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Abstracts Tuesday 15th June

Talk 1, 13:30-14:20

Marta Conti Lorenzo (King's College London)

From Large Sets of Moving Particles to Thermodynamic Systems: a Case Study of Metaphysical Dependence Relations in the Sciences

The aim of this talk is to assess two accounts of metaphysical dependence, Jessica Wilson's powers-based subset account and Carl Gillett's compositional relations, against a case study: the realisation of a property of a thermodynamic system, in particular of temperature, by properties of the particles composing the system. Wilson accounts for metaphysical dependence by providing a realisation relation between higher-level features and lower-level relational features of a collective. Gillett, however, considers that to account for metaphysical dependence one must posit compositional relations between the features of higher-level entities (i.e. powers, properties, and processes) and the features of the many lower-level components from which both the entities and their higher-level features arise.

The main locus of contention between the two views is whether an account of metaphysical dependence must take as the realisation base the relational lower-level features of collectives, or the individual features of lower-level components. In short, whether metaphysical dependence is a many-one or a one-one relation. To defend his position, Gillett (2002, 2010) introduces the Problem of Qualitative Distinctness for subset strategists, or what I call in short the Flat Objection. Roughly, Gillett argues that by positing a middleman property between many lower-level properties and a higher-level property, the subset strategist is unable to account for the key feature of scientific making-up relations: higher-level properties are qualitatively distinct –i.e. have different powers, ground different processes, etc. – from their lower-level realisers, properties P1-Pn.

Wilson has only briefly addressed this objection. In Wilson (2015) she argues that there is nothing substantially lost or gained by taking realization to be a one-one or a many-one relation, beyond the positing of a middleman feature in the former case. This middleman feature is non-problematic because it merely consists in what we accept to be non-emergent features of the lower-level aggregate. However, in this discussion Wilson does not explain how a many-one approach is compatible with the subset condition on the powers of higher-level properties, as Gillett has opposed.

My contribution to this debate is an analysis of whether Gillett's Flat Objection works in the following case study: the realization of temperature, a higher-level property of a thermodynamic system, by the properties of the particles composing the system. This is an interesting case because we can actually define (and derive) the higher-level properties of thermodynamic systems, such as temperature, from the lower-level properties of its constituents. This derivation enables me to discuss the nature of higher-level properties of a system such as a crystalline solid, and how they are related to the properties of the atoms that compose it. Against the Flat Objection, I argue that Wilson's subset view can account for the metaphysical dependence relation between temperature and the components of the collective at least as well as a many-one relation would do. Moreover, from this discussion it will be apparent that, contra Gillett, higher-level properties such as temperature or entropy are not easily equated to any set or combination of lower-level properties.

Talk 2, 14:35-15:25

Michael te Vrugt (University of Münster)

The Mereology of Thermodynamic Equilibrium

The special composition question (SCQ), formulated by Peter van Inwagen ("Material beings", Cornell University Press 1990), establishes a central debate in modern metaphysics. It asks for the necessary and sufficient conditions for a system of objects to compose a further object. Various answers have been given in the literature, ranging from nihilism (there is no composition) to universalism (all objects compose). A particularly promising line of inquiry is to consider scientific arguments for composition. Arguments of this form have been formulated based, e.g., on quantum entanglement or physical bonding. These positions belong to the tradition of "inductive metaphysics", which tries to answer metaphysical problems based on scientific results.

In this contribution, I consider the implications of thermodynamics for the SCQ. Thermodynamics is a highly fundamental theory in which composition plays an essential role. As I show, the minus first law of thermodynamics, which states that every system spontaneously approaches a unique state of equilibrium, provides an argument for a new approach to the SQC, the "thermodynamic composition principle" (TCP): Multiple systems in (generalized) thermal contact compose a single system. This principle is justified based on a systematic classification of possible mereological models for composite thermodynamic systems. This classification shows that the property "being in equilibrium" is realized by the composite system as a whole, rather than being easily reducible to a relation between its parts.

Notably, the TCP can form the basis of an inductive argument for universalism, provided that the universe as a whole can be understood as a system approaching equilibrium. Possible implications of modern results on the thermal properties of, e.g., nonequilibrium systems, small quantum systems or self-gravitating astrophysical systems for both the TCP and the argument for universalism are also addressed.

Moreover, I provide a logical analysis of the TCP based on the mereotopology, which is a combination of mereology and topology. Here, the notion of "thermal contact" can be given a formal definition in terms of the mereotopological predicate "self-connectedness". Regarding this predicate, I show that certain definitions of "self-connected" that are popular in the literature are actually insufficient to capture the idea of a non-scattered object.

Talk 3, 15:55-16:55

Prof Olimpia Lombardi (University of Buenos Aires, CONICET)

About the relationships between chemistry and physics

One of the hottest topics in the philosophy of chemistry is the question about the relationships between chemistry and physics. Since the beginnings of the twentieth century, the extraordinary success of quantum mechanics promoted the idea that chemistry can be reduced to physics. It was only in the last decades of the century that some philosophers began to challenge that idea, pointing out that many chemical concepts cannot be easily explained by quantum mechanics. Since then, the controversy between those who favor reductionist views and those who advocate for a kind of theoretical independence of chemistry has permeated the discussions in the field of the philosophy of chemistry.

The central concept in this debate is that of molecular structure, due to its essential role in chemistry: molecular structure is the main element factor in the explanation of reactivity. It has even been claimed to be so fundamental that to explain molecular structure is pretty much to explain the whole of chemistry. The problem is that the concept seems to find no comfortable place in the theoretical framework of quantum mechanics. The purpose of this talk is to take a fresh look at the problem of molecular structure on the basis of a clarification of the problem at issue and the distinction between different meanings of the term 'molecular structure'.

The first step is, then, twofold:

– I will distinguish between what I will call "the problem of reduction" and "the problem of elimination." In our case, the problem of reduction is the question of whether the concept of molecular structure can be explained exclusively by means of the concepts and the laws of quantum mechanics. The problem of elimination is the question of whether scientists can dispense with the concept of molecular structure when pursuing their explanatory and predictive goals. My point here is that a positive answer to the second problem is not yet a positive answer to the first.

– I will distinguish between two senses of 'molecular structure.' In molecular chemistry, the term refers to the spatial arrangement of the atoms in the molecule and the chemical bonds that hold them together. In quantum chemistry, a molecule is a system in physical space, composed by nuclei surrounded by inert inner-shell electrons, placed in definite positions, and bonds are explained in terms of interacting "bonding" electrons; the structure of this system is defined by these elements in their spatial arrangement.

The second step is to discuss some issues usually related to the problem of molecular structure in the light of the above distinctions:

– The problem of the Born-Oppenheimer approximation: whether this is an approximation compatible with the principles of quantum mechanics and to what extent it might be dispensable. – The problem of symmetry: whether quantum mechanics can account for certain asymmetric properties of molecules and to what extent this answers the problem of molecular chemistry.

– The problem of isomerism: whether quantum mechanics can account for the existence of the experimentally observed isomers.

Talk 4, 17:10-18:00

Quentin Ruyant (Universidad Complutense de Madrid)

What kind of explanations are reductive explanations?

Explanatory reduction occurs when a type of phenomenon or a regular pattern described in a high-level theory (for example biology) is given a “deep” low-level explanation (in chemistry). Reductive explanations are often considered versions of causal explanations, which are sometimes analysed in counterfactual terms (Woodward 2003). I will argue that this approach is problematic, and that a unificationist conception of reductive explanations is more promising.

As is well known, high-level phenomena are typically multiply realisable, so that many different low-level descriptions can correspond to the same high-level description. This entails that a high-level pattern is not associated with a single low-level explanatory model of the phenomena, but rather with a class of low-level models. Furthermore, I will argue that in general, none of the models of this class, taken separately, is explanatory. One reason is that low-level descriptions typically describe parts in isolation rather than the phenomena to be explained in its entirety Kaiser (2015). However, even if these partial models were combined into more complex descriptions of the entire phenomena in the low-level theory (which does not correspond to scientific practice, but could perhaps be done in principle), the phenomena would still not be causally explained by every single low-level model. Rather higher-level causal patterns would be accounted for by the presence of corresponding patterns between model parameters in a class of low-level models. That is, the whole class of possible realisations of the phenomena must be taken into account (and parametrised in relation with high-level vocabulary) in order to explain. Since for single instances, only one of the possible realisations is actual, the low-level theory is unable to causally explain particular instances of the phenomenon. It makes more sense to understand general causal patterns as constituting the explanandum of reductive explanations, but reductive explanations are not themselves causal.

Reductive explanations could still be analysed in terms of a counterfactual of the form “if things were different, then the higher-level causal pattern would not occur”. This could be interpreted as a metaphysical counterfactual. However, it is not clear what the antecedent of the counterfactual should be. I examine various options in this regard: the antecedent could concern a constitution postulate, or a low-level law. However, contrarily to the case of causal explanations, considering specific alternative possibilities (alternative constitutions or laws) does not seem to enhance the explanation. A unificationist conception of reductive explanations (Kitcher 1989) is more promising, given that low-level models typically describe parts in isolation, assuming that the same characterisations of these parts are applicable in a wide range of alternative explanatory contexts.

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Abstracts Wednesday 16 June

Talk 1, 13:30-14:30

Dr Eleanor Knox (King's College London)

Lewis, Dennett, Functionalism and Reduction Functionalism, particularly of the Lewisian kind, has often been seen as a tool for reduction. More recently, in the philosophy of physics literature in particular, it has also been associated with emergence. Which is it? This talk will examine recent claims (Butterfield and Gomes) that philosophers of science should focus on Lewisian functional reduction. I'll argue that doing so misses interesting features of functionalist thinking, and illustrate the point with an example from spacetime physics.

Talk 2, 14:45-15:35

Gregorie Dupuis-Mc Donald (University of Salzburg)

Going around? Causal loops and multiscale coupling in complex systems of international migration

Since the past three decades, there is a sharp increase in international migration trends (the international migrant population has grown from 2.9 percent in 1990 to 3.6 percent in 2020 as a proportion of the world's popu-lation, an increase of 120 million people) (IOM 2020). That state of affairs calls for an explanation of the causes that drive migration processes. Yet, there is a causal complexity involved in the phenomenon of migration. That complexity stems from the multiscale structure that underlies the various levels at which salient causal variables can be identified in migration sys-tems. Indeed, there are different levels (viz. micro-, meso- and macro-level) at which causation can be operating, and each level needs a distinct theoret-ical narrative (e.g. psychological, economic, social, political, demographic, and environmental).

In my contribution, I emphasize that the problem of causation in mi-gration science is that neither is there a preferred level on a scale separa-tion map at which causation can be described and modelled, nor is there a definite causal direction, - (top-down or bottom-up), - for the coupling of sub-levels in a migration system. Causation can be "going around". In fact, one can argue that there are causal loops between agents and their environ-ment in the co-evolution of migration systems (Thober et al 2018). In that context, certain philosophical assumptions concerning causation need to be explored. I identify 3 potential candidates, viz. 1) bottom-up causal reduc-tionism, i.e. sufficient causal information about the constituent elements of a system suffices to explain the phenomenon at higher scales (Green and Batterman 2017); 2) top-down causal robustness, i.e the behaviour of a sys-tem is insensitive to changes in its sub-system realizations and fine-grained details (Wiesner et al 2019); 3) causal dependence, i.e. sub-systems are not self-contained, in the sense that they give rise to emerging simplicity or sophistication through information feedback and coupling (Strevens 2015; Winsberg 2010; Chopard et al 2014).

That being said, the objective of my contribution is to defend a complex-system approach in migration science. Specifically, I want to show how that approach helps make progress in the understanding of the causal complexity of migration. I suggest that models of complex systems of migration can explain the emergence of large scale migration trends by locally describing the multiscale bridging that connects agents, their decisions and interactions, as well as the specific causal forcings that account for the behaviour of regional migration patterns. My proposal is the following: First, we need Agent-Based Models (ABMs) that represent the elements, interactions and decisions that lead to migration; second, we need a general causal account that conceptualises the feedback bridging the different levels of causation in a given system. All in all, my proposal indicates that a complex-system approach is a multi-science response to the problem of causation in migration science.

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Talk 3, 16:05-16:55

Dr Margarida Hermida (University of Bristol)

Composition at the Same Level

Composition is usually thought to take place between levels: subatomic particles compose atoms, which compose molecules, which in turn compose all sorts of macroscopic objects. There is a case, however, in which composition seems to happen at the same level: biological organisms.

I take 'organism' to refer to all physical objects characterized by the essential property of 'being alive'. We may distinguish between simple organisms, such as bacteria, and composite organisms, such as animals. To be sure, simple organisms are composite objects, and even bacteria are quite structurally complex, but they are simple in the sense of not being composed of any parts that are themselves alive. Composite organisms, in contrast, are composed of other living organisms.

In a parallel with van Inwagen's Special Composition Question (SCQ), we might consider a 'biological SCQ': when do n organisms compose another organism? Again, the answer will resemble van Inwagen's own reply to the SCQ. We might say that some organisms compose another organism when their combined activities constitute a life, in addition to the lives of the individual organisms. There are multiple ways in which composite organisms can be generated, including multicellularity (e.g. animals), multicellular aggregation (slime molds), endosymbiosis (eukaryotic cells), and coloniality (siphonophores).

So it seems then that, in contrast with the traditional picture of composition, within biology there can be composition at the same level – organisms composed of organisms. Nevertheless, several objections might be raised against the idea that organismal composition is an example of composition at the same level.

We might, for example, deny that there are composite organisms, by requiring that only the larger living object counts as an organism. However, this seems to be an unprincipled requirement. If we deny that cells in a multicellular organism are themselves organisms, even though they are alive, we must 1) deny that organisms are a natural kind defined by the property "being alive"; and 2) specify a kind "living non-organism" to apply to living beings that are part of composite organisms.

Alternatively, we might say that there is organismal composition, but not at the same level: each new form of organismal composition is a new level. This is a coherent view, but while we might say that, for example, unicellular and multicellular organisms represent different levels of biological organization, they can hardly pertain to different levels of reality. It also seems desirable to be able to say that both are organisms, albeit very different ones.

Finally, we might deny that composite organisms are (entirely) composed of simpler organisms; they have other components as well. But we can overcome this objection by qualifying the statement as saying that composite organisms are entirely composed of simpler organisms plus their dead remains and materials produced by them. It is still the case that the life of a composite organism emerges from the combined activities of the organisms that compose it.

In conclusion, composite organisms can be seen as an example of composition at the same level.

Talk 4, 17:10-18:00

Roope Ryymin (King's College London)

Can the world be composed of its fundamental constituents?

Building-based approaches to fundamentality that understand fundamentality in terms of building relations have grown more popular in the recent years (Bennett 2017, Paul 2012). Following Bennett (2017), call generalist monism the view that there is exactly one building relation. Call mereological generalist monism the view that the only building relation is mereological composition.

Some philosophers (Paul 2012) attracted to mereological generalist monism motivate their view by appeal to the composition intuition — the thought that the fundamental constituents of reality build the world and the things in it by mereological composition. In this paper I argue that the composition intuition does not motivate mereological generalist monism. I argue that the two are in fact in tension, at least on the assumption that the fundamental constituents of reality are the unbuilt builders. I show that the conjunction of these three claims entails that there is only one thing, the world, that the fundamental constituents build. This leaves us with a trilemma. Either (a) we deny the composition intuition and claim that world does not exist, (b) we deny generalist monism and introduce some other building relation into our ideology, or (c) we bite the bullet and claim there are only fundamental constituents and a single all-encompassing thing they build.

The paper's main argument goes like this.

Firstly, according to the mereological generalist monist, fusing or composing is the fundamental building relation. It is the relation by which the fundamental combine to make everything else up. The fundamental are modelled as the mereological simples — the things that have no proper parts. On the assumption that the fundamental are themselves unbuilt, since on the standard mereological definition of composition everything composes itself, we need to distinguish between composition and proper composition which excludes the simples from being composed. This turns out to have a substantive logical consequence. If proper composition is building, and the fundamental are what build everything else, then it follows that (proper) parthood is vacuously transitive: no mereological complex is a proper part.

Secondly, according to the composition intuition, there is a world that is built from its fundamental constituents. If, as per the mereological general monist, we should interpret this in mereological terms, we end up with the claim that there is something that has everything as its parts that is properly composed of the mereological simples. But if that is right, and no complex is a proper part, then the world is the only complex and thus the only thing that the fundamental constituents properly compose. Thus if we do not want to say that the world is the only thing the fundamental constituents build, we either need to deny that there is something that has everything as its parts or that proper composition is the only building relation.

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Abstracts Thursday 17 June

Talk 1, 13:30-14:20

Niccolo Negro (Cognition and Philosophy Lab, Monash University)

The emergence of consciousness as Integrated Information

In this talk, I shall argue that the Integrated Information Theory of consciousness (IIT) (Oizumi et al. 2014; Tononi et al. 2016) is a form of strong emergentism. After a brief introduction of IIT, I will highlight both the metaphysical assumptions and the main formal results of the theory. As for the metaphysical assumptions, I will focus on IIT's endorsement of pandispositionalism, whereas for the formal results, I will build upon the work of Hoel et al. (2016) and Marshall et al. (2018) to demonstrate that integrated information reaches its maximal value at a macro, instead of micro, scale. Given IIT's exclusion postulate (i.e. only maximal integrated information corresponds to consciousness), I shall demonstrate how this implies that consciousness, according to IIT, is not reducible to a micro level property, but it is instead a structural property of a system as a whole.

My claim is that this metaphysics and this formal result together lead to a form of strong emergentism, that I call Emergentist IIT. In the second part of the talk, I frame such emergentism within the traditional philosophical debate, and argue that Emergentist IIT's peculiarity consists in its compatibility with minimal physicalism (Lewis 1983), contrary to some previous readings of strong emergentism (Chalmers 2006; Wilson 2015). To do so, I analyse the emergence of maximal integrated information through various ways that philosophers have conceptualized the dependency relation (DEP) of the macro upon the micro, and the autonomy (AUT) relation of the macro to the micro.

With respect to DEP, I consider i) causation; ii) supervenience; iii) realization; iv) fusion. I conclude that the best way to understand the dependence of integrated information on its basis is through a combination of some aspects of supervenience and some aspects of fusion (Humphreys 1996).

With respect to AUT, I consider i) non-linearity; ii) fundamentality; iii) multiple realizability; iv) downward causation. I conclude that the best way to understand the autonomy of integrated information from its basis is through the notion of downward causation. In particular, through the idea of global-to-local determination (Thompson and Varela 2001).

The upshot of Emergentist IIT is thus a theory that sees consciousness as an emergent phenomenon derived by the fusion of the causal powers of the micro (non-mental) level. Such a fused phenomenon in turn determines the unfolding dynamic of the micro level phenomena upon which it depends. I will argue that this picture is not only consistent with IIT's metaphysical assumptions, but also compatible with minimal physicalism, as there is only one ingredient in reality, a physical one: causation. According to Emergentist IIT, consciousness is just causation in a specific (emergent) form.

I argue that we should take Emergentist IIT as a serious metaphysical proposal, as it combines formal and conceptual analysis to measure the emergence of consciousness and to make sense of its place in nature.

Talk 2, 14:35-15:25

Dr Alexander Franklin & Dr Katie Robertson (King's College London & University of Birmingham)

Emerging into the Rainforest: Emergence and Special Science Ontology

Many philosophers of science are ontologically committed to a lush rainforest of special science entities, but are often reticent about the criteria that determine which entities count as real. On the other hand, the metaphysics literature is much more forthcoming about such criteria, but often links ontological commitment to irreducibility. We argue that the irreducibility criteria are in tension with scientific realism: for example, they would exclude viruses, which are plausibly theoretically reducible and yet play a sufficiently important role in scientific accounts of the world that they should be included in our ontology.

In this talk, we show how the inhabitants of the rainforest can be inoculated against the eliminative threat of reduction: by demonstrating that they are emergent. According to our account, emergence involves a screening off condition as well as novelty. The screening off condition is akin to a causal Markov condition: the key idea is that while the underlying microdescription is unconditionally relevant for the macroscopic phenomena, the microdescription is nonetheless irrelevant given the macrodependency. In addition, the macrodependency must also be suitably novel to avoid trivialising emergence; we suggest that a macrodependency is novel if it's not type-identical with a corresponding microdependency, or if it gives rise to novel causal powers. For example, the molecular motion in the kettle is unconditionally relevant to the water boiling, but conditional on the temperature of the water, the molecular motion is irrelevant. That the dynamics of fluids is distinct from the dynamics of molecules secures the emergence of the fluid.

We go on to demonstrate that this account of emergence satisfies common intuitions concerning what should and shouldn't count as real: viruses are emergent, as are trouts and turkeys, but philosophically gerrymandered objects like trout-turkeys do not qualify.

In relation to extant accounts in the literature, we claim that entities are real if they are emergent and that our emergence is both ontological and compatible with reduction. We argue that this proposal improves on Jessica Wilson's (2010) account of emergence, and builds upon Butterfield's (2010) popular account. Our goal is that emergence is understood in metaphysical rather than epistemological terms, as such while we aim to subsume the rainforest realism espoused by Ladyman and Ross (2007), we hope to enhance its credentials as a metaphysics by excising the information-theoretic elements.

Talk 3, 15:55-16:45

Hamed Tabatabaei Ghomi (University of Cambridge)

Irrationality suggests indecomposability. Indecomposability implies emergence.

The focus of this paper is on transformational emergence. According to Humphreys (1997; 2016), transformational emergence happens when a fundamental member of a domain changes its nature and becomes a member of another domain as a result of this change. There should not be a third domain that explains the nature of the object in the first and the second domains and the shift between the two. Humphreys' formulation of transformational emergence shows great promise for the modelling of emergence across sciences. In practice, however, it is hard to find well-supported examples to pinpoint the occurrence of such emergence. That this difficulty is particularly challenging outside fundamental physics limits the application of this theory of emergence. I try to address this problem by providing examples from biology and, moreover, by suggesting a general probabilistic marker to identify other examples.

I provide close theoretical analysis and extensive empirical evidence to substantiate my examples of transformational emergence in biology. The focus of these analyses will be on biological engineering, a practice which, I argue, reveals the true nature of biological systems as indecomposable systems, a feature that necessitates transformational emergence of biological parts, and transformational emergence of biological systems as a whole. In particular, I analyse the failures of biological engineering and look at the measures adopted by biological engineers to tackle them and their heavy reliance on so-called irrational methods. Rational methods are those based principally on some a priori theory about the underlying mechanisms in the system under study, whereas irrational methods are those that rely on a posteriori observations of the system. I suggest, through close theoretical and empirical scrutiny of real cases, that heavy dependence on irrational methods in biological engineering is probably due to indecomposability of the biological systems. I assert that the indecomposability of these systems implies transformational emergence in their constituent parts and in their systemic features.

Generalizing from these examples, I propose what I see as a practical argument for emergence. I suggest that indecomposability is one important way in which transformational emergence occurs in nature, and recourse to irrational methods is a probabilistic marker that can indicate cases of indecomposability and henceforth, transformational emergence. I summarise the conclusions of this paper in the following maxim:

Irrationality suggests indecomposability. Indecomposability implies emergence.

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Talk 4, 17:00-18:00

Prof Sandra Mitchell (University of Pittsburgh)

Are emergent phenomena real?

The convergence or replicability of experimental results is taken to be strong evidence for the reality of phenomena. Attempts to apply this strategy to robust emergence exposes the philosophical, scientific and empirical assumptions required for any use of this strategy. Real phenomena are co-constructed, not simply observed.