European Science Foundation

SETTING SCIENCE AGENDAS FOR EUROPE

The Future of Knowledge
Mapping Interfaces

Standing Committees for the Humanities (SCH); Social Sciences (SCSS); Life, Earth and Environmental Sciences (LESC)

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Interdisciplinary Workshop Report

The Future of Knowledge: Mapping Interfaces
Reykjavík, 16-17 June 2009

The European Science Foundation

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• Marine Sciences
• Materials Science and Engineering
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• Polar Sciences
• Radio Astronomy
• Space Sciences

Contents

1. Introduction

Ulrike Landfester and **Gísli Pálsson**

1. Introduction

The 'Future of Knowledge' and the European Science Foundation

The European Science Foundation Strategic Plan for 2006-2010 emphasises that exciting developments in many fields of science require an "increased scale of European cooperation and a wider scope of disciplines including more interdisciplinarity". This increased inter-disciplinarity is at the heart of the ESF project *Mapping Interfaces: The Future of Knowledge* (acronym: MIKnowledge), the focus of this report. In line with ESF objectives, the project seeks to explore critically the borderlines evident in the production of knowledge (including the five-fold disciplinary structure of the Standing Committees of the ESF), the forces of resistance to realignment and collaboration, and the possibility of alternative divisions of scientific labour. In doing so, it is hoped that a better coordination of targeted research and more realistic and meaningful philosophies and policies of science might be achieved in Europe. It fits the aim of the Interdisciplinary New Initiatives Fund (INIF) until recently active under the ESF, namely to strengthen the interaction between Standing Committees, in a natural way.

The Steering Committees involved in the Mapping Interfaces project established a Steering Committee with the following members:

- Professor Gísli Pálsson, Chair (University of Reykjavik, Iceland; subject representative for anthropology; Standing Committee for the Humanities)
- Professor Ulrike Landfester, Vice-Chair (University of St. Gallen, Switzerland; German literature studies; Standing Committee for the Humanities)
- Professor Pasqualina Perrig-Chiello (University of Bern, Switzerland; psychology; Standing Committee for the Social Sciences)
- Dr Sonja Lojen (J. Stefan Institute, Ljubljana, Slovenia; environmental sciences; Standing Committee for the Life, Earth and Environmental Sciences)
- Dr Nina Kancewicz-Hoffman (Head of the Humanities Unit, European Science Foundation)

The Steering Commmittee organised a workshop at the University of Iceland in Reykjavík on 16-17 June 2009. The preparation of the workshop and logistics were handled by Kristín Erla Harðardóttir, Director of the Institute of Anthropology, University of Iceland.

A number of speakers from a variety of fields and disciplines were invited to present papers. Candidates were selected on the basis of two criteria: (1) scientific expertise in a 'border' area and (2) willingness to engage in a meaningful dialogue beyond conventional disciplinary borders. The policy aspects of interdisciplinarity are obviously not limited to Europe, given the common epistemologies of regional science and the global nature

Figure 1. Tag clouds produced with TagCrowd (http://tagcrowd.com) using the text of the present report

of most scientific efforts, and, as a result, invitations were also sent to non-European scholars.

This report briefly presents the rationale of the Reykjavík workshop, the workshop programme and paper abstracts. Also, it contains two broad essays by two of the workshop participants, Julie Thompson Klein and Christian Pohl. Klein's essay focuses on the discourses of disciplinarity, highlighting at the same time some of the issues and arguments raised by other workshop participants, while Pohl's essay discusses the relevance of interdisciplinarity in the context of a critically important contemporary issue, that of environmental change and sustainability. Furthermore, the Chair and the Vice-Chair of the project conclude with some general thoughts about disciplinarity in the modern academe. Finally, the report lists the participants in the workshop.

Workshop Rationale

The classification of academic fields and disciplines has for a long time now been accepted as somehow natural or predetermined, as a final state of affairs bound to be eventually revealed or brought forth through the processes of history. Fostered by the development of European institutions of learning since the 18th century, the honing of specialised expertise and the accompanying differentiation of academic disciplines led to Wilhelm Dilthey in the second half of the 19th century claiming a fundamental methodological incompatibility of the arts and the humanities on the one hand and the so-called 'hard' natural sciences on the other.

During the last years, however, academics have increasingly seen this simplifying binary construction as masking a much more complex field of differences

and interferences both within the two cultures and between them. Recent research in the fields of cultural theory, sociology and anthropology as well as both history and philosophy of science has readjusted the ontological notion of knowledge as something which is already there and only needs to be retrieved, towards the epistemological notion of knowledge as something which is produced by sets of practices, mechanisms and principles assembled by structural affinities, necessity and historical coincidence.

The conditions for academic practice continue to change and, as a result, the disciplines and their division of labour continue to change. At the same time, new fields emerge in response to new intellectual and pragmatic developments. Indeed, much reshuffling is going on in the academe in the current age, as a result of major changes in the 'real' world. Not only has the modernist project with its notions of truth and grand narrative increasingly been challenged, the academic landscape of fields and disciplines in itself is tense and unstable. Quite possibly, the changes now taking place within it are just as spectacular as the changes represented by the Renaissance and Enlightenment eras.

The *Future of Knowledge* project sought to facilitate an unprecedented, broad discussion of the issues involved, challenging the nature-society divide by drawing upon theoretical developments in a variety of disciplines. Such a conflation of fields, it was hoped, would generate new and exciting intellectual avenues and research agendas. Keeping clearly in mind that a reassessment of the established academic formations of discourse must not deny the necessity of expert codes or of the disciplinary subdivision of science into cultures of science, the *Future of Knowledge* project aimed at creating a level of self-awareness in the area of scientific communication which allows for trading zones between these cultures. In the process, it also aims at uncovering trading zones or interfaces that in fact may already have been in existence without being effectively put to their full use. Given the theoretical relevance and pragmatic importance of transdisciplinarity, the structural inertia in many contexts, the cultures of science as they unfold, and the nature of the forces of resistance to movement across borders – if not the deconstruction of the borders themselves – pose important questions. Many of these questions were broadly addressed by the Reykjavík workshop.

Figure 2. *Wall flower* by André de Jong.

Organisation of the Workshop, Themes and Key Questions

One of the major dividing lines of the academe and its disciplinary architecture and classification, if not *the* dividing line, is that represented by the separation of the natural and the social. In recent years, this separation has increasingly been challenged, partly because of ongoing changes in the real world. Thus, with the new genetics, what used to be called 'life itself' is obviously modified by humans through artificial means, including genetic engineering, undermining the separation of the old categories of the 'natural' and the 'artificial' If the major conceptual dividing line between nature and society – and by extension, the natural sciences, on the one hand, and, on the other, the humanities and the social sciences – has collapsed, if the philosophical grounds for current divisions of labour have disappeared and the pragmatics of ongoing research show a growing tendency towards transdisciplinary approaches, it seems essential to critically reflect on and rethink the cartography of the scientific project across the entire landscape of the academe. The *Future of Knowledge* workshop aimed to do so. A number of key persons from the life sciences, medicine, the natural sciences, the humanities and the social sciences were invited to present their thoughts and perspectives in a transdisciplinary fashion. Three overlapping major themes and questions were addressed:

1. Theorising Disciplinary Interfaces

Disciplines, sub-disciplines and fields of enquiry arise, develop and disappear, much like natural species. How should one represent this evolutionary process, how is it disciplined (in the dual sense of controlling and fragmentation), what establishes the candidacy for a discipline or a field, and what would be the languages

1. Introduction

and metaphors most appropriate for the theoretical understanding of current and future developments? In the past, spatial metaphors have typically been used with respect to disciplinary fragmentation; thus, the language of borders, zoning, areas, fields, provinces, pastures and territories. Recently, new hybrid zones of intellectual discourse *bordering on* different fields of science have appeared at a growing rate. The field of pragmatics is a case in point, a fusion of several disciplinary perspectives, including those of linguistics, logic, sociology, anthropology and cognitive psychology. Indeed, there are strong grounds for arguing for transdisciplinarity, as much creative work develops at the interfaces of established fields of scholarship. What are the implications of such bordering for the objects of knowledge generated by the new discourse?

2. Empirical and Experimental Sites

An interdisciplinary approach to interdisciplinarity seems in order, focusing on specific border zones and experimental sites. What are the empirical lessons from emerging experiments and developments? What are the sites of promising enquiry? One important site is that of the interfaces of the 'biosocial' and 'natureculture'. These interfaces may be usefully expanded to frame human impact, generally, on the 'natural' order. Once seen as entirely beyond the human domain, climate is now known to become increasingly artificial, a byproduct of human activities, as the growing scientific and public discourse about global warming testifies. To what extent does the notion of the biosocial open up new perspectives on environmental change and 'life itself', and which new approaches towards academic divisions of labour can be developed from these perspectives? Several other fields and sites, beyond those represented by biosociality and environmental change, might also be explored, including those of ageing, gender relations, water management, urban studies and life-long learning.

3. Policy for the Future Academe

Moving on from theory and empirical results regarding research and teaching at border zones, what is the relevant academic policy for the future? How is the academe likely to be restructured and disciplined? Funding agencies, including the ESF and many of its member organisations, often favour transdisciplinary perspectives and approaches. While much is to be gained by constructively overcoming disciplinary boundaries, often there is strong resistance in academies and universities, funding agencies and research institutes to *genuine* transdisciplinary collaboration in either teaching or research. What are the forces of resistance and to what extent should they be monitored and, possibly,

overcome? Will the current 'blurring of genres' make the academe multicultural or transcultural, even *post*disciplinary? To what extent, and how, should education, publishing and bibliometrics be refashioned in the light of the redefinition of borders and the development of hybrid fields? Finally, how should one characterise the relationship between the academe and the social context in which it is embedded, and what changes can be expected in the future?

2. Workshop Programme

Day 1: 16 June

09:00-09:10
Opening: **Professor Gísli Pálsson**,
Chair of *Mapping Interfaces: The Future of Knowledge* Steering Committee

Session I

Chair: **Professor Ulrike Landfester**,
University of St. Gallen

09:10-09:40
Professor Julie Thomson Klein, Interdisciplinary Studies Program, Wayne State University, Detroit
The metaphorics of mapping interdisciplinary knowledge

09:40-10:10
Professor Aant Elzinga, Department of Philosophy, Linguistics and Theory of Science, Gothenburg University
The humanities in a time of changing demands, boundaries and reconfigurations

Session II

Chair: **Professor Pasqualina Perrig-Chiello**,
University of Bern

10:40-11:10
Dr Christian Pohl, td-net, Bern
Coming to grips with inter- and transdisciplinary research

11:10-11:40
Professor Sally Jane Norman,
Culture Lab, Newcastle University
AMI: Artfully mapping interfaces

Session III

Chair: **Dr Sonja Lojen**,
J. Stefan Institute, Ljubljana

13:30-14:00
Professor Casper Bruun Jensen, Department of Organization, Copenhagen Business School
Recursive partnerships: Knowledge interfaces and exchange of perspectives in global development aid

14:00-14:30
Dr Monica Konrad, Department of Social Anthropology, University of Cambridge
The portfolio, the multiversity and conceptual origami

Session IV

Chair: **Professor Ulrike Landfester**

15:00-15:30
Dr Matthijs Hisschemöller, Institute for Environmental Studies, Free University Amsterdam (co-authors Eefje Cuppen and William N. Dunn)
Stakeholder dialogue as a social experiment

15:30-16:00
Professor Mitchell G. Ash, Department of History, University of Vienna
Were there ever only two cultures? Cultures of science and scholarship in historical perspective

Day 2: 17 June

Session V

Chair: **Dr Sonja Lojen**

10:00-10:30
Professor Hans-Jörg Rheinberger,
Max-Planck Institute for the History of Science, Berlin
Molecular biology: A paradigm of 20th Century science – On the nature of disciplines and on cultures of emergence

10:30-11:00
Professor Marianne Sommer, ETH Zentrum RAC, Zürich
Anthropological genetics and other ways of making history

Session VI

Chair: **Professor Pasqualina Perrig-Chiello**

11:30-12:00
Professor Helga Nowotny, Vienna Science and Technology Fund (WWTF)
Mapping the interfaces of biosociality in time and space

Concluding session

Chair: **Professor Gísli Pálsson**

3. Paper Abstracts

3. Paper Abstracts

Julie Thompson Klein

The metaphorics of mapping interdisciplinary knowledge

Iceland is an appropriate setting for a meeting on mapping interfaces of knowledge. It is the site of a fissure and drifting between the Eurasian and American plates. The new paradigm of plate tectonics revolutionised the way we understand the structure and dynamics of the Earth. Over the past several decades, a parallel shift has been occurring in the way we describe knowledge. Images of a static foundation and structure have been replaced by dynamic properties of a network, a web, a system and even a rhizome without a central root. Spatial metaphors – turf, territory, border and domain – continue to highlight the demarcation and regulation of knowledge formations. Another set of metaphors, though, highlights connection. Organic images – generation, crossfertilisation, mutation and interrelation – compare intellectual movements to processes in ecology and the evolution of new species. The operations of place and production are not isolated. They occur simultaneously and, Michael Winter suggests, models may even be combined to form a third type, highlighting interactions between social groups and environments. Mapping the interactions associated with inter- and transdisciplinarity requires a common conceptual vocabulary capable of describing and tracking the current heterogeneity and relationality of knowledge.

Aant Elzinga

The humanities in a time of changing demands, boundaries and reconfigurations

In historical perspective and even in current debates about the role of scholarship in the humanities one may identify at least three approaches. I call them traditionalist, pragmatic and critical, respectively, and argue that in practice all three of these may be found to a greater or lesser degree, while at the institutional level the mix is more complex. Against this background several examples will be taken of scientific and technological advances that (should) bring the two communities, the natural sciences and the humanities, closer together, thus rendering C.P. Snow's notion of 'two cultures' obsolete, at least in practice, even though we are sorely aware how the division remains in the mentalities and still tends to trigger heated and endless discussion whenever mentioned in contexts dominated by mainstream scientific practitioners. New computer-aided visualisation techniques, data mining and simulation modelling, in particular, are having an impact that cuts across many
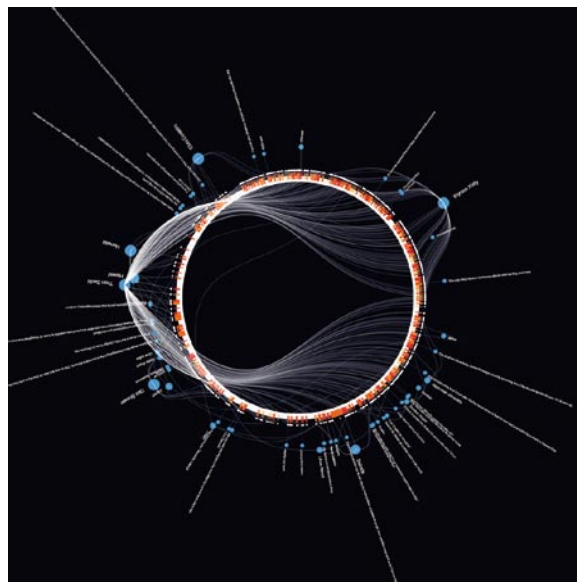

Figure 3. *Open Calais Content Maps* by Jer Thorp: a content map based on the text of the first half of Haruki Murakami's short story *Hanalei Bay* created using OpenCalais (http://www.opencalais.com), a web service through which it is possible to generate a list of elements (people, countries, organisations, etc.) and a tentative visualisation of their relationships out of any unstructured text.

domains, both natural scientific ones and humaniora. The process appears to be attended by new forms of data-driven or technology-driven modes of research with strong elements of constructivism that have interesting epistemological implications. But we must also turn the lens back onto ourselves and look critically at the 'audit gaze' promoted when the methods of New Public Management move into one societal realm after another and are now also pushing the universities to what Daniel Greenberg calls campus capitalism. Is it possible that computer-aided bibliometric methods of assessing academic performance are contributing to the creation of cultures of compliance in which new regimes of perceptibility and (ac)countability fix only on what can be measured in quasi-quantities and the metrics determine who and what (dimensions) are 'seen' and therefore 'count'? If the answer is yes, a paradox arises, in as far as traditionalist and critical approaches in the humanities will find it even more difficult to maintain a foothold at a time when they are most needed to counteract the increasing dominance of pragmatic utilitarian thinking and action that appears to be a strong driver behind some of the ongoing reconfigurations of the organisational and epistemic landscapes (epistemic cartography) that characterise science and scholarship.

Christian Pohl

Coming to grips with inter- and transdisciplinary research

The transdisciplinarity-net of the Swiss Academies of Arts and Sciences (www.transdisciplinarity.ch) was launched to support transdisciplinary research. In the Swiss context transdisciplinary research stands for research that crosses disciplinary boundaries and boundaries between science and society in order to address 'real world issues' like global environmental change, migration, poverty or public health. Transdisciplinary research is usually conceptualised similar to what Gibbons and Nowotny have identified as mode-2 knowledge production, as a process of knowledge production for which people come together in temporary networks. If such research projects are mainly temporary collaborations of disciplinary researchers and actors of further sectors of society, then the questions are whether, which and how experiences gained in one project can be depersonalised and transferred in order to disburden other projects from reinventing the wheel in each case. During the last years we have tried to identify experiences that we consider typical for such research projects, and conceptualised them as challenges from the perspective of those involved in the research process. First experiences with the concepts and further tools suggest that they help projects to come from exaggerated expectations on inter- and transdisciplinarity to a structured and reflexive approach to integrative, collaborative and implementation-oriented research.

Sally Jane Norman

AMI: Artfully mapping interfaces

The founding of epistemological frameworks to tackle the multiple temporal and spatial scales inherent to interdisciplinary challenges requires conceptual agility. Wider adoption of these frameworks in turn requires a sense of shared confidence and social cohesion. In its crafting of symbolic materials to generate communicable cognitive experience, art can effectively address both these requirements, acting as a mutagen for the collective imagination, and offering arenas for engaging cultural groups in memorable, shareable events. My paper will discuss the value of creative insights, wilful ambivalence and playful associations, that can whet our appetite for the startling patterns of emerging epistemologies, allowing us to entertain and share vitally new visions.

Figure 4. *Siamese Animal Crackers* by hexodus.

Casper Bruun Jensen

Recursive partnerships: Knowledge interfaces and exchange of perspectives in global development aid

This paper takes its starting point in what might be called the experimental site of contemporary development aid partnerships. This globalised site of interaction between multiple actors spanning all continents through networks of asymmetric exchange is overflowing interfaces of knowledge, functional or not. Since the Paris Declaration on Aid Effectiveness was signed in 2005 by 111 countries, policy institutions, NGOs, sociologists, anthropologists, economists, geographers and natural scientists from dozens of disciplines have participated in discursive, organisational and technical practices of doing development as partnerships. This requires creating interfaces and implementing formats for sharing information. Border-crossing knowledge, and its multiple impediments, are de facto problems, not future developments in these settings. For the social scientist who is studying this situation, 'mapping interfaces' comes across as an apt metaphor; an experimental device through which one can probe characteristics of new modes and relations of knowledge production. Yet, with such an aspiration the question is which interfaces to map and why. Per definition development partnerships are found everywhere: from the high-level meetings where heads of state sign declarations as much as in the Vietnamese village, where Danish NGOs ally with villagers in order to induce behavioural change in hygienic practices. The mantle of partnership also envelops researchers wanting to document and understand this situation. Social researchers are allowed onto this scene only in the guise of partners, their knowledge making ambitions subject to interfacings and translations in

the same way – on the same level as – the actors they study. To the extent that partnerships may illustrate one (present) future of knowledge, the recursivity whereby research is enrolled in that which it studies poses interesting questions for the qualities of knowledge produced through this process. Not least interesting is the question of how diverse ways of interfacing knowledge support or inhibit 'exchanges of perspectives', through which disparate development partners can both receive information and learn to understand their engagements differently.

Monica Konrad

The portfolio, the multiversity and conceptual origami

As the idea of the 'specialist' diversifies and as knowledge communities ramify within and beyond the academe, what are the social concepts of the future that will make a difference? What is research supposed to be doing in an age of reallocated resources and how does a global twenty-first century scholarship organise itself? Whose knowledge counts and against whose expectations? This paper asks what it means to engage in such debates for the kind of knowledge we wish the

Figure 5. *Origami* by Ana Carol Mendes.

debates themselves to generate. The more attentive we become to the politics of funding and research sponsorship for sustaining disciplinary innovation, the more critically charged the notion of 'research' itself becomes. Crucial to the refinement of these questions are the concepts and metaphors with which we work. 'The portfolio, the multiversity and conceptual origami' is a critical exploration of the portfolio concept and the work it can do as an intellectual and organisational resource for theorising relations of research in the knowledge economy. Opening up the portfolio, it is argued, means learning to see its derivatives as a material object, multi-organisational form and metaphorical device. The paper considers the consequences of retrieving the portfolio as a carrier for conceptual work and the cultural forms this may take.

Matthijs Hisschemöller
(with Eefje Cuppen and William N. Dunn)

Stakeholder dialogue as a social experiment

The production, storage, dissemination and use of knowledge in modern democracies is facilitated and also restricted by institutions that can be referred to as knowledge systems. Policy-science interfaces play an active role in these systems, as they maintain the formal and informal rules of the game that shape the decision making on which knowledge is in some way usable, relevant, irrelevant or unwanted. Knowledge (re)produced by academic institutions and private consultancies plays a key role in providing public policies with a legitimate and impartial knowledge base. Therefore, the study of knowledge systems is important to unravel mechanisms of power and influence that are not at first sight visible. It is especially meaningful to get a picture of the players at the heart of the knowledge system and small players who are situated at the margin or outside. Stakeholder dialogue can be a vehicle to gain insights into the actual functioning of knowledge systems. The paper will first discuss the basic methodological features of such a dialogue and will briefly describe the process. Next, it will present some examples from recent dialogue projects that focus on the exploration of technological and institutional options for the transition to a sustainable energy system. It will be shown how a dialogue can articulate options that compete with those in the heart of the knowledge system. It will then set out to identify and understand biases in the dominant knowledge system, especially for the Netherlands, that form an obstacle for competition between energy options. These biases have to do with a rather closed knowledge network from large energy companies and major knowledge insti-

tutes that hardly cooperate with small and medium sized innovative businesses. Finally, the paper addresses the question as to whether a stakeholder dialogue that is able to articulate knowledge claims in the margin of the knowledge system and assess their merit vis-à-vis more consensual options in the heart of the knowledge system may be considered a social experiment. The discussion will especially concentrate on the conditions for quasi-experimentation.

Mitchell G. Ash

Were there ever only two cultures? Cultures of science and scholarship in historical perspective

The 'two cultures' debate has been going on for quite a while now. Perhaps it is time to ask why this is so, even though it could be and has been argued that the essentialistic distinction between two 'cultures' in C.P. Snow's book, which gave the debate its name, presented a picture of the situation in science and scholarship that was fundamentally flawed even in the 1950s, and has become less rather than more accurate over time. In this paper I will begin by describing very briefly the current situation in the history of science and scholarship, which is characterised by efforts to go beyond the history of disciplines, focusing instead on knowledge areas broadly conceived, and on the historical analysis of changing ideals of knowing at the meta-level. I will then direct attention to a number of cases taken from the history of science and the humanities since the 19th century, in order to provide some historical perspective on the 'two cultures' idea. Among these will be: (1) the rise of large-scale, frankly positivistic scientific research in the 19th century *humanities*, just at the time at which the essentialistic distinction between the sciences and the humanities was invented; (2) the case of psychology as a protean multi- or transdiscipline, which has resisted classification under any of the available essentialistic headings, for good reason; (3) the 'behavioural sciences' and 'cognitive science' during the Cold War and the 'human sciences' today, which mark serious and often productive efforts to overcome the alleged 'two cultures' divide. Though such examples may not suffice to support broad generalisations, I nonetheless would like to state two basic claims as possible implications, and to put them perhaps too strongly in order to stimulate discussion:

1. There have never been only two cultures of science: either there have been many such cultures, or only one – academic research per se versus other forms of culture. Talk of 'two cultures' is thus not a description but a trope – a tool for organising discussion that may

Figure 6. *A grazing encounter between two spiral galaxies*; credit of NASA/ESA and The Hubble Heritage Team (STScl). Shot in 1999, this Hubble telescope image of a galactic near-collision revealed a large concentrations of gas and dust in both galaxies subject to erupt into regions of active star formation. The press release at the time informed that these two galaxies trapped in their mutual orbit, would have continued to distort and disrupt each other and, eventually, billions of years later, merge into a single, more massive galaxy. It is believed that many present-day galaxies, including the *Milky Way*, were assembled from a similar process of coalescence of smaller galaxies occurring over billions of years.

be convenient in some ways but, on further examination, is revealed to be a historical construct invented in a particular historical context, which obscures actual affinities in method and interactions in practice across the alleged boundary line.

2. The construct appears today to be an artifact of academic identity politics and a counter in the ongoing – probably never-ending – struggle for power and influence within academic institutions, rather than a guide to improved understanding of science and scholarship in actual practice. Perhaps it would therefore be better to consign 'two cultures' talk to science studies and cultural history, or to the sociology of research and funding organisations, and to search for more useful terms, better able to capture the complexities of the current situation.

Hans-Jörg Rheinberger

Molecular biology: A paradigm of 20th century science — On the nature of disciplines and on cultures of emergence

The paper analyses the short life of molecular biology as a discipline, its emergence and eventual dissolution. It tries to draw consequences from this example for the changing disciplinary constitution of the sciences in general – natural and social – at the turn of the 21st century. It argues that the dynamics of recent science are no longer to be formed on a disciplinary level, but rather in what Gaston Bachelard once called "cultures of emergence".

Figure 7. *Butterfly emerges from stellar demise in planetary nebula* NGC 6302; credit of NASA, ESA and the Hubble SM4 ERO Team.

Marianne Sommer

Anthropological genetics and other ways of making history

In 1962, Emile Zuckerkandl coined the term 'molecular anthropology' to designate the study of primate phylogeny and human evolution on the molecular level. For Zuckerkandl and others, the gene sequence preserved more history than anything else in a living system. The gene was the most authentic document of history, because it was "fundamental" and "bare of environ-

mental distortion." In addition, the molecular approach of protein sequencing (as a proxy for the gene) was considered methodologically superior to other approaches such as physical anthropology and palaeoanthropology. At the time of the Human Genome Diversity Project, the large-scale comparative analysis of the genetic variation between human populations had become feasible. In its aftermath, the genetic approach has been applied to the phylogeny and migration history of human populations from genetic Eve and Adam to the history of the Jewish diaspora, the Indian caste system, and many other national population constituencies and histories. The genetic approach thus not only interfaces with physical anthropology, palaeoanthropology and archeology; it has become associated with the notion of a scientisation of history. Genetic history has also been commercialised. Genetic ancestry tracing companies offer to determine one's place of origin, ancestral population(s) and place in the human phylogeny. Here, the notion of the gene as the fundamental historical archive and the rhetoric of the objectivity of the genetic approach are central. In my talk, the history of genetic anthropology is discussed with a view to the role of scientific objects and of scientific objectivity in the ways in which different approaches to human origins and history interface. I will also raise the question of how anthropological genetics, its commercialisation and popularisation may impact understandings of history as biohistory.

Helga Nowotny

Mapping the interfaces of biosociality in time and space

Following the more general outline of mapping interfaces *Contemporary encounters between the natural and the social sciences*, to be published in the Annals of the IIS, this presentation focuses on one of the "promising sites of enquiry" mentioned in the background note, namely on biosociality. As defined by Paul Rabinow, biosociality denotes the current situation in the life sciences in which 'knowing life' means *de facto* changing life through human intervention. The natural and the artificial can no longer be clearly separated. Using my recent book, *Gläserne Gene. Die Erfindung des Individuums im molekularen Zeitalter*, with Giuseppe Testa as a backdrop, the attempt is to map some of the interfaces of biosociality in time and in space:

1. The interface between the 'old' and what is considered to be 'new'. David Edgerton has forcefully argued in his *The Shock of the Old* against the innovation-centric view in the history of technology. I argue that, confronted with often exaggerated claims of radical breakthroughs in the life sciences (reinforced through

media hype), a more sober analysis reveals that the latest scientific and technological achievements and their real or imagined societal impact represent both continuities and discontinuous, novel features. To recognise something as new, as noted already by Niklas Luhmann, always entails a change in the self-description of the system. Its emphasis on discontinuities enables it to organise its coupling capabilities differently and to do away with traditions. The new therefore has to overlap somehow with what appears as familiar if it is to be recognised at all. As examples taken from human reproductive technologies and from human enhancement will show, the interface of 'old' and 'new' knowledge and practices has far-reaching consequences for the relative ease with which the new will be accommodated in society or whether it will engender resistance. To carefully map the interfaces between old and new knowledge and practices allow us to understand better why some scientific-technological innovations are rapidly embraced while others are rejected.

2. The interface between decontextualised and (re)contextualised knowledge. The fascination of 'gene talk' among the general public and the persistence of a widespread genetic determinism cannot only be attributed to a kind of 'cultural lag' in the public's knowledge about the latest developments in the life sciences. As we argue in *Gläserne Gene*, it is the visibility of genes that allows us to conceive them as entities upon which essential qualities are conferred. The visibility of genes is achieved by radically decontextualising them. While this is maybe accepted practice in the life sciences (although the discovery of epigenetics implies at least a biological recontextualisation), stripping the newly manufactured entities entirely from their social context leads to severe distortions or even alienation in society.

Finally, I raise the question as to whether a recontextualisation of biosociality is possible and if so, whether it is already occurring in the form of standardisation. A new kind of interface may be in the making, consisting in the coproduction of standardised scientific and technological procedures that converge with processes of standardisation that can be observed in society. The rise of bioethics and of other human technologies like law and governance will illustrate the convergence.

4. The Metaphorics of Mapping Interdisciplinary Knowledge

Julie Thompson Klein

Professor of Humanities (Department of English)
and Faculty Fellow in the Office for Teaching
and Learning Wayne State University (USA)

4. The Metaphorics of Mapping Interdisciplinary Knowledge

"I view maps as a kind of language… as reciprocal value-laden images used to mediate different views of the world."

J. B. Harley, *Maps, Knowledge, and Power*

Iceland is a fitting location for an international workshop on mapping interfaces of knowledge, because it is the site of a fissure and drift between the Eurasian and North American tectonic plates. In the mid-20th century, the new paradigm of plate tectonics revolutionised the way we think about the structure and dynamics of the Earth. Over the past several decades, a parallel shift has been occurring in the way we think about knowledge. Our host for the workshop, the European Science Foundation (ESF), is keenly aware of the need to reflect critically on the changing cartography of knowledge. Along with other national science policy bodies, educational organisations and funding agencies, the ESF is weighing the impact of increasing interdisciplinarity and transdisciplinarity. Discussions, though, are typically dispersed across forums. This chapter offers a common meeting point, with a conceptual vocabulary for mapping knowledge today based on insights from the current literature on inter- and transdisciplinarity as well as presentations of workshop participants. It highlights shared metaphors of mapping and boundaries as well as the underlying keywords of *discipline*, *boundary crossing*, *interface* and *classification*.

4.1 Social cartography and boundary work

The cartographic trope is a pervasive figure of speech. We map everything from the atom, the brain and the human genome to social structures, the global environment and the cosmos. Traditional maps of knowledge in the West bear a resemblance to historical maps of the Earth. The centre of the Earth for European cartographers was dominated by Europe and North America. The techno-science of Peters projection also made countries of the South appear smaller or marginal in relation to centred powers. Likewise, after the formation of modern disciplinarity in the 19th and early 20th centuries knowledge was represented as a designated set of domains of inquiry and teaching. In both cases, entities were presumed to be 'natural' and fixed. All maps, however, are subject to change due to new discoveries, historical developments and shifts in theory and practice that require new ways of thinking. Workshop participant Monica Konrad highlighted this need in calling for new social concepts of the future that will make a difference. Konrad asked, in particular, whose knowledge counts and against whose expectations? Comparably, Sally Jane Norman called for epistemological frameworks and

Figure 8. *Odd days* by Luciano Lozano.

visions with the conceptual agility to tackle temporal and spatial scales of interdisciplinarity.

The ideas of 'social cartography' and 'boundary work' offer social concepts for the future and the agility that Konrad and Norman called for. They originated in different contexts but share a common capacity to illuminate both continuity and change. Social cartography, Nelly Stromquist explains, is both a metaphor and an analytical tool for writing and reading maps in order to address questions of location and relationship in the social milieu (1996, 224). As an analytical tool, Paulston and Liebman note social cartography borrows notions of place, space and location from geography. It is also informed by the work of Bourdieu, French poststructuralists and feminist scholars (1966, xvi). Boundary work originated in science studies. It is a label for the composite set of activities by which individuals and groups work directly and through institutions to create, maintain, break down and reformulate boundaries between knowledge domains. Initial studies focused on disciplinarity, though subsequently the concept was extended to interdisciplinary formations (Fisher 1993; Klein 1996). Combined as umbrella concepts for mapping knowledge, social cartography and boundary work help to explain both the social locations of inter- and transdisciplinary work as well as movements, interactions and relationships across boundaries. Four related keywords deepen understanding of the changing landscape of knowledge: discipline, boundary crossing, interface and classification.

Keyword #1: Discipline

Two sets of metaphors populate descriptions of disciplinarity. Spatial metaphors – turf, territory, border and domain – highlight the demarcation, normalisation and control of domains of intellectual inquiry. They accentuate stable structures, fixed foundations, linear development and universal properties dominated by a coherent core and *habitus*. In contrast, organic metaphors highlight connection. Images of generation, crossfertilisation, mutation and interrelation compare intellectual movements to processes in ecology and the evolution of new species. They accentuate heterogeneity, permeability and change, while positing new models of a network, a web, a system and even a rhizome without a central root. The operations of place and production, however, are not isolated. They occur simultaneously and, Michael Winter suggests, spatial and organic models may even be combined to form a third type that highlights interactions between social groups and environments. The Greek word *oikeos*, he reminds us, meant household or settlement. The root idea is to make and reinforce jurisdictional claims and exploit resources to produce new forms and settlements (Winter 1996).

Matthijs Hisschemöller and Hans-Jörg Rheinberger echoed both sets of metaphors in their contributions to the workshop. Hisschemöller emphasised the roles that 'habit of mind' and 'tacit knowledge' play in reinforcing the social labour that occurs in knowledge spaces. The study of knowledge systems is crucial to unraveling mechanisms of power and influence that are taken for granted and are usually not visible at first sight, including informal rules that shape decisions about which knowledge is usable, relevant, irrelevant or unwanted. Hisschemöller offered stakeholder dialogue as a vehicle for gaining insights on the actual functioning of knowledge systems, from the heart of systems to small players situated at the margin or outside. Rheinberger

highlighted the emergence and dissolution of molecular biology as an example of the changing disciplinary constitution of sciences in general at the turn of the 21st century. The dynamics of recent science, he argued, are no longer to be formed on a disciplinary level, rather in Gaston Bachelard's notion of "cultures of emergence." Disciplines, sub-disciplines and fields of enquiry arise, develop and disappear much like natural species, thereby pluralising and diversifying expertise and specialism. New hybrid zones of intellectual discourse bordering on different fields of science have also been appearing at a growing rate.

Keyword #2: Boundary crossing

In a book reporting on how boundaries are being redrawn in literary studies, Stephen Greenblatt and Giles Gunn (1992) advised that boundaries "can be crossed, confused, consolidated and collapsed". They can also be "revised, reconceived, redesigned and replaced". They cannot, however, be entirely abolished. Furthermore, they differ. Boundary lines are drawn in bold, unbroken strokes and as a series of intermittent, irregular dashes. They have multiple functions, stances are accepted or redrawn, and boundaries are crossed, overlap or converge at different places and in differing degrees. Furthermore, multiple boundaries are at stake today, not only disciplinary borders but also national-geographical, historical-generational, racial-ethnic, social-political, ethical-religious and trans-sector divisions. Mapping, Stromquist exhorts, sheds light on the moments at which spaces are crossed, how they are crossed, or why some are seldom crossed (1996, 244). Echoing Frederic Jameson, Crystal Bartolovich adds, mapping attempts to describe not only where social subjects are situated but also theoretically and practically what has been and might now go (1996, 376). Gender, ethnic, ecological, regional and national groups have all created alternative maps that disrupt 'central' truth claims through alternative views and new rhetorical spaces. Comparably, the migration of specialists across disciplinary boundaries to work on new problems and questions challenges conventional practices and paradigms. Methods and concepts also diffuse, and social redistributions of knowledge occur in collaborations, partnerships and new hybrid enclaves.

The duality of boundaries is underscored in the rhetoric of borders. A border, Stromquist reminds us, protects from challenges by others and preserves identities. Border work strengthens boundaries and the distinctions that separate entities. Border crossing moves into other spheres and spaces, creating opportunities for developing shared values and views (1996, 228). Yet, separation and connection may be simultaneous. The Both/And

Figure 9. *Mutation: blue and white cornflower (I)* by Bad Alley.

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strategy of women's studies exemplifies Winter's third model. Scholars constructed spaces of women's studies, as well as gender and sexuality studies, in order to provide a 'home' for developing feminist theory, methods and practices. At the same time, they occupied disciplinary spaces, using them for feminist research, teaching and professional service. Feminist practices also engaged the multiple boundaries of knowing and doing; subjective and objectified consciousness; gender, race, class and culture; academic and indigenous knowledge; and disciplinary-professional-interdisciplinary affiliations. In describing a boundary line of a different kind, workshop member Mitchell G. Ash cited the widely-held idea of 'two cultures' of science and humanities. Close scrutiny of the history of science and the humanities since the 19th century indicates that there have never been only two cultures of science: either many such cultures or only one, academic research versus other forms of culture. Talk of 'two cultures' is not a description but a trope – a tool for organising discussion in a particular historical context that obscures actual affinities in method and interactions in practice.

Keyword #3: Interface

The idea of an interface between knowledge domains goes by many names, including trading zones, liminal and interstitial spaces, hybrid enclaves and communities, and matrix structures. In science studies, the term 'trading zones' arose to describe heterogeneous inter-

actions of scientific cultures (Galison 1996). They range in formality from a 'pidgin zone', in the linguistic sense of an interim form of communication, to a 'creole zone', the main subculture or native language of a group that develops a new hybrid role and professional identity. The idea of an interface overlaps with the idea that a border functions as a dividing line and a zone of crossing. Both borders and disciplines, Michael Kearney suggests, are riddled with holes and contradictions. They are zones of contested space, capital and meanings. Classical anthropology and history, for instance, were challenged and reordered by new 'antidisciplinary' studies of border areas and their cultural politics. New interfaces, though, are not without their own risks of institutionalising new forms (Kearney 1991).

Five workshop participants presented models of interfaces. Christian Pohl's account of Transdisciplinarity-net illustrated different temporal scales of collaboration at interfaces. Teams and networks form to cross boundaries between disciplines and between science and society in order to address particular 'real world issues'. When a problem is solved or redefined, they may reassemble in different groups with different people, often in other locations and around other problems. Describing the experimental site of development aid partnerships, Casper Bruun Jensen emphasised that networks of asymmetric exchange require creating formats for sharing information that are robust enough to cross the borders of organisations, disciplines and countries. Strategies between donor countries and recipients need to be

Figure 10. Composition of stone and brick walls textures. © Mayang Murni Adnin, 2001-2006 (http://www.mayang.com/textures).

aligned, and donor systems and procedures harmonised for ensuring mutual accountability between development partners. Three other members presented cautionary tales from biological research. Marianne Sommer highlighted interfaces of the genetic approach with physical anthropology, palaeoanthropology and archeology. The gene became regarded as the most authentic document of history, because it was granted the status of being 'fundamental' and 'bare of environmental distortion'. The methodology of protein sequencing was also given priority. Helga Nowotny and workshop host Gísli Pálsson added the example of bisociality. Mapping real and imagined societal impacts of breakthroughs in life sciences reveals why some scientific-technological innovations are embraced and others rejected, as the 'new' trumps the 'old' in a popular philosophy of genetic determinism.

Keyword #4: Classification

Classification orders disciplines and fields into recognised categories of knowledge. Two major tools of classification – taxonomy and assessment – have traditionally favoured disciplinary domains. The growth of inter- and transdisciplinary activities, though, has fostered rethinking of traditional taxonomies. Three examples signal changes in education. The U.S. National Center for Educational Statistics (NCES) documents the increasing presence of both the generic category of 'Multidisciplinary/Interdisciplinary' programmes and particular fields, including biomedical fields, nanoscience and computational sciences. In Fall 2010, the Department of Education's Classification of Instructional Programs (CIP) began allowing wider reporting of areas such as ethnic and gender studies, health sciences, neurobiology, informatics and computation sciences, nanotechnology and genome sciences. And, a new taxonomy for graduate education, resulting from review of the U.S. National Research Council's (NRC) 1995 taxonomy of research-doctorate programmes acknowledges the need for greater recognition of interdisciplinary fields. In 2005, a subcommittee on taxonomy and interdisciplinarity recommended an overall increase in the number of recognised fields – including basic biomedical fields in medical schools and emerging fields of feminist, gender and sexuality studies as well as nanoscience, bioinformatics and computational biology. It also advocated expansion of the category of global area studies and renaming 'biology' 'life sciences' while including agricultural sciences. In the NRC's final report, life sciences received the closest attention, though the 2009 methodology guide also cites 'Emerging Fields' of bioinformatics; biotechnology; computational engineering; criminology and criminal justice; feminist, gender and sexuality studies; film studies; information science; nano-

science and nanotechnology; nuclear engineering; race, ethnicity and postcolonial studies; rhetoric and composition; science and technology studies; systems biology; urban studies and planning (Ostriker and Kuh 2003, I; Ostriker et al. 2009).

Research taxonomies are also being reconsidered. In 2008, the NRC commissioned a Panel on Modernizing the Infrastructure of the National Science Foundation's Federal Funds for R&D Survey. Like the Frascati manual used in Europe, the classification scheme for fields of Science and Engineering has not been updated since 1978. As a result, the category of 'not elsewhere classified' is overused. It lumps together a plurality of developments, including new subfields, single-discipline projects for which a separate field has not been assigned, emergent and established interdisciplinary fields, cross-cutting initiatives and problem-focus areas of research.
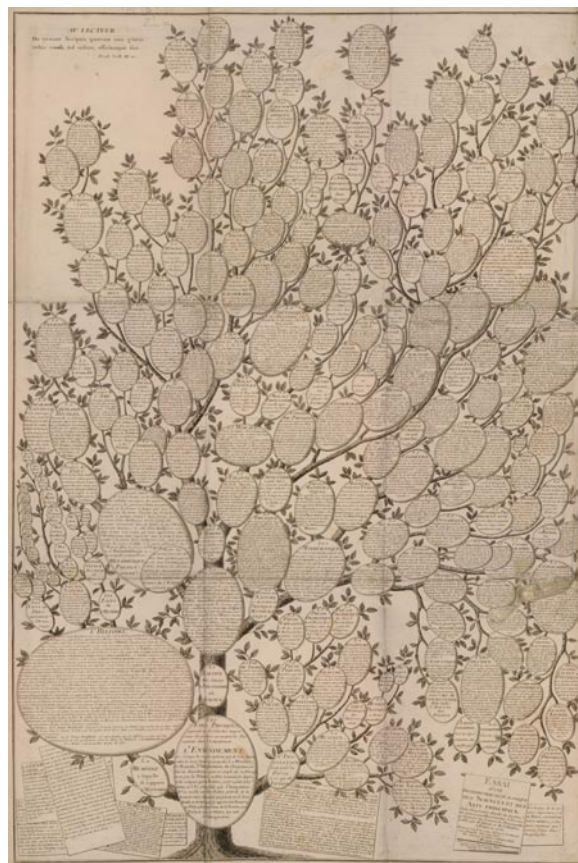

Figure 11. Fold-out frontspiece in volume I of Pierre Mouchon, T*able analytique et raisonnée es matieres contenues dans les XXXIII volumes in-folio du Dictionnaire des sciences, des arts et des métiers, et dans son supplément*, (Paris, Panckoucke, 1780.), engraved by (Robert) Benard [sic]. This image is from the copy held at the University of Chicago Library Special Collections, Rare Books Call No.: fAE25.E57.

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Among its rcommendations, the Panel urged taking advantage of new technologies to federate, navigate and manage data. It highlighted in particular the National Institute of Health's Research Condition and Disease Classification (RCDC) database system. The RCDC demonstrates the potential of bottom-up comprehensive systems to incorporate taxonomic elements while permitting users to construct crosswalks with agency-relevant keywords (tags) used in projects and programs (Data 2010). Even so, Aant Elzinga cautioned workshop participants, computer-aided bibliometric methods of assessing academic performance are contributing to the creation of cultures of compliance in which new regimes of perceptibility and (ac)countability operate.

4.2 Implications: from metrics to research policy

Elzinga's caveat echoes in a recent literature review of indicators and measures of interdisciplinary output commissioned by the US National Science Foundation (Wagner 2009). Authors of the review questioned the narrowness of conventional metrics. Units and levels of analysis vary by specificity. Database classification systems produce different results for the same measure of interdisciplinary research. And, standard measures and quantitative metrics rely on indirect or field-based indicators rather than the direct substance of the work, such as numbers of patents, publications and citations, grants, and rankings determined by social procedures of peer review and proxy. The emergent literature on interdisciplinary assessment, which draws on both qualitative and quantitative approaches, reveals that variability of goals drives variability of criteria, while identifying expanded indicators of inputs, processes and outputs (Klein 2008). Ultimately, authors of the NSF literature review concluded, 'structure' is too static to capture all manifestations of intellectual work in a dynamic knowledge system. New technologies reveal linkages between specialities and clusters of specialities, while showing exchanges, shared interests and common methods across subject categories. They afford a more open, flexible, dynamic and transactional approach that depicts research in a network representation more aligned with changing configurations of research, taking advantage of new techniques such as semantic mapping, web and text mining, controlled thesauri, tag clouds, internet-based, user generated taxonomies (folksonomies). In short, they are mediating expanding and alternative views of knowledge.

Gaps persist, however, between the widespread rhetoric of support for inter- and transdisciplinarity and the realities of practice at two policy levels, local institutions and national research systems. At local levels, there is a documented trend toward more favourable environments. However, few universities have implemented systemic reforms for lowering institutional barriers and creating favourable campus cultures in both research and education (Klein 2010). Promotional rhetoric is checked by uneven patterns of success and sustainability of programmes and projects, and variations in the willingness of faculty and administrators to accept and reward them. At higher levels of policy, research administrators, funding agencies and national science policy bodies have devoted increased attention to inter- and transdisciplinarity, punctuated by a rhetoric of innovation, competitiveness and the cutting edge. Numerous reports document the heightened priority of collaborative modes of research and strategic targeting of national and societal needs. Yet, uncertainty about definition and best practices continues (Huutoniemi et al. 2010). The current heightened priority of instrumental exigencies is also further marginalising humanities and fields of interdisciplinary studies forged in movements for greater social and political justice. At both policy levels, it is crucial to draw on the accumulated body of theory and practice that is rich in models, guidelines and appropriate criteria of evaluation. They are crucial to building capacity, leveraging resources, realising project outcomes and establishing deep roots within organisational behaviour and norms. The European Science Foundation's broad-based invitation to map interfaces is also a reminder that knowledge is not static. It continues to change. Universalist models do not capture the full extent of changes and how they emerge, evolve and are situated in differing epistemological and national contexts.
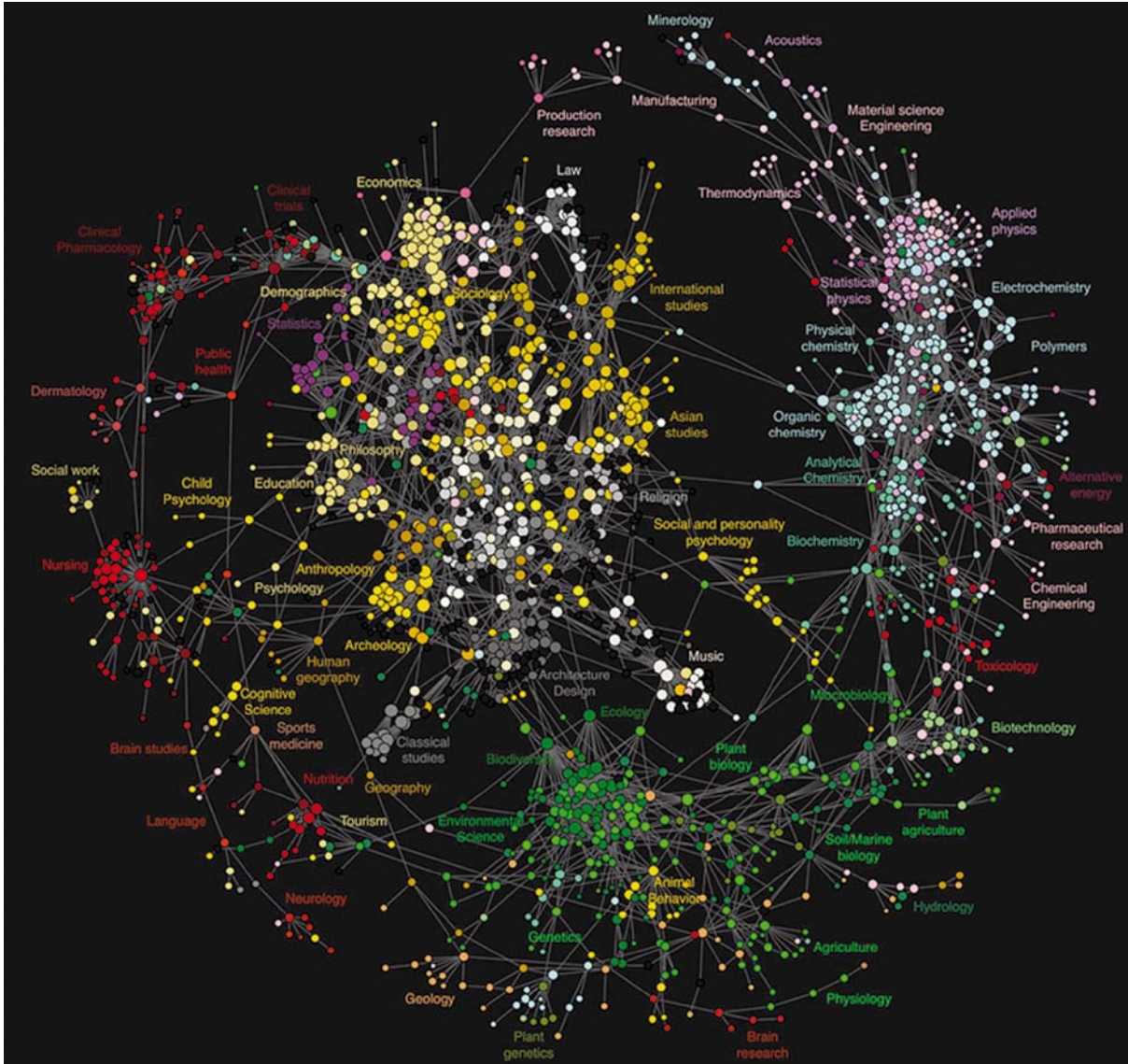
Figure 12. 'Map of knowledge' assembled by scientists at the Los Alamos National Laboratory research library in 2009. It is based on users' data searches on different journals and thus on the associations established between them. The model represents a visualisation of "a journal network that outlines the relationships between various scientific domains and clarifies the connection of the social sciences and humanities to the natural sciences." It also corrects "the underrepresentation of the social sciences and humanities that is commonly found in citation data." See Bollen J, Van de Sompel H, Hagberg A, Bettencourt L, Chute R, *et al.* 2009 Clickstream Data Yields High-Resolution Maps of Science. PLoS ONE 4(3): e4803. doi:10.1371/journal.pone.0004803.

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5. Collaboration of Natural and Social Sciences in Research for Sustainable Development

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5. Collaboration of Natural and Social Sciences in Research for Sustainable Development

Abstract

Based on a review of studies of collaborative research in the field of sustainability, two challenges of collaboration are identified: (1) a lack of mutual understanding of natural and social scientists, for instance, of the role of research in social change; (2) a strange perception of social sciences and participation as exchangeable means to bridge research and social change. Both challenges can be addressed by (a) clarifying roles and expectations of natural and social sciences in research for sustainable development; (b) exploring collaboration through collective problem framing of current sustainability issues; (c) balancing power and resources of the interpretative and the positivist approach.

Figure 14. *Atlanterhavsveien* by Andreas Levers. The Atlanterhavsveien is a 5 mile long road in Norway that connects several islands by bridges and landfills.

5.1 Introduction

The issue of collaboration of natural and social sciences has been a loyal companion of research for sustainable development[1] for several decades. When Meadows et al. (1972) presented the modelling results of Earth's collapsing human population in 2020 – assuming stable patterns of consumption and economic, population and pollution growth – the natural and social science's perspectives were joined in a systems dynamic model of the Earth, and expressed in rates of economic growth, environmental pollution, agricultural production and human reproduction. During the 1980s the natural sciences took the lead in framing more specific problems: acid rain, eutrophication of lakes and the Baltic Sea, forest decline, the ozone hole, the greenhouse effect and biodiversity loss are the concepts through which global environmental change entered the awareness of academe and society at large. The social sciences were a marginal power in framing the problems and the societal answers to it, as developed, for instance, in the frame of the international conventions and protocols of Montreal (ozone hole), Kyoto (greenhouse), Gothenburg (acid rain and eutrophication) and Cartagena (biodiversity).[2]

The uneven involvement of natural and social sciences in environmental research and problem framing becomes an explicit concern in the scholarly literature during the 1990s. For Redclift it is mirrored in the structure of the IPCC's working groups:

> The natural science agenda manifest in the way that the work of the Intergovernmental Panel on Climate Change (IPCC) was originally conceived – the taxonomy began with scientific 'processes' (Working Group One) and led on to 'impacts' and the 'responses'. The point about this view of science is that it begins with the physical, and takes on a human character some way down the road… (Redclift 1998, 177)

Consequently, Redclift further states, the climate problem (the etiology of climate change") is framed in terms of natural sciences, and – with a view on the central role of Working Group One – in terms of atmospheric physics. Rayner and Malone (1998) edited a four-volume book entitled *Human Choice & Climate Change*, presenting numerous social scientific approaches to climate change. The title of the book is meant as a programme, asking whether the problem of climate change might have been framed in the wrong way and in fact should be seen as a problem of humans making the wrong choices in everyday life – rather than a climate that is changing.

As Rapport argues, a collaboration of natural and social sciences on equal terms is required, since environmental or sustainability issues are problems of the

entire socio-anthropo-bio-geo-hydro-atmosphere and therefore need to be addressed from different perspectives simultaneously:

> Through much of the 20th century, progress in science has been measured by going deeper into the more specialised areas of knowledge. Environmental challenges call for another standard, measured by the degree of synthesis or integration among the parts. The new face of science will be more public-spirited and be characterised by its problem solving capability. It will draw upon the disciplines and not compete with them. It will seek models in which there is no longer the separation of the human from the rest of the biosphere, and in which uncertainty, surprise and incompleteness are not taken as signs of failure, but rather as better approximations of the real world. (Rapport 1997, 289)

Researchers who engage in such collaborations are usually trained in and belong to a specific disciplinary community. They look at the world through the eyes of this community's paradigm (Fleck 1986 [1947]; Kuhn 1996). And they are evaluated according to what they contribute to this paradigm's understanding of progress.

Rapport's vision challenges such researchers in the sense of 'asking for things that they are not trained to do'. Two such challenges are:

- To bridge to other disciplines in order to come up with a comprehensive understanding of an environmental or sustainability issue.
- To bridge between the academic and non-academic world in order to connect research and social change towards sustainability.

The following section discusses the first challenge, the inner academic collaboration. The challenge is described in terms of bridging a positivist and an interpretative paradigm. In section 5.3 both paradigms will be used to briefly discuss the strange perception of social science and participation as exchangeable means to bridging research and social change. Section 5.4 concludes by giving three recommendations.

5.2 Collaboration within academia

The collaboration of natural and social sciences within academia is motivated by "the recognition that the present and future paths of environmental dilemmas are inextricably linked to dynamics of coupled human and biophysical systems" whereas "[i]nterdisciplinary research, particularly between social and biophysical scientists, is deemed both essential and urgent to addressing these challenges" (MacMynowski 2007). Research programmes in the field of environmental and

sustainability issues have been promoting such collaborations since the early 1990s.[3]

Empirical studies of such collaborative research suggest that the collaboration of natural and social sciences is more elaborated on the level of concepts, proposal prose and the programme management than in practice of research. Bruce et al. (2004, 468) – analysing the fifth framework programme that should promote interdisciplinary research within Europe – found "disappointingly few projects among those funded in the early calls of the FP5 Programme that seemed by our criteria to be clearly interdisciplinary, particularly in terms of crossing the boundary between natural and social sciences". A comparative analysis of a Swiss and a Swedish environmental research programme revealed that a period of three years of close collaboration may be needed to understand the other researcher's perspective and to be ready for jointly framing research questions. And even after years of collaboration, the question that bothered some of the researchers most was – as stated by a social scientist: "As a sociologist to collaborate intimately with a biologist. What should we write about? I don't know!" (Pohl 2005, 1169).

Thus, one of the main barriers for collaboration seems to be a lack of deep mutual understanding, which is only achieved through intensive intellectual work. If the scholarly debate on collaboration in research for sustainable development is taken as the point of reference, this lack of understanding does not relate to natural and social science, but to the underlying paradigms. Hirsch Hadorn et al. (2010, 432) consider the emancipation of the interpretative paradigm in social science research since the 19th century – and thus the possibility to collaborate on equal terms with a positivist approach – as one of the core historical developments nurturing transdisciplinary research until today. Krohn (2008, 371) juxtaposes the two paradigms, the ideographical (interpretative) that at that time had to emancipate from the nomothetic (positivist) paradigm:

> Nomothetically, a case is taken as an exemplar of a more general kind and its specific features will be neglected. Eventually it becomes an abstract instance of a general law (e.g., a falling body as an instance of gravitation). Ideographically, the case is taken as an object to be valued for its unique composition of highly specific features: it counts in its own rights (e.g., a falling Chinese vase). (Krohn, 2008, 371)

Snow developed his famous distinction between the two cultures 50 years ago along similar lines: the problem-driven nuclear physicist and the discussion-driven, contemplation-oriented literary intellectual. Looking at the falling Chinese vase, Snow's physicist would see

gravitation at work and the literary intellectual the irretrievable loss of cultural heritage. Snow was concerned that the lack of communication between the two cultures "is making it difficult or impossible for us to take good action" (Snow 1964, 60), by "good action" meaning to solve the problem of unequally distributed wealth and goods on earth – to promote sustainable development in today's terminology. The two cultures, not willing or able to collaborate and therefore not of help in research for sustainable development, persist:

> There was always a tension between the engineers, who came with a technology in search of a market, and the anthropologists, who were trained to understand and possibly protect the values of the indigenous culture. (Fenstad 1995, 61)

> [W]hile the natural sciences proceed by closing down debate, by establishing near-consensus between everybody, the social sciences proceed by opening up debate, by admitting the existence of competing controversial universes, or distinct epistemic communities. It should not be surprising that both natural and social sciences get so frustrated with the way in which the discourse is often conducted, since their expectations are mutually incompatible. (Redclift 1998, 178)

The two paradigms do not only differ in how they perceive a specific sustainability issue. They also differ in the (implicit) assumptions about, for instance, what the role of research in collaborations for sustainable development is. Elkana (1979, 276-783) distinguishes within every paradigm a specific body of knowledge – the state of knowledge with its methods, solutions, open problem, theories – from the paradigm's specific image of knowledge. The image of knowledge is build by the beliefs "held about the task of science (understanding, prediction, etc.), about the nature of truth (certain, probable, attainable, etc.), about the sources of knowledge (by revelation, by ratiocination, by experiments through the senses)". And in the present context one can add: beliefs held about the general role of research in social change; beliefs held about the specific contributions of natural and social sciences in co-producing knowledge for sustainable development.

Guba and Lincoln (1994; 2005) tabulate such images of knowledge – using the term 'paradigm' – of positivism, postpositivism, critical theory, constructivism and a participatory approach. Although Guba and Lincoln (1994, 105-109) emphasise that all five images of knowledge can be found within qualitative research, they still see the positivist image of knowledge as the one that has been dominating science in general for several centuries. Table 1 is an extract of their juxtaposition for the image of knowledge of positivism and critical

Figure 15. Rifts and tensions in the landscape by the Skaftá River in the Icelandic highlands (Photo: Gísli Pálsson).

theory et al. Guba and Lincoln (1994, 109) use critical theory et al. as "a blanket term denoting a set of several alternative paradigms, including additionally (but not limited to) neo-Marxism, feminism, materialism, and participatory inquiry". Thus Table 1 confronts a specific positivist image of knowledge – here standing for the natural environmental sciences – with a specifically engaged social science paradigm – here standing for the social environmental sciences. The reason for depicting both positions in Table 1 was that they were – to my understanding – closest to the two positions I found in conflict in the scholarly debate in research for sustainable development. They are, however, not comprehensive: just think of all the constructivist social scientists that are not represented.

Table 1 depicts the two paradigms as ideal typical simplifications in Weber's sense (1962). Real researchers' images of knowledge will not necessarily include all features of one type. For example, Snow's physicist is generally a positivist and still an activist, aiming at solving the world energy problem by nuclear power. Snow's literary intellectual, on the other hand, might be a historical realist (or relativist) and yet more distant towards action than the positivist physicist. Note that the paradigms do not represent natural and social sciences in general. A biologist, for instance, who lives in a community of apes to learn about their behaviour, may hold the image of knowledge of critical theory et al. An economist searching for basic rules (like maximising personal utility) that govern human economic behaviour might be in the positivist paradigm.

If the main barrier for collaboration is a lack of deep mutual understanding, then collaboration of natural and social sciences is less difficult, if researchers from both groups share the same paradigm or at least some of its images of knowledge. Collaborations of 'positivists' can

Table 1. Elements of the image of knowledge of the positivist and the critical theory et al. paradigm (Guba and Lincoln 2005, 193-198)

Issue	Positivism (here also: nomothetic)	Critical theory et al. (here also: interpretative, ideographic)
Ontology	naive realism – 'real' reality but apprehendable	Historical realism – virtual reality shaped by social, political, cultural, economic, ethnic and gender values crystallised over time
Epistemology	Dualist/objectivist; findings true	Transactional/subjectivist; value mediated findings
Methodology	Experimental/manipulative; verification of hypotheses; chiefly quantitative methods	Dialogic/dialectic
Nature of knowledge	Verified hypotheses established as facts or laws	Structural/historical insights
Values	Excluded – influence denied	Included – formative
Inquirer posture	'disinterested scientist' as informer of decision makers, policy makers and change agents	'transformative intellectual' as advocate and activist
Action	Not responsibility of the researcher; viewed as 'advocacy' or subjectivity, and therefore a threat to validity and objectivity	Found specially in the form of empowerment; emancipation anticipated and hoped for; social transformations, particularly toward more equity and justice, is end goal

be found in recent sustainability science approaches, working with abstract nature-society-models on the global scale (Schellnhuber 1999; Kates et al. 2001; Lüdeke et al. 2004). The analysis of sustainable development of a concrete situation, however, asks for research combining both paradigms: a sophisticated reaction to the falling Chinese vase has to consider the vase as drawn by gravitation and as materialised cultural heritage simultaneously. In addition, such collaborations are not only challenged by the different paradigms, but also by their respective position and power within the academic system:

[R]econciling different biophysical and social models of the world is in one part about how those usefully represent reality for the explicit research goals, and in another part, it is about the power that those approaches bring with them. What does power mean in this context? Power can manifest in many ways: an accepted account of an environmental problem, individual scientific status, the inclusion or exclusion of researchers, relative impacts of research findings, access to resources, or perceived relevance to policy decisions, for example. (MacMynowski 2007)

Figure 16. Photograph by Yuga.

5. Collaboration of Natural and Social Sciences in Research for Sustainable Development

5.3 The strange perception

The collaboration of natural and social sciences in environmental research is motivated by the idea of contributing to the world's sustainable development. In an ideal research situation such collaboration starts with problem framing and goes over problem analysis to problem handling and proposing solutions respectively. Pohl and Hirsch Hadorn (2007, 30) define such transdisciplinary research by its aims, namely to "(a) grasp the complexity of problems, (b) take into account the diversity of life-world and scientific perceptions of problems, (c) link abstract and case-specific knowledge, and (d) develop knowledge and practices that promote what is perceived to be the common good". The normative concept of the common good is in the present context concreticised – as well as deliberated – as sustainable development.

The collaborations of disciplines and non-academic actors from civil society, the public or the private sector are means to meet the requirements (a)–(d). How these means will be used in a project depends on the site-specific circumstances and available competences and resources. In contrast to this general view of collaborating disciplines and societal actors as means that can be used more or less wisely to meet the requirements (a)–(d), in current research for sustainable development, participation is sometimes seen as if it could substitute social sciences:

> Anthropologist: "So, how are you integrating the social sciences into your research programme?"
>
> Regional Catchment Group Manager: "Well… er… we are talking to a lot of people, so we figure we have got that covered." (Strang 2009, 3)

However, it would be wrong to assume that users will automatically have a better understanding than academics of the 'real world' nature of problems. On the contrary, user communities might have only a partial understanding of what their problem is and, in certain cases, might compromise the quality of the research and even lead it in unproductive directions. Though user involvement was seen by some as an alternative to social science inputs in technical research and development projects, the latter offered tools and concepts not necessarily possessed by users. (Bruce et al. 2004, 466)

The findings of Lowe et al. (2009) point in a similar direction. Lowe et al. asked ecologists how they would take into account the social/human dimension of their work. Half of the ecologists ranked "work closely with stakeholders and end-users" as the first thing to do, whereas only a quarter ranked firstly "work closely with social scientists in research projects" (Lowe et al. 2009,

302). The strange perception of participation and social sciences as exchangeable means is mostly visible from a natural science perspective.

The two paradigms can be used to give a tentative explanation (Table 1):

1. In the natural scientist's positivist paradigm, the non-academics are the change agents who have to be informed about research's findings on sustainable development. Furthermore, they are experts of the historically situated case and provide the ideographic knowledge required to come up with solutions adapted to the specific circumstances. With that idea in mind, the positivist natural scientist is looking for a collaborating social scientist, basically to help him/her to transfer knowledge on sustainable development.

2. A positivist social scientist is the wrong collaborator, because neither is (s)he scientifically interested in the case-specific knowledge of the social actors, nor does (s)he think of being responsible for informing change agents about the natural side of, e.g., global change. His/her responsibility is to inform change agents about the general social aspects of, for instance, climate change.

3. A critical theory et al. social scientist is the wrong collaborator, exactly since (s)he would be very interested in the case-specific expertise of the social actors as well as in the specific circumstances that make the situation as it is. For him/her social change means to make the actual power relations transparent, that stabilise the situation and its current dynamic. Such "transparency about social relations and empowerment has the potential to be subversive, and is therefore not necessarily welcome" (Strang 2009, 11). So (s)he will not inform social actors about natural science's findings, but as a transformative intellectual will provide knowledge that promotes social transformations, particularly toward more equity and justice.

4. Since none of the social scientific collaborators suits the positivist natural scientist's idea of what should be done, (s)he decides to directly address the societal actors in the way (s)he is interested in through participation.

Keeping in mind that Table 1 gives a selective and over-simplified picture of the paradigms held within natural and social sciences, the above explanation gives an idea of how a deeper mutual understanding could help to overcome the strange perception and to further the collaboration of natural and social sciences in general.

5.4 Conclusions for research and funding

The collaboration of natural and social sciences in research for sustainable development faces two major challenges:

1. A lack of deep mutual understanding of the different images of knowledge underlying specific disciplines.
2. A strange perception of social sciences and participation as exchangeable means to bridge research and social change.

Three suggestions can be made of how to change the presently unsatisfying situation:

a. Clarifying roles and expectations in research for sustainable development

The clarification of the roles of natural and social sciences in research for sustainable development – the discovery of the underlying images of knowledge – is not yet systematically elaborated. A clarification of roles and expectations is specifically relevant, because it may uncover differing beliefs about the role of science in social change, about the role of specific disciplines and of specific social actors in co-producing knowledge. If researchers will not engage in such a reflexive discussion of the collective endeavour, the present distribution of roles and misinterpretations will persist and the marginalised paradigms (currently the critical theory et al.) will carry the double burden of doing good research and arguing why such an approach is needed anyway.

b. Exploring collaboration through collective problem framing

Researchers should not only critically review the roles and expectations on a meta-level, but also explore collective problem framing 'on the ground'. It has to be critically explored in how far such collective problem framing "helps to overcome fragmented perspectives and the partiality that can arise when natural scientists make naïve assumptions about the social world or social scientists make naïve assumptions about the natural world" (Phillipson and Lowe 2008, 224). This could be done for recent or upcoming sustainability issues such as climate change, nanotechnologies, endocrine disruptors and migration. The questions to answer are: What is the current dominant way of looking at the problem and who promotes this viewpoint? What are further perspectives and what academics or non-academics are promoting them? What would be an encompassing reframed view on the problem? And will research based on this reframed view provide knowledge useful for problem handling? (Hickling 1982; Hubert et al. 2008) Such

Figure 17. *Modern plantation* by Taís Melillo. This photograph depicts the *Public Farm One* (P.F.1) by WORK Architecture Company from New York, who won the ninth annual MoMA/P.S.1 Young Architects Program in 2008 with this urban farm concept. Constructed from large cardboard tubes, the top surfaces of P.F.1 act as a working farm, nowadays blooming with a variety of vegetables and plants. P.F.1 is conceived as a living structure made from inexpensive and sustainable materials, an interactive bridge between outside and inside space with multiple zones of activity.

questions, however, cannot be answered in a series of workshops, but need to be addressed in the same way as any serious research project.

c. Balancing power and resources of interpretative and positivist paradigm

The fact that environmental problems have mainly been framed from a natural science perspective is not only an expression of their specific interest and concern in the subject matter, but also of the academic structures in terms of resources and power. Therefore promoting the collaboration of natural and social sciences – and of researchers with positivist and critical theory et al. or further paradigms in mind – does also concern the institutional setting. In general, I believe, only long-term funds, positions and institutional environments will make a competent interpretative paradigm and social science community growing and engaging in research for

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sustainable development. Such a changed institutional setting within the academic sector would in the longer run – e.g., through education – also influence how other societal sectors address issues (Price 1965). This is because academia, civil society and the private and public sector do not develop independently of each other: "Dominant intellectual paradigms are, inevitably, reflected not just in research, but also in everyday practice" and "in the structural organisation of the Government and non-government agencies involved in caring for 'the environment'" (Strang 2009, 7).

Notes

1. The term 'research for sustainable development' is used here as a general expression for research that addresses issues of sustainability. Sustainable development is conceived according to the Brundtland definition as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It contains "the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs" (World Commission on Environment and Development 1987 *Our common future.* Oxford University Press, Oxford). Research for sustainable development includes environmental research as well as development research and is driven by concern about the environment and social justice.

2. Recently the global environmental change issues are – in the search for adaptation and mitigation measures – reframed as issues of energy, mobility, housing and consumption. These topics seem easily approachable from the social sciences, since they describe human activities. However, the social sciences might again stay a marginal power, if the issues are primarily framed from an engineering perspective.

3. Examples are the Swiss Priority Program Environment (1992-2000), the Swedish Foundation for Strategic Environmental Research (MISTRA, since 1994), Austrian Research for Nature and Society (KLF, ProVISION since 1995), and German Social Ecological Research (since 1999).

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6. Conclusions

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Disciplining Disciplines

The theme of boundaries and their uses, significance and fashioning in 'real' life has a long and lively career. Its trajectory has followed a bumpy road, through both peaceful times and maddening cultural battles on colour, class, gender and culture, but it has left behind a very important legacy. While the issue of 'ethnicity' is normally applied in the context of nationalism, race and spatial fragmenting, it is closer to the world of the academe than one may think, underlining the splitting and culturing of any kind of community. One of the classic works in this field, *Ethnic Groups and Boundaries: The Social Organization of Culture Differences* (Barth 1969), suggests that boundaries are *made* for specific pragmatic purposes, an argument that is still very much valid (Pálsson 1993). Not only is it a central argument in modern studies of ethnicity, it is also highly relevant for studies of the fragmenting of universities. It seems important as well in current debates on human biological differences, the comparative sampling of 'populations' and the bounding of genes in space and time (Gannett 2003). Recently, a similar idea has been highlighted by science studies under the banner of 'boundary work'. Humans, it seems, are endlessly engaged in some kind of boundary work, in all places at all times; perhaps it makes sense to speak of 'workaholics' in this respect. As a result, needless to say, boundary work needs to be repeatedly theorised and scrutinised, comparatively and in specific ethnographic contexts. This is a theme usefully explored by Klein (this report), emphasising the metaphors of disciplinary mapping and the cultural baggage that come with them.

The *Future of Knowledge* project has drawn attention to the lines of divisions among academics and the ways in which we both separate 'us' from 'them' and relate to significant and insignificant others in the academic landscape. The reference to 'disciplining' in this context is Foucauldian in a dual sense, in its allusion to both the archaeology of knowledge and the policing of boundaries. "Disciplining", as Clifford remarks (2005, 24), "is not only a matter of defining scholarly territories, research topics and analytic methods – the 'content' of a discipline. The term evokes older traditions of normative training and ascetic practice that take modern form in pastoral and governmental institutions, including the university". Hacking argues in the same vein (2008), pointing out that the word 'discipline' is both a noun and a verb; some people, he suggests, are "disciplined by disciplines", "bullied by bosses who sternly strive to maintain pre-established institutional structures of inquiry".

Inter-, trans-, even *post*disciplinarity, however, have become central themes in research and funding in many academes and funding agencies, including the European Science Foundation, the European Research Council, the U.S. National Science Foundation, and many national science councils. Indeed, a growing body of literature has been developed on these issues, underlining the historicity of academic divisions of labour, the restrictive constraints of disciplined scholarship and the creativity of border zones. Also, with the critique, decline, if not collapse, of modernist hierarchies, the concept and community of research collaborators have been significantly expanded, blurring the divide between experts and lay persons, observers and observed, the West and the rest.

In recent years, the contexts of learning and production of knowledge have changed rapidly in both Europe and elsewhere. Not only has the university been subject to neoliberal forces and auditing systems, it has also been firmly embedded in a 'global knowledge economy'. As a result, there is a growing sense of uncertainty about the university's role in society and the classification and demarcation of subjects and disciplines (see, for instance, Nowotny, Scott and Gibbons 2001). Some observers speak of a 'schizophrenic university' (Shore 2010), troubled by pressing and conflicting demands. The emphasis is no longer on 'uni' or oneness but on multiple roles, poliversities or multiversities built on differences and multiple communities (Milojevic 1998).

It seems pertinent that we turn our boundary expertise and our observant gaze inward, to our own academes, our field, its subfields and practices – to boundary work at home (Klein 2001). This involves taking a critical look at issues of disciplinarity, emphasising the central importance of exploring actual experiences and cultural contexts for the purpose of addressing the limits and potential of border-crossing and broad collaboration. For this purpose, multi-sited scholarship is essential, in an extended sense, in terms of disciplinary focus as well as empirical domains. Not only has the *Future of Knowledge* project explored all of these issues, the ESF seems committed to them on several other fronts.

One Culture, Two Cultures... N Cultures?

In his famous Rede lecture of 1959, termed 'The Two Cultures', Charles Percy Snow established the duality of the natural sciences and the humanities as a seemingly self-evident reality organising academic production of knowledge as a matter of course (Snow 1964). Despite its universalist appeal, Snow argued, the university was a divided community with radically different cultures and languages, a Tower of Babel. In the wake of rapidly expanding universities in many contexts in the 1970s, the *third* culture has firmly established itself, namely the social sciences (Kagan 2009). Somewhat unexpectedly,

Figure 18. *Cerdanya* by Mariluz Rodriguez. Cerdanya is a small region of the eastern Pyrenees divided almost evenly between France and Spain: a sort of geographic enclave between the two countries borders.

Snow's thesis had major impact. Endlessly cited, quoted and challenged, it exaggerated and reified structures that to some extent were already there, sometimes engraved in the architecture and layout of campuses.

The different disciplinary cultures, of course, have never remained completely autonomous as some cultural mobility has always taken place. Nevertheless, as Greenblatt emphasises, the university is characterised by rigid compartmentalisation of mobility: "Although in the past twenty years or so many academic disciplines have formally embraced ideas of 'cultural mobility,' they have for the most part operated with tunnel vision: the times and places in which they see significant mobility occurring remain strictly limited; in all other contexts, they remain focused on fixity" (2010, 2-3). Academic departments, Greenblatt goes on, "are routinely organised as if the division between English and, for example, French were stable and timeless, or as if the Muslim and Christian worlds had existed in hermetic isolation from one another, or as if the history of ideas were somehow entirely independent of the history of exile, migration, and economic change" (Greenblatt 2010, 3-4).

The notion of the rigid and stable structures of the academe flies in the face of historical evidence. After all, as Foucault showed with his 'archaeology' of knowledge (1970), academic fields and disciplines are recent and unstable phenomena established and modified in particular historical contexts. Indeed, the modern world puts immense pressures on the idea of the stability of the 'two cultures'. Not only is global climate traditionally seen as a 'natural' thing par excellence independent of human activities, refashioned through human activities, some of the structures of life itself, genomes, cells,

organisms and species, are increasingly 'cultured' by humans. Rabinow (1996) launched the concept of 'biosociality' to capture this situation. In his vision, the conceptual division of nature and culture was about to collapse with the new genetics and the mapping of the human genome. The genome itself, he suggested, the "object to be known", would be known in such a way that it could be changed (p. 93); "in biosociality", he went on, "nature will be modeled on culture understood as practice" (1996, 99). Clearly, Snow's thesis seems increasingly archaic, given the current conflation of all kinds of domains and the destabilisation of the normative dualisms of the past.

In some cases, the separation of the natural and the social is firmly established *within* disciplines, in particular anthropology and psychology. As to the former, anthropologists are increasingly concerned about the importance of a non-reductionist fusion of the social and the biological – arguing for a *one*-field approach (see, for instance, Pálsson 2010). Anthropologists can continue to craft their professional selves and their imagined academic communities on two different tracks and they may continue to practise the study of *anthropos* as if it involved the investigation of two radically separated domains, defending the sub-disciplinary boundaries as if they were engraved in our subjects. But this would be both ethnocentric and out of time. It is time to rethink the field on the assumption that *Homo sapiens* is an undivided being and that decoding it – to the extent that the language of 'decoding' is the appropriate one – requires integrative perspectives that, in the absence of a better non-dualistic language, resonate with our biosocial natureculture.

This will not be easy, given the fragmenting of academic communities, methods and training programmes, but it is the only meaningful way to go. Alternatively, keeping in mind the arguments for a *strong* form of interdisciplinarity, the creativity of border zones and the realities of biosociality, we might think of anthropology as an *n-field* approach, not just two-field or four-field but an approach that allows for a series of flexible combinations. It is difficult to see why such an approach should not be applied to many other humanities and social sciences, well, in fact the entire disciplinary spectrum of the academe.

Blurring Genres or Simply Collaboration?

Interdisciplinarity, no doubt, takes many forms. Thus, one can speak of both weak and strong forms. For some, interdisciplinarity simply means collaboration across pre-established fields. Such a *weak* form of interdisciplinarity is advocated by Hacking (2008). While he has known people who have been "disciplined by disciplines",

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"bullied by bosses who sternly strive to maintain pre-established institutional structures of inquiry", and he respects "these victims of the system", disciplines are not the key problem:

> "I would like to tell another story, of collaborations between disciplines, of the openness that has long existed between fields of expertise. Not a tale of breaking down of boundaries, but of mutual respect, which, as a new group of issues arises, may create a new discipline. In my opinion what matters is that honest and diligent thinkers and activists respect each other's learned skills and innate talents… I never seek help from an 'interdisciplinary' person, but from a 'disciplined' one."

Hacking seems, however, to qualify his statement with second thoughts. "Never?" he asks, adding "Well, hardly ever".

Others take a *stronger* position, emphasising the "distinctively inhibiting effects" of disciplinary boundaries (Lloyd 2009, 3). Exploring the history of several fields, Lloyd suggests we have much to learn from the diversity in the ways in which disciplinary ambitions "have been implemented, developed, and sometimes thwarted, in societies past and present across the world, and every reason to expand our own horizins beyond the familiarity of our modern Western experience" (2009, 4). Lloyd emphasises the role of elites claiming specialist knowledge in some particular field, professionalising their subject. However, "elites are not always engines for growth":

> One of the recurrent phenomena we have encountered to a greater or lesser degree in all our individual studies is that of an elite jealously guarding its privileges – even, it may claim, its mandate – in the matter of how the subject should be pursued. The effect of elite influence may sometimes be not to stimulate and provide a framework for further development, but rather to restrict it, not to encourage innovation but to block it. By definition any elite has a limited membership. (Lloyd 2009, 175)

For Lloyd, there are plenty of examples where successful innovation is achieved "by bringing to bear ideas, models and methods that originate in other neighbouring or even quite distant fields. However, those who seek to combine the insights of several disciplines thereby run the risk of being criticised by the elite of each. Interdisciplinarity itself has no such elite, which may make innovation easier but acceptability in existing academic circles more difficult" (Lloyd 2009, 181).

The Environment: The Ultimate Challenge

An important and exemplary interdisciplinary effort recently developed by the ESF in a joint activity with COST is that of the Forward Look RESCUE – Responses to Environmental and Societal Challenges for our Unstable Earth. RESCUE seeks to transcend all kinds of boundaries, which is appropriate for the scale of environmental problems involved, combining different disciplinary perspectives, different national perspectives and different levels of policy making. How can the humanities, the social sciences and the natural sciences be realigned with each other and the world of policy making and how can they collectively help to inform the mitigation of major environmental problems? One of the important roles that the humanities and the social sciences can play on this front is to engage in a dialogue with the people who experience the instability of the Earth directly, at the grass roots level.

In particular, it is important to empirically explore how people understand climate change and its implications and how they organise themselves and act with respect to growing environmental problems. To what extent, for instance, does the global environmental crisis necessitate new kinds of subjectivities, citizenship and socialities? Given the scale, interdependencies and hybrid nature of environmental problems, it seems fundamental to search for new transdisciplinary modes of research and new kinds of social institutions, appropriate for the understanding and resolution of environmental problems. The RESCUE effort is heading in this direction. How might the recent notions of naturecultures and the biosocial open up new perspectives on environmental change, and which new approaches might be developed from these perspectives?

While times are changing, transdisciplinary approaches are clearly on the agenda in most contexts and the environment receives growing attention, far more consistent and sustained collaborative, integrative efforts and policies are needed both in Europe and elsewhere. While current academic divisions of labour have a long history and a spectacular record, they are not well suited for the massive task of understanding human-environmental interdependencies and facilitating necessary change. In a sense, the environmental threats of the modern age represent the ultimate challenge of transdisciplinary efforts. As Pohl explores in his essay (this report), it is important to attend to both the tensions and possibilities of interdisciplinary endeavours in the environmental domain.

Figure 19. *Tree of knowledge* by moneymakermj.

The Road from Reykjavík

Collectively the papers presented at the Reykjavík workshop explored the broad terrain of interdisciplinarity, emphasising the need to move beyond standard disciplinary frameworks. The concluding discussion suggested that further work should be guided by the following principles:

1. While European funds, academes and agencies have adopted a series of measures and programmes for advancing interdisciplinarity, including the ESF scheme of which 'Mapping Interfaces' is a part, more consistent and thorough policies need to be developed along these lines both within and outside the academe in order to overcome the "tyranny of the disciplines" (Milojevic 1998, 597).

2. Theorising on transdisciplinarity needs to be matched with empirical studies of actual developments, including ethnographic studies of particular knowledge economies. Such reality checks must inform broad generalisations and forecasting.

3. Attempts should be made to bring all sides of both the knowledge community and the arts to the same table. Given the changes taking place in the global knowledge economy – including the challenges posed by major environmental problems, the realignment of academes, states and commerce in the virtual multiversities of the future – interdisciplinarity will remain an important theme and no field should abstain from collaborative efforts.

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