GST 113 — Ontological Hierarchies and Causal Levels

Formal Description

An ontological hierarchy (also called an assembly hierarchy in this framework) is a nested arrangement of physical entities in which assemblies become components of more extensive assemblies. A causal level is distinguished by the establishment and maintenance of an emergent capability: the organised components can produce or accept physical transfers that they cannot produce or accept independently. Not every additional assembly level establishes a new causal level. Causal levels are relative to particular assembly pathways; they may branch or converge rather than forming one universal sequence. Epistemic levels are distinctions used in our descriptions and models of physical reality, and need not coincide with causal levels.

Plain English Explanation

A machine can contain smaller machines, which contain still smaller parts. A living organism contains organs, tissues and cells. These are examples of nested assemblies: a smaller physical entity becomes part of a larger one.

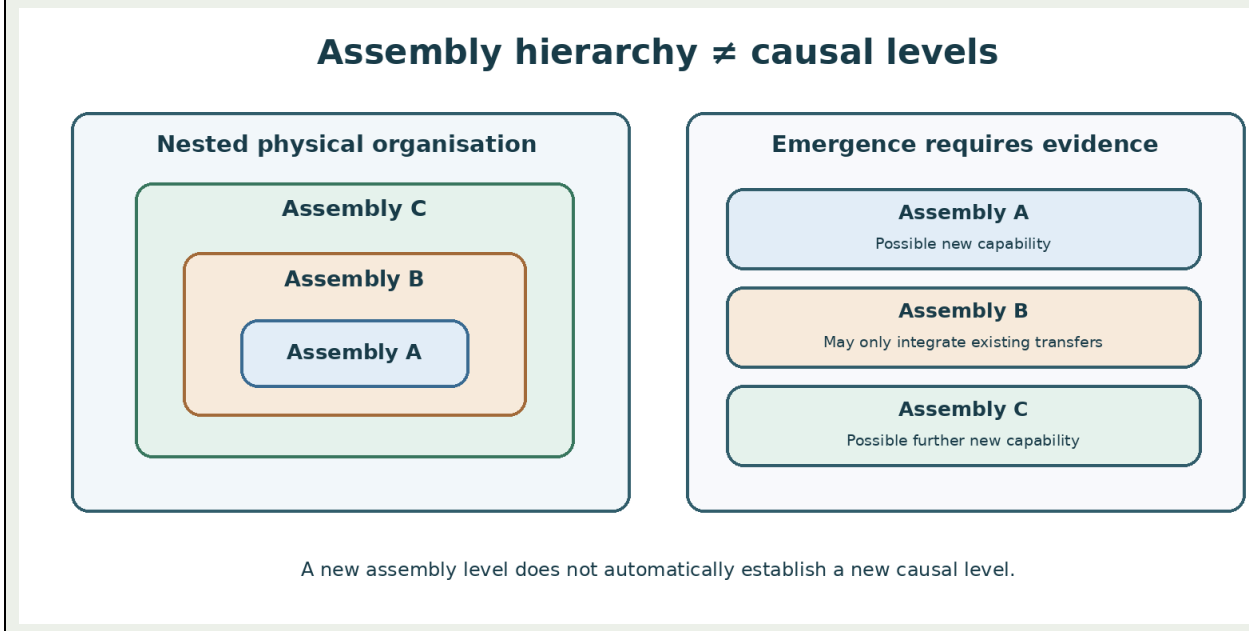
But building a larger assembly does not automatically create a new capability. Components may simply become connected, or transfers that once crossed a boundary may become internal to the larger assembly whilst others remain external. That is causal integration, not necessarily emergence.

We identify a new causal level only when the organisation makes possible a capability to produce or accept a transfer that the participating components could not produce or accept independently. We must trace the transfers and test the claimed capability; merely naming a higher level is not enough.

Scientists also use levels as a convenient way to organise explanations; for example, molecules, cells, organs and organisms. These are epistemic levels. They can be very useful, but the categories in our descriptions do not, by themselves, prove that emergence occurred at every boundary. Different assembly pathways may create different capabilities, so causal levels need not form a single ladder.

An epistemic level does not necessarily correspond to a single causal level. Depending upon the purpose of our investigation, it may encompass several levels of causal emergence. For example, when studying an organism at the cellular level, we may treat each cell as a single entity, even though it contains several nested assemblies with their own emergent capabilities. Conversely, we may distinguish several epistemic levels within an assembly without identifying a new emergent capability at each level. Epistemic levels are therefore useful simplifications of physical reality, rather than necessarily exact representations of its causal levels.

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The left-hand diagram shows three nested assemblies. The right-hand panel illustrates that the existence of each assembly does not, by itself, establish a new causal level. Labels such as "possible" indicate hypotheses requiring investigation, not conclusions.

Examples

A generator within a power-supply installation. A generator can possess an emergent capability to convert mechanical input into electrical output. Adding cables and a housing creates a larger assembly, but does not necessarily establish another emergent capability. If a coordinated installation acquires a genuinely new capability, that claim must be investigated separately.

A biological organism. Cells can be organised into tissues and organs, and organs into an organism. Some arrangements establish capabilities unavailable to their components independently, while other organisational distinctions may reflect useful classifications or integration of existing capabilities. The causal evidence must be assessed in each case.

A social organisation. Individuals may form teams, and teams may form departments. These are nested assemblies of interacting people. A department is not automatically a new causal level merely because it has a name and a manager. The question is whether its maintained organisation enables a genuinely new capability to produce or accept physical transfers, including physically embodied communications.

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Provenance and Links

This module develops the treatment of ontological hierarchies, causal levels and epistemic levels in *A Causal Account of Emergence* (Challoner, 2026). It builds on *Causal Assembly Theory: Assembly and Disassembly as Causal Processes* (Challoner, 2026), particularly the treatment of nested assemblies, causal transfers and system capabilities. Related concepts include emergence, causal integration and epistemic compression.

Practical Exercise

Consider a public library with individual staff members, a lending desk, a book-catalogue system and a wider network of libraries.

1. Sketch an assembly hierarchy showing the relevant components and larger assemblies. State where you have chosen the boundaries.
2. Choose two interactions and identify the physical transfers involved, including any physically embodied information. Which transfers are internal or external at each chosen boundary?
3. Suggest one capability that might be emergent at one of the assembly levels. Explain what the components could do independently and what evidence would be needed to test your claim.
4. Identify one organisational level that might not establish a new causal level. Explain why its existence alone is insufficient evidence.
5. Finally, propose a useful epistemic classification of the library system. Explain why that classification need not match the causal levels exactly.

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