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# Three Concepts of Chemical Closure and their Epistemological Significance

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## Abstract

Philosophers have long debated 'substrate' and 'bundle' theories as to how properties hold together in objects — but have neglected to consider that every chemical entity is defined by closure of relationships among components — here designated 'Closure Louis de Broglie.' That type of closure underlies the coherence of spectroscopic and chemical properties of chemical substances, and is importantly implicated in the stability and definition of entities of many other types, including those usually involved in philosophic discourse — such as roses, statues, and tennis balls. Characteristics of composites are often presumed to 'supervene on' properties of components. This assumption does not apply when cooperative interactions among components are significant (as they usually are in chemistry). Once correlations dominate, then adequate descriptions must involve different entities and relationships than those that are involved in 'fundamental-level' description of similar but uncorrelated systems. That is to say, descriptions must involve different semantics (topology) than would be appropriate if cooperative interactions were insignificant. This is termed 'Closure Henri Poincaré. Networks of chemical reactions that have certain types of closure of processes display properties that make other more-complex coherences (such as biological and cultural systems) possible. This is termed 'Closure Jacques Cauvin.' Each of these three modes of closure provides a sufficient basis for warranted recognition of causal interaction, thus each of them has epistemological significance. Other modes of epistemologically-important closure probably exist. It is important to recognize that causal efficacy generally depends on closure of relationships of constituents.

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