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BOOK REVIEWS

Review of Charles H. Pence's *The Causal Structure of Natural Selection*

Charles H. Pence, *The Causal Structure of Natural Selection.* Elements in the Philosophy of Biology. Cambridge: Cambridge University Press (2021), 75 pp. $22.00 (paperback).

The seventy-five pages of Pence's Element are devoted to "an examination of the last several decades of efforts to describe the underlying causal structure of the theory of evolution by natural selection" (4). Such efforts are often grouped into one of two camps, baptized in the philosophy of biology literature as the "causalists" and the "statisticalists." In short, the causalists (among which Pence counts himself) maintain some version of what Pence calls the "received view": natural selection is a bona fide causal process that acts on populations (and perhaps, Pence will argue, individuals). The statisticalists, on the other hand, argue that natural selection is not a genuine cause but a theoretical construct that describes a certain pattern of change in the trait distributions within a population. Of course, such changes result from genuine causal relationships among individual organisms and their environments—birth, predation, competition, and so on. However, the statisticalist argues, the evolutionary biologist's concept of natural selection does not pick out a single causal process that exists "out there" in the world (8).

A notable highlight of Pence's Element is his introduction of a schematic diagram of natural selection—a qualitative state space model—that he uses to depict both the causalist and the statisticalist interpretations. The diagram, the general form of which is familiar to philosophers of science, "helps us to see that there is something about this debate that transcends the disciplinary boundaries of evolutionary biology" (17–18). Furthermore, when modeled accordingly, the diagram represents causalism and statisticalism with identical schemas. They differ only in their interpretations of the relationships between states, that is, whether they interpret those relationships causally or noncausally.

The metaphysically noncommittal nature of this diagram is central to Pence's contribution because, instead of arguing for one interpretation or another, he uses the Element to clarify the state of play. His strategy is to disentangle the many interesting philosophical and biological questions that are often kludged under a causalist or statisticalist banner. When one reads the literature on the causal structure of natural selection, one can expect to find answers to the usual questions, such as "How should we define natural selection and genetic drift?" or "Where is the 'causal action' within an evolving population?" Yet hidden in these answers, Pence argues, are implicit commitments to much broader positions in the philosophy of science. Indeed, at least

sometimes, defending a position in the causalism/statisticalism debate requires one to engage with questions concerning "the role of observer-dependence or abstraction in the generation of evolutionary explanation" and the nature of the relationship between composite wholes and constituent parts (10–11).

Therefore Pence's aim is to resolve the "general sense of stagnation surrounding the discussion," a situation that is "in part, at least, due to our having pervasively talked past one another" (4–5). I believe Pence is successful in this aim: by highlighting its intersections with problems that permeate the philosophy of science, his Element breathes new life into the causalism/statisticalism debate. And although the monograph makes several notable contributions, one example is particularly demonstrative of its success.

Pence emphasizes the familiarity of the debate by highlighting its similarities with Jaegwon Kim's "causal exclusion argument" in the philosophy of mind (see, e.g., Kim 1993). Those who endorse a "Kim-style exclusion argument," as Pence calls it, reject downward causation, that is, macro-level entities causing changes in micro-level entities. For Kim, this means that mental states in one moment cannot cause brain states in the next moment; all the causal action occurs at the lower level, and the supervening mental states are causally inert "epiphenomena." Pence nods to earlier work by Lawrence Shapiro and Elliot Sober (2007), who attribute an analogous view to statisticalism: there is no population-level process—namely, natural selection—that causes changes at the individual level. All the relevant causal details can be cashed out in terms of the births and deaths of individual organisms. Natural selection, therefore, is epiphenomenal—a statistical shadow of more fundamental processes.

Pence considers how the causalist might respond to a Kim-style exclusion argument. He sketches a response, although he leaves the finer details for future endeavors. Looking to recent work from Richard Boyd (2017), Pence says, "The key move [for the causalist] is to argue that the relation of composition is itself doing work here. It is precisely the fact that individuals are arranged population-wise that enables the population to be causally effective as a result of the causal powers of those individuals" (48). In other words, on the Boydian picture of selection that Pence is sketching, causal action at the individual level by no means precludes the possibility of genuine causal action at the population level. Far from disregarding natural selection as an epiphenomenon, the supervenience of populations on individuals offers us "a way in which we might have a 'definitional' connection that transmits causal efficacy from the lower level to the upper" (49).

Pence views this application of Boyd's framework as a "genuine, live alternative" to evolutionary epiphenomenalism (53). Yet, because constraints of space prevent Pence from all but sketching the framework, the Boydian picture of selection is opaque and requires some demystification. The principal claim is that genuine macro-level causes emerge when the whole comprises parts that are arranged in a particular structure. When the parts are not arranged in this way, then causal efficacy will not percolate up to the higher level. Here a familiar example may help us understand the importance of micro-level structure: in the same way that acceleration emerges when two race cars travel in a certain proximity to each other, natural selection emerges when individuals relate to each other in specific ways. In both cases, emergent causal processes are at play. When the race cars fall in line (a technique called "drafting"), their new formation is a higher-order cause, and an increase in speed is the effect

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(see Brandon and McShea 2020, 48). It is not the cars that give rise to this phenomenon but the cars arranged *just so*. Similarly, when a population is subject to a selective pressure, the resultant variation in fitness is a higher-order cause, and a change in trait frequencies is the effect. It is not the individuals that give rise to this phenomenon but the individuals arranged *just so*. The result, Pence says, is an emergent "causal profile" at the population level that is qualitatively distinct from the causal profile of the constituent individuals.

If the preceding argument is an accurate reconstruction of the Boydian picture of selection (as Pence understands it), then the statisticalist's parry is clear. An available strategy is simply to deny the emergent character of natural selection. In other words, the statisticalist may respond that biological populations and pairs of race cars are importantly disanalogous. In the drafting case, the pair of cars reaches speeds that—given their individual energy expenditures—would not have been possible had the cars been driving meters apart. The causal profile of the pair is genuinely distinct from the causal profile of the individuals. But perhaps we cannot say the same for biological populations that are subject to a common selective pressure.

Indeed, without explicit argument, it is unclear why the reader should accept the claim that being subject to a selective pressure (and the resultant variation in trait fitness) is an emergent property of populations. Surely the statisticalist does not doubt that entire populations are subject to common selective pressures or that trait types vary in fitness in the face of these selective pressures. What they doubt, however, is that populations—as opposed to individuals—are the entities on which selective pressures impinge. Consider a hypothetical selective pressure, such as a rise in water temperature. One aquatic organism tolerates the warming water, survives, and reproduces, while another organism cannot tolerate the rising temperature and perishes. These are the causes—the births and deaths of individuals—that make the difference. It does not matter for the statisticalist that entire populations are subject to common selective pressures; a population will respond to the selective pressure only insofar as its constituent individuals respond. From a causal perspective, it is how the *individuals* fare against the selective pressure that matters for the statisticalist.

It is worth noting that, although Pence does not explicitly mention emergent properties in his discussion of Boyd, I believe such an interpretation is necessary for the view. Otherwise, the Boydian picture of selection is merely a stipulation that causation "trickles up" through levels of organization. Therefore whether one accepts this "Boydian" picture will depend on whether one accepts the emergent character of selection. But we need not despair at this apparent impasse. On the contrary, and thanks in large part to Pence's recent work, it is an exciting time to reengage with the causalism/statisticalism debate, as we are now reminded of the conceptual terrain that remains unmapped.

Taking up the mantle from others, Pence has made a significant contribution in revealing the familiar and ever-vexing philosophical problem of composition and emergence in the causalism/statisticalism debate: "recognizing that there is nothing uniquely biological about this portion of the debate—that is, the debate over causal structures—is perhaps our best hope for resolving it" (44). After reading his monograph, I share Pence's hope that illuminating similarities with other research programs in the philosophy of science "can offer us a clearer way to understand

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the problem, theoretical resources that we can use to attack it, and the possibility for future collaboration" (62).

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Review of Gualtiero Piccinini's *Neurocognitive Mechanisms: Explaining Biological Cognition*

Gualtiero Piccinini, *Neurocognitive Mechanisms: Explaining Biological Cognition*. Oxford: Oxford University Press (2020), 416 pp. $115.00 (hardcover).

It is common for philosophers of neuroscience to be deeply engaged with the relevant experimental literature. This may be why the last couple of decades have seen an increase in philosophers of neuroscience obtaining formal training in neuroscience concurrently with philosophy or coming to philosophy from a previous life as a neuroscientist. By the turn of the twenty-first century, scientific practice came to inform and inspire the new mechanist movement. Philosophers of neuroscience interested in cognition often find themselves attempting to integrate work on experimentation and mechanisms with research in the cognitive sciences and psychology that commonly centers on computational understandings of cognition. It is within this background that Gualtiero Piccinini's latest book is situated.

Piccinini's general aim in his book is to defend a "computational theory of cognition" (CTC) and extend many claims he previously made about the nature of computation (Piccinini 2015) to cognitive neuroscience research. More precisely, it defends the thesis that "*biological cognitive capacities are constitutively explained by multilevel neurocognitive mechanisms, which perform neural computations over neural representations*" (1; emphasis original). Piccinini's writing is excellent: it is clear and straightforward, and the argumentation is often incisive. The book is nicely organized with effective chapter transitions that provide helpful "here's where we're at" summaries.

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