Emergent Mechanisms

Reductive Explanation for Limited Beings

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1. Auflage

mentis 2012

Verlag C.H. Beck im Internet:
www.beck.de
ISBN 978 3 89785 777 3

Zu Inhaltsverzeichnis

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mentis
MÜNSTER

Gedruckt mit Unterstützung des Förderungs- und Beihilfefonds Wissenschaft der VG Wort

Einbandabbildung: © David Espin – Fotolia.com

Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation
in der Deutschen Nationalbibliografie; detaillierte
bibliografische Daten sind im Internet über
http://dnb.dnb.de abrufbar.

Gedruckt auf umweltfreundlichem, chlorfrei gebleichtem
und alterungsbeständigem Papier ♾ ISO 9706

Eisenbahnstraße 11, 48143 Münster, Germany
www.mentis.de

Printed in Germany
Einbandgestaltung: Anne Nitsche, Dülmen (www.junit-netzwerk.de)
Satz: Rhema – Tim Doherty, Münster [ChH] (www.rhema-verlag.de)
Druck: AZ Druck und Datentechnik GmbH, Kempten
ISBN 978-3-89785-777-3

1
The Mechanical Mind

Recently, in philosophy of mind and cognition new mechanistic approaches to explanation have been stirring up debates about the relation between mental or cognitive capacities and the brain structures upon which these supervene. Notably, Bill Bechtel and Robert Richardson (1993), Carl Craver (2007), and Bill Bechtel (2008) have presented accounts of mechanistic explanation that directly aim at capturing explanatory practices in the neurosciences and/or the cognitive sciences. They thereby shed light on the relation of cognitive phenomena and the underlying brain or information processing structures. In their own view, the result is an account of explanation that incorporates both reductive and non-reductive aspects.

The standard take, though, on the relation of mental and physical phenomena currently is that either mental phenomena are reducible to physical phenomena and some form of reductive physicalism is true or that mental phenomena cannot be reduced to physics and some form of nonreductive physicalism is true. (With a few Australian exceptions, dualist positions are generally not highly regarded at this time.) But the mentioned mechanists position themselves somewhere between these extremes. They propose an account that incorporates both reductive and non-reductive aspects. And they claim that their account adequately captures the actual scientific practice in different special sciences, including the cognitive sciences. Both reductive and nonreductive physicalism have something to them and capture different aspects of how higher and lower levels relate. Reductionism and antireductionism are reconciled by disentangling different claims to reduction and the irreducibility of higher levels respectively. In the end, this mechanism is reductionistic in that it holds that higher-level phenomena are produced by underlying mechanisms. It is non-reductionistic in that it holds that higher levels are nonetheless indispensable for explaining a wide range of phenomena. But at closer scrutiny the claims to a reductive aspect and the untouched indispensability of higher levels are not as clear as one might wish.

In this book I want to give a reconstruction of the central tenets of this strand of contemporary mechanism and the implications these have on how higher and lower levels generally, and cognitive and neural phenomena in particular, relate. In the course of this reconstruction I attempt to clarify some of the issues that one or the other of these mechanist accounts does not treat satisfactorily. Most centrally, I am going to be concerned with what makes a mechanism an explanation of some higher-level phenomenon and how complex mechanisms are still just mechanisms. Accordingly, I will depart from the discussed strand of mechanism at several points in the discussion. But the resultant account is nonetheless recognizably

mechanistic, and, as I believe, more clearly so than the alternative accounts of Craver, Bechtel, and Bechtel & Richardson. Eventually, the result will be that mechanism can best be made sense of as a reductionistic account of explanation, and that mechanists' attempts to reconcile reductive and non-reductive physicalism is best understood as accepting ontological and epistemological reductionism and rejecting methodological reductionism. Mechanism's merit, though, lies in presenting a new account of explanation and thereby changing the picture of what epistemological reductionism amounts to. It thereby provides us with a better understanding of what reductionism nowadays should look like—in a time where even the alleged fundamental sciences delve into investigations of the complex, and where the discovery of long-range universal laws of nature seems to play less of a role in many scientific research programs than attempts to explain the particularities of a given range of complex physical systems.

The question of which role laws of nature play in scientific explanation is actively debated in the context of mechanistic philosophies of science. And quite a number of contemporary mechanists propose that laws of nature do not play (much of) a role in all sciences concerned with mechanisms. In chapter 2 I am going to broadly follow this line of argument by claiming that causal relations are central to explanation, not some events' being covered by laws of nature. This leaves open the question whether a metaphysical account of causation is based on laws or not. But according to one line of mechanistic philosophy, in addition, the important feature of mechanisms is that they are causally productive in a metaphysically strong sense. Their causal productivity is to eliminate altogether the need for laws of nature. It is the causal powers of mechanisms and their components that produce the net of causal relations in the world, not that the worldly goings-on are governed by laws. Important as the metaphysics of causation might be, in the current essay I am going to discuss whether mechanism is a reductionistic account of *explanation*. And I am not going to get into discussions of the metaphysics of causation.

1.1 The Layer-cake Model

Which side of the standard opposition between reductive and non-reductive physicalism to take clearly depends on one's account of reduction, which in turn depends on the subscribed theory of explanation, and on how mental or cognitive phenomena are characterized. In what I want to call its classical form, reductive physicalism holds that all phenomena, including living things and their mental lives, are ultimately explainable in terms of fundamental physical theory. Something along the following lines can plausibly be taken to be the classical motivation for reductive physicalism: The goal of science is to advance understanding of the world, and that understanding can only be generated by explaining. Explana-

tion, in turn, is understood as the subsumption of particular facts under general laws and as deriving the new from what is already known. Physics describes the most fundamental laws. And before the advent of modern physics, Newtonian mechanics was assumed to be fundamental. Which means that the (mechanical) motions and collisions of simple parts comprise the fundamental explanatory level. Furthermore, the motions and collisions of simple particles, as described by Newtonian mechanics, are taken to be what is best graspable by human minds. Therefore, physical explanations are fundamental and most satisfying.

In order to understand the worldly goings-on we must explain them in terms of the particles that constitute them and how these move and bump into each other. More complex objects can be divided into simpler components which can in turn be explained in terms of the mechanics of their parts. If such explanations do not "leave anything out", they are reductive. In the classical picture, reductive physicalism is true if all higher-level phenomena can be stepwise derived from fundamental physical theory. The result is the so-called layer-cake model of the world, according to which it is divided into different levels, each of which is explainable from what goes on on the next lower level. Psychology can be reduced to biology which can be reduced to chemistry which reduces to physics. Ultimately, everything that goes on in the world is describable on the level of fundamental physical particles, and the world is governed by the laws of mechanics.[1]

Because of its appeal to mechanical laws classical reductive physicalism is also sometimes called mechanism. But it is to be distinguished from its contemporary variants. With the advent of modern physics this label for reductive physicalism has become somewhat misleading. Current reductive physicalists do not usually hold that fundamental level physics describes the motions and collisions of corpuscles. Elementary particle physics has become more complex and more mathematical. And due to this increasing complexity of modern physics contemporary reductive physicalists cannot appeal to the alleged ease with which fundamental explanations are grasped by the human mind in order to make reductive physicalism plausible or desirable. Quantum mechanics, for instance, is a highly mathematical theory for which it does not suffice to have mastered just the basic rules of calculus. Fundamental physical explanations, if there are such, are complicated and quite difficult to understand. At least they require a significant amount of professional training. The ample complexity of fundamental physics notwithstanding, reductive physicalists hold that everything that happens in the world is a result of the goings-on on the fundamental level and that everything is explainable in terms of this fundamental level theory. The motivation for contemporary reductive physicalism therefore lacks the epistemic dimension found in its classical form that the

[1] An especially nice presentation of what I term classical mechanism can be found in the mechanism entry in C. G. Herbermann, E. A. Pace, C. B. Pallen, T. J. Shahan, and J. J. Wynne (Eds.) (1913). *Catholic Encyclopedia*. New York, NY: The Encyclopedia Press.

fundamental level is especially easy to grasp. It is mainly made plausible by the conviction that there is just one causally coherent world and that unexplainable higher-level occurrences would have to amount to witchcraft or miracles.

Non-reductive physicalists, on the other hand, hold that higher-level phenomena, especially mental or cognitive phenomena, cannot thus be explained in terms of fundamental physics. And even the step-wise reduction suggested by the layer-cake picture in which cognition and the mental would be reduced to biology which would in turn be reduced to chemistry and so on is not taken to be possible for cognitive or mental goings-on. All attempts at reducing the mental to biology or some other lower-level science have not been successful. For instance, mental predicates cannot be translated into biological or chemical predicates. And mental and, for example, biological properties are certainly not identical. Nor are there any bridge laws connecting the biological and the mental. As a result, the regularities holding for the mental cannot be expressed in terms of the biological, and the mental cannot be reduced to lower levels.

Non-reductive physicalism comes in a whole range of different variants. According to a classical idea, mental properties are emergent from lower-level properties in the sense that the whole is 'more than just the sum of its parts'. Emergentism grew strong in nineteenth and early twentieth century philosophy of biology as an attempt to avoid both dualist vitalism and classical mechanism. Life seemed to require more than just a complex assembly of chemical processes. But vital spirits were nonetheless deamed metaphysically suspicious. After the obvious successes of molecular biology, though, emergentism has become unattractive concerning biological phenomena. But it still remains a live option to take the mental to be emergent from the biological. And emergence remains a striving research topic. Nonetheless, functionalism has become the non-reductive physicalist mainstream position in philosophy of mind over the second half of the twentieth century. According to functionalism, mental properties are functionally individuated, i. e. in terms of the behavior they enable and the role they play in an internal household under a certain range of conditions. Functional properties, in turn, are multiply realizable and cannot be reduced to physical properties. On a lower level, multiply realized functional properties are extensively disjunctive. The lower-level property reducing some multiply realizable higher-level property would have to be a disjunction of all realizers of the higher-level property. But disjunctive properties are usually not taken to be scientifically respectable properties. Given some functional characterization of the ability to play chess both Garry Kasparov and Deep Blue can play chess. But they play chess in very different ways. Kasparov uses a brain while Deep Blue uses a number of electronic microprocessors. Furthermore, a different human player might use different brain structures for playing chess, and different chess playing computers might exhibit very different architectures. And other creatures might be made up of completely different stuff, but nonetheless be able to engage in a game of chess. An attempt to reduce the ability to play chess to

the physical level would have to accommodate all of these different ways of playing chess. And presumably, this would only be possible by giving an individual story for each particular case of playing chess. The result would be a vast disjunction of different realizers of playing chess which few participants in the debate would deem explanatory, because disjunctive properties do not support laws.

Contemporary mechanists, now, are reluctant to engage in any one of these lines of reasoning. Reductive physicalism is taken to be unattractive, mainly because the layer-cake model gives an inadequate picture of the structure of the world and how science explains phenomena. Explanation does not proceed by subsumption of particular facts under general laws, it is argued, and the sciences do not form a neat hierarchy in which each discipline comprehensively explains phenomena at a particular size scale or in a certain range of organizational complexity. Rather, scientific fields are by far more heterogeneous than the layer-cake picture suggests, and several fields are regularly involved in explaining some given phenomenon. Most importantly, in order to properly understand scientific explanation, especially in the special sciences, the underlying account of explanation as derivation of particular facts from general laws of nature must be replaced. The covering law account of explanation, as it is called, is modeled along the lines of some idealized exemplary explanations in physics. It is argued that it has a number of fatal shortcomings and should be replaced by an account of explanation that is true to actual explanations in the sciences under consideration. When such explanations are considered, it becomes clear that general laws usually do not play a big role in explaining, for instance, biological or psychological phenomena and that, instead, the mechanisms that produce these phenomena are critical for explanation. In what I am going to take to be the core cases of mechanistic explanation—and which are, at any rate, the relevant cases for whether mechanism is reductionistic—phenomena are explained in terms of *underlying* mechanisms. At the same time, finding these underlying mechanisms, it is held, does not make higher levels explanatorily superfluous. The result is a mechanistic account of explanation according to which phenomena are explained by underlying mechanisms, but mechanisms do not blatantly reduce phenomena to lower levels.

The arguments mechanists present for the non-reductive aspect of mechanistic explanation and the resultant non-reductionism, though, are different from the attacks functionalists launch against reductive physicalism. According to the mechanists I am going to focus on, what is wrong with reductive physicalism is the aspiration to find a comprehensive fundamental level on which everything that goes on in the world can be explained. Instead of supposing that there is one fundamental causal layer and building everything else up from the causal interactions of the fundamental-level entities and their interactions, as the layer-cake model would have it, mechanists start with the explanandum phenomena and 'dig down' into lower mechanistic layers from there. The effect is that mechanisms are always