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BIOGRAPHY

John Robinson is executive director of the University of British Columbia (UBC) Sustainability Initiative and a professor at the university's Institute for Resources, Environment, and Sustainability, and the Department of Geography. In his role in the UBC Sustainability Initiative he is responsible for integrating academic and operational sustainability on UBC's Point Grey campus.

His own research focuses on the intersection of climate change mitigation, adaptation, and sustainability; the use of visualization, modelling and citizen engagement to explore sustainable futures; sustainable buildings and urban design; creating private/public/NGO and research sector partnerships for sustainability; and, generally, the intersection of sustainability, social and technological change, behaviour change, and community engagement processes. A major current project is the development of the research and partnerships programs relating to the new Centre for Interactive Research on Sustainability (CIRS), now under construction on the UBC campus.

Dr. Robinson is a member of the BC Hydro External Advisory Committee on Electricity Conservation and Efficiency, and the Program Committee of the Pacific Institute for Climate Solutions; on the board of the Sustainable Cities Foundation and the Pembina Institute; a member of the steering group of HELIO International; and on the editorial boards of the journals *Integrated Assessment*, *Ecology and Society*, *Building Research and Information*, and the *Journal of Industrial Ecology*. He is a Fellow of the Trudeau Foundation and has been a lead author of the last three reports of

the Intergovernmental Panel on Climate Change, which won the Nobel Peace Prize in 2007.

ABSTRACT

How do we, as researchers or practitioners, come to grips with daunting societal issues like sustainability? What kind of knowledge do we need, and how do we use it in the service of social change? Can we combine academic work with social engagement, theory with practice? This paper will explore some of these questions in the context of an academic career that has been driven by a felt need to contribute to an urgently required process of societal change in the direction of sustainability. This has led to a focus on what I call "issue-driven interdisciplinarity," a sometimes uneasy, but always inspiring blend of research and community engagement, aimed at combining various kinds of "expert" knowledge with public values, attitudes, and practices in support of a transition towards sustainability. In reflecting on these issues, I will try to draw some lessons from many years of attempts to pursue issue-driven interdisciplinarity as it applies to energy, climate change, gaming and simulation, buildings, and urban sustainability, and conclude with some discussion of where we plan to take such work in the future.

LECTURE

On Beyond Zebra: Being Undisciplined in Support of Sustainability

Ryerson University

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Introduction

I would like to start with a brief quotation from one of my favourite authors:

> Said Conrad Cornelius o'Donald o'Dell,
> My very young friend who is learning to spell:
> "The A is for Ape. And B is for Bear.
> The C is for Camel. The H is for Hare
> The M is for Mouse. And the R is for Rat."
> "I know all the twenty-six letters like that…
> … Through to Z is for Zebra. I know them all well."
> Said Conrad Cornelius o'Donald o'Dell.
> "So now I know everything anyone knows.
> From beginning to end. From the start to the close.
> Because Z is as far as the alphabet goes."
>
> Then he almost fell flat on his face on the floor
> When I picked up the chalk and drew one letter more!
> A letter he never had dreamed of before!
> And I said, "You can stop, if you want, with the Z.
> Because most people stop with the Z.
> But not me!!!
> In the places I go, there are things that I see
> That I never could spell if I stopped with the Z.
> I'm telling you this 'cause you're one of my friends.
> My alphabet starts where your alphabet ends!"[1]

1. Dr. Seuss, *On Beyond Zebra* (New York: Random House, 1990).

I do not want to pretend that I can elevate my career to the sublime level of Marco, Dr. Seuss's protagonist in *On Beyond Zebra*, but I confess to a strong degree of sympathy with Marco's attempt to go beyond the conventional alphabet to try to find new ways of expressing our understanding of the world. So I take Marco as a kind of guide for what I have been trying to do in my career: help to create new forms of interdisciplinary understanding and practice in support of sustainability.

In this paper, I want to talk about four things:

1. The way we were: a brief overview of the intellectual climate of the 1970s
2. The meandering path: a potted history of attempts to apply the insights derived from that experience
3. Being undisciplined: some lessons learned from those attempts
4. Further on beyond zebra: fostering societal change in the service of sustainability.

The Way We Were

Though now somewhat lost in the mists of intellectual history and overtaken by more recent events, the 1970s was an exciting time to come to intellectual maturity. I want to reflect briefly on what were to me, as a graduate student struggling to come to grips with environmental issues, some of the key currents of thought that appeared to be highly relevant to my efforts. I believe that some of the questions raised at this time pose intellectual and practical challenges that are still very relevant today.

In painting this picture of the intellectual climate of the 1970s, as seen from a very particular and limited perspective, I want to start with the context. As some may recall, this decade was famously labelled as the "Me Decade" by Tom Wolfe in 1976.[2]

2. Tom Wolfe, "The 'Me' Decade and the Third Great Awakening," *New York Magazine*, August 23, 1976, 26-40.

Wolfe meant to mark a contrast between what he saw as an individualistic, narcissistic, and selfish turning away from the more socially concerned and communitarian 1960s. As a high school student in Ontario in the late 1960s, and then an undergraduate at the University of Toronto in the early 1970s, I had witnessed the late flowering and withering away of the view that inserting flowers in rifle barrels was a sign of the impending revolution,[3] but had also been heavily influenced by what I saw as the underlying call for a more just, more egalitarian and progressive, and more environmentally benign world. It seemed clear to me at the time that this was the right goal to be striving for, and also that the world was then on a rather different trajectory.

A key component of this vision was its focus on environmental concern. In important ways, the modern environmental movement grew out of the social ferment and analysis of the 1960s, and wove together that social and cultural concern with earlier debates over the preservation and conservation of wilderness, and urban health and sanitation, that had their roots in the late 19th century. What emerged in the late 1960s and early 1970s, in the wake of Rachel Carson's path-breaking *Silent Spring* in 1962, was a series of critiques of modern industrial society, ranging over Lynn White's *The Historic Roots of our Ecologic* Crisis (1967), Garret Hardin's *Tragedy of the Commons* (1968), Ken Boulding's *Economics of the Coming Spaceship Earth* (1968), Paul Ehrlich's *Population Bomb* (1968), Barry Commoner's *The Closing Circle* (1971), *Ecologist* magazine's *Blueprint for Survival* (1972), the Club of Rome's *Limits to Growth* (1972), Barbara Ward and René Dubos' *Only One Earth* (1972), Schumacher's *Small Is Beautiful (*1973*)*, and Herman Daly's *Towards a Steady State Economy* (1973), to name only a few of the most prominent.

3. For a strong critique of this approach and of the very idea of the counter culture, see Joseph Heath and Andrew Potter, *The Rebel Sell: Why the Culture Can't Be Jammed* (Toronto: HarperCollins, 2004).

While there are significant differences in the specific arguments put forward in these documents, what was common was a sense that humanity had reached or was fast approaching a watershed in its relationship with the natural world and coming up against natural constraints and limits that required major changes in human behaviour, technology, institutions, and policy.

These views were powerfully reinforced by the "Energy Crisis" of 1973-74, which seemed to confirm the view that the world was running out of oil, the most important and pervasive natural resource.[4] At the end of the decade, large increases in the price of oil associated with the Iranian Revolution also triggered fears of shortages.

So the stage seemed set, by the end of the 1970s, for major changes in policy, behaviour, and institutions to reflect the emerging reality of a resource-constrained and -limited world.[5] But meanwhile, a very different set of events was unfolding in the academy, events that seemed to call into question, at a fairly deep level, some of the underlying tenets of the environmental argument about the role and status of scientific understanding in society.

For me, the core arguments on this issue emerged in the history and philosophy of science, where Thomas Kuhn's *The Structure*

4. In fact, while the energy crisis led to lineups, and a few deaths, at the gas pump in the United States, actual oil deliveries from the Middle East to North America did not decline following the embargo. However, a number of oil tankers developed mysterious engine troubles in mid-Atlantic, which delayed their arrival in North American ports, while oil prices rapidly rose on a daily basis (John Blair, *The Control of Oil* [New York: Pantheon Books, 1976]).

5. In the event, such changes did not transpire, in large part due to the emergence of a world oil glut in the mid-1980s, which took the wind out of the sails of the view that we were imminently running out of oil. The major drop in the real price of oil that ensued in the 1980s led to a massive drop in plans for and investments in energy efficiency and alternative energy supplies, and a corresponding evisceration of energy policies that promoted such approaches.

of Scientific Revolutions had burst on the scene in 1962. Building in part on arguments made by Stephen Toulmin, Norman Hanson, and Michael Polanyi, Kuhn presented a picture of the development of natural science that was shocking in its implications for those who had more or less subscribed to the empiricist idea of science as telling us true things about the real world, based on verifiable empirical observation. Kuhn introduced the term "paradigm" to convey his view that what he called "normal science" was based upon a combination of exemplary experiments and understandings, and underlying epistemological commitments and beliefs that were themselves incommensurable and not verifiable in any ultimate sense, and subject to being overthrown in scientific revolutions.

Kuhn's work set off a firestorm, not only in the history and philosophy of science, but also across the social sciences. The term "paradigm" became one of the most common (and perhaps most misused) terms in many social science disciplines,[6] and the epistemological implications of Kuhn's work became the basis for a whole series of significant debates. A key challenge seemed to be one of reconciling the apparent relativism of Kuhn's work with the view that scientific progress was possible and scientific knowledge was reliable.[7]

Across many fields, a form of anti-realist epistemology seemed to my impressionable eyes to loom into view. Whether it was Peter

6. Margaret Masterson famously found 44 ways in which the term "paradigm" was used in Kuhn's own work (Margaret Masterson, "The Nature of a Paradigm," in *Criticism and the Growth of Knowledge,* eds. I. Lakatos and A. Musgrave [London: Cambridge University Press, 1970], 91-196).

7. Ironically, Kuhn invented the concept of paradigm precisely in order to rescue science from the strong relativism implied in the work of authors like Hanson and Toulmin. This comes through very clearly in an early work of his: Thomas Kuhn, "The Function of Dogma in Scientific Research," in *Readings in the Philosophy of Science*, ed. B. Brody (Englewood Cliffs, New Jersey: Prentice-Hall, 1970), 356-373.

Winch talking about understanding a primitive society, Isaiah Berlin talking about understanding political theory, Clifford Geertz taking an anti-anti-relativist stance, Karl-Otto Apel on the tri-lemma of epistemological justification, Ernst Gombrich on art and illusion, Leon Festinger on cognitive dissonance, Benjamin Whorf on language and meaning, Robert Ornstein on admitting other forms of knowledge to a new humanistic psychology, Lawrence Tribe on the limits of instrumental rationality, Piaget and Bruner on constructivist developmental psychology, Jürgen Habermas on science as a knowledge-constitutive interest, Thomas Berger and Thomas Luckmann's pioneering work on the social construction of reality, Merleau-Ponty on the phenomenology of perception, or George Steiner on language and translation, there was a sense that truth claims based on empirical observation now had to be relativized to some degree as a result of the active role of paradigms, schemata, frameworks, and other epistemological structures in shaping our perceptions and our interpretations.

Of course this is not to say that all of these very varied authors were in agreement with each other, or that their work presented a unified or consistent view of the many issues about which they were writing. On the contrary, major disagreements existed on key issues. But it seemed to me, as a graduate student struggling to find some theoretical or conceptual ground on which to stand, that these authors collectively reflected the emergence of a form of skepticism about truth claims that had to be taken very seriously in my own work.

This skepticism seemed to me to have particular force in a key arena of environmental discourse and debate: the idea that science and technology could provide objectively true and value-free understandings of the nature of the environmental challenge we faced. This idea was strongly rooted in much environmental literature, which was full of formulations that could in essence be reduced to the claim that "ecology proves" that we are running out, doing harm, or exceeding limits. At the same time, however, some environmental

discourse, reflecting in part its counter-cultural roots, was explicitly critical of scientism and the role of science and technology in creating and supporting modern industrial society. Sometimes these two rather different views about science were expressed in the same writings.

To me, as a budding graduate student in the late 1970s, what was exciting about all this was the sense that the developments I have been discussing might all come together. The links between environmentalism and the social, political, and cultural developments of the 1960s were of course explicit. Both suggested the need for some kind of transformation of modern industrial society towards more socially progressive and environmentally benign outcomes, though there was plenty of disagreement about what exactly had to change and how. But it was the more theoretical arguments in the social science literature that I found most exciting. The various epistemological challenges to conventional empiricist approaches to knowledge and understanding seemed to me to suggest that it would not be enough to marshal strong scientific arguments in favour of changes in behaviour and policy. Rather, what was at stake was the concept of rationality underpinning the whole modern enterprise. If we think of the course of the last few centuries of Western development as encompassing the progressive application in many fields of the implications of an essentially mechanistic and empiricist view of nature and society first clearly articulated in the natural sciences in the 17th century,[8] then what the writers I have mentioned seemed to be offering was a critique of that enterprise. This critique sug-

8. On this point, see Morris Berman, *The Reenchantment of the World* (New York: Bantam Books, 1984) and Richard Tarnas, *The Passion of the Western Mind* (New York: Ballantine, 1991). I have explored this argument in about 25 years of teaching several courses on the history and philosophy of environmental thought. I am grateful to my colleague Bob Gibson, with whom I taught two versions of these courses for a number of years, and to many generations of students at the University of Waterloo and UBC from the mid-1980s to today, who helped me refine my thinking on these issues.

gested that we needed to replace our conventional conceptions of truth, objectivity, facticity, value neutrality, and so on with a new account that was more contextual, more culturally conditioned, and more focused on social processes of knowledge creation and understanding.

As a result of these considerations, I found myself on the side of the environmental argument that was skeptical of the views that environmental and social concerns could be unambiguously demonstrated by finding out the facts of the matter, or that truth and value-free objectivity were the most useful ideals in addressing complex issues. Instead, as I tried to argue in my dissertation, what were needed were processes by which we could collectively construct viable understandings of sustainability issues, guided more by criteria of coherence and fruitfulness than by consistency with reality or objective truth.[9] In the words of Donald Michael, which provided the title of my dissertation,

> What is needed here is a state of mind, a state of being, in which [we] see [ourselves] as creating viable and humane but temporary myths, rather than seeing [ourselves] as describing "objective reality." Both feet planted firmly in mid-air. Because once one moves away from recognizing the need to live in a world of temporary myths, one runs the grave risk of coming to believe that the myths one creates are *the* reality.[10]

In retrospect, the twin desires to contribute something concrete to the kinds of changes that I felt were needed in the world, and simultaneously to better understand the underpinnings of the thinking that has given rise to that world, have shaped most of my

9. John Robinson, "Both Feet Planted Firmly in Mid-Air: An Investigation of Energy Policy and Conceptual Frameworks," PhD thesis, Department of Geography, University of Toronto, 1981.

10. Donald Michael, "Planning's Challenge to the Systems Approach," in *Futures Research—New Directions*, eds. Harold A. Linstone and W.H. Clive Simmonds (Don Mills, Ontario: Addison-Wesley, 1977), 98.

subsequent activities in and out of the academy. And the tension between these two goals has been a fruitful source of motivation for me.

The Meandering Path

From one point of view, accepting the constructivist approach to sustainability[11] described above gives rise to very serious problems. How are we to make convincing claims about the need for significant societal change if we reject the authority of truth and objectivity? Both those who are skeptical of the need for such change and those who most passionately argue for it typically rely heavily on the use of scientific research to buttress their position. As Habermas has said, science is the epistemological arbiter of our age; there is no other comparable source of authority for our claims about the world around us. And integral to our concept of science are precisely the concepts of truth, value-free inquiry, and objectivity. What are the alternative bases for sustainability analysis and proposals if not those ideals?

One way to approach these issues is by redefining the question a little, and shifting the focus from the content of scientific work to the question of the social role of science and the technology to which it gives rise.[12] Work in fields such as the sociology of scientific knowledge, the social studies of science, science and technology studies, and the social control of technology has given rise to a rich body of theory and analysis of how scientific knowledge is created and validated, and how applied science and technology connect to

11. I shift here to "sustainability" from "environmental and social concern." Since the term "sustainability" did not come into widespread use until the early 1990s, this language is a bit anachronistic in the early part of this section. However, it best captures the complex of environmental, social, and economic issues I will be talking about in this paper.

12. As Kuhn pointed out, this is a standard move in scientific revolutions. A new paradigm does not so much give new answers to old questions as it changes the questions that are seen to be of interest.

social processes. The picture they paint is of a very human process of knowledge constitution and application, in which certain values are deeply embedded and reinforced, and alternative frameworks of understanding and interpretation are developed, contested, and applied. The cultural context of such activities plays an important role in determining not only what gets studied, but also how, and with what results. In most such work, the focus shifts from questions of truth and objectivity to questions of coherence, fruitfulness, and relative consistency with the evidence.

In my view, such approaches provide a pragmatic way forward out of the apparent impasse presented by constructivist accounts of human knowledge production. Moreover, such accounts do not undermine but, rather ironically, reinforce two of the core methodological principles of modern science: peer review and replication. If what is going on in our attempts to understand the world is less about discovering objective truths and more about building a coherent body of understanding that is consistent with our other understandings of the world, and stands up to our various attempts to test it empirically (which to be sure are themselves to some degree theory-dependent), then the processes of peer review and replication become the major ways in which we can be sure these tests are met. Put another way, to the extent that our various understandings of the world are necessarily socially constructed,[13] the social processes of peer review and replication offer a route to some kind of intersubjective agreement on what is the case. This formulation does not depend on any claims as to the "objective truth" of such agreements.

13. I do not address here the ongoing debate about *the degree to which* reality is socially constructed. While this is a very important question, it is enough for my argument in this paper to claim only that such social construction exists, and leave unanswered the question of how far it goes. I tried to provide one answer to that question in my dissertation, based on a strong form of epistemological relativism (see footnote 9); my position today would not be very different.

It acknowledges that such understandings are inherently provisional, and subject to being changed by the communities involved, but recognizes that they can nevertheless be very robust at any given time.

Guided by this kind of understanding, my own trajectory through the sustainability field focused initially on two questions: how do we best address future states of the socio-ecological systems we are interested in? and what do we mean by sustainability if we can no longer rely on science to tell us unambiguously what it is? My initial work in the 1970s on these issues focused on energy questions, as I had become convinced that energy was a key point of entry into the key questions at issue. The type of energy system we would have in the future would go a long way to determining the environmental and social consequences of our activities.

Backcasting

In the mid-1970s, Amory Lovins electrified the energy world with his argument that the world faced a choice between two approaches to energy futures. These were the hard energy path, characterized by continued rapid growth in energy demands, continued reliance on large-scale centralized energy supply systems, and an inevitable eventual switch to a fast breeder nuclear power–based energy system, and the soft energy path characterized by a strong commitment to energy efficiency and to energy supply sources that are diverse, renewable, flexible, and matched in scale and quality to end-use needs. Lovins's arguments laid the conceptual basis for the development of an alternative energy movement around the world, and strong echoes of his approach still inform the arguments of most advocates of renewable energy or climate change mitigation. Just as important as his substantive arguments, however, was a methodological argument he made about how to analyze energy futures. Building on the earlier work of Herman Daly, Lovins argued that instead of trying to predict the most likely energy future we

should articulate the outlines of our preferred future and then analyze how to get there from here. His first application of this approach was in Canada, in a study done for the Science Council of Canada in 1975, a year before his famous article in *Foreign Affairs*.[14]

In my opinion, this methodological argument of Lovins's, which was contemporary with the development of the celebrated Shell scenario approach but went beyond it, represented a fundamental challenge not only to the practice of predictive energy demand forecasting that was essentially universal at the time in the energy field, but also to the implicit epistemology underlying that practice. According to positivist philosophy of science, successful prediction is the fundamental goal of scientific explanation, and thus the measure of scientific understanding. Reflecting this approach, most scientific and economic modelling is explicitly intended to predict the future outcomes of the system being modelled.

Energy demand forecasting takes place in this same framework and is generally oriented toward providing governments, utilities, or other energy companies with the best scientific judgment of the most likely level of energy demand in the future. The models used for such analysis are thus explicitly predictive, intended to produce outcomes that converge on likelihood. Where policy alternatives are to be compared, much energy is spent on producing "base case" projections, representing the most likely future trajectory of energy demand, which can be altered to reflect the estimated impact of the policy measures under consideration.

The Lovins approach suggests we turn the question around and ask not where we are most likely to be in the future but where we would like to be, and then how to get there from here.

14. Amory Lovins, «Energy Strategy: The Road Not Taken?» *Foreign Affairs* (October 1976), 186-217. That article led to the most reprint requests in the history of that prestigious journal and to the commissioning of dozens of papers and books intended to rebut his arguments.

Methodologically, this seemed to me to be a very good basis for an alternative epistemology of futures studies, one that eschewed the idea of a most likely future in favour of a recognition that there are multiple possible futures, and that the most useful policy questions are often what kind of futures do we want? and how can we achieve them? These questions became a primary focus of my work. In 1977, I coined the term "backcasting" to describe this type of normative futures analysis and have since devoted myself to exploring how it could be done and where best it could be applied.

The social construction of sustainability

The second strand that has been woven through my research has been based on the view that we need to recognize the socially constructed nature of our understanding of sustainability issues, and go beyond approaches to analysis or policy response based solely on instrumental rationality. This suggests the need for approaches to analyzing sustainable futures which treat the concept of sustainability not as a set of scientific findings that need to be communicated to various audiences, such as the public or policy makers, but rather as a set of views, preferences, and understandings about preferred outcomes that is emergent from a process of examination of the trade-offs and higher order consequences associated with different choices about the future.[15]

One relatively uncontroversial way to express this insight is to say that sustainability is not essentially a scientific concept but rather a normative ethical principle about how we want to live in the world. This approach is of course highly consistent with the backcasting method, which itself is intended to explore normative visions of desirable futures. But it also has serious implications for the question

15. I have elaborated on this approach to sustainability in John Robinson, "Squaring the Circle: Some Thoughts on the Idea of Sustainable Development," *Ecological Economics* 48, no. 4 (2004), 369-384.

of who participates in the analysis. To the extent that there are such normative dimensions to the problem, then the question of whose norms and values get represented is necessarily front and centre to a greater degree than seems to apply in more traditional analyses, where the purpose is, for example, to find out the cost and benefits of various technological options for climate change mitigation, the sustainable yield of a particular fishery, or the atmospheric chemistry of a particular air pollutant.[16] In turn this implies the use of highly participatory processes of social learning, where the goal is to allow participants to act as active members of the research team, helping to define the questions being addressed, develop the tools of analysis, and participate both in the analysis itself and the interpretation of results.[17]

A social construction of sustainability approach also requires that we examine the role of the researcher or analyst in the mix. Ironically, to the extent that researchers define themselves as producing value-free, objective analysis, then they are by definition not an appropriate source of normative content (they can describe it but not provide it). Even if they eschew such a stance and acknowledge the degree to which their own analysis embeds a series of normative value judgments, their normative contribution has no special status and certainly cannot be assumed to be representative of the norms and values of the community or society being examined.

16. Normative considerations also apply in all of these examples, such as the weighting or degree of monetization of costs and benefits, what is meant by sustainable yield, and even the types of pollution that are important and should be studied.

17. See John Robinson and James Tansey, "Co-Production, Emergent Properties and Strong Interactive Social Research: The Georgia Basin Futures Project," *Science and Public Policy* 33, no. 2 (2006), 151-160.

Putting it all together

The result of engaging with the foregoing considerations has been a 35-year trajectory of studies intended to explore desirable futures in increasingly participatory ways. Focusing initially on energy systems at the national level,[18] the work expanded in the 1980s, while I was at the University of Waterloo, to sustainability more generally (achieving a soft energy path in a hard energy path economy was clearly problematic), with a team of researchers constructing quite detailed national scenarios of a transition to a sustainable society in Canada by 2025.[19]

This early work was based on a very traditional model of research dissemination, where the role of the research was seen as seeding a process of public discussion through publications. But a key lesson learned in this work was that the real learning about future options and possibilities came in the actual process of scenario construction and testing. This learning was hard to convey in the publications we produced, which focused on the outcomes of the analysis. This led one of my colleagues, Sally Lerner, to pose the question, what if we built a kind of computer game-like version of our model, so that anyone could reproduce the learning we went through in constructing and evaluating our scenarios? At the time (1991), the modelling system we were using took six hours to compute a scenario, so this idea did not immediately come to fruition. By 1994, however, I was located at the University of British Columbia and involved in a study of the future of the Lower Fraser basin in that province. Blessed with two graduate students—Dave Biggs

18. Friends of the Earth Canada, 2025*: Soft Energy Futures for Canada* (Federal Departments of Energy, Mines and Resources; Environment; and Supply and Services: Ottawa, 1984).

19. John Robinson, Dave Biggs, George Francis, Russell Legge, Sally Lerner, Scott Slocombe, and Caroline Van Bers, *Life in* 2030*: Exploring a Sustainable Future in Canada* (Vancouver: UBC Press, 1996).

and Mike Walsh—with expertise in modelling and computer science, and heartened by the advances in computing technology and platforms, we constructed what turned out to be the prototype of a series of computer game–like simulations of sustainable futures at the regional and then municipal scale.[20] The simulation engine we constructed, called QUEST,[21] allows anyone to construct their own scenarios in an iterative process in which the initial scenario choices may lead to undesirable consequences, leading in turn to changes in those choices until a satisfactory set of outcomes is reached. In this way, scenario creation workshops can be the locus of a process of social learning, in which the final scenarios that emerge reflect the learning that has gone on in earlier iterations.

A key characteristic of the QUEST approach was an attempt to combine quantitative modelling to express our best understanding of the trade-offs and consequences associated with different choices about the future, with an entirely qualitative interface based on

20. For the first version, Lower Fraser Basin QUEST, see Dale Rothman, John Robinson, and Dave Biggs, "Signs of Life: Linking Indicators and Models in the Context of QUEST," in *Implementing Sustainable Development: Integrated Assessment and Participatory Decision-Making Processes*, eds. Hussein Abaza and Andrea Baranzini (Cheltenham, United Kingdom: Edward Elgar, 2002). The subsequent version, Georgia Basin QUEST, is described in Jeff Carmichael, James Tansey, and John Robinson, "An Integrated Assessment Modeling Tool," *Global Environmental Change* 14 (2004), 171-183. For some of the lessons learned in using GB-QUEST, see John Robinson, Jeff Carmichael, James Tansey, and Rob VanWynsberghe, "Sustainability as a Problem of Design: Interactive Science in the Georgia Basin," *Integrated Assessment Journal* 6, no. 4 (2006), 165-192. In 1997 Dave Biggs and Mike Wash created Envision Sustainability Tools to commercialize the QUEST software. Various municipal-scale versions of QUEST have now been sold to 18 cities across North America. See MetroQuest, http://www.metroquest.com.

21. QUEST was an acronym, standing originally for Quasi-Understandable Ecosystem Scenario Tool, and later (we hoped) for Quite Useful Ecosystem Scenario Tool. In its later incarnations with Envision Sustainability Tools, Inc., it has become MetroQuest, with no acronym.

narrative and metaphor. Another key characteristic was the explicit involvement of partners and stakeholders in the model development process, the creation of scenarios, and the interpretation of results. It turned out that involving users in the creation of the scenarios was critically important in creating a level of engagement and buy-in for those scenarios that was very hard to achieve when the scenarios were created and presented by the research team.

QUEST itself was only one tool used in the research projects in which it was developed. A suite of other tools, including a digital library, a website of resources of NGOs, a personal climate change calculator, and several exhibits at our local science museum, Science World, were developed, as were a series of processes through which these tools could be used, including a short-lived web-based process, three municipal case studies, extensive workshop-based sessions, and classroom pilots at the secondary school level. We also did some preliminary work on testing the effect of using QUEST on the mental models of participants in QUEST workshops.[22]

Subsequent work has seen a developing partnership with UBC researchers on exploring landscape visualization as a technique to communicate scenario results, studying the effect of different modes of delivery of scenario information, and a series of regional applications in British Columbia in partnership with colleagues in the federal government. In all these projects we used a backcasting approach to explore desirable futures.

While this work has been rewarding and fruitful, it has become clear that it has had very limited ability to effect change at the scale that is required to achieve sustainability. Individual projects, no

22. Jeff Carmichael, Sonia Talwar, James Tansey, and John Robinson, "Where Do We Want To Be? Making Sustainability Indicators Integrated, Dynamic and Participatory," in *Community Indicators Measuring Systems*, ed. R. Philips (London: Ashgate Publishing, 2005); John Robinson, Jeff Carmichael, James Tansey, and Rob VanWynsberghe, "Sustainability as a Problem of Design: Interactive Science in the Georgia Basin."

matter how participatory, are constrained in scope and participation. What was needed, we began to believe in the late 1990s, was a way to institutionalize the approach we were developing and create a highly visible home and showcase for sustainability that would reach new audiences, provide a test-bed for new ideas and approaches, and address in a more detailed way the implementation approaches and strategies required to move sustainability from the fringes to the mainstream. The result of these thoughts was the development of a proposal, initially articulated in 1999, to create a living laboratory and showcase of sustainability, called the Centre for Interactive Research on Sustainability (CIRS), which will open its doors in the spring of 2011.

The CIRS concept was for a three-part program, each of which would have research and applications dimensions. Part 1 was to build the most sustainable building in North America, where everything in the building—the paint, the furniture, the cladding, the structure, the energy and water systems, and so on—would be an ongoing test-bed and research project in sustainable design, construction, and operation. The research program would extend over the lifetime of the building, which would be designed in a modular, plug-and-play fashion, with systems being unplugged and replaced with new ones as technology improves. Part 2 would be an active community engagement program, with a large number of displays, exhibits, and interactive technology, including an immersion-equipped decision theatre. Part 3 would be an active program of consultation and interaction with private, public, and NGO sector partners, aimed at developing the policy approaches and commercialization strategies needed to take sustainable technologies, services, and behaviours to the political and economic marketplace.

The trajectory of research and engagement described in this section has given rise to a varied set of research findings about modelling, backcasting, community engagement processes, and

the policy and behavioural preferences of project participants.[23] Here I would like to step back from these more specific findings and focus on the lessons learned about academic engagement with societal problems at a more general level. This will be done by focusing on two issues: (i) the characteristics of the kind of issue-driven interdisciplinarity we have been practising and (ii) how to achieve societal change in support of sustainability.

Being Undisciplined[24]

Sustainability is by its very nature an interdisciplinary field. Our experience in participatory backcasting projects, in developing the QUEST system, and in getting CIRS started have led to a particular

23. See Alison Shaw, Stephen Sheppard, Sarah Burch, Dave Flanders, Arnim Wiek, Jeff Carmichael, John Robinson, and Stewart Cohen, "Making Local Futures Tangible—Synthesizing, Downscaling, and Visualizing Climate Change Scenarios for Participatory Capacity Building", *Global Environmental Change* 19 (2009), 447–463; John Robinson, "Being Undisciplined: Transgressions and Intersections in Academia and Beyond", *Futures* 40, no. 1 (2008), 70-86; Livia Bizikova, Sarah Burch, Stewart Cohen, and John Robinson, "A Participatory Integrated Assessment Approach to Local Climate Change Responses: Linking Sustainable Development with Climate Change Adaptation and Mitigation," in *Climate Change, Ethics and Human Security,* eds. Karen O'Brien, Asuncion Lera St. Clair, and Berit Krisstoffersen (Cambridge University Press, 2010); Livia Bizikova, Sarah Burch, John Robinson, Alison Shaw, and Stephen Sheppard, "Utilizing Participatory Scenario-Based Approaches to Design Proactive Responses to Climate Change in the Face of Uncertainties," in *Climate Change and Policy: The Calculability of Climate Change and the Challenge of Uncertainty*, eds. Johann Feichter and Gabriele Gramelsberger (Springer-Verlag, forthcoming); John Robinson, Sarah Burch, Mike Walsh, Sonia Talwar, and Meg O'Shea, "Envisioning Sustainable Development Paths: Recent Progress in the Use of Participatory Scenario-Based Approaches for Sustainability Research," *Technological Forecasting and Social Change*, special issue on backcasting (forthcoming).

24. The arguments in this section draw on the discussion in John Robinson, "Being Undisciplined: Transgressions and Intersections in Academia and Beyond".

approach to interdisciplinarity. This approach is driven primarily by a desire to engage with issues in the non-academic world, issues that do not primarily emerge in disciplinary journals or in academic discourse alone, but often have to do with fundamental dilemmas or crises in society that do not seem to lend themselves to easy solution by traditional approaches or methods of analysis. Practitioners of this style of interdisciplinarity do not find themselves at the margins between disciplines, but in the sometimes uncomfortable borderlands between the academy and the larger world. We tend to start from real world issues and move from there into the arena of scholarly knowledge. This means that the criteria with which we select from among the various forms and types of knowledge differ from those that would be suggested if the starting point was the problems and puzzles emerging from within the academic enterprise itself.

Since the real world issues this type of interdisciplinarity is trying to address are not easily expressed in terms of disciplinary knowledge (life tends to present itself as a seamless whole), this approach tends to be critical of disciplinarity itself and is typically more interested in creating forms of knowledge that are inherently useful, rather than in creating new disciplines.

An important characteristic of this style of interdisciplinarity is a very strong focus on partnerships with the external world, partnerships which go beyond treating partners primarily as audience and instead involve these partners as co-producers of new hybrid forms of knowledge. We might call this type of interdisciplinarity "*issue-driven interdisciplinarity.*"[25]

25. Some scholars argue that such a problem-based focus is a defining characteristic of transdisciplinarity, while others argue that transdisciplinarity is not necessarily problem based but focuses on new forms of integrative understanding. I use the term "interdisciplinarity" partly in order to avoid engaging in that debate.

Based on the experiences described above, I would like to suggest the following as key characteristics of issue-driven interdisciplinarity (Table 1).

- Problem-based
- Integrated
- Interactive and emergent
- Reflexive
- Based on strong forms of partnership

Table 1 Key Characteristics of Issue-Driven Interdisciplinarity

Problem-based

Being problem-based is a defining characteristic of interdisciplinarity of the kind being described in this paper. Such an approach identifies issue-drive interdisciplinarity with the influential concept of "Mode 2" knowledge production, the first attribute of which is its problem-driven nature.[26] This emphasis on problems is also a defining characteristic of what has been called "post normal science," which focuses on problems that are introduced through policy issues where facts are uncertain, values are in dispute, stakes are high, and decisions are urgent.[27]

In other words, issue-driven interdisciplinarity must be a hybrid activity, in which academic participants work in tandem with partners in the community to bring different forms of knowledge to bear on societal problems. In this sense the partners are not just an audience for the findings of the research but are in some way directly involved in the definition of the research problems; the design and implementation of the research; and the interpretation, as well as the use, of the results.

26. Michael Gibbons, et al., *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (London: Sage Books, 1994).

27. S.O. Funtowicz and J. R. Ravetz, *Uncertainty and Quality in Science for Policy* (Dordrecht, Netherlands: Kluwer Academic Publishers, 1990).

Integrated

By its nature issue-driven interdisciplinarity involves reaching across different disciplinary, theoretical, and methodological boundaries. In turn this raises questions about conceptual and procedural coherence.

The roots of the approach to interdisciplinary integration proposed here lie in an interpretive approach to interdisciplinarity, which is cautious, if not suspicious, about the utility and meaning of overarching theories and conceptual frameworks. Instead, such an approach emphasizes the inherently local and place-based nature of such concepts as sustainability, and the need for meaning to emerge from within the interplay between theoretical knowledge and local circumstance.

We have found that approaches based on complex systems thinking can illuminate the interplay between local and more global knowledge and concepts and between different forms of understanding. In the sustainability field, such approaches emerged out of the analysis of ecosystem dynamics but have increasingly come to be applied to the interaction between human and natural systems. Key characteristics of such approaches are a recognition of the inherently non-deterministic nature of the systems under consideration; an emphasis upon interactions across temporal, spatial, and functional scales; a resultant focus on feedbacks and dynamics (including thresholds and irreversibilities); and recognition of the emergent nature of many social and biophysical phenomena.

Interactive and emergent

Both the approach to integration and the concept of problem-based research proposed in this paper necessarily imply that the research is highly interactive and participatory. In the projects described above, we developed an approach to interactivity that was based on the principle that participants in the projects should be directly involved in all aspects of the research.

In order to live up to this principle we needed to build modelling and information tools that did not present scenarios or information to our research partners for them to respond to, but instead allowed them to generate their own information or scenarios and, in the latter case, to make changes in those scenarios, based on consequences and trade-offs, until they were happy with the outcome. In that way, their own preferences, values, and attitudes were part of the information or scenario creation and evaluation process, giving rise to processes of social learning.[28]

We also needed to involve the partners in all stages of the process, including problem definition, research design, the research itself, and the interpretation and use of results. As noted above, we started our attempt to follow these principles by involving our community partners directly in the design of the modelling framework we developed so that it would address issues of interest to non-expert users. In principle, we worked back from those issues to the question of what the interface should look like, to the design of the sub-models themselves, though in practice the process was more iterative than that. In the end, quite a lot of effort went into interface design, not normally a strong point of academic models.

Reflexive

A defining characteristic of interdisciplinarity is the existence of multiple knowledge domains, in the forms of disciplines, sub-disciplines, interdisciplines, fields of study, and so on. Of course many of these different domains have inconsistent or even contradictory positions on specific issues. A key question for interdisciplinary scholarship then is how to acknowledge and adjudicate among contradictory or competing claims, especially given a constructivist

28. I call this approach "second-order" backcasting. See John Robinson, "Future Subjunctive: Backcasting as Social Learning," *Futures* 35, no. 8 (2003), 839-856.

epistemology of the kind suggested above. This implies a form of reflexivity that is self-aware about the conceptual and methodological assumptions embedded in different forms of understanding, and open to creative ways to respond to these differences, consistent with Funtowicz and Ravetz's argument about post-normal science, and the arguments of Gibbons and colleagues about Mode 2 science. It amounts to another argument against any attempt to develop and impose a single over-arching conceptual framework, and provides support for a more practice-based approach.

In the case of our work, we have attempted to apply this type of reflexivity in the way in which we developed and applied our modelling tools. Recognizing the difference between "models" and "stories" as representing two historically different approaches to analyzing the future, and in keeping with a growing trend in futures studies work, we tried to locate the design and use of our QUEST model somewhere between quantitative modelling and qualitative storytelling, and to reveal the critical importance of underlying assumptions in the model. For example, we asked users of the model to identify their "worldview" by specifying what they thought was true with respect to human adaptability, ecological fragility, and technological innovation. These settings changed the outcomes of the scenarios, thus demonstrating the dependence of scenario outcome on worldview assumptions. In addition we asked users to specify their values. These settings then changed the way that the (unchanged) scenario outcomes were displayed, thus demonstrating the dependence of the interpretation of the scenarios on values. We also developed qualitative storylines that connected scenario inputs and outputs and used these to guide workshop facilitation.

Perhaps the most important manifestation of reflexivity in our projects has been the engagement of our community partners in the creation and evaluation of preferred scenarios, as described above. This permitted the interpenetration of our judgments, as embedded in the modelling or digital library system, and the values

and preferences of the users. It also allowed the final decision as to what was a preferred scenario to be made by the community partners involved, not the research team, reducing the degree to which the latter imposed their own view on the process.

The approaches described here were intended to bring some of the underlying assumptions of participants to the surface and allow them to be examined. However, this did not resolve tensions within the research team itself about the very idea of using a model-based approach for certain kinds of research, or about the possibility that our community partners would choose the "wrong" scenario. These tensions indicated a deeper level of concern about what assumptions were embedded in the tools and approaches we used in our work. This in turn led to much discussion among research team members and various attempts to reach consensus on our approach, but the issues remained contentious. It may well be that some differences in underlying perspectives are sufficiently divisive that choices need to be made as to what position is to be taken as the proposal is developed and the research team assembled. Again this suggests the importance of considering such issues and engaging in significant ongoing discussion among the research team early in the process.

Based on strong forms of partnerships

The four characteristics discussed above necessarily imply a degree of collaborative exchange among the members of the research team and between the research team and community partners that goes well beyond that required in disciplinary and discipline-based interdisciplinarity research.

In general, our experience in the projects described above was that collaboration among the members of the research team and partnership with non-academic organizations at the level required for strong issue-driven interdisciplinarity to occur presented significant problems but offered significant rewards. Perhaps the most general lesson was the need to devote significant project resources to

support such collaboration and partnerships, on an ongoing basis over the life of the project.

The five characteristics of issue-driven interdisciplinarity outlined here represent a model of doing research that attempts to reflect the tension I described above: the need to respond to the urgency of sustainability issues, while respecting the socially constructed nature of our understanding of the world, and the multiplicity of claims and preferences about desired outcomes. The point is not that anything goes and any claim is as valid as any other one. Instead, the approach underlying these characteristics is based on the following argument:

- our best understandings of the world are necessarily provisional, and subject to change
- however, at any given time there may be more or less consensus about such understandings, on the part of those recognized as having expertise in the fields in question
- such recognition, and the measure of consensus on any particular topic, are based on the collaborative processes of peer review and replication, which are our best ways to achieve inter-subjective agreement on complex questions on the part of those who study such issues
- insofar as the social practice of scholarship is explicitly based on attempts to exclude the subjective preferences and values of the scholars themselves from the field of analysis, then such analysis cannot address the normative issues integral to decisions about issues like sustainability
- moreover, the ways in which expertise is certified and recognized in society excludes forms of "lay" understanding, knowledge and expertise that are extremely relevant to decision-making on sustainability
- we therefore need tools for, and processes of social deliberation that embody our best research and scholarship on the way the world works but also encompass the normative values and preferences excluded from that scholarship and the also the

"unlicensed" perspectives found outside the halls of professional scholarship

- and expertise the goal of such work is to combine scholarship with "public" values, attitudes, beliefs and preferences in such a way as to give rise to emergent understandings of what sustainable futures may be available and desirable.

Put another way, we find ourselves at the intersection of choice, uncertainty, and constraint. Uncertainty, from this perspective, is not a matter of estimating probabilities, but of exploring the feasibility and desirability of alternative possibilities. Human choice, based on intentionality, is a fundamental feature of the very systems we are studying. Yet not all possible futures are available: our best understandings of outcomes and system interactions suggest the existence of important constraints on our choices. Various kinds of models can embed these understandings and illustrate the trade-offs and consequences associated, with different choice. One of the key roles of issue-based interdisciplinary research of the kind proposed here, then, is to explore the space and account for the pressures generated by the interplay of uncertainty, choice, and constraints.

Further on Beyond Zebra

While issue-based interdisciplinarity offers what seems to me to be a very fruitful approach to engaged research on sustainability, it is by its nature a research activity and is therefore limited in terms of contributing to the kinds of changes it examines. Here I would like to move outside the academy and paint a very rough picture of the kind of approach to societal change more generally that emerges directly out of the work I have described above. This approach is embedded in the CIRS program and in the work we are doing as part of the new UBC Sustainability Initiative.[29]

29. UBC Vancouver Sustainability Initiative, http://www.publicaffairs.ubc.ca/2010/01/27/ubc-vancouver-sustainability-initiative/; see also UBC Sustainability, http://www.sustain.ubc.ca/.

The goal of contributing to positive social change in the direction of increased sustainability is of course not a new one. Two routes of intervention have been commonly pursued. The first is the well-established process of policy analysis aimed at providing useful advice to decision makers. This is a major focus for academic contributions to public policy issues. The second is the development of information and education programs aimed at the public, which have the purpose of changing individual consumer behaviour. This is the preferred route for much environmental education and also NGO activism.

These two approaches to intervention are well established (and not just in the sustainability field) and are likely to continue to be popular. However, I believe that alone they are not likely to lead to transformative societal change. In the interests of broadening the scope of intervention, the CIRS program will build on the work described above and focus on three additional routes for contributing to the sustainability transition.

The first route focuses on community engagement tools and processes. Rather than changing individual behaviour, the emphasis is upon social mobilization processes intended to inform stakeholders about the trade-offs and consequences associated with different collective decisions. The bases of this approach are twofold. First, many of the decisions that will strongly affect future sustainability for a given region do not happen at the level of individual consumption but instead at the level of collective decisions about such issues as land use, urban form, density, transportation infrastructure, and energy and water systems. And second, the policy makers responsible for such collective decisions, are not able to change easily the existing trajectory of such decisions if there is not a political constituency for such changes. They can more easily continue in the same direction since the political interests and constituencies for such decisions are already in place. Non-incremental change requires challenging well-

established interests and is difficult to accomplish without the existence of strong political constituency for such change.

The second route has to do with institutional and organizational change. Though a strong focus of much sustainability research and intervention is on contributing to policy change, there are many changes that can have powerful effects on the achievement of sustainability that do not require changes in policy. The institutional rules that govern how organizations act in the world can usually be changed endogenously, that is, without change in the enabling policy or legislation that created those institutions. A good example in the sustainable building field is the existence of building codes, which can usually be changed without any necessary change in the underlying policy context. More generally, there exists a set of institutional rules, including codes, standards, job descriptions, performance evaluation criteria, assessment metrics, and so on, which have a large effect on what decisions get made by organizations. Institutional change aimed at changing these rules can therefore be an important method of contributing to transformative social change. Indeed, as with social mobilization, such institutional change is likely a prerequisite to the kinds of changes required.

The third and final route for intervention shifts from a sole focus on the realm of public policy and institutions to include a major emphasis on the marketplace. It is clear that the private sector is the locus of much of the behaviour that transforms our world, for good or ill. It is therefore critical that a strong emphasis be given to making private sector investment and behaviour more sustainable. While government policy and regulation are one way of influencing such behaviour, the focus needs to extend to also include processes of commercialization and market transformation. In essence, the argument is that to the extent that it is in the economic interest of private sector organizations to invest in, produce, and market more sustainable products and services, then the market itself can become an

engine of change in the direction of greater sustainability. Moreover, if this can be accomplished, it can work together with policy change to set up self-perpetuating and self-amplifying processes that have the potential for transformative effect.

These three more novel routes of intervention interact with each other, and with policy analysis and individual behaviour change strategies. Clearly, successful social mobilization or agency in support of changes in collective decisions will lead to policy changes, many of which in turn will contribute to institutional and perhaps individual behaviour changes. Institutional changes themselves can occur in the private as well as the public sector, and in so doing contribute to commercialization and market transformation. And successful processes of policy change and commercialization of sustainability technologies and services will give rise to products that will make possible individual behaviour change and also support changes in collective decisions.

The conceptual framework outlined here is not intended to be exhaustive. No doubt there are other possible routes to supplement policy analysis and education programs aimed at individual behaviour change. However, these routes seem to offer a fruitful way to think about transformative social change.[30]

Conclusion

I began this paper with a quote from that well-known social theorist Dr. Seuss. The point of that quotation was to suggest that the challenges of sustainability indicate the need to go beyond the conventional alphabet of academic responses in order to draft some new letters that will help us describe and engage with new approaches. That old

30. They also connect to the rather extensive literature on socio-technical change, for example , which suggests that significant institutional and organizational changes are required to have any chance of fostering transformative societal change.

alphabet can be described as a view of scholarship, rationality, and truth that is based on an Enlightenment ideal of value-free, objective and disengaged academic inquiry, leading to the production of verified truthful knowledge, which can then be used in any number of ways to improve our world. I do not want to disparage the power of that approach. In many ways it has brought us the incredibly rich and powerful set of tools and understandings that characterize our modern condition. Yet my own understanding, both of the current state of the world and of the frameworks of rationality and understanding that underlie that world, is that we need to find ways of collectively making our way in the world that are different in both these dimensions. That is, we need to develop tools and processes of collective engagement and institutional change that are not based on any transcendent understanding of the nature of truth or reality, but are instead the emergent consequence of imminent processes.[31]

31. I owe this use of the concepts of immanence and transcendence in this context to David Maggs, who is currently doing a PhD under my supervision on arts, culture, and sustainability.