Without Reductionism: A Reply to Lowney[1]

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Key Words: dual control, emergence, completeness of physical theories, causal closure of the physical, downward causation, layered ontology, Michael Polanyi, Charles Lowney.

ABSTRACT

My arguments against Polanyi's notions of a layered ontology and dual control of entities were introduced in Margitay 2010 and defended against criticism in Margitay 2013. However, it has become clear from Lowney's and earlier comments that my presentations were not sufficiently clear. So I will explicate some points of my argument against dual control. First, I will contrast the metaphysical thesis of The Causal Closure of the Physical with the semi-empirical thesis I hold, The Completeness of Physical Theories. I have argued that Polanyi's theory of dual control involving downward determination is inconsistent with standard physics because of the completeness of physical theories. I support this claim by what I term the no difference and the completeness counterarguments. Secondly, I shall show these arguments do not involve or entail any sort of reductionism, and they do not question the ontological autonomy, the reality, and the irreducibility of higher level emergent entities and their properties.

I thank Charles Lowney for his intriguing and detailed comments (in this issue which I will cite by page numbers in parentheses). They shed fresh light on many issues. The discussions by Lowney and other commentators in *Tradition and Discovery* (*TAD* 39:2) reveal a gross misunderstanding of my position. I discussed and criticized three of Polanyi's arguments for a layered ontology (Margitay 2010, 2013): the argument from the Correspondence Thesis, from dual control, and from identification. All three have the objective of establishing a multilevel ontological hierarchy on the basis of the characteristics of our knowledge. My attack on dual control, however, elicited the fiercest response and greatest misunderstanding, so in this abbreviated reply to Lowney, I will focus on clarifying some points in this reasoning to dispel the charge of reductionism.

I offered an internal criticism of Polanyi's stance, not an external one from a reductionist point of view. Yet all my commentators except Kertész (2013) interpreted my position as criticizing Polanyi from a reductionist-objectivist stance (Lowney, 25-26). I was astonished, for I accept neither scientific nor epistemological/ontological reductionism. I attributed this misunderstanding to the objectivist ontological language I adopted from Polanyi's Correspondence Thesis. Thanks to Lowney's thoughtful comments and to helpful personal discussions with Walter Gulick, Mihály Héder, and Gergö Kertész I now see this attribution was incomplete. The thesis of the completeness of physics is also responsible for the misunderstanding.

Probably my critics attribute more ontological content, on the basis of the popular metaphysical notion of completeness, to my understanding of the completeness of physics than I intend. To answer Lowney's comments regarding dual control (and space does not permit commenting on his other points) and to rectify misunderstandings, I will first distinguish two distinct notions of completeness. Second, I will recast my critique of Polanyi's argument for dual control to show that my notion of completeness does not presuppose the metaphysical completeness principle or any sort of reductionism. Finally, the philosophical roots that generate the internal inconsistency in Polanyi's argument will be pointed out.

Causal Closure and the Completeness of Physical Theories

The metaphysical thesis that most of my critics assumed I hold is the Thesis of Causal Closure. A simple formulation is the following (see Robb and Heil 2013):

> **Causal Closure of the Physical (CC):** Every physical effect has a sufficient physical cause.

It is often called the thesis of the (causal) completeness of the physical. It is to be distinguished from my thesis of the Completeness of Physical Theories (see below).

According to CC, only physical causes can produce physical effects; non-physical causes cannot bring about physical changes in the world. Physics by itself can give a full causal explanation for any physical effect and in this sense is complete. CC presupposes deterministic causal relations; however, it can also be formulated in a way that permits probabilistic causal effects.

While CC need not exclude non-physical causes, they are superfluous. For instance, mental causes would seem to be ad hoc additions to the effective physical causes that are needed to make bodily changes. Many would add that if something does not have causal power and cannot make any difference in the physical world, then it does not have the real existence that physical objects have. So CC is a very strong ontological thesis, and it easily leads to the physicalist thesis that everything is physical or can be reduced to physical objects and parameters.

What I mean by the completeness of physics has much weaker ontological implications.

> **Completeness of Physical Theories (CP):** Physical theories are complete in the sense that, for all physical properties of a system in the intended applications of a physical theory (and only in this domain), physical laws and their input parameters account for (i.e., determine and explain) all the subsequent physical parameters of a system. In short, physical theories are complete in the sense that they determine (precisely or in terms of a probability distribution) every physical state and property of a physical system within the domain of their application.

CP is a modest claim about the theories of physics as they are understood and used in the practice of physicists. It is a direct consequence of the logical and epistemological structure of physical theories. Physical theories describe the temporal development of a particular type of physical system from a particular point of view. The particular viewpoint is captured by a certain set of physical parameters. The value of these parameters gives a full description of the physical state of a system (from the selected viewpoint). Given that physical laws are universal statements, they determine all the future parameters of all the systems in the domain of their intended application. CP says that laws should account for all the physical parameters of all the systems the theory is meant to cover. If a physical theory in which laws are universal statements is epistemologically true in the domain of its intended application, then it must be complete in the above sense.

The word "determinism" is a dangerous one in Polanyian circles (and probably in all discussions of emergence). It can easily trigger the vision of Laplace's Demon and associate my position with undesired philosophical doctrines such as CC. Determination in CP means that, given an initial state, any later state of the physical system *logically (mathematically) follows from* the laws of physics and their input parameters. Note that determinism as used in this paper does not presuppose that a particular form of causality

must prevail in all ontological domains. In this way, CP differs from CC. It is important to emphasize also that CP and my arguments presuppose the logical determination *only* within the domain of application of physical theories, and I think most Polanyians affirm the validity of physical laws in determining how the physical state of a thing changes once initial conditions are established.

CP should be seen as a semi-empirical rather than a metaphysical claim. It describes how scientists and engineers carry out their calculations within the domain of proper application.

Physicalism and Reductionism in CC and CP

While CP is a relatively modest claim about the properties of physical laws in their domain of intended application, CC is a bold general metaphysical claim. CC presupposes the truth of CP but not vice versa. CP must be augmented with three further claims to support CC:

(1) Laws of physics are causal laws expressing causal relations.
(2) All input parameters of laws must themselves ultimately be physical parameters.
(3) Laws of physics apply universally to all domains.

The first claim is compatible with the practice of physicists insofar as fundamental forces and Newtonian mechanics are concerned. It is less clear that other laws of physics (e.g., the gas laws) should be interpreted as causal laws. In any case, (1) involves a substantial ontological commitment that goes far beyond the logical-epistemological requirements from which CP is derived. Moreover, (1) prioritizes efficient causality and excludes other sorts of causality if they are not compatible with universal physical laws.

Whether the second claim is true is a matter of empirical fact. It is a contingent fact that as to whether non-physical properties (e.g., the mental properties of an observer) do not affect the physical properties of a system.[2] In principle, some physical theories may admit non-physical forces. The dynamical equations of Newtonian mechanics can have non-mechanical parameters (e.g., Coulomb forces) and could admit non-physical parameters like mental forces to determine the mechanical parameters of a system. Newtonian mechanics sets no constraints on what kinds of forces exist.

Now CP together with (1) and (2) results in a restricted version of CC—Causal Closure restricted to the domain of intended application of physical laws. The addition of claim (3) brings us to the general and very problematic thesis of CC. Some would make this third step on the basis of faith that a grand unified theory of all the physical forces can be attained which would be universally true. However, CP and my arguments do not require the attainment of such an ambitious and speculative achievement. While some argue from CP as a premise for the Causal Closure of the Physical and for physicalism (cf. Melnyk 2003 and Papineau 2000), I view any reach beyond CP as unwarranted and unnecessary.

It is a recurrent theme of my critics that I am a reductionist because of adopting CP (see see Lowney 2013, Gulick 2013, and Héder 2013). In the context of Polanyi's notion of dual control by different types of laws, reduction would amount to some sort of inter-theoretic relation by which higher level laws can be reduced to lower level laws. I reject the view that satisfactory inter-theoretic reduction can be achieved in all cases. I side with those who have serious reservations with even paradigm examples of inter-theoretic reduction like the reduction of phenomenological thermodynamics to statistical physics. CP does not require ontological or inter-theoretic reduction. Moreover, CP does not entail ontological reductionism (contrary to CC) or inter-theoretic reduction. Both forms of reductionism involve a relation between physical objects and properties and prime facie non-physical objects and properties, saying that the latter can be reduced to the former. Note, however, that the thesis of the Completeness of Physical Theories

does not refer to anything else but to physical objects and properties.

It says nothing about whether there are non-physical entities and properties and if yes, how they are determined. Obviously, the claim that Newtonian mechanics determines the *dynamical* properties of the billiard balls on a table—position and momentum, etc.—does not entail that their many other properties such as their color are also determined by Newtonian mechanics. In sum, CP is not a reductionist thesis about the structure of the world either inside or outside of physics.

Polanyi's Argument from Dual Control

It is Polanyi himself who, like other emergentists, places emergent systems within the domain of the intended application of physical theories. According to the theory of dual control, every emergent entity is also a physical entity to which the laws of physics apply. Machines, living organisms, human beings, and cultural entities are the main categories of emergent entities for Polanyi. Their behavior is controlled by both lower level natural laws including those of physics and higher level laws often called operational principles. For the sake of simplicity, let us discuss only machines in detail.

Operational principles define the purpose of a machine and its function-supporting structure that realizes the purpose; they specify how parts fulfill their special function in combining to an overall operation which achieves the purpose of the machine. For example, a watch "is kept going by its mainspring, uncoiling under the control of the hair spring and balance wheel; this turns the hands which tell the time. Such are the operational principles of a watch, which define its construction and working. The principles cannot be defined by the laws of nature" (*KB* 153). The purpose of a watch is to tell time. As to the relationship between the higher and lower levels, "each higher level principle controls the boundary left indeterminate by the next lower level" (*TD* 49) and "it is impossible to represent the organizing principles of a higher level by the laws governing its isolated particulars" (*TD* 36) on the lower level. Machines are subject to the laws of physics:

> Thus a machine can be described as a particular configuration of solids. . . [A] particular specimen of a machine is characterized by the nature of its materials, by the shape of its parts and their mutual arrangement, which can be defined by the boundary conditions of the system. . . [T]he laws of physics and chemistry are equally valid for all solids, whatever their materials and shapes, and the boundary conditions determining their arrangement. From which it follows that neither the materials . . . nor their arrangement, can be derived from physics and chemistry" (*KB* 175).

From texts like these (see also *PK* 348), Polanyi's argument can be reconstructed in terms of the following premisses:

> (1) Lower level (physical and chemical) laws are not fully able to determine the properties or control the behavior of higher level (emergent) entities.
> (2) Higher level laws/principles are necessary to do this, and they do it by making use of boundary conditions.
> (3) Higher level laws/principles and their concepts are irreducible to lower level laws and concepts.
> (4) Therefore, these entities are ontologically emergent entities, and their properties controlled by the higher level laws/principles are emergent properties.

The Critique of Polanyi's Argument without Reduction

My counterarguments proceed from the following question: How is such dual control possible from the point of view of *physics*? Is it compatible with standard physics? My conclusion will be that standard physics is incompatible with the role it is supposed to play in dual control. The conflict arises from that both laws of physics and operational principles are going to determine the same type of physical parameters.

Higher level operational principles governing emergent machines determine two types of physical parameters. On the one hand, the constituent parts of a machine and its structures, like the properties, shape and arrangement of its parts (e.g., the shape of the balance wheel and the coefficient of elasticity of the hair spring), will be determined by an operational principle. On the other hand, the operational principle must establish and control the dynamic processes that fulfill the functions of the machine (e.g., the rate of rotation of the hands of the watch). What is true of machines would appear to be true of all emergent entities, including human beings, since all realize their higher level role via physical changes. Living organisms feed and reproduce by bringing about physical changes inside and outside their bodies. *So higher level laws* (including operational principles) *of necessity determine structural and functional* physical *parameters the determination of which is the competence of physics.*

Two Counterarguments to Dual Control

Thus Polanyi's higher level laws are claimed to be able to determine some of the physical properties of machines and other emergent entities according to premise (2) above. That is, Polanyi thinks operational principles exhibit downward determination. Moreover, premise (1) asserts that the laws of physics cannot account for all the physical properties and behaviors of an emergent entity—at least not for the physical parameters that are controlled by higher level laws. I will challenge premise (1) by what I term the counterargument of no difference, and I will counter premise (2) with the notion of completeness articulated in CP.

So Polanyi's argument presupposes that laws of physics together with their input parameters cannot define certain physical parameters of emergent entities. This claim is highly dubious. Its problematic nature is revealed when we consider the physical similarity between the rotation of the Earth and the rotation of the hands of a watch. Emergent entities (watches) are also physical entities with physical parameters. Higher level laws determine certain physical parameters of emergent entities (the rotation of the hands). Polanyi's theory of dual control assumes that these physical parameters of emergent entities cannot be fully determined by physics. However, standard physics *can* determine the same type of physical parameters of non-emergent entities (the rotation of the Earth), and there is no *physical* difference between the *physical parameters* of emergent and non-emergent entities according to standard physics (both are rotation with certain rotation rates). Therefore, standard physics *should be able to* determine the physical parameters in both cases: just as it can determine the rotation rate of the Earth, it should be able to determine the rotation rate of hands. Consequently Polanyi's theory of dual control is inconsistent with standard physics.

It could be objected that a watch is not only a physical object but also a machine, and as a machine it falls also within the domain of intended application of higher level laws. But this reply misses the point. What should be proved is that the motion of the hands of the watch does not lie in the domain of the application of physics, and not that their motion is subject to other laws as well. But since Polanyi recognizes that a watch is a physical object, almost by definition the *physical* properties and behavior of the watch are subject to the laws of physics.

Lowney (2013, 24) in agreement with Gulick points out that machines and organisms are telic entities,

whereas planets are not. However, this rejoinder misses the point in the same way the previous reply did. It shows only that that one set of physical properties (the higher level) has an emergent property (being telic) that is missing in the case of the lower level physical properties. But we are not told why one physical set of properties can be fully determined (given initial conditions) by physics while the other cannot.

By now it should be clear that the no difference argument involves no reduction in any sense. It includes claims only about physical parameters of systems and makes no reference to non-physical properties that could or should be reduced to physical ones.

Now let us turn to my second argument, to the argument from CP. In brief, it runs like this. Physical theories are complete in standard physics, that is, physical laws and their input parameters describing an emergent entity *qua physical object* determine *all the physical* parameters of that entity. Therefore higher level laws cannot determine physical parameters of emergent entities (save the cases in which they are redundant). According to the theory of dual control, higher level laws should determine some of the physical parameters of an emergent entity. Therefore standard physics is inconsistent with the theory of dual control in which higher level laws are physically efficacious.

The point of this argument is that *the completeness of physical theories excludes that higher laws be physically efficacious.* CP rules out the possibility of downward determination in dual control. Higher level laws cannot determine, account for and explain physical parameters. Operational principles, for example, cannot determine the shape and material structure of the parts of machines and their mutual arrangement, their motion, electric properties, etc. Biological laws cannot determine the motion of organisms—the physical processes of their digestion, reproduction, etc.—because all involve some physical parameters that have already been determined by physics.

Of course higher level laws may stand formally in a determinative relation with physical parameters, but this determination is only epiphenomenal on physical determination. My argument does not exclude the possibility that higher level laws and their inputs determine non-physical properties, such as the purpose of the motion of the hands of a watch, the function of the balance wheel, or the cultural significance of keeping time. Thus the argument from CP does not involve reductionism. It does not question the ontological autonomy, the reality, or the irreducibility of higher level emergent entities. But it does entail that these higher level laws cannot explain changes in physical parameters because that explanation is reserved to physics—at least if standard physics is applied on the lowest level.

The laws of physics can determine the physical state of a system only together with initial conditions. It might be argued that an engineer designing a watch is establishing the initial conditions for the mechanical keeping of time. But of course the production of a watch is itself conditioned by prior physical conditions. The first point where some initial states are left indeterminate is at the moment of the Big Bang. It is a misleading epistemic abstraction to think that there can be isolated physical systems immune from previous determination by the laws of physics.

Conclusion

Theorists of emergence would like to satisfy two demands. On the one hand, they would like to retain our well-established and highly successful physical theories and laws to describe the physical aspects of our world. On the other hand, they would like to build a complex ontology that is much more complex than physics provides us and that satisfies our philosophical concerns for meaning and purpose while being compatible with physics. The conclusion of this paper is that both demands cannot be satisfied at the same time. A completely new logical structure and epistemology of physics would be necessary to resolve the

incompatibility between physics and physically efficacious higher levels. Polanyi's theory of dual control is a noble but unsatisfactory attempt to articulate how such a complex ontology might be envisioned.

Endnotes

[1]An intense correspondence with Walter Gulick and a discussion with Mihály Héder helped me to explicate my position with more clarity. I am especially grateful for Walt's benevolent, though passionate, criticism and his friendly encouragement.

[2]It is a contingent fact if CC or physicalism is not presupposed. If either is presupposed, then CP plus (1) and (2) cannot be used to argue for CC without begging the question.

References

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