

Special Series

Short Biographies of Philosophizing Chemists

This series is intended to present short biographies of chemists who philosophically reflected their own discipline. References should be carefully selected according to philosophical pertinence. References to secondary literature are welcome.

Friedrich Adolf Paneth (1887-1958)

by Klaus Ruthenberg

The Austrian Friedrich (Fritz) Paneth studied chemistry at the universities of Munich and Vienna, where he received his Doctorate in 1910 (*Über die Umlagerung des Chinidins durch Schwefelsäure* and *Über die Einwirkung von naszierendem Wasserstoff*). In 1912, he became assistant of Stefan Meyer at the Institut für Radiumforschung at Vienna, in 1913, the Habilitation (*venia legendi*) followed. Between 1917 and 1919 he was assistant at the Deutsche Technische Hochschule Prag, then he went as Extraordinarius (associate professor) to Hamburg. In the following, he taught at the universities of Berlin (1922-1929) and Königsberg (until 1933). Although he was a Protestant, his parents had been of Jewish faith. This fact and his rejection of Hitler's politics led him to the decision not to return from a lecture tour in England. Until 1939, he taught as a Guest Lecturer at the Imperial College of Science and Technology and the University of London, where he was appointed Reader of Atomic Chemistry in 1938. He then was called to the University of Durham until his retirement in 1953. During World War II, he was head of the chemistry division of the Joint British-Canadian Atomic Energy Team in Montreal (1943-1945). Keeping his British citizenship, he returned to Germany in 1953 to become Director at the Max Planck Institute of Chemistry at Mainz. His research interests were widespread: he began as an organic chemist but changed to radiochemistry early. In his collected papers entitled *Chemistry and Beyond* (ed. by H. Dingle and G.R. Martin, Interscience Publishers: New York-London-Sydney, 1964, 286 pages) there is a complete bibliography divided up into the following sections: Radioactivity and the Transformation of Elements (44 entries), Radioactive Indicators and Adsorption (24), Gaseous Hydrides (24), Free Radicals (12), Helium Investigations (17), Atmosphere and Stratosphere (24), Meteorites (31), Periodic System and Isotopes (24), Historical Studies (45), and Various (5). The mentioned edition includes contributions pertinent to philosophy and history of chemistry, like "Chemical Elements and Primordial Matter: Mendeleev's view and the Present Position", "Goethes Scientific Background", and "The Trend of Inorganic and Physical Chemistry since 1850".

However, Paneth's most central text on philosophical problems of chemistry is his lecture "Die erkenntnistheoretische Stellung des chemischen Elementbegriffs", given to the Königsberger Gelehrte Gesellschaft in 1931, obviously intended as to honour the great old philosopher of Königsberg, whom he later referred to in historical studies on astronomical theories. This lecture was first published - not easy accessible, as the author later admitted - in German: " (*Schriften der Königsberger Gelehrten Gesellschaft, Naturwissenschaftliche Klasse, Heft 4, Max Niemeyer Verlag: Halle, 1931*). Fortunately, the article was later translated into English by Paneth's son, Heinrich Rudolph Paneth, and published as "The epistemological status of the chemical concept of element" (*The British Journal for the Philosophy of Science*, 13 (1962) 1-14, 144-160). All following citations refer to this English edition. The lecture is divided up into six sections: "The Need for Epistemological Clarification of the Fundamental Concepts of Chemistry", "The Concept of Substance in Chemistry", "The Epistemological Standpoint of the Ancient Atomists", "The Epistemological Position of the Concept of Element Introduced by Lavoisier", "The Double Meaning of the Chemical Concept of Element: Basic Substance and Simple Substance", "The Double Meaning of Other Chemical Concepts".

Stating the neglect of chemistry by philosophers, Paneth adds an interesting aspect to the discussion of reasons for that dissatisfying fact, namely the aspect of a supposedly wrong education: "But even today we find a wider spread of physical than of chemical

knowledge and interest amongst philosophers, whether this be due to tradition in the profession or the curricula of our secondary schools" (p.1). As far as the columnist is concerned, this topic should be discussed in more detail in the philosophy and education of chemistry.

Two questions are the main concern of Paneth's lecture. First, the epistemological/ontological problem: "In what sense may one assume that the elements persist in compounds?" (p.3). Secondly, the methodological problem "...whether or not it is true that chemistry should and will dissolve into physics" (p.3). According to Paneth, chemistry is about qualitative characteristics, is the science of the change of substances, or "...a science in which interest is directed towards the secondary qualities of substances" (p.8). Therefore, chemists are first of all naive realists, epistemologically speaking. Going through the history of atomism and the history of elements, Paneth concludes that certain assumptions are to be added to the primitive initial view-point of chemistry: "As a result of these observations we affirm that some Greek thinkers had already realized that it is the aim of the natural sciences to find the laws of a world that is objectively real, whose changes are indicated in our consciousness by processes quite different in kind; and that to understand the change of properties of substances we require transcendental hypotheses" (p.14).

Since the works of Joachim Jungius, Robert Boyle, and particularly Antoine Lavoisier, elements had been defined experimentally: the preparability rather than the non-decomposability has been significant. "In this way an experimentally determinable criterion was introduced into the definition of element, and the interminable and obscure discussions about the true elements brought to an end" (p.146). Moreover, the characterization of a certain element is given in terms of chemistry by its properties, like colour, taste, solubility, and its reactivity as well. But naive realism seems not to lead us anywhere, if the following question is raised: "What sense at all is there in saying that the element sulphur is preserved unchanged in its compounds, such as the gaseous, colourless, pungently smelling sulphur dioxide?" (p.149). In addition, the assumption of persistence of elements in their compounds is widely and successfully applied in case of the Periodic System. Therefore, Paneth suggested a dual concept of the term 'element'. The first he called 'simple substance' (*einfacher Stoff*) which refers to the form in which the second, the 'basic substance' (*Grundstoff*) is presented to our senses. Thus, simple substances are observables in the framework of (naive) realism, whereas the basic substances are non-observables because they belong to the transcendental world. Accordingly, Paneth did not only speak at the same venue as Kant, he also borrowed a great deal of Kantian philosophy. Hence, it is not totally mistaken to point out the correspondence of simple substances and the *Phaenomena* on the one hand, and basic substances and the *Noumena* on the other.

Regarding his second topic, reductionism, two quotations may express Paneth's opinion: "Even if the character of chemistry should change essentially in the future owing to penetration by mathematico-physical methods, its history during the nineteenth century, in which it achieved such successes without mathematics, must never be ignored in its philosophic evaluation" (p.8). "Indeed, we may add even when one day this problem [the nature of primary matter, K.R.] is solved, chemistry (...) will still be justified in going no further than the reduction of the phenomena to the chemically indestructible substances, the elements, and thus in retaining qualitative differences in its fundamental concepts" (p.160).

Closing up, I would like to make a remark on the style of argumentation and writing of Fritz Paneth. Different to many scientists - particularly chemists - who write on philosophical issues of their discipline, Paneth attained a consistently reasonable level and exhibited a mastership in both history of science and history of philosophy. He did not only quote, but also discussed in length thoughts of, for example, Aristotle, Bachelard, Kant, Meyerson, Mill, Rickert, Schlick, and Spinoza from primary sources. Accordingly, it may be judged as a pity that this exceptional scholar had not written more on the philosophy of chemistry. However, his biographer Herbert Dingle stated: "One never had the feeling that he was changing from one subject to another; he was looking at the same subject from another side".(*op. cit.*)

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