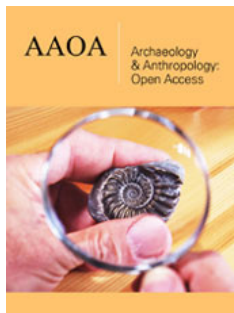


Natural Kinds and Scientific Classification

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Opinion

The notion of natural kinds could date back to Aristotle's works on substance, essence and form. According to Aristotle, kinds of substance are determined by essence which are properties necessarily possessed by things to exist, and kinds defined by essence have objective existence. John Locke differentiates two kinds of essence: Nominal essence and real essence. Nominal essences are abstract ideas associated with kind terms and determine the classification of things. Real essences are the objective internal structures of things but cannot be used as the basis of classification because of our ignorance of them. Aristotle and Locke's views represent two different traditions respectively: Namely, natural kind essentialism and realism as well as natural kind anti-essentialism and anti-realism. In nineteenth century, J. S. Mill officially proposes the word "Kind" and associates it with induction. Mill doesn't claim to define kind by essence, but he emphasizes the objectivity and reality of kinds as well as precise boundaries between kinds. Quine also relates natural kinds to problem of induction, but he tries to define natural kinds by similarity and believes that the concept of natural kind will dissolve with the progress of science.

Although the debates over natural kind essentialism and anti-essentialism, as well as natural kind realism and anti-realism provide significant enlightenment for us to understand natural kinds, we must resolve two key problems to answer the questions of what natural kinds are: (a) naturalness problem, i.e. what is the criterion of distinguishing natural kinds from non-natural kinds; (b) kindhood problem, i.e. what kind of causal structures of the world kinds correspond to so that they can satisfy the naturalness criterion. At the same time, the answers to the previous questions must be able to explain the important epistemic values possessed by natural kinds over non-natural kinds, which are supporting inductive inference, laws of nature and causal explanation. Kripke and Putnam resurrect the traditional natural kind essentialism by virtue of the causal theory of reference. According to natural kind essentialism, natural kinds are groups of things defined by essence. The essences are properties which are intrinsic, necessary and sufficient, modal necessary, micro-structural and discoverable by science. The essential properties can not only distinguish natural kinds from non-natural kinds, but also provide the ontological basis of the epistemic value of natural kinds. However, such a strong essentialist view cannot flexibly accommodate diverse scientific classificatory practices. Especially, the classifications in biological science and social science generate severe challenges to natural kind essentialism, that is, the problem of ontological status of biological species and the metaphysical problems of social kinds. After the standard natural kind essentialism was proposed by Kripke and Putnam, many philosophers of science constructed various alternative theories of natural kinds, based on actual scientific classificatory practices. Natural kind pluralism objects that there is only one correct classification in term of essential properties by natural kind essentialism. Instead, pluralism holds the interest-relativity of classification and adheres to that there are many different but equally legitimate ways of classifying things into kinds. It complies with the intuition of plurality of species concepts and diverse scientific classificatory practices, but it

couldn't provide a satisfactory explanation of the epistemic value of natural kinds because it defines natural kinds in terms of fulfilling certain pragmatic interest or aim.

In addition, natural kind (and species) pluralism may not be compatible with realism and lead to eliminating a general and unified concept of natural kind. On the other hand, the cluster theory of natural kinds is not in favor of precise boundaries of natural kinds defined by essentialism. It defines natural kinds by a cluster of stable recurring properties. According to the popular Homeostatic Property Cluster theory (HPC), natural kinds are defined by stable clustering of properties which are maintained by homeostatic mechanisms, while none of the properties or mechanisms is necessary and sufficient for the kind membership. HPC theory can explain many scientific categories including biological species and social kinds of as natural kinds, and epistemic value of natural kinds, namely, supporting induction and explanation. But it still faces many difficulties, including failing to explain away some scientific categories such as historical kinds and functional kinds. The epistemic theories of natural kinds directly focus on the epistemic values of natural kinds and use them as the criteria to distinguish between natural kinds and non-natural kinds, while they keep neutral and silent on the metaphysical nature of kinds. The epistemic theories of natural kinds can avoid the issue of what exactly the metaphysical basis of natural kinds is, but they cannot identify all natural kinds by virtue of epistemic values only and may contain some non-natural kinds. Besides, the epistemic theories of natural kinds are not capable of explaining the ontological source of epistemic values and fairly treating the role of non-epistemic values in scientific classificatory practices.

This report attempts to integrate current main theories of natural kinds and puts forward a comprehensive explanatory framework to deal with the problems of natural kinds. The comprehensive explanatory framework of natural kinds is based on dynamical systems theory which aims to describe how things evolve with time. The dynamical system theory has features of wholeness, self-organization, openness and stability. According to the dynamical systems theory of natural kinds, natural kinds are groups of things or sets of properties defined by stability. Stability is described by attractors in dynamical systems, and it is a dynamical equilibrium and could accommodate change with greater flexibility. So this kind of stability can provide a criterion of distinguishing between natural kinds and non-natural kinds and an account of the epistemic value of natural kinds. More importantly, this stability can be used as a common ontological basis of various types of natural kinds (essential or micro-structural kinds, HPC kinds, historical kinds, functional kinds or epistemic kinds etc.), because the stability is multi-realizable. To put it differently, essence/microstructures, homeostatic mechanisms or historical continuity are all considered as different manifestations of stability. Therefore, this stability could provide an ontological unity to accommodate the heterogeneous natural kind categories in special sciences. The dynamical systems theory of natural kinds is naturalistic, non-essentialist and non-reductionist, and it is an ontology-only theory. Thus, the new synthesis provided by dynamical systems theory of natural kinds could integrate the insights of current theories of natural kinds and offer a more reasonable resolution to the problems of natural kinds.