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Stream C: Innovating for Adaptation

Title: The Emergence of Collective Entities

Abstract: We consider how adaptive processes operating at multiple levels enable the emergence of collective entities in populations of simpler agents. The creative power of adaptation rests on a simple algorithm of applying a biased selection function to variations in a system's properties, but it takes a wealth of details to specify any particular instance of adaptation. We present a conceptual model of adaptation which identifies its emergent properties, and connects them to those details and to relevant aspects of the system's environment. This permits us to discuss how the emergent properties of adaptation contribute to metrics of success and failure for the systems that are doing the adapting – be they individual agents, or populations, or emergent collectives. This approach suggests insights into several interesting questions, including the nature of individuation, and the conditions under which different types of collective entities might emerge.

Bio¹: Anne-Marie Grisogono is a complex systems scientist, with a PhD in Mathematical Physics. She has worked in experimental and theoretical atomic and molecular physics, and lasers and nonlinear optics in various universities, followed by 20 years of applied R&D in the Defence Science and Technology Organisation (now DST Group), working on systems design, modelling and simulation, and future concept development and experimentation. Presently she is an Adjunct Professor in the College of Science and Engineering at Flinders University, and a Visiting Fellow in ANU's National Security College. She has held several national and international leadership roles within DSTO, in NATO and in The Technical Cooperation Program (TTCP), in the fields of simulation, systems engineering and systems science, human sciences and complexity science, and has served a 3 year term on the Australian Research Council's College of Experts 2013-16. Her current research interests include fundamental questions of complexity science, and improving the methodologies and tools that can be applied to dealing with complex problems.

Bio²: Paul E. Oppenheimer is an Assistant Editor of the *Stanford Encyclopedia of Philosophy* and a Visiting Lecturer in Philosophy at the University of Adelaide. He has published in epistemology, metaphysics, and logic. Outside of philosophy narrowly construed, he has published in condensed matter theory, quantum chemistry, automated deduction, and robotic vision. He studied philosophy at Princeton University.