

***BRIDGING THE DIVIDE BETWEEN NATURAL SCIENCE
AND SOCIAL SCIENCE AND THE HUMANITIES:
Identifying Methodology for Integrated Sustainability Assessment***

Responding to Kington and Littleboy's paper
'Integration and Social Processes'
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INTRODUCTION

Integrated sustainability assessment options have to deal with human beings, their normative practices and interpretations, their institutional activities, and form useful indicators of these for practical responses. Primarily researchers working on integrating social processes into their research have to audit, model, understand and respond to the processes within communities that underpin all these practices and interpretations (Power 1997). The communities include communities of researchers, and the activities include research processes and inquiry. Questions for inquiry therefore necessarily include the reflexivity of human cognition, how it normatively proceeds, and how through intuitive and iconoclastic framing, cognition and practices may change (Ashmore 1989; Alvesson and Sköldbberg 2000). For the latter authors "Reflexivity is an essential part of the research process (and a) central problem of research methodology." Analysis and critique are key contributors to both institutional and societal change and social science is the base for their scholarly review. Cultural, philosophical and social concepts provide the best available knowledges we have for comprehending change and resistance to change in human systems (for a critique for instance of contemporary audit society see Strathern 2000).

Of course, as Kellow (2002) pointed out in the Academy of Science Annual Symposium 2002, sustainability involves highly contested concepts, and the study of these is within political theory and links with human framings of knowledge (Gallie 1955-56; also see Davison, 2001). What becomes integrated in successful sustainability research will be political and philosophical as much as more narrowly social. Cultural and historical as much as it is economic, integrated sustainability research has to overturn methodological barriers to integrating humanities, social sciences and natural scientific knowledges (Booth *et al.* 2000).

I was therefore looking forward to a paper on integration and social processes addressing how the measurement skills of natural science could be coupled with social, political and cultural understanding, so that integrated sustainability assessment processes would result. Through case studies – recently strongly argued as the basis for an effective social science by Bent Flyvbjerg – Professor of Planning at Aalborg in Denmark (Flyvbjerg 2001) – we can now begin working on the enormously challenging problems of complex human processes of interaction. Strategies and processes through which social science understanding forms, and develops, and then becomes a part of human change and community development, are essentially hermeneutic and phenomenological (spelled out in Alvesson and Sköldbberg 2000). Scholarly acquaintance with these, comparable to a social scientist's grasp of basic mathematics, can be linked in with a

natural scientist's research producing an integrated framework for tackling the questions of sustainability science (Kates *et al.* 2001).

The present paper, to which I am responding, by Kington and Littleboy from CSIRO, is written within this context of sustainability science needing to integrate the assessment options for complex processes so that social and economic factors do not continue to be isolated from biophysical knowledge frames. The forum for discussion of integration and social processes at the 2004-2005 national forum 'Sustainability Options' is an opportunity within the Australian context to examine how far research in Australia has come in attempting this integration, and what still remains puzzling and obscure.

WHAT IS THE PROBLEM THE FORUM ON SOCIAL PROCESSES IS ADDRESSING?

The online forum on questions of integration and social processes in sustainability research, must ask:

- how has integration been attempted?
- how far have these attempts succeeded?
- and what insights do researchers now have into how to integrate social process studies with biophysical research studies?

Kington and Littleboy (K & L) provide good starting material for all three of these questions. They have also stressed how related this is to puzzles of interdisciplinarity. I strongly agree (Booth *et al.* 2000).

Sustainability Science: avoiding reduction

Behind the problems of sustainability for human societies is a history of human activities being divorced from any consideration of their global effects. Much of the problem can be (and is) traced by social science studies (and by some natural scientists, see below) to reductionist aspects of science (particularly natural science). For reasons of wanting to make progress, scientific knowledge is built out of simple cases, substances and processes reduced through purification and by externalizing complexities, and therefore works on manageable examples. Laboratory preparations and pure samples are very different to what ecologists encounter, but they can be very powerful in giving humans ways to theorize and construct effective natural world responses. This is admirable for the progress in techniques (laboratory techniques in particular) it engenders. Yet it also sets up mindsets that are focused (disciplined) and have strategies for avoiding complexity conundrums. Reductionism in scientific and technological innovation is a key part of the **problem** for sustainability, not the certain and granted centre for its dissolution.

Ecologists are of course very aware of this (see, e.g., Rapport and Regier, 1995). Many social scientists made the same mistake of remaining ignorant for a long time of their own inherent reductionism. That was why a distinction had to be made eventually between standard research practices – often now called 'positivist' and the various alternatives to standard forms of data gathering becoming notable through the 1960s, such as 'naturalistic field research', 'action research' and 'participant observation'. All these latter ways of doing social science had to break with some part of what through natural science's reductionist principles had been regarded as essential for being scientific.

There is now much in applied science that has had to go the same way. Especially when the 'production of knowledge' faces complex issues (Gibbons *et al.* 1994). Even experienced

consultants advising clients are ill equipped for problems high in uncertainty and public levels of risk perception. Funtowicz and Ravetz (1991) call the expertise needed here 'post-normal science'. I share with them the insight that norms for 'normal' scientific method do not apply. When Kuhn (1962) coined the expression normal science, and contrasted his understanding of a paradigm shift, it was cognitive change that most concerned him. The intuitive skills that can now make a difference in solving complex problems have a meta-relationship to existing disciplines. They are skills at integrating these into do-able practices for a future sustainability science.

I suggest these skills might be termed post-disciplinary. The translator of older forms from pre-existing disciplines, to serve the needs of new problems, avoiding both misunderstanding, ignorance, hubris and the problems of reductionism, has to reflect impartially on all disciplinary boundaries equally. Knowing what criteria have operated in a good variety of disciplinary contexts is a necessity to adjust these, and through this active, reflective, borrowing (from several social and natural science disciplines) to attempt to advise on methodologies for the new context. Such translating is a post-disciplinary skill, yet still uses disciplinary achievements. Skilled in words and in such humanities as philosophy and history, such a 'translator' is not primarily a person trained well in one discipline exclusively for many years, and she may not even be primarily a social scientist. She is – if we have to have a word – a post-disciplinarian. These are the skills of integrative study, inquiry and science. This where a sustainability science has its focus, in as much as 'focus' still applies when integrating diverse approaches. Yet sustainability science is another contribution to human knowledge, and so in its an innovative metaphysical way, might be called another discipline. I prefer to call it a post-discipline. For this project the current forum of the Joint Academies Committee is timely. The emphasis has to be on interorganizational processes, but the cognitive outcome will be postdisciplinary skills.

Making sense of sustainability

Beyond the borders of scientific disciplines, moreover, we have societal norms that are also, in both good and bad ways, strongly influenced by natural science's history of reductionism. An example is current policies in favour of monitoring professional workplaces – the so-called audit explosion (see Power, 1994, 1997). Other outcomes of science are the production lines of Fordist society, of the food industry, of pharmaceutical companies, of paper production even garment manufacture. With the mass production of super things for people's lifestyles, technological change has encouraged people to trust science and to respect its role.

Yet for sustainability science there is an irony in all this. One account of how unsustainability has grown uses histories of commodification, of lifestyle changes and the commercialization of technology to construct how conditions have developed for overusing (abusing) earth's resources and stressing (often to breaking point) the ecosystems that service us all. Theorising commodity production, analyzing lifestyles and examining processes of commercialization, together with the studies of human motivations and values, and of organizational and business culture are all activities within social science and humanities. The above postdisciplinarian, in translating concepts and advancing ways to match the impact of these 'social processes', will be making new technologies for promoting sustainability out of humanities and social science inputs. K & L are, for instance, examining whether and how far social and economic integration shows up in case studies both within CSIRO and to a degree internationally.

Even within social science, however, excellent work, on how technology has become institutionally unresponsive to the wider contexts in which human production occurs, gets lost

and readily sidelined by the reductionist tendencies within disciplines. Attempts at complex study (see for instance Sharp 1983) in linking (translating) psychological, political and philosophical themes into environmental awareness, do not fit the categories of any one of psychology, philosophy or political science. Having such work examined and disseminated is difficult. The work is time-consuming and its outcomes risky for practitioners (as K & L's study of case studies does conclude) and, as Kellow remarked, the judgments make use of highly contested concepts. All of this makes integration an issue needing attention, and not just by sustainability advocates and activists. The problems for the Forum are key questions for the very future of science.

Lest this seems to give greenies, idealists and other enthusiasts that Funtowicz and Ravetz evoke as inhabitants of the public arena of distrust (1991) too strong a critical role, let's just note who is taking complexity seriously here. The entrepreneur's retort (explicitly but perhaps only circumstantially claimed of Lang Hancock) "let them starve in the dark then!" regards light and food as what people want, and green idealism as risking these benefits. Yet being pragmatic and having the sense to see what benefits people, is what scientists and the greenies here share. Complex issues do not reduce to brute existing choices, and only entrepreneurs of fixed vision are likely to maintain that position. Negotiating complex frames of both evaluation and of response, and working to effect an integrated human understanding, is the problem for sustainability science. The National Academies' Forum on social processes has to reflect on how integrated approaches to sustainability are going to emerge, and to consider present analyses of human processes.

HOW KINGTON AND LITTLEBOY'S PAPER ADDRESSES THIS PROBLEM

Tools and Constraints

Within CSIRO the problem clearly takes on an institutional form and it is in trying to consider institutional factors coherently that their paper puts the role of social processes in integrative research into two distinct boxes:

- *The practice of using social processes (in their many forms) as tools for defining, informing or delivering integrative research outcomes.*
- *The existence of social processes that act as constraints on the delivery of integrative research outcomes.*

It needs responding that social understanding is as major an element in getting results as any other skilful know-how. It is not just a tool used and a nuisance that can impede 'delivery'. To deliver integrative outcomes researchers have to be focusing on the social processes in which research is embedded, not describing these as if they were outside the research as 'constraints'. Orienting towards internalities and externalities may seem comprehensive but rests on backgrounding assumptions about the boundaries of the 'realities' of research and how social processes relate to these. It suggests predominantly that social processes are encountered under two guises:

- A resource, linked to the techniques various personnel have to offer, and
- A frustrating lack of control, mainly noted when implementation problems impede delivery of programmes

The first dot point places social abilities and processes as capacities and techniques for teams to use. Yet the second dot point makes the social an externality that implementing research faces

as a problem. Neither is giving appropriate weight to social research itself as one of the factors that the research team has to integrate into its process as an equal in carrying on research. Neither is placing attention on 'reflexivity', a theme that social studies cannot finally avoid. The boundaries adopted are themselves a major part of how the problems are tackled.

The writers may mean to imply 'using work on social processes' when they write 'using social processes' but nowhere else in the paper is there any direct consideration of the problems of integrating the mindset of social psychologists or language specialists or cultural studies, or anthropological ethnographic inquiry, or politically contested concepts or the work of philosophers on conceptual analysis into what the CSIRO research teams count as research expertise. This is a profound lack.

Although these writers seek directly to encourage consideration of the relationship between social processes and integrated research outcomes, the social processes they discuss are not those in the wider society that affect the norms and discourses of the institution's own practices. Since research is embedded in a society that has norms for what counts as research, and the practitioners in the case studies are acting in that society, the way the research institution adopts dominant criteria for success in its research is dependent on the same cultural constraints as it has to unpick and work around. This needs detailed inquiry into the institutionalisation of the research process an inquiry that is closer to social studies of science than it is to say NRM research.

Cases

Kington and Littleboy make the claim that they engage with a range of case studies to evaluate from these how social processes have influenced the general goal of integration. Let me here review these case studies briefly to see how they may cast light on how the authors are viewing and so classifying social processes.

Discipline-fixated lines of thinking give too little weight to local and intuitive processes (Hillier and Gunder (2003) and other papers in *Planning Theory* 2003 and 2004 apply recent work on this to new conceptions of what to look for in planning processes). While case analysis is no surprise for CSIRO's SEI, or LWA's SIRP, the stories of those case studies have to reveal details of person to person interactions in order to analyse how well integration of skills was working. Social science studies social interactions through anecdotes and gestures, as well as articulations and other practices. While scientific descriptions rely characteristically on universalisable discursive frames, new strategies for social and sustainability science are requiring innovative concepts of how measurement frames adequately what is being studied. (see Booth *et al.* 2000). Research team members can pick up skills from these analyses, and if they are informed about the particulars of each case, can then apply them with some hope of success to other cases. It is innovative concepts and an understanding of the processes embedded in the case descriptions that K & L's case studies may provide.

In K & L's paper:

The Case Studies cover areas as diverse as water management, petroleum exploration, agricultural sustainability, regional futures, mining research and greenhouse gas mitigation. Complementary examples have been taken from national and international studies.

These may be diverse within the corpus of biophysical research projects within CSIRO and internationally, yet for producing innovative concepts, an understanding of the processes hindering social process study, and clues to new methodological possibilities for research

integration generally, case studies from one area and mostly one institution can still be very limiting.

Problems in integrating basic social and economic factors into research will of course be highlighted for CSIRO in areas of biophysical research, where these factors have in the past been absent from studies. However integration of social processes *in general* into research projects would prioritize interorganizational tasks. This would place the research as focused on human activities in relation to Earth's ecosystems, i.e. a rather different category to the 'biophysical'. These tasks will not simply raise such problems as did we add this in, and if so, how well and where? 'Social processes' are not objects like water flows, out there to be grasped as single entities and either ignored or controlled. Institutional and cognitive factors are embedded in any research process, even when the researchers' conceptualizations are blind to these. The boundaries assumed by this term 'biophysical' would be transgressed from the beginning. As with urban design, and institutional policy-making, the impact of people on the research focus would unavoidably a part of planning the research and carrying it through from the beginning.

The planning moreover could not, under present (and here largely unexamined) institutional conditions, be along the lines of the principles repeated by K & L from Grigg (1999):

All disciplines should be involved in the project from the beginning, including in the setting of the research question and research methodology . . . [my emphasis]

How would CSIRO realistically achieve this?

An ability to cooperate with scientists from other fields is a minimum requirement, which involves the ability to grasp the core problems and basic theoretical assumptions of some other fields . . .

If 'scientists' includes those who work on social concepts and on people's normative and interpretive frames, what interorganizational capacity developments will CSIRO need to bring these other fields into the research?

Interdisciplinary research requires extensive networks, considerable time, and researchers' mobility among disciplines . . [my emphasis]

Where are the communication and education strategies for achieving that desirable mobility?

Constructing the research as not primarily or only 'biophysical', but involving people from the beginning, might have curtailed the pure irony in several of the research outcomes in K & L's cases, well illustrated in the first three cases:

- The insight that the research had needed to look at the social environment and psychology of its research recipients. [FARMSCAPE]
- That "In a large project, multiple accountabilities can develop which work can [sic] effectively disempower researchers." [Urban Water System programme]
- "[T]he CSIRO project leader has moved into the public sector to push an agenda for better agency interaction." [CHRRUPP]

The emphasis on tools and constraints readily follows I suspect from the starting emphasis on biophysical cases. Once categorization has reinforced the separation of human processes from 'biophysical' ones integrative sustainability is already compromised. Human actions and practices are then either added in as afterthoughts (other 'techniques') or later 'discovered' as sad omissions that are hampering research outcomes.

What is 'human' becomes partly assimilated to the natural sciences, in such an analysis, as if, very like natural processes as isolated in theoretical accounts, social processes could be made subject to additions in technical expertise. In this frame people who 'know' about these processes are other specialists, yet what they 'know' about is so all pervasive, that even as the research is being planned human activities, insights, and shortcuts, intervene. Until knowledgeable social science is reflexively resourced for clarifying the organization of institutions that claim to do integrated sustainability research it is hard to see this changing.

Grigg's three pointers I have quoted, do set up the conundrum, but are no guide to the interorganizational processes that need to take place. For generating interorganizational processes, for involving, cooperating and extending mobility, among diverse scholars, communicational strategies for teams facing complexity have to be designed. The LWA study mentioned earlier presented a strategy for communication of research team insights through the development of an international journal based in Australia (see report UMU14 of LWA's SIRP). This would provide a forum for studying cognitive creativity and innovation in team processes, and would be one way of encouraging interorganizational dialogue about integrating social science knowledges into NRM and similar research. The capacity building needed by teams would also be a theme of research team members' sharing of their experiences, and communicating how they thought through or attempted to conceptualize their team process.

Institutional Personnel and processes of Categorising their Skills

Reflexivity includes for social science noting how it frames its own problems, and how these frames affect the ways problems are approached. This is all good grist for sustainability science. Studying reflexivity can start from quantitative inquiry; and given the background to the Kington and Littleboy paper it is appropriate to examine as an example the following figures (on numbers of people) I have gathered from CSIRO's directory of personnel with SEI (social and economic integration) expertise and interests:

- Social 33
- Economic 23
- Biophysical 9
- Integrative 37

These are not scores in a competition, or any exact rendering of experience or choices, but the figures do record (in an integrated assessment fashion for practical purposes) how many employees of the institution can be listed according to background expertise in various important areas. The lists significantly overlap, so that there are far fewer than 102 separate individuals listed.

Analysis of the names on these lists shows how the fourth list comes to be so many. Economic analysis seems moreover to move readily across into social knowledge. And of course ecological economics, in particular, while departing from economic frames in its own search for better processes for measuring, and implementing human uptake of new procedures, has a practical orientation ensuring its strong representation here.

Critical management studies, human resources theory, the history of accounting and many other humanities and social science disciplines, important for sustainability, utilise work on power and knowledge that I cannot detect among the backgrounds of CSIRO personnel. Historians, anthropologists, literary theorists, policy analysts, qualitative researchers, methodologists, philosophers, researchers in social studies of science, actor network theorists, ethnomethodologists, as well as sociologists, some psychologists and many political scientists

have had strong reasons for reflecting on discursive practices. These researchers from many schools of thinking have formed well-informed responses to, for instance, Foucault's grasp on power and knowledge issues (Rabinow 1984), Lyotard's writing of the post-modern condition of knowledge (1984), and Lacan's work on agonistics (see Hillier and Gunder (2003). This is not one body of techniques to pick up or ask for second-hand, but a well-developed set of overlapping frames, for analysing a set of related central problems, more like a variety of statistical tests than say a general account of survey work.

We all have basic knowledge of water, yet we do not expect that there is no need for a hydrologist, and/or several other specialists in a team carrying out water catchment area research. Integrating say, cultural understanding, institutional considerations and psychological reactions sets us a similar problem of how to integrate insights. My short quantitative study (raw data available for others' reconstructions courtesy of the CSIRO website) is suggestive that the category 'social' is not serving CSIRO well for indicating reflexively its own state of social scientific knowledgeability. The Joint Academies Committee may wish to look further into what this implies for sustainability research in particular.

Engagement

The writers' note that:

The main lesson emerging from CSIRO's recent history into integrated research is that the success of the research is fundamentally determined by the quality of engagement – the support of institutions and managers for the project, the rapport within the project team and the commitment of stakeholders to the goals of the project.

p. 14, beginning of section 'Lessons learned about integrated research'

The Summary to *Integration of the Water Accounts and Benefits Team Research*, a case study presented by Kington and Littleboy in their second appendix, marks clearly the same insight:

The main message is that engagement, both internally and externally, is key [sic] to combining talents and finding a path towards contributing effectively to very complex research challenges. (Dyack 2004)

I find Kington and Littleboy's careful consideration of institutional factors that affect integrated research becoming engaged within the research institution a useful beginning. It is timely and helpful to stress that integrated research *is* expensive and time-consuming, so that a key recommendation for any institution is to reward complex and discipline-crossing work in teams, and to ensure researchers do not impede their careers by engaging with such work.

A comment by Kington and Littleboy towards the paper's end (p. 17) is revealing of their orientation to the wider issues of engagement and the interorganizational processes needed to underpin engagement. Under the heading 'Gaps in governing principles for designing and implementing integrated research projects' they write:

Additionally, much has been made of the difficulty of measuring IP outcomes from social processes since it [sic] does not necessarily conform to the criteria of traditional biophysical research practice. Establishing 'fair' IP ownership rules and measurement criteria would help establish social processes as a respected and valued research discipline [sic].

Their assumed boundaries for this comment are no doubt the institutional processes within CSIRO, but I am concerned to note that this reflects a view more generally of both measurement criteria within the social sciences and a view about the disciplinary bases of studies in social science.

HOW KINGTON AND LITTLEBOY'S CONCEPTUALISATION REFLECTS SCIENCE PRACTICE

As part of one forum within the National Academies Forum to address Sustainability Options, the paper I am examining is inevitably following a path set for it. I shall briefly examine whether the lead up to the National Academies Forum has opened up a dialogue on new ways of conceiving of 'science' and 'research' or whether K & L and maybe other papers are hampered by a dominant earlier conception of science.

TRANSITION TO SUSTAINABILITY *and its Valuing of Social Science Disciplines*

At the Academy of Science Annual Symposium in 2002 on the theme of sustainability, Professor Aynsley Kellow made this point with regard to sustainability's 'social aspects':

Undertaking the journey requires not just good natural science, but also the development of good policy. The humanities and social sciences will be indispensable in this process because it will require the application of ethical judgments, concerns with distributive justice, efficient allocation of resources, the legitimacy of decision processes, and many other processes which are the domain of such disciplines.

Kellow places the humanities and social sciences solidly into a policy context. Kellow comments (see my introduction) on the many expressions in language that are contested yet sustainability science cannot place contested terms to one side as unsuitable for scientific discussion. They need to be worked through as interpretive and normative expressions (Booth 1989). Then we can understand their impact on problems centering on allocation, distribution and legitimacy (Pollard 1998). Once 'science' is evoked, with its values of clarity of expression, laboratory definition and measurement (all reductionist) implicitly valued, the presence of social scientists among the scientists (as opposed to advisers on policy-making) becomes uncertain.

The subsequent 'blueprint' at the Symposium for a "science needed to underpin Australia's transition to sustainability" (Pearman *et al.* 2002) is a further example of unreflexive encouragement to continue science modes from a long past tradition when it states:

Above all, it is about the scientific community helping the wider community make the transition to a sustainable future, in a way that minimises threats to our security, well-being, economic strengths and social imperatives, and analogously for our natural communities. It is also about, where appropriate, the scientific community, with its own particular views and perceptions of the existing and potential futures, demonstrating leadership.

In the blueprint these writers do reflect:

The science that needs to be added is more integrative. . . . Many of our scientists are trained in reductionist science. This in itself is particularly challenging when it is realised that integration in this science is more than interdisciplinary or multidisciplinary. It involves bridging the divide between natural science and social science and the humanities.

Yet is that integrative science – translating across the divide, and avoiding reductionism – admitted vigorously into the present forum on sustainability options? Or are the forum’s sustainability options mostly adding auditing possibilities to well trodden paths?

Batterham (2002) speaking on science adds background to the blueprint:

I do suggest that ultimately one can do no science that is targeting change without also having the contributions from the social sciences and humanities. All things that are asking people to change involve social processes.

But it remains a background element. His listing of “the sort of priorities that might be of interest for Australian science, all of them one way or another having a longer term contribution to sustainability” foregrounds:

- * bushfire research;
- * dryland salinity;
- * plant genomics;
- * biotechnology;
- * child health;
- * moving beyond Kyoto;
- * biodiversity;
- * information communications technology

Only two are (partially) social science topics – child health and ICT. Quite beyond the scope of this list are those concerns for social science inquiry which would enlarge knowledge of political, social, institutional and interpretive practices impeding sustainability – reductionism, category politics, globalization, normative science, consumerism, economic rationality, legitimation, institutionalisation, commercialisation, corporate social responsibility, policy analysis, community knowledge, individualism, tacit knowledge, culture, lifestyle, production, managerialism, interorganizational forms. That science needs ways to integrate these topics into scientific study is what I have been suggesting is the ‘problem of integration’.

Such topics and their past history are core intellectual issues for social science and humanities. They are at the centre of what has to be of concern for a sustainability agenda. Negotiation and collaboration skills and know-how at local as well as national level are what social science can provide and eventually will be providing – there is nowhere else to find them. Social sciences, along with humanities, play substantial roles in social change, not as authorities on limited topics, but as the bedrock of thoughtful deliberation on human processes and cultures. The model for integrating traditional scientific analyses with the complex understanding of contemporary social sciences, taking account of local understanding (see Brian Wynne in Lash *et al.* 1996), communities of practice (Lave and Wenger 1991), and human action and decision-making (Miller, Hickson and Wilson 1996) cannot be one based mainly on science as wise authority. When science includes social science, the critical edge that social science brings to human affairs becomes central in the new integrated methodologies.

WHAT’S WRONG, FROM A SOCIAL SCIENCE PERSPECTIVE, IN HOW KINGTON AND LITTLEBOY CONCEPTUALIZE THE PROBLEM

The Social and Economic Integration initiative (SEI) within CSIRO has a category of ‘Emerging science areas’. CSIRO has recognised the importance of developing policy tools for taking account of equity and social issues in the implementation of economic reform. Writing, as on one website within CSIRO July 2004, of including “both biophysical and human factors for change” or of integration of social and economic metrics with biophysical metrics, may be

practical within a context where biophysical has not so far included humans. Once this has been begun, the discursive shift to placing humans and biophysical processes within one context so that the impact of one on the other can be accommodated is paramount. Another step to take then is finding ways to relate economic metrics to social understanding, to cultural constraints, to frameworks of value. These steps are what sustainability is about. Mentioning them indicates how far we have to go, in training, in joint understanding and in institutional initiatives.

The issue clearly involves a difference of interpretation, where one frame suggests social and related factors being integrated into ongoing biophysical research while the other places the onus of integration onto getting together processes in which a variety of forms of inquiry – humanistic, social scientific and natural biophysical – do share effectively ways of reaching understanding and making progress, making new knowledge and new forms of integrative assessment possible.

My initial reaction (as a fellow traveller with social scientists) to Kington and Littleboy's placing of 'IP' regarding social processes was: How can these writers put 'social processes' alongside the desideratum of a 'respected and valued research discipline' as if a single entity were waiting to be 'established'. Yet I can see on reflection how from the perspective of the culture of biophysical research practice, it is 'natural' wishful thinking, to believe that maybe just one set of related entities has to be added. For them no doubt many very different disciplines are brought together to examine complex biophysical processes. Adding in 'social processes' will seem to them a single process supported in its conception by the way our present online forum is constituted: i.e. alongside water, energy, regions, urban systems, and institutions we have social processes to consider. Let's search for the experts in that particular area and then we can assess on-going procedures using their established criteria.

Sociology, anthropology, psychology, economics, political science etc. do not use 'empirical' data in the same ways. This is for sound reasons stemming from their historical development. Moreover they have practitioners within their boundaries who disagree over methodology as well as theories and data, and they do not usually generate usable IP. The social sciences are diverse and there is no one discipline. IP features less when the commercialisation of findings is rarely an issue, but the absence of saleable techniques, of final outcomes, of definable 'products', does not show these disciplines to be of less value, just different from biophysical studies. It is the complexity of human activities, cultures and cognitions that leads to this. This is what sustainability science has to set about integrating into scientific practice. The National Academies Forum is an occasion for generating better understanding about these differences of process.

While I hope my response to K & L suggests the expertise involved in social science work, and its variety of approaches, the study of key boundaries for inquiry and of methods taken up historically by those different disciplines of social science is complex. I cannot simplify it here. What I shall try to do is underline where capacity to work with complexity is available in social scientific work and how this can be used to understand integrative processes for research teams studying sustainability.

Efforts to construct interdisciplinary knowledge in social science do not help establish a single body of expertise. If this were to happen it would indeed be reductionist and not a science of humans but an attempt to control them. Earlier efforts at categorizing the interdisciplinary (before say 1995) now employ 'trans-disciplinary' (Somerville 1998, cited in the K & L paper,

is an example). Adding in disciplinary techniques, as if once this was complete the study could have everything, is replaced conceptually by the skill of moving between disciplines with knowledge of their presumptions and assumptions. The trans-disciplinarian can thereby keep moving and stay upright, while negotiating a terrain full of holes for the unwary. Think of a streetwise traveler who can find her way confidently around several cultures and through their capital cities. I prefer the term 'post-disciplinary' as some of the skills and expertise will be valuable in moving through terrain previously unexplored and not the expertise of any discipline group.

The post-disciplinarian in this sense can cope to a degree in the jungle of complexity. When problems of uncertainty and of public concern for risk are examined by Funtowicz and Ravetz (1991) under the rubric 'postnormal science' (reviewed in Booth *et al.* 2000) the science they envisage is based on an ability at translating across disciplines as broadly different as policy-analysis and cultural studies and still finding the insights for acceptable and reasonable action. How to do the translating and how to acquire the skills to be insightful is a major part of what an inquiry into integrative sustainability assessment has to look into.

Post-disciplinary expertise does not supplant the skills of those trained in disciplines; forming a workable model of collaborative research means making disciplinary know-how useful by members of research teams. This implies finding ways of skillfully sharing (translating between frameworks) their sometimes contradictory practical understanding. This is what I expected to find in the paper, but mainly perceive only in places where the paper indicates where institutional change will be needed. By noting that case study outcomes are often ironic, and that procedures and lack of engagement often hinder achievement the paper further reflects the difficulties.

HOW COULD A SOCIAL SCIENCE PERSPECTIVE DEAL WITH THE PROBLEM OF INTEGRATION?

I shall turn more directly now to this problem of integration as I have outlined it. A prior question, however, taxing K & L's writing at times is what has to be integrated in case studies, and why is that integration so difficult? On the institutional factors in this K & L's account is I think a timely beginning. The research *is* time consuming and frustrating, and needs carefully placed rewards if it is to flourish.

Kington and Littleboy do start to write directly in general terms similar to mine of what social scientists offer integrative research. They state:

An important learning from the Case Studies is that social processes are not necessarily about public participation. Any form of integrated research involves, by definition, the participation of different disciplines and cultures. Occasionally, these are all brought together within a single researcher. More often, (and in all of the Case Studies presented above) it requires the coming together of a team of researchers.

In reflecting further on the team process however, the paper returns to engagement:

At the beginning of any integrated research, it is important to consider the questions "who am I trying to engage with, why am I trying to engage with them and when should I engage with them". The answers to these questions will define the nature of the social processes to enable the necessary integration. . . [emphasis in original]

Yet the interorganizational, let alone transcognitive, puzzles that this query raises remain unfocused. The questions are angled too much towards the individual research leader, and not towards much more difficult questions of integrated process. What the paper then addresses is morale and the 'nature' of individuals:

And if behaviour is so important, then individual characteristics and team morale are important and the researchers' personalities and levels of commitment are critical to successful integrative teamwork.

I outline below how the subsequent writing up on engagement of individuals could be more responsive to the questions of how to integrate the research process.

Although K & L draw on earlier research into interdisciplinarity, e.g. Rossini and Porter (1979), Klein (1990), Miller (1994), Somerville (1998), it will be clear that I do not think the paper follows through on the implications of two of its comments:

- *Any form of integrated research involves, by definition, the participation of different disciplines and cultures.*
- *In many instances, it may require the participation of individuals and groups from outside the research team.*

Insights and concepts anthropology, ethnographic research, social studies of science, action research, ethnomethodology, and further approaches to human processes and cultures could introduce into research teams, through their analyses e.g. of norms, of interpretive frames, of laboratory life (Latour and Woolgar 1986) disappear in K & L's framing of the issues. They are absorbed into an individualised study of engagement as character. By contrasting this absorption to comments I make below that are skill-oriented, I hope to illustrate in practice how a social science background, especially if interorganizational collaboration makes possible more sharing of social scientific know-how, might contribute to how integration within teams occurs.

Integrated sustainability assessment procedures need to focus on "doing things differently" as well as "thinking differently" about research" as K & L acknowledge towards the end of the paper. I agree with their judgment there that "there is a clear distinction between disciplinary based integration and new forms of interdisciplinary research" and also with their judgment that "no solidly defined terminology" yet gives this a framework (for some reasons for this see Rodgers *et al.* 2004).

K & L do not follow up the implications of recognising the skills involved in creating new knowledge across disciplinary lines. Since those skills are poorly understood they are not being counted significantly as skills of research. Thinking about capacities is then dominated by the additive notion of integrating prior expertise, rather than pursuing ideas for capacity building in transdisciplinarity. Sustainability assessment options could include (or focus) on whether cases of research achieved the integration of some of the topics of social science research I noted above. Simple checklists for social science concepts and their analysis would be a start. The ASSA and AAH could play a role in setting these up by surveying fellows and other social scientists and humanities scholars for what to include. These topics would then become a focus within teams of researchers, replacing the 'engagement characteristics' on which K & L focus. I can briefly illustrate this.

One of the case studies on which the paper under review puts emphasis shows how easily traits and skills of team members can become confused with communicational and analytical skills stemming from study or acquaintance with key social science

topics and concepts. K & L's second appendix lists characteristics that individual members were taken to need from a draft of a case study (Dyack, 2004) within a broader project: WATER FOR A HEALTHY COUNTRY FLAGSHIP. It is presented here as an integration case study within the Flagship's goal of identifying opportunities for increasing the benefits derived from improved water use in Australia.

The draft is insightful in discussing both external social factors and the internal processes within teams of researchers, and in this it mirrors the organization of the Kington and Littleboy paper. The roles of culture, community processes, understanding and concepts, framing of issues, and both psychological and political factors are left pending presumably as externalities of the team process of understanding and evaluating tradeoffs in the Murray region as a whole. Personal characteristics, on the other hand, are presented as 'Keys to Engagement' and make sense as a first guess at desirable conduct, as viewed by an outsider. However, these also convey biases towards 'expertise' as science rather than social science, and to communicational ability as a personal character trait. I give the elements of their list in bold, each time followed by my comment, and some of the social science behind the comments:

- ***Trust in each other's expertise without having to learn each other's expertise;***

Trust suggests indeed 'not questioning', and not trying to become familiar with the assumptions on which the other's contribution is based. Clegg and Hardy (1996) point out using Luhmann (1979) that "power is in fact a 'functional equivalent' of trust in ensuring predictability in coordination" (1996: 679). The conceptual shifts needed in sustainability discourse cannot simply respect another's theorising – they have to be ways of examining say, a tradition's measurement processes, so as to make better connections (see Booth, 2000).

- ***Bravery to 'go out on a limb' and risk debate and challenge;***

Bravery is not directly a skill, while learning where others are coming from is the beginning of one. The skill in putting previous 'normal science' knowledges into a wider picture requires more than debate and challenge (see the critique of the adversarial manner in some humanities' debates in Harding and Hintikka 1983). Translating from other frameworks needs a scholarly skill in 'situating' those knowledges (Haraway, 1988).

- ***Openness to share the full extent of what each has to offer as well as to challenge what others present;***

This usefully corrects the heroic stubbornness implied by bravery, yet 'the full extent' is a tall order, and the humanistic importance of listening skills (Carl Rogers, see e.g. Anderson 1973) implies far more than 'offering' to share. 'Challenging' is here openly adversarial.

- ***Ability to question ourselves and others – even caring enough to make the effort required to question;***

Drawing on others' experiences and inviting them to make themselves clearer in the way they present stories and cases would match work on distinguishing 'understanding' from 'expertise' or knowledge (Flyvbjerg, 2001). But the reticence of the added comment suggests needing an effort – being lethargic – and so uninspired by shared understanding. The ability to ask key questions, in a timely way, is a primary active skill of engagement resting on experience and past involvement.

- ***Tenacity so that we can persist with a process that is not easy;***

Uncertainty and high decision stakes in post-normal science (Funtowicz and Ravetz 1991) require tenacity for sure. Older forms of 'knowledge' (Gibbons *et al.* 1994) only had to convince disciplinary peers. Once public relevance makes the social complexity arduous, through involving those who wish to contest key concepts in the ongoing debates, the legitimacy of understanding will rest on carefully pursuing details beyond previously existing boundaries. Sustainability science will never be easy. And crossing the boundaries will require skill as well as persistence.

- ***Patience with others and the process even though the process is uncertain;***

The problem is usually one of placing the process itself. For a lively pedagogical example think of 'measuring' the coastline of Australia (using say a centimetre ruler, or one a kilometre long) for very different purposes: tourism, spotting illegals, doing a study of bacteria or algae, supporting fisheries, being concerned for dune rehabilitation, or watching for unstable geological features. Note that the uncertainty here is not in the answer – what is the length of the coast? – uncertainty comes from the diversity in human purposes, practices and frames. In more complex problems, the earth as trickster (Haraway 1988) will also require skill to manage and to respond.

- ***Accepting of the intimacy all this necessary engagement engenders.***

Private interactions and public discourse – both keyed indissolubly, as distinctions both to gender and to rationality (see Lloyd 1993) – do help in conceptualising dilemmas of sustainability science. Dualisms however (to engage or not to engage, that is the question) evoke many processes in which researchers, as social beings, are entrapped. Skill at moving around these trammels is still at a premium and I have been arguing that many and varied areas are involved and I certainly would not exclude intimacy (Booth 2000). But I do add that both its study and its practice involves skilful action; and the skills of intimacy are the skills of democracy (Giddens 1992).

These 'characteristics' are all aspects of self-presentation, as subjectively 'trustworthy, brave, open, questioning, tenacious, patient and closely engaged'. By amending them through commentary I have tried to indicate how such subjective self and other categorisations interweave with careful judgments about particular skills. Three decades of social science constructivism (Shotter 1993; Parker 1998) have clarified that what people do as skilled action in performance is not necessarily the same as what they present as characterising their subjective selves. More importantly there are

outcomes to these social constructions. Skilful performance as a team member, assessed as a contribution to collaborative integrative research, requires not subjective character traits but intellectual capacities at translating between frames of skill and conceptual forms. We may gloss these capacities as ‘understanding and working with diverse others’ but do not be deceived: a social scientist does not read this reduced statement as would most natural scientists, indeed a historian does not read it as would a psychologist, nor an ethnomethodologist as would a lawyer. Nor of course are any of these categories of disciplinarian in social science themselves unitary.

The complex communicational skills developed in social science research are now comparable to being able to do and apply mathematics. They constitute abilities at integrating experiences with theories without privileging either. These are not simple primary and basic social science skills like how to conduct an interview or how to phrase a question in a survey. We are not examining here something like the social science equivalent of how to pour acid into a test tube, nor something character forming like keeping your nerve. These capacities are more like knowing when to do a statistical test and how to interpret the resulting figures. Michael Polanyi (1962) expressed the complexity well using the example of reading an X-ray, interpreting the signs more and more as an experienced practitioner, through practical knowledge beyond what a beginner can conceive.

When Dyack (2004) in the draft of a case study in K & L’s appendix comments:

The vital team characteristics include a need for continuity of team members and management so that the unique integration process that evolves keeps evolving

I strongly concur. Her further point that one “key is good mentoring of new members” itself gestures towards skills needed for a sounder grasp of integration.

While stages in research such as understanding, strategy, implementation and evaluation, certainly warrant careful reflection, there is a danger here that these are seen as sequential terminating in established methods for assessment. Although action research casts similar stages as following each other, this methodology continues iteratively in a long-running spiral with no terminating point. Frames of planning, acting, observing and reflecting follow one another along the spiral. Examining people processes, and their institutional contexts, is not an art, unfit for study by scientifically-minded people unless they have artistic aptitude, it is a useful set of skills fostered within the social sciences and humanities and also working for practical purposes outside these. Social sciences can work alongside other sciences as equals in tackling sustainability questions that are problematic and need integrated study. Integrative assessments will then be products of both social and natural studies *at the same time*.

CONCLUSIONS: RECOMMENDATIONS FOR A SOCIAL SCIENCES / HUMANITIES PERSPECTIVE ON SUSTAINABILITY SCIENCE

Social science and humanities’ work on meaning and on meaningfulness, on cultural and disciplinary backgrounds, on frames of analysis, discursive practices, tacit knowledges and strategies, on categorization, action and discrimination, is now much closer to philosophy than in its earlier more reductionist days. In this sense social

scientific work has come closer than it ever has been to mathematics. Social science (and much work in the humanities) is building a contemporary body of work on frames of thought, of cognitive and cultural innovation and of new processes (artistic and scientific and both together) for thinking through and grasping (socially elaborating) the complex sharing of processes, concepts and procedures. Studying in social and humanity faculties at universities may not produce **absolute** bodies of knowledge, but like philosophy or pure mathematics as a training, what it establishes as cognitive resources has great depth and constant contemporary relevance.

I agree with the blueprint paper from the Australian Academy of Science Symposium (Pearman *et al.* 2002) that sustainability science:

is likely to need new methodologies, newly trained people, and perhaps new institutions. There is a need for networks and collaboration across disciplinary boundaries, political boundaries, institutional rivalries, etc., that transcend anything that has gone before. . . . it must be recognised that time is running out; now is the time for action. (emphasis in original)

The Joint Academies Committee might consider:

- (1) communications and networking strategies to promote discussion between their fellows on sustainability research projects,
 - (2) strategies for encouraging participation in local sharing of issues by fellows working on sustainability from *all* the academies, by their disciplinary colleagues and especially by their trans-disciplinary peers,
 - (3) promoting an international journal, based in Australia, for sharing skills in team work processes from NRM and similar teams of researchers,
 - (4) assessment options that examine directly how well humanities and social science knowledges, techniques and concepts are entering sustainability analyses,
 - (5) a gathering of examples of relevant knowledges, techniques and concepts from fellows and their colleagues so that (4) is carried out in a well-informed and comprehensive way.
- (5) will require thinking of ways to develop discussion between natural scientists and groups from humanities and social science arenas that have a special interest in social studies of science, ethnomethodology, communities of practice, local and cultural knowledge, modes of research in various social sciences and creativity management processes in organizations (including management of tacit knowledge – see Baumard 1999). Knowledge and understanding of these research areas and their concepts and methods is scant among biophysical researchers.

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