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Introduction to the Novel Entities Boundary

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Radiation from nuclear detonations. Genetically modified organisms. Synthetic biological compounds. Microplastics in clouds, rain, and bodies. Endocrine-disrupting chemicals that mess with how amphibians and other animals – including humans – develop and reproduce. These are some of what the planetary boundaries framework characterizes as novel entities, a category 'restricted to include only entities that, in the absence of the anthroposphere, are not present in the Earth system' (Richardson et al. 2023: 3). This planetary boundary, perhaps more than any other, has expanded considerably with respect to definition and measurement. Its concern with different kinds of entities also raises deeper ethical questions, from those regarding what is truly new when it comes to how anthropogenic forces affect planetary evolution, to the variety of risks, uncertainties, and moral challenges that arise when different materials and technologies are grouped together as novel entities.

Novel entities weren't in the 2009 planetary boundaries framework. Instead, 'chemical pollution' held this space. At that time, however, there was not yet sufficient information to suggest a boundary (Rockström et al. 2009). In the 2015 update, 'novel entities' were introduced, with ozone depletion acting as an example that was closely related to what the new category sought to capture (Steffen et al. 2015). Critically, the 2015 update established criteria for how a growing multitude of chemicals might be understood for their effects on the Earth system. These criteria drew on Persson et al. (2013: 12620, original emphasis), who explored approaches to '*unknown* planetary boundary issues [that] likely exist'. The tens of thousands of chemicals introduced into the environment with very little known about their aggregate individual effects, or the ways they might combine, presented exactly the kind of 'known unknowns' that could not be ignored. Their proposals, adopted in the 2015 framework, had three main points of consideration for determining a planetary boundary: the chemical must have a disruptive effect on vital Earth-system processes, not be discovered until it 'is a

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problem at the global scale', and, finally, have an effect that is not readily reversible (Steffen et al. 2015: 7).

As chemical pollution morphed into 'novel entities', researchers examined how this planetary boundary turned on the capacity of Earth processes to assimilate chemical pollutants (Diamond et al. 2015). Reducing pollution was an obvious goal, and when Persson et al. (2022a) published a new global assessment they found Earth was exceeding the planetary boundary for novel entities even when that boundary was restricted only to chemicals. Still, as they acknowledged, their assessment had not really shown '*where* the boundary for novel entities is' (Persson et al. 2022b: 6788, original emphasis). And this is for good reason: novel entities are multidimensional owing to how they might impact biological, biogeochemical, or geophysical aspects of the Earth system. Measuring thousands of interactions individually, let alone in concert, presents a near-intractable challenge. In this way, Persson and colleagues were very much faced with the kinds of issues identified at the outset of this book: a boundary is a normative idea that does not necessarily rely on full knowledge of where a quantifiable threshold might be. Boundaries are normative. So, they can countenance some ignorance while still retaining a commitment to gathering more information and revising as necessary in future. When the planetary boundaries framework was updated in 2023, novel entities were expanded beyond chemicals with a 'control variable' determined by 'the percentage of chemicals released to the environment without adequate safety testing' (Richardson et al. 2023: 6). Unlike other boundaries that have quantified values, this is as far as this boundary's measurement goes – to a ratio of chemicals released to the environment to their testing. Because in the Holocene no such entities existed, and since hundreds of thousands of such chemicals now circulate globally, the only safe boundary was determined to be zero. Zero would remain the boundary unless those chemicals are fully tested and determined to be harmless – a standard derived by taking the Montreal Protocol for ozone as an example for thinking about novel entities.

Not everybody agrees on zero for a safe planetary boundary on chemicals, and neither is there always agreement on what counts as novel or why. Several feminist scholars, for instance, hesitate over normative claims that chemicals are wholly bad since many can provide socially valued goods too, such as pharmaceuticals that have health benefits (Murphy 2017; Balayannis & Garnett 2020). Likewise, the chapters in this part offer different assessments of how claims about novelty do not operate free from broader considerations about human interactions with the planet. These two chapters do this in very different ways. The first, by Andreas Bachmann and Ariane Willemsen, looks at the ethics of novel entities from the perspective of ethics within public administration. In these contexts, decisions on

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definitions and descriptors matter critically for assessing moral matters. Fuzziness will not do. In their chapter, they offer a carefully considered critical engagement of how the planetary boundaries framework treats 'novel entities' and what is at stake if different interpretations of that boundary are followed through to their ethical conclusions. The second chapter also takes a critical approach to planetary boundaries but is also a different format to previous chapters. In this case, the chapter is an interview transcript with Erle Ellis, a scientist who examines human-Earth interactions at a range of spatial and temporal scales. For Ellis, questions of novelty must be set within broader considerations regarding *for whom* planetary crises are really a crisis. They must also be set within a broader appreciation of how human and non-human ecologies interact at a range of scales and over time. For Ellis, framing problems at the 'planetary' scale often do not sufficiently identify those responsible for forcing the Earth system into a novel state, such as through anthropogenic climate change, and so thinking through the ethics of the planetary boundaries framework requires situating it amid a broader set of concerns crisscrossing science and society.

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