

## Editorial: Substances versus Reactions

Is chemistry primarily about things or about processes, about chemical substances or about chemical reactions? Is a chemical reaction defined by the change of certain substances, or are substances defined by their characteristic chemical reactions? What appears to be a play on words to the modern scientist, is actually one of the most fundamental ontological question since antiquity, prompted by the most radical change – the chemical change or the ‘coming-to-be and passing-away’ as Aristotle’s treatise on theoretical chemistry came to be known. The question has bothered philosophers ever since, who were not satisfied with the much too simplistic answer of atomism, according to which the basic elements of nature are atoms, *i.e.* things, persisting in full integrity through time, and any perceived change is only a rearrangement of the otherwise unchangeable atoms. We know that the answer is wrong, that today’s atoms are no atoms in the original sense, that their electronic structures and sometimes even their nuclear states, change in the course of a chemical reaction. And yet, while the burden of atomism has shifted towards high energy physics, towards the begging for money for increasingly bigger and more expensive particle accelerators that might prove or disprove the existence of ultimately elementary particles, persisting in full integrity through time, the original question, which is a philosophical issue of chemistry proper, has somewhat disappeared from the radar screen of both philosophers and chemists.

A number of recent philosophers of chemistry have addressed the issue, however, particularly when freeing themselves from the odd constraints that philosophy of chemistry must reiterate the century old quantum debates – and thereby court the philosophy of physics community. Whether chemical substances or processes have ontological priority is a question that is above and beyond any issue of quantum mechanics, including the notorious reductionism issue, and that substantially determines how chemical knowledge is structured and if today’s efforts of maintaining separated databases for substances and reactions are meaningful. Steven Weininger (2000), for instance, has pointed out that, although chemical processes are the center of much of chemical research, the conceptual apparatus for describing processes is surprisingly poor compared to that of describing structures. Jaap van Brakel (1997, 2000) has suggested that chemistry is essentially about the transformation of substances and that events are the basic elements of chemical ontology. In several publications (*e.g.*, Schummer 1996, 1998), I have argued for an integrating approach that conceptually combines substances and processes in a network of dynamical relations, such that substances and reactivities mu-

tually define each other, both on the experimental and theoretical level. Last but not least, by drawing on the works of the English mathematician and philosopher Alfred North Whitehead (1861-1947), particularly on his *Process and Reality* (1929), Joe Earley has developed an increasingly sophisticated process philosophy of chemistry since the early 1980s (e.g., Earley 1981, 1993, 1998, 2003). It is in this same Whiteheadian tradition that also Ross Stein now provides further arguments “Towards a Process Philosophy of Chemistry” in the present issue of *Hyle*.

The important general point is not, however, whether chemistry needs to be understood exactly according to Whitehead’s own process philosophy or those of his forerunners, such as Leibniz and Aristotle, or those of later proponents, such as David Griffin, John Cobb, Nicolas Rescher, or even Ilya Prigogine. Rather the important general point I want to make, and my reason to devote an entire editorial to this, is that there are fundamental questions waiting to be addressed by philosophers of chemistry, philosophical questions that require both chemical understanding and philosophical knowledge and skills, and not just a familiarity with the technicalities of some theory or with the writings of one particular philosopher. Whether chemistry is primarily about things or about processes does not follow from any experiment or theory but is, knowingly or not, rather presupposed instead, and such is the nature of a philosophical question.

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