Studies in History and Philosophy of Biological and Biomedical Sciences 64 (2017) 65–74

Contents lists available at ScienceDirect

Studies in History and Philosophy of Biological and Biomedical Sciences

journal homepage: www.elsevier.com/locate/shpsc

Whewell on classification and consilience

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ARTICLE INFO

Article history:
Received 13 April 2017
Received in revised form
9 June 2017
Available online 4 July 2017

ABSTRACT

In this paper I sketch William Whewell's attempts to impose order on classificatory mineralogy, which was in Whewell's day (1794–1866) a confused science of uncertain prospects. Whewell argued that progress was impeded by the crude reductionist assumption that all macroproperties of crystals could be straightforwardly explained by reference to the crystals' chemical constituents. By comparison with biological classification, Whewell proposed methodological reforms that he claimed would lead to a natural classification of minerals, which in turn would support advances in causal understanding of the properties of minerals. Whewell's comparison to successful biological classification is particularly striking given that classificatory biologists did not share an understanding of the causal structure underlying the natural classification of life (the common descent with modification of all organisms).

Whewell's key proposed methodological reform is consideration of multiple, distinct principles of classification. The most powerful evidence in support of a natural classificatory claim is the consilience of claims arrived at through distinct lines of reasoning, rooted in distinct conceptual approaches to the target objects. Mineralogists must consider not only elemental composition and chemical affinities, but also symmetry and polarity. Geometrical properties are central to what makes an individual mineral the type of mineral that it is. In Whewell's view, *function* and *organization* jointly define life, and so are the keys to understanding what makes an organism the type of organism that it is. I explain the relationship between Whewell's teleological account of life and his natural theology. I conclude with brief comments about the importance of Whewell's classificatory theory for the further development of his philosophy of science and in particular his account of *consilience*.

1. Introduction

Snyder's recent work (2006, 2011) on William Whewell (1794–1866) includes a brief account of his views on classification. However, this aspect of Whewell's philosophy remains largely unexplored. Though his history and philosophy covered the breadth of natural science, he took pains to familiarize himself with the science of classification in particular (Whewell & Douglas, 1881, p. 122). He travelled to Germany to study with mineralogists and there encountered sophisticated biological classifiers as well (Rieppel, 2016; Whewell & Douglas, 1881, p. 98). Analysis of Whewell's thought on classification thus provides insight into the contemporary theories and practices of natural classification. This is particularly valuable given that the critical overthrow of accounts of pre-Darwinian biological classification as "unscientific" (Amundson, 1998; Wilkins, 2004; Winsor, 2003, 2006) have cleared space for positive accounts of just what nineteenth century classification was about (Winsor, 2015). Amundson (2005) demonstrated that pre-Linnaean biologists (and commonfolk and theologians) believed that organisms could change species and that species could change in a variety of ways. Carolus Linnaeus established the belief that transformation of species, or of organisms from one species to another, is impossible (or rare enough that naturalists could ignore it in practice) (Amundson, 2005, p. 17; Locy, 1915; Osborn, 1894; Perrier, 1884; Thomson, 1899). This set up active research questions (Quinn, 2016a): how many forms of natural relationship are there between organisms and between species? How are taxa to be placed within the natural system? What constitutes evidence for relationship?

In this paper I sketch Whewell's attempts to impose order on classificatory mineralogy, which was in Whewell's day a confused science of uncertain prospects. Whewell argued that progress was impeded by the crude reductionist assumption that all macroproperties of crystals could be straightforwardly explained by

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http://dx.doi.org/10.1016/j.shpsc.2017.06.007
1369-8486/

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Whewell's key proposed methodological reform is consideration of multiple, distinct principles of classification. The most powerful evidence in support of a natural classificatory claim is the consilience of claims arrived at through distinct lines of reasoning, rooted in distinct conceptual approaches to the target objects. Mineralogists must consider not only elemental composition and chemical affinities, but also symmetry and polarity. Geometrical properties are central to what makes an individual mineral the type of mineral that it is. In Whewell's view, *function* and *organization* jointly define life, and so are the keys to understanding what makes an organism the type of organism that it is. This theoretical framework enabled biologists' success in making natural classificatory claims. Whewell's account thus provides insight into pre-Darwinian systematists despite their ignorance or rejection of the evolutionary framework that is now central to the success of biological systematics.

First (section 1) I explain Whewell's diagnosis of the problem with his contemporary classificatory mineralogy. I present his analysis of classificatory science, modelled on botany, and show how he developed the method of *natural affinity* to solve the problem. In section 2 I discuss the justification for this principle in a non-evolutionary context, which Whewell ties to his views on natural theology (section 3). I conclude with brief comments about the importance of Whewell's classificatory theory for the further development of his philosophy of science and in particular his account of *consilience*.

2. Natural affinity

Whewell was appointed Chair of Mineralogy at Trinity College in 1828, and published an *Essay* (Whewell, 1828) on mineralogical classification that same year. In that work and his later *History* (1837a) and *Philosophy of Inductive Sciences* (1840b), he contrasted the disorganized state of mineralogy to the success achieved in zoology and especially in botany. He was Chair of Mineralogy until 1832 and was then appointed in moral philosophy. Though he researched a wide variety of philosophical and scientific subjects, he did not pursue any further substantive work on minerals. His critique of mineralogy remained essentially the same in 1840 (and in Whewell, 1858) as in 1828.

The problem with mineralogy, Whewell argued, was premature causal speculation. He held that the ultimate goal is to discover causal laws that would explain crystalline form and why there are the groups of crystals that there are. However, before causal laws can be posited, Whewell argued that we need a better vocabulary for describing mineralogical properties, and then a better understanding of the natural classification of minerals. Only then would investigation of causal laws be fruitful. Confusion had arisen because it was erroneously assumed that crystalline properties would be wholly explained using the elemental vocabulary of chemistry. Attempts to form classifications of crystals based on the proportional mass of constituent elements had not proved useful. The problem is that such explanatory and classificatory attempts presume that elemental composition causes the crystallographic properties in a straightforward manner that would be reflected in the natural classification of crystals.

Whewell accepted the presumption that the macroproperties of crystals — their geometrical forms, optical properties, cleavage, and so on — must be caused by the crystals' microstructures, because, he reasoned, there is nothing else that could explain the macroproperties (Whewell, 1847b, pp. 401; 403, 460). Whewell allowed that it is quite possible that the crystals are formed of arrangements of atoms, whose elemental nature and spatial arrangements cause the macroscopic properties. He argued, however, that researchers have focused narrowly on the elemental nature of the atoms and ignored the crucial aspect of the atoms' orientations. What was needed was consideration of the properties essential to the nature of the classificatory entities themselves. Whewell claimed that the essential mineralogical properties must be understood in terms of *symmetry* and *polarity*.

He expected that the natural classification of crystals would be compatible with chemical laws about combinations of elements. Indeed Whewell claimed that the agreement of a classification formed on the basis of crystallographic properties with a classification based on chemical properties would be powerful evidence supporting the combined classification of all minerals. It might turn out that elemental composition, polarity, and symmetry serve different explanatory roles respecting different causal processes relevant to mineral classification. More immediately, the availability of conceptually distinct approaches to classification crucially informs methodology.

The critical methodology is what Whewell calls *natural affinity*. Historians have taken a range of approaches to the nineteenth century meaning of natural affinity. Most frequently in the secondary literature, affinity is described as referring to the real relationships described by the natural classification, whatever the basis of the natural classification is taken to be. For example, Ospovat (1981) identified affinity as the relationship evidenced by Richard Owen's (both pre- and post-evolutionary) concepts of "homology". Ospovat identified Étienne Geoffroy Saint-Hilaire as Owen's source for the distinction between relationships of affinity and mere analogy. Snyder (2006, p. 160) synonymized natural affinity with "essence" or "some underlying essential commonality" on the assumption that the natural classification delineated objects on the basis of their metaphysical essences. Snyder (2006, p. 157) stated that in 1825 Whewell converted to the "natural classification system" which grouped entities on the basis of natural affinity. Snyder apparently intended the term *natural affinity* to indicate an ontological point (affinity refers to something real in the world), a normative point (it provides a superior basis for classificatory science), and a historiographic point (its use was a new method in classificatory science, linked to a concern to discover the natural system).

It has become increasingly apparent that *natural affinity* meant different things to different naturalists. See Winsor (1976) on Louis Agassiz; Appel (1987) on Étienne Geoffroy Saint-Hilaire; Quinn (2016a) on Charles Girard (Rieppel, 2016); on Ernst Haeckel; Stevens (1994) on Antoine Laurent de Jussieu; Novick (2015) on William Sharp Macleay; and Winsor (2015) on Hugh Strickland. As will be seen, for Whewell *natural affinity* held a very specific methodological meaning, which has largely been overlooked.[1]

The idea of comparing mineralogical and botanical sciences may seem strange, given the differences between inorganic and organic materials. Classifying rocks and organisms within the same natural system was a regular practice in some eighteenth and nineteenth century works (e.g. Rafinesque, 1815; see; Stevens, 1994). One issue is that it is not clear that pieces of inorganic mass can be considered

[1] The most recent substantive published account that I have found is in Bather (1927).