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Etiological Kinds

Abstract

Kinds that share historical properties are dubbed "historical kinds" or "etiological kinds" and they have some distinctive features. I will try to characterize etiological kinds in general terms and briefly survey some previous philosophical discussions of these kinds. Then I will take a closer look at a few case studies involving different types of etiological kinds. Finally, I will try to understand the rationale for classifying on the basis of etiology, putting forward reasons for classifying phenomena based on diachronic features, thereby making a provisional case for considering at least some etiological kinds to be natural kinds.

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Etiological Kinds

1. Introduction

Members of natural kinds are widely considered to share a number of properties. This is perhaps the most minimal condition on natural kinds, and one with which practically everyone writing on the topic would agree. This characterization remains neutral on some crucial questions, such as what type of properties need to be shared, why those properties are shared or co-occur, whether the properties are singly necessary and jointly sufficient for membership in the kind, whether they are shared in every possible world in which the kind exists, and so on. In particular, this characterization does not tell us whether the properties that members of natural kinds share are supposed to be intrinsic causal properties (or causal powers), or whether they can consist of historical properties, such as a common origin or shared etiology. Kinds that share historical properties are sometimes dubbed "historical kinds" or "etiological kinds" and they have some important features that distinguish them from other kinds of kinds.[1] Despite the fact that etiological kinds are invoked across the sciences, there has been relatively little philosophical discussion of their similarities to and differences from synchronic kinds. In particular, there is scant attention in metaphysics and the philosophy of science to the question of whether etiological kinds can be natural kinds. In this paper, I will make an effort to remedy this

[1] For reasons that will emerge in due course, I prefer the expression "etiological kind" to "historical kind" and will use it throughout this paper. The expression "etiological kind" is not meant to carry a commitment to the claim that etiological kinds are natural kinds, which is a claim that will be considered in section 4.

situation by providing an account of etiological kinds and their utility for science and by considering whether at least some etiological kinds could be natural kinds. In section 2, I will try to characterize the phenomenon of etiological kinds in general terms and will briefly survey some previous philosophical discussions of these kinds. Then, in section 3, I will take a closer look at some case studies, which will enable us to take into account various types of etiological kinds and compare some of their features. Finally, in section 4, I will try to understand the rationale for classifying on the basis of etiology, putting forward some reasons for the scientific interest in classifying phenomena on the basis of diachronic as opposed to synchronic features. In so doing, I will make a provisional case for considering at least some etiological kinds to be natural kinds.

2. Characterization and Historical Precedents

One way of characterizing etiological kinds in general terms is as follows:

> *An etiological kind is one whose members share a (token or type) causal origin, history, or trajectory.*

This characterization immediately gives rise to a distinction between those kinds whose members share a *token* causal origin, history, or trajectory, and those whose members share the same *type* of causal origin, history, or trajectory.[2]

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[2] Franklin-Hall (2017) has drawn a distinction between two kinds of historical kinds on this basis. She also puts forward a proposal to explain why scientists individuate historical kinds, which I will not have space to discuss here. In a similar vein, Magnus (2012, 171) has

Token-etiological kinds have members that all originate in the very same event, or have followed the same token causal trajectory, or share the selfsame history. One of the most extensively discussed cases of this type is that of biological species. According to a widely accepted view of the nature of species, members of a biological species are classified together because they are all descended from the same set of common ancestors. Consequently, they have the same token origin and share the same token history. When it comes to at least some (and perhaps all) token-etiological kinds, it seems as though it is open to us not to consider them as kinds at all but as individuals. For example, given that they have relatively well-defined spatial and temporal boundaries, some biologists and philosophers of biology propose that species should be regarded as individuals, namely "spatiotemporally localized cohesive and continuous entities" (Hull 1978, 336; cf. Ghiselin 1974). On this proposal, what we ordinarily think of as members of a species are better conceived as proper parts of individuals. This alternative construal may also be extended to other token-etiological kinds. Similar points could be made about certain social phenomena that can be considered examples of token-etiological kinds. For instance, we can think of Semitic languages as a kind that has as members a number of languages that have a single origin in the pre-historic Middle East, namely: Arabic, Hebrew, Aramaic, Amharic, and other languages. But it is also possible to think of this group of languages not as discrete individuals belonging to the same kind but as a single historical entity originating circa 3800 BCE as a stem language and spreading from southwest Asia into Africa,

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distinguished among token and type historical kinds understood as homeostatic property cluster kinds.

while differentiating and diverging like the branches of a tree.[3] It would seem as though it is possible to think of token-etiological kinds as individuals rather than as kinds, given that they can be identified with a continuous causal-historical process that has definite boundaries in space and time. But since I do not think that conceiving of them as individuals is obligatory, I will treat them as kinds for the purposes of this paper.

As for *type-etiological kinds*, they do not share the very same token origin or history but rather the same type of origin or history. Their members do not originate in the same event or follow the very same causal pathway; rather, their origins or histories are tokens of the same type. For example, in geology, igneous rocks do not all originate from the same source but they are created by the same *type* of process, namely the solidification and crystallization of hot magma or lava. This is a repeatable process in the history of the earth (and perhaps other planets) and has occurred a multitude of times, each time producing rocks with the same type of origin and causal history. Igneous rocks are classified as such on the basis of the process that led to their formation rather than their intrinsic or synchronic properties.

The above examples also enable us to introduce another distinction, orthogonal to the first, between *pure etiological kinds*, whose members share nothing but an origin or history, and *impure* or *hybrid etiological kinds*, whose members share intrinsic or synchronic features too, and may be classified into kinds based on both etiological and non-etiological features. To put it

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[3] Compare Wylie (1995) on the "demic-diffusion" model that has been put forward to account for the distribution of Indo-European languages across western Asia and Europe, which posits a steady spread of a population of agriculturalists carrying their language and displacing sister languages.

more precisely, members of pure etiological kinds do not share any synchronic properties that are not also shared with members of other kinds.[4] By contrast, members of hybrid etiological kinds do not just share diachronic properties, they also share synchronic properties that distinguish them from members of other kinds. These hybrid etiological kinds are no less etiological than their pure counterparts, but they are instances of kinds whose members are individuated not just in terms of historical properties but additionally on the basis of non-historical properties. In these cases, the diachronic mode of classification and the synchronic one coincide. By contrast, pure etiological kinds do not share any synchronic properties that they do not also share with members of other kinds. This distinction can be illustrated using the case of biological species, since a common history is not the only thing that members of a biological species typically share. For many species, the ability to interbreed and produce fertile offspring is widely held to be criterial for species membership.[5] Apart from some extreme polymorphisms, members of a given species also often have a loose cluster of intrinsic features in common, so biological species are what might be called hybrid (token-) etiological kinds,

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[4] Members of etiological kinds also belong to some superordinate kind that specifies a broader sortal, which often corresponds to a synchronic property that they share with non-members. For example, members of the kind *igneous rock* are *rocks*, which is what distinguishes them from non-rocks that may share the same causal history. I am grateful to an anonymous referee for pressing me on this point.

[5] In the words of Ernst Mayr (1969, 26): "the members of a species form a reproductive community. The individuals of a species of animals recognize each other as potential mates and seek each other for the purpose of reproduction."

since they share more than just a history. By contrast, the class of igneous rocks can be considered an example of a pure (type-) etiological kind, since there are no synchronic properties (or even a loose cluster of properties) that all igneous rocks have that they do not share with other rocks. They are classified together on the grounds that they have been produced by the same type of geological process (as will be shown in section 3).

So far, I have contrasted etiological kinds with kinds that are individuated on the basis of synchronic properties. It is worth pointing out that synchronic kinds can include kinds individuated intrinsically as well as those individuated extrinsically. In other words, etiological kinds are not the only subtype of extrinsic kinds, since there can be extrinsic kinds that are synchronic not etiological.[6] Functional kinds are also extrinsically or relationally individuated, but often synchronically rather than etiologically. Hence, etiological kinds are individuated (at least in part) both extrinsically *and* diachronically, by contrast with many paradigmatic natural kinds, which are individuated on the basis of both intrinsic and synchronic features.

To gain further insight into the nature of etiological kinds, it will be useful to look briefly at a few preceding discussions. Perhaps one of the earliest attempts to discuss classification on historical grounds, can be found in William Whewell's *Philosophy of the Inductive Sciences*. Whewell delimits a class of historical sciences, as follows: "…the class of Sciences which I designate as Palaetiological are those in which the object is to ascend from the present state of things to a more ancient condition from which the present is derived by intelligible causes"

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[6] The distinction between intrinsic and extrinsic properties is notoriously hard to pin down, but I'll assume that something like this distinction is in place for the purposes of this paper. For further discussion, see Langton and Lewis (1998).

(1847, 637). He explains that he dubs them “palaetiological” on the grounds that they are concerned with ancient or *historical* (paleo-) matters and with *causation* (etiological), in that they classify on the basis of *causal history*. Whewell elaborates that these sciences include geology, philology, archaeology, and astronomy, though he recognizes that these sciences may not be exclusively historical, since (for example) astronomy is concerned not just with etiology but with synchronic causal processes as well.[7] Nevertheless, he holds that classification in these sciences is at least sometimes based on shared history.

Since Whewell's seminal treatment, philosophers do not appear to have paid the topic of etiological kinds in general much heed,[8] though there has been renewed interest in recent years in the historical sciences and in historical explanation in particular (see e.g. Beatty 2006; Cleland 2011; Ereshefsky and Turner (forthcoming)). Meanwhile, there has also been a great deal of implicit discussion of etiological kinds by philosophers of biology in the course of the extensive discussion of the species category, as already suggested. The classic debate between pheneticists and cladists in biological systematics is largely about the virtues of synchronic and etiological classification, respectively. Although pheneticism is sometimes characterized as holding that biological organisms ought to be classified based on overall phenotypic or genotypic similarity, what would seem to be crucial for pheneticists is an exclusive focus on synchronic rather than diachronic features. Pheneticists assess similarity without regard to lineage or a history of descent. On their view, “biological classifications should be made independent of any

[7] Compare Currie (2018), who argues that there may not be a distinct class of “historical sciences.”

[8] Two recent exceptions are Magnus (2012, 165-175) and Khalidi (2013, 130-142).

theoretical assumptions concerning evolutionary relations" (Ereshefsky 2001, 67). Cladistic classification, on the other hand, is based entirely on the attempt to reconstruct lineages in evolutionary history and capture phylogeny. For cladists, classificatory categories are etiological. These two approaches to classification, synchronic and diachronic, are usually regarded as opposing rivals, but some biologists adopt an intermediate position, which takes into account both synchronic and diachronic considerations in classification. Thus, their taxonomic categories are hybrid ones.[9]

A less obvious manifestation of the debate between non-etiological and etiological classification, and one not derived from biology, can be found in recent philosophy of mind and language. One way of understanding the distinction between "narrow" and "wide" content, and the associated debate between semantic internalists and externalists, is as a difference between those who would classify contentful mental states on the basis of their synchronic causal powers and those who would do so based on their causal history. Externalists type mental states on earth and twin earth differently in the familiar twin-earth scenario based on the fact that earthians and twin earthians have picked up the term 'water' and the associated concept as a result of (possibly indirect) contact with H_2O and XYZ, respectively. This is so, regardless of the fact that the two substances would be indistinguishable to the thinkers involved and the behavior of the thinkers and their causal powers of identification and discrimination are the same. Even though externalism is often characterized in terms of relations to the natural or social environment, it is

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[9] For some of the classic papers on the species concept, representing different approaches to biological taxonomy, see Ereshefsky (1992). For more recent contributions on species by philosophers and biologists, see Wilson (1999).

more properly understood as a thesis about individuation based on etiology. On most externalist accounts, the term ‘water’ as used by an interstellar traveler from earth to twin earth would not undergo a change of meaning or reference immediately upon arrival, like an ordinary indexical term. Rather, the traveler would have to have a certain history of contact with XYZ before the term ‘water’ would come to refer in their idiolect to XYZ rather than H_2O. The historical or etiological individuation of semantic content comes out clearly in a thought experiment first broached in Davidson (1987), which has a precursor in Millikan (1984). Davidson considers a case in which a lightning bolt reduces his body to its constituent molecules while it simultaneously creates a molecule-for-molecule replica of him from a dead tree in a nearby swamp. According to him, the replica created in the swamp does not mean anything by the sounds it makes even though it is indistinguishable from him and no one can tell the difference between them. The reason is that “Swampman” does not have the right causal history, at least at the beginning of his career. As Davidson (1987, 456n.4) goes on to explain, “The Swampman simply needs time in which to acquire a causal history that would make sense of the claim that he is speaking of, remembering, identifying, or thinking of items in the world.” This example was also taken up in Millikan (1996), where she argued that both ontogeny and phylogeny are relevant to a creature’s having thoughts and other mental states.[10]

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[10] In earlier work, Millikan (1984, 93; original emphasis) had considered a similar scenario: “Suppose that by some cosmic accident a collection of molecules formerly in random motion were to coalesce to form your exact physical double… that being would have no ideas, no beliefs, no intentions, no aspirations, no fears, and no hopes…. This [is] because the evolutionary *history* of the being would be wrong.”

Perhaps the most explicit treatment of etiological kinds in the recent philosophical literature occurs in Millikan (1999), where the term "historical kind" appears to make its first appearance. In subsequent work, Millikan (2004, 20-21) associates three features with what she calls "historical kinds" or "copied kinds" (she seems to use the terms interchangeably). First, *reproduction* (or copying): all members have been produced from one another or from the same models. Second, *environment*: members have been produced by, in, or in response to, the same ongoing historical environment, including other copied kinds. Third, *function*: some function is served by members of the kind, where "function" is roughly an effect raising the probability that its cause will be reproduced. For instance, if organisms perform their function effectively, they survive and reproduce, thus raising the probability of the creation of another token of that type. Similarly, for artifacts, if a specific model of automobile does its job effectively it raises the probability that new instances of that model will be created. According to Millikan, members of these kinds are copied or reproduced precisely because they share certain synchronic features, so her "historical kinds" or "copied kinds" are impure or hybrid etiological kinds (in my terminology). Millikan also characterizes them as follows: "The members of these kinds are like one another because of certain historical relations they bear to one another… rather than by having an eternal essence in common" (1999, 54). Biological species are the most obvious example of Millikan's copied kinds, but she also includes some kinds of artifact (e.g. *1969 Plymouth Valiant*) and social profession (e.g. *doctor*) in the class of copied kinds. In addition to being hybrid etiological kinds, I would argue that copied kinds are a distinct subset of etiological kinds since they are the result of a particular type of causal process, copying. Moreover, copied kinds would seem to be token-etiological as opposed to type-etiological kinds, since members of copied kinds are all copied from one another or a common blueprint, indicating a token historical process. But as we shall see in section 3, some token-etiological kinds are not copied kinds.

3. Etiological Kinds across the Sciences

In this section, I will consider a number of examples of etiological kinds drawn from a range of different sciences, with a view to clarifying various features of these kinds, including the distinctions introduced in the previous section between token- and type-etiological kinds, and between pure and hybrid etiological kinds. A look at some case studies should give us a better understanding of the reasons that scientists choose to classify on the basis of history and will also help us determine whether some etiological kinds can be considered natural kinds.

3.1. Astronomy and Cosmology

As recognized by Whewell, there are clear examples of etiological classifications in astronomy and cosmology. Take the kind *meteorite* in planetary astronomy. Meteorites are rocks found on a planet or moon that originate elsewhere in the universe. Most meteorites that have been investigated by scientists are collected from earth, though some have also been identified on the moon and on Mars. Terrestrial meteorites primarily share an extra-terrestrial origin and they have diverse structures and compositions. Perhaps the only intrinsic property that almost all meteorites possess that is not also possessed by non-meteorites is a "fusion crust" on the surface of the rock.[11] If they are so different in intrinsic properties, why classify them together as

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[11] "Almost all newly fallen meteorites may be recognized by the presence of a fusion crust. This is a layer of 1-3 mm thick that formed during atmospheric flight by the solidification of the melt

meteorites? In short, they all reveal information that enables scientists to reconstruct aspects of the history of the solar system and the universe beyond. Terrestrial meteorites that come from other parts of the solar system provide information about the history of the solar system, such as "clues to the timing and formation of the planets" (Voosen 2018). A recent study reports that based on isotope levels in different types of meteorites, we can tell that some originated from asteroids located near the current location of the asteroid belt, while others came from asteroids that were once located near Saturn's current orbit but were later pushed by the giant planets into the current asteroid belt (Nanne et. al. 2019). This allows scientists to understand better the early state of the solar system and the changes in orbits of the planets and the asteroid belt. Terrestrial meteorites are a type-etiological kind, since they share the same type of causal trajectory, having all been drawn to earth by the earth's gravitational field.

Another significant etiological kind in astronomy or cosmology is cosmic microwave background (CMB) radiation, which is radiation left over from the Big Bang. It is a form of microwave radiation that peaks at 160.23 GHz, whose features indicate that it is a remnant from the very earliest stage of the formation of the universe. Even though instances of CMB radiation have common properties in terms of frequency and temperature, what distinguishes CMB is not its synchronic properties, since radiation at the same frequency and temperature would not be classified as CMB radiation if it did not have the right origin and causal history. The interest in this kind of radiation lies primarily in what it can tell us about the origin of the universe. CMB radiation is considered part of the evidence for the Big Bang and against, for example, the

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on the surface when frictional heating ceased as the meteoroid slowed to subsonic velocity." (Hutchison 2004, 13-14) steady-state theory of the universe. In addition, slight irregularities in the radiation are indicative of quantum fluctuations in the distribution of matter in the very early universe. Unlike *meteorite*, *CMB radiation* is a token etiological kind, since all its instances have the same origin and an identical causal trajectory (at least in the absence of multiple universes). But despite being a token etiological kind, *CMB radiation* is not a copied kind since it does not result from a copying process. Even though all instances of CMB have identical intrinsic properties, those properties do not differentiate them from other instances of radiation with the same frequency and temperature, so *CMB radiation* is also an example of a pure etiological kind.

3.2. Geology

The basic geological division of rocks into *sedimentary*, *igneous*, and *metamorphic* is a classification based on etiology. As mentioned earlier, igneous rocks are classified as such because they are the result of a process of solidification and crystallization of lava or magma. Igneous rocks have a range of different compositions and contain a variety of different minerals. Their intrinsic properties are extremely variable but their classification as *igneous* reveals something about the geological process by which they were formed. Many of them contain radioactive isotopes that hold clues about their origin and the precise processes that led to their formation. Sedimentary rocks are similarly classified based on their etiology, since they are rocks formed when small particles are transported by water, wind, or gravity and deposited in one place and later compacted to form larger rocks. Here again, the intrinsic properties of sedimentary rocks can be starkly different, depending on the material from which they are formed, the exact processes that led to their formation, and other factors. Geologists study “diagenesis” to ascertain the physical and chemical changes that occur during the conversion of sediment to sedimentary rock. Based on the structure and composition of sedimentary rocks, they can reconstruct their "diagenetic history," retracing the precise causal pathways that led to the formation of sedimentary rocks. Moreover, stratigraphy is the study of the history of strata and its relationship to the geological time scale (Zalasiewicz 2016). Thus, both of these types of rock are classified based on their causal history and the processes that led to their formation, even though in both cases, some sub-categories of the categories *igneous* and *sedimentary* are individuated intrinsically, based on such properties as chemical composition. *Igneous* and *sedimentary* rocks are both type-etiological kinds since they are the result of different token causal processes of the same type. They also tend to be pure etiological kinds since there are no intrinsic properties that all igneous rocks share or that all sedimentary rocks share that they do not also share with members of other kinds. The only thing that ties them together and sets them apart are the causal processes that led to their formation.

3.3. Biology

As mentioned in section 2, many biologists and philosophers of biology consider biological species to be etiological kinds. They are hybrid token-etiological kinds, since members of a species originate from the very same set of ancestors and they typically share a loose cluster of properties, notwithstanding some extreme polymorphisms. Higher phylogenetic taxa (e.g. genera, families, etc.) are also classified primarily on basis of descent, but are sometimes classified partly on the basis of etiology and partly on the basis of synchronic features.

Another case of an etiological kind in biology is *homology*. At least according to the most prevalent conception of homology, homologous phenotypic features derive from the same ancestral structures in different species or higher taxa.[12] Homologies are often contrasted with analogies (or homoplasies), which are features that share synchronic causal or functional properties, despite having different ancestral origins. The difference between homologous and analogous classifications can be understood as a difference between classifying features on the basis of historical origin and on the basis of synchronic or functional properties. Classification on the basis of analogous features allows biologists to understand how similar selection pressures or environments might give rise to features that perform the same function across different lineages, as in convergent evolution. For example, we might be interested in understanding how similar selection pressures gave rise to wings in the lineages of insects, birds, pterosaurs, and bats. Meanwhile, classification on the basis of homology helps scientists explain the evolution of phenotypical characters with different features from a single ancestral form. Comparison of three homologous organs, a feline leg, a bat wing, and a dolphin fin, all of which are instances of the etiological kind, *mammalian forelimb*, can help us understand how different selection pressures modified a common ancestral form to adapt to different environmental conditions.

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[12] Ereshefsky (2007) contrasts two main approaches to homology: the taxonomic approach, which regards traits as homologous when they are derived from a common ancestor, and the developmental approach, which focuses on the ontogeny of traits within and among organisms. The account I am assuming here is more closely aligned with the taxonomic approach to homology than the developmental. Brigandt (2002) explicates various different accounts of homology in use among biologists and philosophers of biology, including accounts that operate at different levels (e.g. genetic, developmental, morphological, and behavioral), emphasizing that homology at one level need not translate into homology at another level.

Once we know that these organs have a common (token) origin, we acquire a better understanding of the specific causal processes that made each of them different from the others despite their common origin.[13] Homologies are token-etiological kinds that are also copied kinds. It is worth emphasizing that analogies can also be understood as etiological in some cases, though the history in question is different from that typically identified when it comes to homologies.[14] While homologies share the very same ancestral forms and hence a token etiology, analogies can in some cases be considered to share a similar type of evolutionary history. Brigandt and Griffiths (2007) point out that analogies have traditionally been considered to have a similar function or to have been shaped by natural selection for the same end. But, as emphasized by Love (2007), functional individuation can be synchronic or diachronic. Functional anatomists are often interested in synchronic functions, while others may be interested in the function for which a feature was selected, which requires an understanding of the selection history for that trait (as in the case of wings in different lineages). Hence, it would

[13] Ereshefsky (2012, 391) explains the difference between explanation on the basis of analogy and homology: "An analogy explanation for the properties of insect wings explains the features needed for performing the function of flight. It explains through design analysis such general features as being aerodynamic, being rigid, and being made of a certain range of materials. By contrast, a homology explanation of insect wings explains more specific features of wings by citing their morphological, genetic, and ontogenetic sources. For instance, a homology explanation tells us why insect wings are membranous and supported by rigid veins, rather than being made of feathers supported by bones."

[14] I am grateful to an anonymous referee for making this point.

be too simplistic to regard homology as etiological and analogy as synchronic, since analogies are sometimes individuated with reference to the same type of selection history, making them at least in some cases, type-etiological kinds.

3.4. Psychology and Cognitive Science

As mentioned in section 2, externalism about concepts can be construed as the view that meaning and mental content should be individuated etiologically. In this case, the historical mode of individuation and the synchronic can come apart and result in unrelated (wide and narrow) mental contents, at least if one is strict about associating mental content with the ultimate cause of the relevant mental state. Some externalists insist that content is determined not by a concept's causal or functional role but by its causal origin.[15] On a strict externalist account of conceptual content, the content of a concept floats free of its functional role or its associations with other concepts and is determined solely by its causal origin. There are also hybrid accounts according to which concepts are individuated at least partly by etiological factors and partly by causal powers, or others in which the two modes of individuation are adopted for different purposes or in different contexts. Some philosophers and psychologists are internalists, but many would insist that etiology is at least relevant to the individuation of mental content.

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[15] In this vein, Fodor (1994, 97) writes (adopting the convention of using small caps to stand for concepts): "Though DOG-thoughts call up CAT-thoughts, LEASH-thoughts, BONE-thoughts, BARK-thoughts and the like in most actual mental lives, there are possible mental lives in which that very same concept reliably calls up, as it might be, PRIME NUMBER-thoughts or TUESDAY AFTERNOON-thoughts or KETCHUP-thoughts."

Another instance of etiological classification in cognitive science concerns episodic memory. Episodic memories are generally considered to be mental representations of events (episodes) in the lifetime of a cognizer. They are representations of personally experienced past events, which are also thought to have a distinctive "autonoetic" phenomenology (Tulving 2002). What makes something an episodic memory is commonly held to be (at least partly) the right kind of causal link to a particular episode that occurred in the past history of a thinker. It is notoriously difficult to spell out the precise causal condition that needs to be met in order to exclude various mundane and bizarre cases (see e.g. Martin and Deutscher 1966; Michaelian 2011). Nevertheless, according to many philosophical and psychological accounts of episodic memory, what distinguishes memories from other sorts of mental representations (e.g. beliefs, imaginations, delusions) is that they originate in a specific past event that is represented in the mind-brain of the thinker.[16] This connection to history is over and above the etiological dimension that externalists insist pertain to *concepts*. Even though many memories have conceptual content, the etiological aspect that is introduced in virtue of having content is additional to the etiology that makes a representation a memory. For example, I can think the thought that dogs are mammals, and if externalists are right, my concept DOG has the content that

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[16] As a result of recent developments in the psychology and neuroscience of memory, some researchers have denied the need for a causal condition when it comes to individuating episodic memory, and have called for erasing the distinction between episodic memory and imagination or prospective thinking. I will not try to address their arguments here, but for defenses of this view, see, for example, Suddendorf, Addis, and Corballis (2009), De Brigard (2014), and Michaelian (2016).

it does in virtue of a link to actual instances of dogs. But I can also entertain a memory about my sister's dog, which is tied to a specific event that occurred last month. Here, the memory has an historical dimension as a result of having conceptual content but it has an added historical dimension insofar as it is an episodic memory. Episodic memories are type- rather than token-etiological kinds, since they (obviously) do not all have the same causal origin or trajectory. What they have in common is the same type of origin and trajectory, the right kind of connection to some past experience in the life of the cognitive agent. They are also often hypothesized to have followed the same type of causal trajectory, which involves the cognitive processes of encoding, storage, and retrieval. But specific episodic memories of some common event that was personally experienced by numerous people, such as the events of 9/11, could be considered token-etiological kinds that have the very same origin. Their instances are the mental representations in the minds of various individual thinkers, which are the individual memories of that event.

One interesting question when it comes to the individuation of concepts and episodic memories has to do with the reasons for classifying them etiologically. Why do many inquirers insist that for something to be a concept of WATER or to be a memory of 9/11, it has to have the right history rather than (merely) a certain set of intrinsic features? When it comes to concepts, it seems to have something to do with the need to ground their content in their external determinants and trace them back to a referent. Semantics is usually thought to involve correspondence to an extra-mental reality and a causal-historical link to the world is deemed to guarantee that correspondence. As for episodic memories, they are thought to be *of* a particular episode, so unless they have the right kind of connection to that episode they cannot be said to be memories of that very episode. A mental state is not an episodic memory unless it originates in an experience in the history of the individual and is transmitted by an uninterrupted causal chain. In both cases, the need for accuracy or validity would seem to justify the etiological mode of classification.

4. Why Etiological Kinds?

After reflecting on the examples discussed in the previous section, two questions might arise. The first has to do with whether classification by etiology is justified in science, and if so, on what grounds. The second, more practical, question concerns the viability of such classifications, since tracing causal history or origin is a tricky business and, hence, a precarious basis on which to build our scientific taxonomies. In this section, I will try to address the first question. But before doing so, a couple of brief remarks are in order on the second question. It is true that retracing causal pathways is often a fraught endeavor and usually relies on slender evidence, but in many domains a range of methods and techniques have been discovered that enable scientists to reconstruct a broad variety of phenomena, from the first few minutes after the Big Bang to the evolutionary history of our hominid ancestors. Moreover, scientific and technological advances are always improving on our ability to retrace causal pathways and recover historical processes based on ephemeral and seemingly insubstantial traces. There is no telling what future techniques will enable us to do when it comes to uncovering historical origins and trajectories.[17]

[17] Cleland (2011, 579) writes: "Scientists have become increasingly adept at extracting information once thought to be unobtainable from traces of the past." For a recent philosophical

As for the question of the justification of etiological categories and the reason for classifying phenomena on the basis of causal history, the examples in the previous section provide us with an appreciation of the variety and diversity of etiological kinds and perhaps a better understanding of the point of such classifications. Based on this brief survey, it would seem as though there are broadly three reasons for etiological classifications:

(a) *Retrodiction* (i.e. prediction of the past): When we classify something into an etiological category, this enables us to make a retrodiction about its past. For instance, if we identify a rock as a meteorite based on its fusion crust, we can infer that it had an extra-terrestrial origin and a certain causal trajectory through the earth's atmosphere.

(b) *Explanation*: Classification in an etiological category can help us understand and explain the causal processes that led to its current state. For instance, classifying two phenotypic features as homologues can help us explain how certain selection pressures led to their current forms, as with a bat wing that is classified as a homologue of a feline forelimb.

(c) *Tracking accuracy or validity*: Classification according to etiology is sometimes in the service of securing an accurate representation of a past event, or indeed ensuring that a current phenomenon bears a mark or trace of some previous state of affairs. For instance, a mental state is classified as an episodic memory based on a connection to a past event and a mental representation is classified as a concept of WATER based on a presumed link to samples of H_2O.

Do these reasons vindicate the use of etiological categories in science? Can they provide a justification for etiological classification? In the first two cases, etiological categories serve

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treatment of the historical sciences that emphasizes the feasibility of uncovering evidence for theories about the past, see Currie (2018).

standard scientific goals of prediction and explanation. At least prima facie, etiological categories seem to be on a par with other scientific categories in this regard. Moreover, these two reasons align with features commonly associated with natural kind categories, namely that they enable explanation and prediction. As for the third reason, securing the accuracy or validity of a representation may also seem to conform with the scientific aim of truthful description. But when it comes to concepts and episodic memories, the representations in question are not those of the scientific observers but those of the agents being studied. If cognitive scientists classify a thinker's mental representation as a concept of WATER based on its causal link to H_2O, this is not done in the service of providing an accurate description of chemical phenomena, since cognitive scientists are in the business of describing (and explaining, predicting, and so on) the minds of thinkers, not the microstructures of chemical substances. Moreover, it is not obvious that describing it as a concept of WATER better helps to explain and predict the thinker's actions.[18] Still, here too, it seems that the overriding purpose is the need to retrace and understand causal pathways, which is often considered to be the ultimate aim of science: to capture the causal structure of the world.

It is worth pausing here to consider whether these reasons for etiological classification are mutually exclusive and exhaustive. They would seem to be distinct reasons, despite the fact that the aims of retrodiction and tracking accuracy or validity are closely related.[19] Both of them

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[18] There is, of course, a heated philosophical debate about whether wide or narrow content should be the mode of individuation adopted by scientific psychology and cognitive science, which I do not have space to tackle here.

[19] I am grateful to two anonymous referees for separately raising this issue.

involve classifying particulars on the basis of etiology for the purpose of ascertaining something about their origin. But the need to reconstruct origins seems differently motivated in the two cases. One way of bringing out the difference is by comparing them to certain etiological kinds in the social sciences. At least some properties and kinds in the social sciences appear to be etiological but not merely because of an interest in retrodiction. For instance, something is not an instance of the kind *money* unless it has the right provenance, and something is not an exemplar of the kind *law* unless it has been enacted or passed by the proper authority or according to the correct procedures. But in classifying particulars as *money* or *law* on these grounds, we are not just interested in retrodiction. When we classify particulars into these categories, the point is not merely to retrodict that a particular token of money originated in a certain mint or a particular statute was issued by the relevant legislative body. Rather, in both cases we do so in order to be assured of authenticity or genuineness. In some respects, those who individuate *concept* or *episodic memory* etiologically are acceding to the same need for authenticity. In the social world, we often have an interest in individuating according to history or origin because we need to be assured that members of the kind are what they purport to be. In such cases, what is at issue is not just retrodiction but the need to ensure that a phenomenon bears the trace of a previous state of affairs. Distinguishing between a memory and an imagination has something in common with differentiating genuine money from counterfeit currency, a commonality that goes beyond differentiating a meteorite from a terrestrial rock. That is why the first and third reasons for etiological classification seem distinct, even though retrodiction may be a necessary condition for tracking accuracy or validity. As for these reasons being exhaustive, I will not try to make the case that there are no other grounds for etiological individuation. The three reasons outlined above seem to account for the examples considered here, but it is an open question whether there are other reasons for diachronic classification and for identifying etiological kinds.

Can etiological kinds be natural kinds? The answer to this question obviously depends on one's conception of natural kinds, but I think there is room for accommodating them on the prevailing contemporary accounts. Recent theories of natural kinds split roughly into two groups, essentialist and naturalist. Essentialists consider natural kinds to be characterized by essences, properties that are necessary and sufficient for kind membership and are modally necessary or shared across all possible worlds. Some essentialist philosophers have also insisted that essences must be intrinsic and that they cannot consist of relational or historical properties. For example, Ellis (2001, 20) holds that "… the distinctions between natural kinds must be based on intrinsic differences." On such a conception of natural kinds, etiological kinds would be ruled out. But other essentialists disagree, explicitly defending origin essentialism for biological species (e.g. Griffiths 1999; Okasha 2002). This would allow etiological kinds that are based on causal origin and, as long as individuating causal histories and trajectories is not problematic, other etiological kinds as well. In the absence of a clear argument for ruling out kinds with historical essences, there does not seem to be a principled obstacle to allowing etiological kinds to be natural kinds on an essentialist construal. Essentialist accounts of natural kinds have recently been challenged by accounts that do not insist on linking natural kinds to sets of necessary and sufficient properties and are at best agnostic about the modal claims associated with essentialism. Such accounts of natural kinds can be considered "naturalist," in the sense that they maintain that the categories of established scientific theories are our most reliable guide to the kinds that exist in the universe (see Boyd 1999a; Kornblith 1993; Magnus 2012; Khalidi 2013). The fact that the etiological kinds discussed in previous sections play a role in the central endeavors of science, including explaining and predicting important features of the world, should lead one to surmise that they are good candidates for being natural kinds. Moreover, many such naturalist accounts emphasize causality and consider that scientific categories aim to discern the causal structure of reality. This emphasis on causation is prominent in Boyd's account of natural kinds and it is exemplified in what he calls the "accommodation thesis": "Kinds useful for induction or explanation must always 'cut the world at its joints' in this sense: successful induction and explanation always require that we accommodate our categories to the causal structure of the world" (1991, 139). Boyd also writes of "the accommodation of inferential practices to relevant causal structures" (1999b, 56). This is also a central feature of Kornblith's account of natural kinds: "It is precisely because the world has the causal structure required for the existence of natural kinds that inductive knowledge is even possible" (1993, 35). If etiological kinds are individuated on the basis of their (token or type) causal origin, history, or trajectory, they should enable us to better describe the causal structure of the world, and they would thereby qualify as candidates for natural kinds on this naturalist understanding.

Before concluding that etiological kinds correspond to bona fide scientific categories and may therefore be viable candidates for natural kinds in a range of different domains, it is necessary to consider two objections to this claim. The first objection is not aimed at historical or etiological properties in particular, but at relational properties and kinds in general. Since etiological properties and kinds are relational, any defender of them must address the objection. Some philosophers have expressed the opinion that relational or non-intrinsic kinds cannot be natural kinds and have no place in a mature science. For example, Fodor (1987, 45) once held that individualism "is a constitutive principle of science" and claimed that *planet* is not a scientific kind since it is individuated relationally rather than intrinsically. Additionally, in the context of cognitive science, some philosophers have invoked the principle of "methodological solipsism" or "individualism" namely that the individuation of mental types ought always to be based on intrinsic features of the individual cognitive agent, rather than extrinsic or historical features. Calling a closely related claim the "Autonomy Principle," Stich (1991, 239) expresses this idea as follows: "any state or property properly invoked in a psychological explanation should supervene on the current, internal, physical state of the organism." Although some philosophers have dissented from this position, for many others, it represents a basic metaphysical claim about the workings of the human mind (as well as other natural phenomena). The thought is that intrinsic causal powers are what do the causing, and hence they are the only properties that will show up in a science of the mind (and indeed in any complete science).

To answer this objection, it must first be acknowledged that etiological properties and kinds are not causally efficacious in the sense that they do not actually do the "pushing and pulling" in our universe. If a material object belongs to the kind *sedimentary rock*, that does not thereby imply that it is endowed with any specific causal powers. By contrast, if it belongs to the kind *limestone* then we know that it is composed of calcium carbonate and is disposed to react with acids to release carbon dioxide, among other things. Similarly, a rock's being a *meteorite* does not give it a tendency to participate in any specific causal interactions, whereas its being composed of *iron* does. Classification of something as a *sedimentary rock* or a *meteorite* tells us what kinds of processes have given rise to these objects and how they have come to have the (possibly diverse) properties that they have, not what they will go on to do. By their very nature, etiological or historical properties are primarily backward-looking not forward-looking. Yet, in both these cases and in the other cases surveyed, that does not mean that these classifications do not have scientific importance nor that they lack metaphysical significance. Their diachronic properties often serve as a guide or indicator for what will occur in the present and future. For instance, when it comes to kinds that are individuated for the purpose of tracking validity or accuracy, this can be a guide to future performance.[20] If an organism's memories are distinguished from other mental states on the grounds that they track past occurrences, this can serve as a guide that states of the same kind will do so in the future. Also, as already mentioned, these classifications can be both retrodictive and explanatory. For example, if we want to explain why a certain rock found in the desert has a fusion crust (that is, a thin surface layer of solidified molten rock), we can cite the fact that it is a meteorite. Now someone might say that this is not a satisfactory explanation, since the real explanation is that the rock travelled rapidly through the earth's atmosphere, slowing gradually to subsonic velocity. An objector might continue by saying that a causal explanation of the fusion crust would cite the velocity of the rock, its material composition, the properties of the atmosphere, and so on, all of which are synchronic, intrinsic properties of the relevant entities. But it would be unreasonable to deny that in certain contexts, a satisfactory explanation of the rock's fusion crust would cite the fact that it is a meteorite. This explanation seems to conform to a type of historical explanation recently identified by Cleland (2011, 554), who has analyzed a pattern of explanation in the historical sciences characterized by two interrelated stages: (i) the proliferation of multiple competing hypotheses to explain a puzzling body of traces encountered in fieldwork, and (ii) a search for a 'smoking gun' to discriminate among them.[21] If we consider the fusion crust on the

[20] I am grateful to an anonymous referee for making this point.

[21] For other recent accounts of historical or narrative explanation that cite historical or etiological kinds, see Currie and Sterelny (2017) and Ereshefsky and Turner (forthcoming).

surface of the rock to constitute the puzzling trace in this case, we might posit a number of different ways of accounting for it, for example: erosion, melting as a result of being subject to high temperatures in the earth's mantle, and passage through the earth's atmosphere. But based on the location of the rock, surrounding geological formations, the specific features of the fusion crust, and other factors (all of which can be considered 'smoking guns'), we might infer that the last hypothesis is the most plausible, thereby concluding that the rock is a meteorite. When we explain a rock's fusion crust by citing the fact that it is a meteorite, we have successfully accounted for some aspects of its current state. It is true that the explanation only explains against a background of additional information about what meteorites are, that is, on what basis they are classified as such. But all explanations are incomplete or enthymematic, including the synchronic causal explanation for the existence of the fusion crust, which keeps in the background certain facts about the heating effects of friction, the reason that the rock does not disintegrate on encountering the earth's atmosphere, the reason that the rock does not orbit earth on experiencing its gravitational pull, and so on.

In claiming that etiological properties and kinds can be explanatory, I have embraced an account of explanation that is ecumenical and allows for other kinds of explanation besides synchronic-causal explanations. But it bears emphasizing that etiological kinds are also causally grounded, even though they cite backward-looking rather than forward-looking causes. That is, they refer to the causal origin or pathway that gave rise to the phenomenon in question. To repeat, if we are interested in describing and understanding the causal structure of the world, then we cannot afford not to identify etiological kinds. Here, a new objection might arise, to the effect that it is one thing to reconstruct causal history and quite another to regard entities that have the same (type or token) etiology as belonging to the *same kinds*. This objection might continue by saying that one can reconstruct the relevant causal pathways without positing the existence of etiological kinds. The problem with this objection is that it is unclear how one can retain the explanations and retrodictions without deploying general terms (e.g. in the claim: "(almost) all meteorites have a fusion crust as a result of travelling through the earth's atmosphere"). Moreover, if we need to use a general category to apply to all phenomena covered by a certain explanation then that prima facie carries an ontological commitment to the class of phenomena picked out by the category. At least from a naturalist perspective, natural kinds correspond to the general categories of our considered scientific theories, and when those categories are explanatory and otherwise further the aims of science, it would be perverse to deny that the corresponding kinds are at least potential candidates for natural kinds.

5. Conclusion

This paper has introduced a neglected kind of scientific kind, etiological kinds. After characterizing these kinds and proposing some distinctions among them (token- and type-etiological kinds, and pure and hybrid etiological kinds), I briefly considered several case studies drawn from: astronomy and cosmology, geology, biology, and psychology and cognitive science. This survey is hardly comprehensive, but it comprises a diverse group of etiological kinds from a range of scientific disciplines. Accordingly, I put forward some reasons for identifying them in science and argued that there are good grounds for thinking that at least some etiological kinds are good candidates for natural kinds. Though they are individuated with reference to diachronic factors rather than synchronic causal powers, I argued that etiological kinds are nevertheless associated with the project of understanding the causal structure of the world.

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