielefeld conference rapporteurs: Maarten Derksen, Koen Frenken, Jessika van Kammen, Catharina Landström and Rita Foss-Fridlizius.

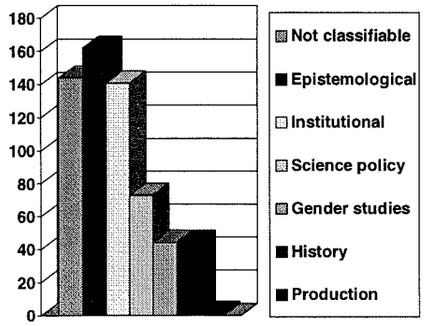
We would also like to draw the readership's attention to a letter by David Edge in *Nature*, 384 (1996), 106, on misconduct in the so-called 'science wars'. The letter follows up on the 'petition' which was presented to the Bielefeld conference, and subsequently was put on the EASST website.

Guenther Kueppers prepared some statistical charts of the conference, two of which below.

Distribution of fields of humanities



Distribution by S&TS-fields: theoretical/methodological perspectives



Sites and Boundaries: Location and Process in the Production of Knowledge

4S Annual Meeting, October 22-26, 1997, Tucson, Arizona

The 1997 annual meeting of the Society for Social Studies of Science will be hosted by the University of Arizona, at the Holidy Inn City Center in Tucson, Arizona. Conference Activities will start on Thursday afternoon, October 23, 1997, with an informal reception Wednesday evening, October 22. Concurrent panels and plenary sessions will run Sunday morning, October 26. The two-hour sessions will be composed of 4 or 5 speakers. Tours of local facilities of interest, including museums, observatories, and archeological sites will be available for conference participants. Other activities and events planned for the conference include a book exhibit and a multi-media display area.

About Tucson

Tucson is literally surrounded by exciting places for you to see. Within the city are many museums and historic sites which give insight into this part of Arizona's colorful past. The frontier West's rugged and romantic legacy is preserved in nearby Tombstone, "The Town Too Tough to Die," and the mysteries of the future unfold for the visitor at Kitt Peak National Observatory.

Call for Papers

Those interested in presenting a paper at the 1997 Annual Meeting of 4S should submit 150-200 word abstracts to the Program Chair no later than March 1, 1997. Those considering organizing sessions should please submit abstracts of all papers together, in an approximate order. Please indicate if your contribution should be directed toward one of the special themes or to general open submissions. An electronic abstract submission form will be available. It can be found at the the http://www.u.arizona.edu/~jlc website. Other electronic submissions and correspondence are encouraged. Please do not encode submitted materials.

Special Themes

The following special topics represent both the continuation of discussions in 4S, and opportunities for future research. Open submissions on other areas of research, theory, and policy are welcome at the 1997 meeting.

Location and Process: Laboratory studies are traditional fare for science and technology studies researchers. But laboratories are reorganizing, and new organizations (centers, technology parks) have emerged. Business plays new roles in creating, distributing, and applying new knowledge. How do computers, telecommunications, and electronic publishing change both the locus and practice of science?

Universities and Beyond: The university has been a traditional site for producing new knowledge. But industrial, government and virtual organizations have also been involved, and are taking on new salience.

Transnational Science and Technology: Science and technology have always been transnational activities. How do configurations of international collaborations, multinational capitalism, and changing demographic and mobility patterns of scientific and technical expertise challenge science and technology studies?

Education: Classrooms are places where knowledge is made and transmitted. What are the important research and policy questions in teaching science and technology, technology in classrooms, and the outcomes of policies and new pedagogical practices, especially for women and underrepresented minorities?

Indigenous Knowledge and Ethnosciences: Ordinary people make, use, misuse, or re-interpret scientific and technological information. Research which describes indigenous knowledge from non-industrialized cultures; cultural reconstructions of science and technology; lay or popular science, technology, medicine, or mathematics; or cases of appropriate(d) technologies is sought.

Museums: Museums are places where knowledge and history are made, stored, transmitted, and interpreted and re-interpreted. They are also places where science and technology are used in processes of conservation and preservation.

Social Knowledge and the Social Sciences: In what ways do extant methodologies in STS fit studies of the social relations and configurations of social knowledge, artistic and cultural production, and the historical development of academic disciplines in the social sciences and humanities?

Disciplines and Methodology in STS: Social studies of science and technology are often perceived as transgressive, challenging conventional ideas about science, technology, and society and the disciplines from which the field originated. This special theme will feature discussions on the impacts science studies approaches have on disciplines and the academy.

For further information about the program, please contact:

Jennifer L. Croissant, Program on Culture, Science, Technology, and Society 16c Harshbarger/MSE, Bldg. 12 University of Arizona Tucson, AZ 85721 phone: 1-520-626-7110 fax: 1-520-621-8059 email: jlc@u.arizona.edu web: http://www.u.arizona.edu/~jlc

For further information about registration, exhibits, and accomodations, please contact:

Office of Engineering Professional Development Harvill Building Room 235, Box 9 The University of Arizona P.O. Box 210076 Tucson, AZ 8572-0076 phone: 520-621-3054 fax: 520-621-1443 email: baltes@bigdog.engr.arizona.edu

Conference Announcements and Call for Papers

Second International History of Philosophy of Science Conference (HOPOS '98) will be at the Reilly Center for Science, Technology, and Values, *University of Notre Dame, Notre Dame, Indiana* on March 12-15, 1998. For more information, contact this year's conference registrar, James Maffie, Independent Scholar, 3280 Sentinel Drive, Boulder, CO, 80301-5498, or email <maffiej@spot.colorado.edu>.

Science and its critics, a meeting to promote dialogue between the two cultures, will be held at the *University of Kansas*, Kansas Union Building, Big 12 Room, on February 28-March 1, 1997. At the science wars meeting, the following topics are to be explored. The scientific method: How is it really practiced?; Science and religion: Are they ever incompatible?; Science and postmodernism: If it is postmodern, can it be science?; Science and politics: Is science mainly a tool for white males to retain power?; Science and education: Are nations scientifically illiterate? Does it matter?

The keynote speaker will be Professor Alan D. Sokal, New York University. For registration information, see the web: kuhep4.phsx.ukans.edu/~baringer/scicrit.html or contact John Pattinson, The University of Kansas, Division of Continuing Education, Academic and Professional Programs, Continuing Education Building, Lawrence, Kansas, 66045-2607, tel 1-913-864-3284.

The *Centre for Social Theory and Technology at Keele University*, UK will hold a workshop on **Actor Network and After** on 10-11 July 1997. Actor Network Theory has become increasingly popular (and controversial) in a range of disciplines. Originating in the History and Sociology of Science and Technology it has moved out into such areas as Organisation Studies, Management, Geography and even Engineering.

What is Actor Network Theory about today? Has it been popularised, moved away from its original concerns? Have people misunderstood, misinterpreted it? What is ANT's message today? The workshop will explore the concerns, possibilities and limits of ANT and how they link with other intellectual traditions. Speakers will include the "founding fathers" of ANT, Prof. Michel Callon (Ecole de Mines, Paris), Prof. Bruno Latour (Ecole de Mines, Paris), Prof. John Law (Centre for Social Theory and Technology, Keelè) and eminent representatives of 'non-ANT' people such as Prof. Marilyn Strathern (Department of Anthropology, Cambridge).

A call for papers and further information for this workshop is available on the World Wide Web pages of the CSTT at: www.keele.ac.uk/depts/stt/cstt2/wose-co.htm. Further information is available from Olaf Boettger at <O.Boettger@keele.ac.uk>.

The **Amsterdam Virtual Research Institute and Laboratory** (AVRIL) at the University of Amsterdam wishes to announce an EU project *The Self-Organization of the European Information Society*. A workshop will be organized in Amsterdam on 3-4 January 1997, in order to establish relations between research groups who share an interest in this approach with the objective to formulate a joint research project in the framework of the TSER program of the EC. The objective of this project is two-fold: (1) to organize the concepts, the semantics, and the modelling techniques developed in the various disciplines for describing the dynamics of complex systems; and (2) to stimulate research in topics relevant to the "self-organization of the European information society" at the European level. For further information contact the coordinator of the Amsterdam group: Peter Van den Besselaar, University of Amsterdam, Social Science Informatics, Roetersstraat 15, NL-1018 WB Amsterdam, The Netherlands, fax 31-20-525-6896; email <peter@swi.psy.uva.nl>.

Philosophy and Literature, a journal, is holding a **Bad Writing Contest**. The challenge of the Bad Writing Contest is to come up with the ugliest, most stylistically awful single sentence from a published scholarly book or article. Ordinary journalism, fiction, etc. not allowed, nor is translation from other languages into English. Entries must be non-ironic, from actual serious academic journals or books - parodies cannot be admitted in a field where unintentional self-parody is so rampant. Winning entries will be checked by our researchers before prizes are awarded.

Judging will be by editorial staff of *Philosophy and Literature*. Finder of the winning sentence will have first choice from among the following titles, second prize will be a choice of the remaining books, and so on. The seven prize books are: Rewriting the Soul, by Ian Hacking (Princeton), The Magician's Doubts: Nabokov and the Risks of Fiction, by Michael Wood (Princeton), Dilemmas of Enlightenment, by Oscar Kenshur (California); Killing Time, by Paul Feyerabend (Chicago); Anti-Mimesis from Plato to Hitchcock, by Tom Cohen (Cambridge); Compulsive Beauty, by Hal Foster (MIT); Georges Bataille, by Michael Richardson (Routledge). If necessary, there will be a eighth prize (a copy of the journal *Social Text*) and ninth prize (two copies of *Social Text*).

With the subject heading "Bad writing entry", email entries to Denis Dutton, editor of *Philosophy and Literature*, at d.dutton@fina.canterbury.ac.nz.
The contest deadline: 31 December 1996.

Managing the Big City is the title of the conference to be held at **Gothenburg University** on 21-23 August, 1997, in cooperation with the Science Centre Berlin and Viadrina University in Franfurt on the Oder. Interested participants as well as papers are invited. The themes are as follows: the practices of city management; travels of metropolitan ideas (translation and imitation in city management); metropolitan discourses (disciplinary continuity and rupture); and metropolis and the media (how the big city is represented in papers and film). For information, contact Barbara Czarniawska-Joerges, GRI School of Economics and Commercial Law, Gothenburg University, Vasagatan 1, 411 80 Gothenburg, Sweden, fax 46-31-773-1466, email <barbarac.gri@mgmt.gu.se>, or Rolf Solli at email <Rolf.Solli@spa.gu.se>.

Web news

MARXISM-GENERAL is brought to you by the Spoon Collective, a group of Net citizens devoted to free and open discussion of philosophical issues on the Internet. This particular list is designed to fill a need in marxism space for a list that offers absolute openness to its subscribers. All posts are distributed to the list without the contents being reviewed or approved by anyone, no subject is out of bounds, there is no editor or moderator, and there is no formal policy for expulsion. To subscribe to the list described below, send the message: subscribe marxism-general to majordomo@lists.village.virginia.edu

Other spoon lists include:
third-world-women, deleuze-guattari, avant-garde, frankfurt- school, film-theory, fiction-of-philosophy, bhaskar, cybermind, french-feminism, nietzsche and an expanding spectrum of marxism lists. The Spoon Collective archives are at http://jefferson.village.virginia.edu/~spoons. For technical information, email Hans Ehrbar at <ehrbar@econ.utah.edu>.

Positions Available

Virginia Tech announces a tenure-track Assistant Professorship in Science and Technology Studies (STS) beginning August 16, 1997. The deadline is 6 January, 1997. Applications are sought from scholars from a wide range of fields dealing with social studies of science and/or technology. Candidates must demonstrate significant research accomplishments and provide evidence of good teaching. Familiarity with the history, philosophy, and sociology of science and/or technology is desirable. The main teaching responsibilities will be in the STS Graduate Program and the undergraduate program in Humanities, Science, and Technology, with the expectation of teaching in other programs and departments as appropriate. Please send applications to Gary Downey, Chair, STS Search Committee, Center for Interdisciplinary Studies, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24061-0247. For additional information, consult the following web pages: http://idstserver.cis.vt.edu/cis/cis/cis.html and http://www.cis.vt.edu/vtstshome.html. You may also call or write: 1-540-231-4761; 540-231-7687; fax 540-231-7013; email downeyg@vt.edu.

The Residential College and the School of Information at the **University of Michigan** seek candidates for a one-semester or two-semester visiting professorship in 1997-1998. Expertise should be in the historical and/or social and cultural analysis of information technologies, with special emphasis on the policy and international dimensions of these fields.
Candidates should have a Ph.D. degree and strong commitments to both teaching and research. The Residential College is a select undergraduate liberal arts college with an existing program in Science, Technology, and Society. The School of Information is a graduate school preparing students for information professions at both the Masters and Doctoral levels. The appointment will involve coordinated teaching in both units, with responsibility for two courses in one semester or three courses in two semesters. Interested candidates should send (1) a cover letter stating their interest, (2) an up-to-date curriculum vitae, (3) some sample papers, and (4) the names of at least three references, to Visiting Professorship, School of Information, University of Michigan, 550 East University, Ann Arbor 48109-1092. For further information, contact Dr. Susan Wright (1-313-763-1194; spwright@umich.edu) or Professor Gary Olson (1-313-763-5644; gmo@umich.edu) and/or visit our web sites at www.rc.lsa.umich.edu/ or www.si.umich.edu/

The Department of Humanities and Social Sciences at **Harvey Mudd College** is pleased to announce the creation of a new position, the Hixon/Riggs Visiting Professorship in Science, Technology, and Society. Harvey Mudd College, a highly selective member of the Claremont Colleges, is one of the nation's premier undergraduate institutions specializing in science, mathematics, and engineering. This position is open to established scholars in all fields of the humanities and social sciences who are concerned with the social and cultural dimensions of science and technology, broadly construed. In general, the Hixon-Riggs Visiting Professor will be expected to teach in her or his area of expertise, to give public lectures and/or presentations, and to organize a conference or similar program on a topic of interest. The appointment is for either a semester or a year, and its terms are flexible and will be negotiated with the individual candidates. The Department hopes to appoint a historian of science or technology during the 1997-98 academic year, but will also consider other fields. Please address nominations or inquiries to: Hal S. Barron, Chairman, Department of Humanities and Social Sciences, Harvey Mudd College, 301 East 12th St., Claremont, CA 91711-5990. Visiting the home page at http://www.hmc.edu/

A Free Copy of the *Bulletin of Sociological Methodology*

BMS is a quarterly scientific journal which publishes in both English and French. Each issue of the BMS contains research articles, extensive book and article reviews, as well as documentation and information on different meetings throughout the world. All research articles have abstracts in both English and French. Twice a year, in March and September issues, the BMS also publishes the Newsletter of Research Committee 33 (RC33) "Logic and Methodology" of the International Sociological Association.

Forr further information concerning the BMS or RC33, send an email message to <bms@ext.jussieu.fr>, tel/fax a message to 33 1 40.51.85.19, or write to BMS, 59 rue Pouchet, 75017 Paris, France. The BMS also moderates a computer listserv, BMSL; for information on how BMSL works, send an email message containing only HELP to <listserv@ext.jussieu.fr>.

The rates are 190 FF for individuals, 370 FF for institutions. Payment should be in the name of the AIMS (59 rue Pouchet, 75017 Paris) and by postal giro (23 279 80 U Paris), money order, bank transfer or check in French francs on a bank in France. Payment may also be made in US$ in the name of Editor Karl M. van Meter. For payment by Eurocheque or any other means, please add 50 FF.

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- in Dutch florins or German marks (Eurocheques) to RC33 Secretary Edith D. de Leeuw (Department of Social Research Methodology, Vrije Universiteit Amsterdam, Koningslaan 22-24, 1075 AD Amsterdam, Netherlands);
- in U.S. dollars or French francs to RC33 Past President Karl M. van Meter (LASMAS-CNRS, 59 rue Pouchet, 75017 Paris, France).

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