William Wimsatt
(University of Chicago)

Patterns of causation in complex adaptive systems

I assume that the kind of causation and complexity we are interested in is found in functioning complex adaptive systems that are products of evolutionary processes. In such systems we can expect several architectural features of great generality and importance that affect the character of their causal interactions:

- Robustness and canalization, securing adequate operation under diverse genetic and environmental perturbations and conditions. Sexual inheritance acts to secure genetic robustness.
- Redundancy in important systems increases reliability of operation.
- Modularity increases the easy of making evolutionary changes, and limits the range affected by breakdowns.
- Differential Entrenchment is a generic property of differentiated systems: the operation of some elements has larger downstream effects than that of others. This reflects the different sizes of causal cascades, and affects the relative evolutionary stability of these elements.
- Evolution builds upon and modifies existing structures, generating differential entrenchment.
- Increasing scale pushes the limits of a given design architecture, increasing differentiation and complexity, and approaching the limits of error catastrophe.

I will consider the nature of these causal patterns and their interactions, and their consequences for evolvability.