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## Editorial

## Developing a systematic “science of the past” to create our future

Over the last 50 years, the “great acceleration” in human development (Hibbard et al., 2007) has impacted our social systems, ecosystems and climate in unprecedented ways, simultaneously escalating and exposing the global interconnectivity of humans and the rest of nature. In academia, researchers have observed, documented and debated dimensions of these changes—but largely within their own disciplines. We now face a profound failure of knowledge: most people are unaware of their most basic ecological dependencies. As we look ahead and consider what continuing on this pathway would mean for life as we know it, the limitations of our knowledge systems are becoming uncomfortably evident. Yet meeting the challenge of providing a new integrative understanding means we need to do unfamiliar and even uncomfortable things.

There are growing calls for concerted efforts to redress this knowledge failure. What this requires might be regarded as a process of deliberate, deliberative knowledge redesign. Such an effort now manifestly demands a global scope, but it also needs to be ambitious in its efforts to push past some of the deeply entrenched disciplinary boundaries, debates and norms of academia.

First, we are deliberately pursuing knowledge for action. This is a major extension of the normal role of academia, a shift in the usually accepted social contract of scholars. A “corrective” approach to managing unsustainabilities has been used in the past, but now, the goal of knowledge creation is to develop understanding that will help society to avoid its most problematic pathways into the future. A new pre-emptive approach to resolving today’s global issues is predicated on a need for scholars to be engaged in social debates much more fully, taking responsibility for the application of their insights, and integrating their knowledge much more thoroughly in creating sustainable futures.

Creating an effective transdisciplinarity is a further persistent challenge. Physical and socio-economic models and data have been coupled for decades in “integrated assessment” and “Earth systems science”, but what is now urgently required is improved collaborative, transformative dialogues between the interpretative humanities and quantitative, empirical natural and social sciences. These dialogues can be uncomfortable. We are not proposing a new Frankensteinian discipline: we are seeking new conceptualisations of the socio-ecological system, with open and inclusive dialogues about what might constitute good scholarship and intellectual rigour in this emerging area. Scholars working at the global scale risk accusations of dangerous reductionism, environmental determinism, cultural imperialism and more. These are real risks

that need to be acknowledged and overcome, not least by being knowledgeable about past fallacies in this regard. Academics embarking on this new pathway will therefore need to develop a new, shared language, ethics, and pre-analytic vision.

Specifically, we need to grab the “learning from the past” debate by the horns. In the end, what else can we learn from? In climate science, the study of past climates combined with contemporary models is becoming a powerful tool for constraining what is plausible and possible in hypothesising about the future. Obviously, process understanding of biogeophysical systems is different from an understanding of the workings of society, but history nevertheless tells important things about socio-ecological changes that at present are not being explored and interrogated. Equipped with our understanding of the Earth system and human behaviour, and our ability to model complex systems, we can seek stronger insights into the non-linear, evolutionary relationships between humans and the rest of nature. There is no reason to argue that human or planetary existence can be subsumed in any overarching laws, nor to assume that predictions, *sensu stricto*, will be possible. Indeed, historical determinism is the ‘nightmare from which I am trying to awake’, as James Joyce put it in *Ulysses* (1922)—but the past can be both constraining and instructive. While staying away from naïve predictions, we maintain that any interpretation of current trends tells us that unpleasant prospects lie ahead on the current social pathways. Insights into past societal experiences are needed to construct planetary scenarios and to set up informed boundaries within which humanity must live in order to manage sustainability (Rockström et al., 2009). The strength of this new integrated history lies in its capacity to tell us more about potential pitfalls, about how quickly societies can turn in the face of crises, and perhaps most importantly about what it takes for human society and individuals to adapt successfully to constraints. We need to see much better integration of knowledge communities ranging from archaeology, palaeoclimate, human and environmental history and contemporary social science to develop a new transdisciplinary science of the past that can inform the future (Costanza et al., 2007).

We will need to take a more evolutionary approach to history, which acknowledges the dynamic and systemic nature of our environment, and the co-evolution of human culture and biology with the rest of nature. This perspective has been put forward by environmental historians to provide more full-bodied explanations of major historical phenomena such as European world hegemony in the Modern era, and the rise of environmental consciousness as part of colonial experience (Crosby, 2004; Grove, 1996). Indeed the very concept of “the environment” is itself a

product of the human interaction with it and its sustainable boundaries have been constantly renegotiated (Sörlin and Warde, 2009). Sustainability as a political goal is historical and subject to change. We need, therefore, to develop an “intelligent pluralism” in our approach. Models are essential to understanding our complex past, but as George Box said, “all models are wrong, some models are useful”. We need to use multiple modelling approaches that are multi-scale in time, space, and complexity. We need more creative ways of testing models against historical data that vary enormously in type, quality and coverage. We need to cross-calibrate models. We need effective collection and management of these disparate data. We need broader participation from the full range of communities in the enterprise, and we need careful synthesis work to put concepts together into working hypotheses that will aid our thinking.

One of the most interesting questions we can ask an “integrated science of the past and future” is just how much of what has happened is contingent – dependent on random events and individuals – and how much is predictable. With our compartmentalized knowledge, models focus on either the natural or the human part of the socio-ecological system, with the other part viewed as external. These models, then, are exogenous to each other, giving no understanding of what the feedbacks might be. Is there an “envelope of predictability” for major socio-environmental changes, within which specific events and timings remain unpredictable? Emerging concepts of complex systems, resilience, path dependence, social traps, net energy, and others represent a new set of ideas that we can now begin to test against the historical record. We can also experiment more with counterfactual, “what-if” history, and apply it to the future: What if this set of events, based on reasonable modeled assumptions, were to unfold? This could never be taken to mean limiting human possibilities; rather, it would serve as an attempt to put the ever-growing mass of data and knowledge of the past to use for fuelling our social imagination.

In the end, we are not out to predict the future, but to create it. To do this we need to know what the relevant processes are and how much latitude we have to design. If we can determine our envelope of predictability going forward, we have a much better chance of creating a future to our liking.

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### References

- Costanza, R., Graumlich, L., Steffen, W., Crumley, C., Dearing, J., Hibbard, K., Leemans, R., Redman, C., Schimel, D., 2007. Sustainability or collapse: what can we learn from integrating the history of humans and the rest of nature? *Ambio* 36, 522–527.
- Crosby, A., 2004. *Ecological Imperialism: The Biological Expansion of Europe, 900 to 1900*. Cambridge University Press, Cambridge, UK (1986), new ed. 2004.
- Grove, R., 1996. *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860*. Cambridge University Press, Cambridge, UK.
- Hibbard, K.A., Crutzen, P., Lambin, E.F., Liverman, D., Mantua, N.J., McNeill, J.R., Messerli, B., Steffen, W., 2007. The great acceleration. In: Costanza, R., Graumlich, L.J., Steffen, W. (Eds.), *Sustainability or Collapse? An Integrated History and Future of People on Earth*. Dahlem Workshop Report 96. MIT Press, Cambridge, MA, pp. 341–378.
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin III, F.S., Lambin, E.F., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.-J., Nykvist, B., de Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J.A., 2009. Planetary boundaries: a safe operating space for humanity. *Nature* 461, 472–475.
- Sörlin, S., Warde, P., 2009. Making the environment historical—an introduction. In: Sörlin, S., Warde, P. (Eds.), *Nature's End: History and the Environment*. Palgrave MacMillan, London, UK.

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