Open Peer Commentaries

on Philipp Aufenvenne et al.'s "On Climate Change Research, the Crisis of Science and Second-Order Science"

Doing Second-Order R&D

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> Upshot • Bringing second-order understandings to the doing of climate science is to be welcomed. In taking a second-order turn, it is imperative to reflect on reflection, or report authentically our doings and thus move beyond sterile debates about what ought to be or what second-order doings are or are not. The field of doing second-order R&D is not a terra nullius, so exploring the full range and domains of praxis is warranted.

« 1 » I am very sympathetic to the arguments being mounted in this target article as it is an area of praxis (theory-informed practical action) that is undeveloped yet very relevant to our times (Ison 2010). In my commentary I do not propose to dwell on the overall thesis but to embellish certain arguments and point to underdeveloped or absent considerations. I do so because I believe it important that readers understand that what is being proposed by the authors is not novel, or untested, but does remain subjugated. And collectively we need to devise strategies to break out of this subjugation. In making this claim, I think it is fair to concede that climate science has, to date, been little influenced by second-order understandings. In turn, this appreciation raises concerns about what is conveniently hidden behind the term "climate science."

« 2 » I have no doubt of the need for greater reflexivity (reflection on reflection, a second-order notion) on the part of those practitioners who claim to be scientists (Ison et al. 2014; Ison 2008). Authenticity arises when there is reflection on experience, because the congruence between espoused theory and theory in use can then be experienced by an other (a reader, a colleague etc.). I was initially left with a sense that the authors had not yet tried to do second-order science – so for me there was an absence of authenticity, e.g., a tendency to speak of science as if such a state, with agency, existed rather than offering a reflection on their own practice as practitioners of science, as embodied doers of science (if indeed this is what they do). However, towards the end of the paper there is a nice list of questions concerned with the doing of science, which have the potential to trigger reflexive insights grounded in praxis. From my perspective, Humberto Maturana's aphorism "all knowing is doing" is apposite, but what science is in its doings is a contested space. A question that needs to be asked is: Do the authors really mean knowledge or do they mean processes of knowing? (see Cook & Wagenaar 2011).

« 3 » Science as a domain of practice can be understood as generating what are or are not accepted as scientific explanations. What is or is not accepted unfolds in social relations. This is very apparent in the field described as "climate science," as can be appreciated at this historical moment as peoples of the world struggle to come to terms with the explanations offered. Framing the doing of science with the term "climate" has also revealed and concealed in ways that may not be helpful. Climate, and its subsidiary, weather, are pervasive, i.e., their effects operate in every domain, from river catchment management to sewage engineering. It is thus problematic when a particular framing captures the discursive space, as well as investment resources, and generates new institutions (e.g., the production of climate change adaptation reports by siloed or isolated departments in local government agencies) to the detriment of all the other domains where climate variations will operate. Practitioners of a second-order science need to be aware of the historicity of their understandings, and how this history informs framing choices, practices and the institutions (norms, rules of the game that humans invent) that surround them (Russell & Ison 1993, 2000; Ison, Blackmore & Iaquinto 2013).

« 4 » It would be a shame if readers of this paper were left with the impression that there was not a developed and evolving praxeology in second-order science. The authors refer to several important lineages but fail, in my view, to mention other important sources, for example the early work of Horst Rittel, who with Melvin Webber called for the development of second-generation systems approaches (Rittel 1972). Also not mentioned, except obtusely through reference to Stuart Umpleby's work, is the whole sub-field of second-order cybernetics and the work of such important scholars as Gregory Bateson, Humberto Maturana, Heinz von Foerster, Klaus Krippendorf, Gordon Pask, Ranulph Glanville, etc. (see the frequent references to these and contemporary authors in papers in this journal). Drawing on these traditions, there has been considerable attention paid to second-order praxis within the fields of agricultural and rural development research (Russell & Ison, 1993; Ison & Russell 2000, 2011), and now systemic innovation (Ison 2015). Other important fields with second-order influences include systemic design (Metcalf 2014), systems science (Ison 2010) and systemic family therapy (Poerksen 2004). These lineages are all praxis lineages, as is science, so there is much to be drawn upon and institutionalised in ways that are socially valued and that attract investment

« 5 » Let me conclude with a plea. Let us not become stuck in a discursive trap about what second-order science is or is not. As Heinz von Foerster might say, how can we move forward in ways that maximise our choices? One way of doing this would be to address the question: What world(s) do we bring forth when we take responsibility for our observing? Or in Maturana's terms: What is it that we do when we do what we do when we claim to do second-order science/R&D (see Ison 2010)?

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On Detection and Attribution

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> Upshot • I discuss the concepts of detection and attribution as they are used in scientific discussions about the cause of global warming.

« 1 » In my commentary on Philipp Aufenvenne et al.'s target article I want to focus on §17, i.e., on "detection and attribution." I claim that their assertion "Since CO2 has long been known to be a greenhouse gas, the observed rise in CO2 concentrations within the atmosphere has suggested itself as the main cause of global climate change" is inaccurate as it applies only to the climate change that began to emerge in the 20th century, when it became clear that human activities would significantly increase atmospheric CO_2 concentrations. For older geologic eras, one would see parallel developments of CO_2 concentrations and temperatures, as derived from proxy records. But the accuracy and temporal resolution of these records was hardly sufficient to decide whether one would lead the other. Indeed, since no external cause for elevated or reduced CO_2 concentrations could be given, it is plausible that it CO_2 follows temperature. In the popular literature, the correlation of the two was made into an argument for elevated CO_2 levels being the cause of the ongoing process of global warming, but not in scientific circles.

« 2 » To deal with the recent change of climate, the concept of "detection and attribution" of Klaus Hasselmann (1979) was invoked, as rightly described by the authors.

« 3 » "Detection" means to identify a change as beyond the range of natural internal variations within the climate system; the presence of variations "without causes" is difficult to understand for lay people, who often enough insist that "where there is smoke, there is fire." The climate system is full of non-linear processes, which as a sum appear as something that is well-described by the mathematical construct of randomness (red noise, pink noise) with significant long-term variations (Hasselmann 1976). "Detection" means, if a dead body is found, that when the death cannot be explained by natural causes, detectives are then asked to look for suspects and to determine who may have done it.

« 4 » The second step is called "attribution." While detection represents a stringent statistical hypothesis test (with the difficulty of determining the appropriate null-distribution), attribution is a plausibility argument, namely: Which of the suspects best fits the profile of the crime? Of course, it can be that the series of suspects that is examined does not contain the real murderer, so that a misattribution takes place. In the end, an assertion is made that "we can explain the ongoing change" best by attributing x% of the change to process X, and y% to Y, etc. If done properly, a caveat "given our present understanding of the system and its sensitivity" is added.

« 5 » The expectations, or "signals" of how a certain possible "cause" may act on the climate system are derived from simulations with dynamical climate models that quantitatively describe these expectations (or "guess patterns"). The output of such models is also used to estimate the range of natural variations. Except for these two applications, the process of detection and attribution does not make use of climate models; instead it is an assessment of observed data.

« 6 » The detection and attribution efforts began to become successful in the mid-1990s (e.g., Hegerl et al. 1996), when analyzing global decadal trends in air temperature. In the meantime, other variables have also emerged as influenced by elevated atmospheric greenhouse gas presence (The International ad hoc Detection and Attribution Group, 2005). Approximately 1/2 or more of the centennial change is attributed to increased CO_2 concentrations and other greenhouse gases, while 1/2 or less may be due to changes in solar forcing, volcanism and aerosol forcing.

« 7 » In hindsight, in the 1980s we may have already detected a global change that needs explanation through external causes (Rybsky et al. 2006). Regionally and locally, the detection and attribution is more complicated (Barkhordarian, von Storch & Bhend 2013), as more "suspects" are present, such as massive changes in aerosol generation and land-use changes (urban developments).

« 8 » In summary, the issue of whether the recent climate change, in particular in terms of air temperature, is related to changes in the presence of greenhouse gases is not based on the co-variability of the presence of such gases and temperature, but on the detection of changes beyond the undisturbed regime, and the determination of the most plausible mix of causes. In terms of air temperature, the recent changes cannot be explained without making use of elevated greenhouse gas concentrations; this explanation is consistent with physical theory, but remains conditional upon the present body of scientific knowledge.

« 9 » In the public domain, this rather sophisticated assessment transforms to the