

Unification of Hierarchy Theory, Duality Theory, and Evolutionary Theory: A Mechanism for Emergence

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Abstract: A key contribution of the ISSS is the work of its individual Special Integration Groups. Their clear focus on a particular and specific area of research in systems science enables a synthesis of its literature, workers, concepts, and results. Without such focus, system's work and workers spread themselves too thin to communicate and build effectively due to the vast span of systems research, methodology, and application. However, unless synthesis also occurs *between* SIG's the overall objectives of the ISSS will not be attained. This paper reviews the output of 3 ISSS SIG's over 3 decades for the purpose of unifying their results. The output of these 3 SIG's amounts to many dozens of papers authored by dozens of capable past and present ISGSR members and they constitute a significant body of insights and results. Many of these papers exist in our past proceedings, but they are unknown to, and therefore not cited by new workers who have recently joined the ISSS. We will bring a CD-ROM edition of these selected papers to the Asilomar meeting for free distribution to interested workers. More importantly, we will present an analysis of the conclusions of these papers, as well as a comparison of their methodologies. We will focus on any consensus or agreement between the papers as the beginning of a unification of the three important systems topics, hierarchy, duality, and evolution. This analysis will continue with a summary critique of why the results of these papers did not become a foundation for future work in all three areas. This will be a detailed case study and example of another presentation at Asilomar that describes what is necessary to improve ISSS work toward a consensus general theory of systems.

Beyond this service to the ISSS in establishing both a detailed example of synthesis of past work and a computerized tool for enabling such synthesis, this paper will introduce a particular case study of unification. We will begin with a comparative analysis of several natural systems at very different scalar levels. This analysis will show what the different systems have in common as regards both their hierarchical structure and duality features. It will also show that one of the mechanisms in duality theory impacts both the formation of hierarchies and the systems-level phenomenon called emergence. The combined understanding of the mechanisms for duality formation and hierarchical structure will be shown to result in emergence of new qualities at new levels of scale and new levels of systems. Thus, emergence will be shown to be a self-organizing result of identifiable mechanisms that are testable. The result will be a system's-level mechanism of emergence, that is, a new *theory of emergence*. We will then emphasize the importance of proving and further investigating the mechanistic theory of emergence and its limits. Arguably, the most important discovery of the nineteenth century was the discovery of the theory of evolution. But a theory of emergence spans a much broader set of natural phenomena than evolution. As such, discovery and further investigation of a natural theory of emergence would be even more unifying and important to a true understanding of living and non-living natural phenomena than evolution. Such work could improve the reputation, utility, and funding for the entire field of systems science in the future.

