# FIFTH SOCIETY FOR THE METAPHYSICS OF SCIENCE ANNUAL CONFERENCE

VICTORIA COLLEGE

UNIVERSITY OF TORONTO

NOVEMBER 7 - 9 2019

# Fifth Annual Conference

# Society for the Metaphysics of Science

November 7-9, 2019

Victoria College, University of Toronto

Toronto, Canada

# FOREWORD

## Message from the President of the Society for the Metaphysics of Science

It is my great pleasure to welcome you, on behalf of the SMS officers, the program committee, and the local organizing committee, to the 5th annual meeting of the Society for the Metaphysics of Science, which follows previous meetings in Newark, Geneva, New York, and Milan.

Metaphysics of science is an exciting domain of research. The papers presented at this conference explore a wealth of metaphysical questions that arise within science or can be raised in the context of the interpretation of science. They bear on many different sciences, from physics and mathematics to biology, psychology and sociology, and on a variety of metaphysical concepts used or presupposed in science, such as space-time, causation, law, mechanism, dependence or ground, composition, possibility, and indeterminacy.

My warm thanks to Katherine Brading, our keynote speaker, to all those who are taking part in the conference by presenting or commenting on a paper or chairing a session, to Jessica Wilson, Michael Miller, Marissa Bennett and other members of the local organizing committee who have taken care of all those large and small things that have made the whole event possible, to Giuliano Torrengo, Cristian Mariani, and other members of the program committee who have put together an excellent program whose diversity covers many aspects of our flourishing field, to Victoria College at the University of Toronto for hosting the conference, and to the Departments of Philosophy at the University of Toronto St. George and Scarborough, and the Institute for the History and Philosophy of Science, for funding assistance.

*Maximilian Kistler*

# SOCIETY FOR THE METAPHYSICS OF SCIENCE

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## FRIDAY 8 NOVEMBER — MORNING

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# ABSTRACTS

**(ordered by title)**

**Charles Sebens (Caltech)**                                      Thursday, 15.45-16.45

*Aligning our Theories of the Electromagnetic and Dirac Fields*

We can align our physics of electrons, positrons, and photons by treating the quantum electromagnetic and Dirac fields as more fundamental than the aforementioned quantum particles. Classically, the evolution of the Dirac field is governed by the Dirac equation. This equation and the other equations of classical Dirac eld theory initially look quite different from the equations of classical electromagnetism. One can bring these two eld theories into closer parallel by manipulating the equations of electromagnetism. When this rewriting is complete, there remains one important disanalogy: whereas the energies associated with both positive and negative frequency modes of the electromagnetic eld are positive, one traditionally associates negative energies (and negative charges) with the negative frequency modes of the Dirac eld. We can bring these theories into closer alignment by correcting classical Dirac eld theory so that the energies associated with all modes are positive and the charges associated with negative frequency modes are positive|making it a theory of both electrons and positrons. These corrections allow us to better understand the classical electron and also to streamline the path to quantum eld theory.

**Tyler Hildebrand (Dalhousie University)**                    Thursday, 12.00-13.00

*Best Systems: Metaphysical or Epistemological?*

I distinguish between different ways in which the notion of a best system can be relevant to laws of nature. Some interpretations of best systems are metaphysical, providing a theory of the metaphysical nature of laws; others are epistemological, providing a theory of how scientists should discover the content of statements of laws. Some systematize all particular matters of fact; others systematize only a subset of particular matters of fact---namely, those facts constituting our evidence. Neither distinction is entirely new, but together they can be put to good use. They help to clarify the epistemology of non-Humean theoretical entities; they reveal some respects in which non-Humean theories fit nicely with scientific practice; and they allow us to diagnose some underlying sources of contention that often lead Humeans and non-Humeans to a stalemate.

**Federica Bocchi (Boston University)**                                    Thursday, 15.45-16.45

*Biological Essentialism. One Last Round?*

Biological essentialism can be characterized as the attempt at pointing out some stable features of an organism that make it what it actually is as a species-member. An essence is usually described, hence, as a "set of features" that identify and explain an organism's specific membership. It is a doctrine that goes back to Aristotle's "bio-metaphysics" (Furth 1988) and, for a long time, it has been said by most to be a dead issue within biology. For the last few decades, however, the philosophical community has been facing a neo-Aristotelianism revival in many fields that is challenging the general consent. In this paper, my aim is to show how Aristotelian biological essentialism (ABE) can resist the objections raised by what I take to be the most insightful anti-essentialist account on the market, formulated by Elliott Sober (1980). Sober's characterization of essentialism is flawed insofar as it infers more than what is entailed by essentialism per se and therefore his account ultimately fails in its attempt to refute it in toto. Even supporting Sober's criticisms, I point out two errors that he makes in describing ABE. The first error is that he does not pay proper attention to the explanatory component of essentialism—which would be consistent with the rejection of constituent definitions. The second error is his reduction of essentialism to typology via the Natural State Model. This latter, indeed, is an instance of typological thinking that posits some over-the-individual entity, a move unnecessary to an essentialist account.

**Chanwoo Lee (UC Davis)**                                    Thursday, 9.30-10.30

*The Chasm Between Scientific and Analytic Metaphysics? A case study: Ontic Structural Realism Versus Ontological Nihilism*

The apparent chasm between two camps in metaphysics, which are often termed "mainstream analytic metaphysics" and "scientific (or naturalistic) metaphysics", is well recognized. I argue that the difference between them is thin. I look into the well-known metaphysical underdetermination argument for ontic structural realism (OSR), which is often suggested as an archetypal instance of scientific metaphysics, to show that its reasoning is precedented in analytic metaphysics known as ontological nihilism or generalism; hence, they effectively yield the same ontology. To strengthen this view, David Glick's recent critique that tells OSR apart from generalism is addressed. It suggests that the relationship between analytic metaphysics and science metaphysics is not necessarily a rivalry, but instead can be likened to a division of labor following 'the Viking approach to metaphysics' by Steven French and Kerry McKenzie.

**Richard Lauer (St. Lawrence University)**                                    Friday, 12.00-13.00
**Kareem Khalifa (Middlebury College)**

*Collective Agents: A Naturalistic Challenge*

Several social ontologists claim that groups can possess mental states that explain collective actions. In this paper, we argue that such claims must be subject to stricter naturalistic standards, and that current work in social ontology does not meet these standards. We support these claims with examples of causal modeling in social movement research and theories of the firm. Four general challenges to proponents of collective agents emerge: explanations positing collective agents risk (a) being imprecise when group members have heterogeneous goals, (b) being insensitive to different kinds of group success, (c) omitting the group's inner workings, which are frequently causally relevant variables, and (d) being explanatorily idle.

**Kenneth Aizawa (Rutgers University, Newark)**            Saturday, 12.00-13.00
**Drew Headley (Rutgers University, Newark)**
*Compositional Relations and Their Discovery*

Episodes in the history of science reveal that the scientists sometimes explain wholes in terms of parts, properties of wholes in terms of properties of their parts, and processes of whole in terms of processes of their parts. In addition, the history of science reveals that the discovery of compositional relations are sometimes made by way of abductive inferences, that is, scientists sometimes come to believe in compositionally relevant entities, because such entities are compositionally explanatory. These observations have numerous ramification for New Mechanist accounts of compositional explanation. First, they suggest that we should expand the scope of compositional explanations to include the explanation of individuals and properties. Second, they suggest that we should find additional "pieces", i.e. properties, in the piecemeal development of compositional explanations. Third, we need not suppose that the only scientific method for discovering compositionally relevant entities is by way of so-called "interlevel interventions". Fourth, we need not suppose that explanatory power derives from the entities invoked in explanations, but may instead consider the extent to which entities might be thought to exist in virtue of the explanatory power they provide.

**Tyler Millhouse (University of Arizona)**            Thursday, 14.30-15.30
*Compressibility and the Reality of Patterns*

Dennett (1991) distinguishes real patterns from bogus patterns by appeal to compressibility. This insightful approach has recently been adopted by several philosophers of science as an account of non-fundamental ontology (e.g., D. Wallace, 2012; Ladyman & Ross, 2013). Drawing on results in information theory, Dennett argues that data is compressible iff that data exhibits a pattern. Noting that high-level models are very simple compared to their low-level counterparts, Dennett interprets successful high-level models as compressed representations of a system's fine-grained behavior. As such, he argues that successful high-level models depend on patterns in this fine-grained behavior. Unfortunately, close attention to data scientific practice complicates this interpretation. This both undermines the traditional justification for real patterns and suggests a revised research program for its defenders.

**Kian Salimkhani (University of Bonn)**            Saturday, 10.45-11.45
*The Constructivist's Programme and the Problem of Pregeometry*

Prominently, Norton (2008) argues against constructivism about relativity, the doctrine that spatiotemporal structure in special and general relativity is only derivative on fields and their dynamics. Particularly, he accuses Brown's dynamical approach to special relativity of being merely half-way constructivist: setting up relativistic fields as presupposed in the dynamical approach to special relativity already requires spatiotemporal background structure, referred to here as pregeometry. In response, Menon (2018) recently tried to defend a full constructivist understanding of the dynamical approach in which the manifold structure is rendered derivative on an algebraic re-representation of the fields and their respective dynamical equations. Albeit in a different manner, Stevens (2018) can also be taken to inspire a full constructivist story. This is, however, based on rendering the manifold as a non-spatiotemporal ordering structure. In this paper, we investigate to what extent a constructivist about special and general relativity is able to do without any presupposed spatiotemporal structure. First, we present a reformulation of the challenge for the constructivist. We then

argue that previous attempts to address the challenge are unsatisfactory. Finally, we offer a solution based on an reevaluation of the problem of pregeometry in light of the well-known debate on indispensability arguments with respect to mathematics.

**Lisa Leininger (Hobart and William Smith Colleges)**                    Saturday, 9.30-10.30
*The Coordination Problem*

Absolute becoming, in which an event comes into existence, is often accepted without much scrutiny as the traditional foundation of the passage of time. I reject absolute becoming, which then means that events in the future do not come into existence - they already exist. Most arguments for the existence of the future appeal to the implications of the Special Theory of Relativity (STR) - Putnam's (1967) "Time and Physical Geometry" being the most famous.   My argument, in contrast, is an argument from metaphysics, rather than an argument from physics.   The heart of the argument involves what I call the coordination problem: that the proponent of absolute becoming cannot explain the continued orderliness of each slice of reality that comes into existence.   I consider the response of appealing to various enforcers - specifically, causation, laws of nature, and dispositions - to ensure this orderliness; however, any appeal to an enforcer fails to explain the continued orderliness of the world.   This ultimately means that proponents of the traditional foundation of temporal passage must do more than merely address its scientific shortcomings; this metaphysical worry must be addressed as well. Until these shortcomings are adequately addressed, we must accept the existence of the future.

**Cristian Mariani (University of Milan)**                    Saturday, 9.30-10.30
*Derivative Metaphysical Indeterminacy in Quantum Mechanics*

Many have focused on quantum mechanics as a motivation for developing an account of metaphysical indeterminacy. The most recent discussions, however, show that quantum indeterminacy (QI) has to be understood not in isolation, but rather by looking at its status in each of the main interpretations of the theory. David Glick (2018) has recently done so, and argued that QI disappears from the fundamental level, from which he concludes that it would be 'eliminable'. I shall call this view *eliminativism* about QI. In this paper I will be focusing on the relationship between QI and fundamentality in order to show that eliminativism about QI should be rejected.

**Christina Conroy (Morehead State University)**                    Thursday, 14.30-15.30
*Deviant Dependence and Entanglement*

There are several intuitions about the metaphysics of determinables and determinates that many seem to hold: (1) determinates are more fundamental than their associated determinables; (2) determinables require one and only one determinate for their instantiation; (3) a determinable of object A metaphysically depends on the associated determinate of object A, and not the determinate of some other object. Jessica Wilson (2012) first showed readers that intuition (1) is suspect by persuasively arguing for fundamental determinables. She (2013), Alisa Bokulich (2014) and Johanna Wolff (2015) have also provided insightful examples of cases in which intuition (2) fails us. What I aim to do in this paper is to show that intuition (3) is no more trustworthy than the others. I will show that there are cases in which the determinable of an object A is metaphysically dependent upon a determinate of a different object B. The most salient example is drawn from the philosophy of

quantum mechanics, and in particular from the example of a system of non-separably entangled particles. If we consider a system of two particles, A and B, that are non-separably entangled insofar as their at least one of their spin properties is concerned, then it can be argued that the spin determinable of A is metaphysically dependent on the spin determinate of B.

**Peter Tan (Middlebury College)**                                    Saturday, 14.30-15.30
*Dispositionalism and Counternomics*

Dispositionalism about modality ('dispositionalism' for short) is the view that the de re modalities and the natural modalities alike are grounded in the world's dispositional properties. Dispositionalism is alleged to be able to ground the natural modalities as well. For the scientific world is replete with dispositional properties and laws of nature that seem to describe what behaviors various sorts of objects are disposed to engage in. I show that this dispositionalist picture is inconsistent with scientific treatments of counterfactuals, laws, and de re modality, since modal discourse in science is rife with counternomic claims for which (by dispositionalist lights) there can be no corresponding dispositional properties. Dispositionalism must be rejected on these grounds, since there are non-vacuous counternomics, and they form an important part of the scientific modalities.

**Amanda Bryant (University of Lisbon)**                                    Thursday, 12.00-13.00
*Epistemic Infrastructure for a Scientific Metaphysics*

A naturalistic impulse has taken speculative analytic metaphysics in its critical sights. Importantly, the claim that it is desirable — or even requisite in some sense — to give metaphysics scientific moorings must rest on underlying epistemological assumptions. If the naturalistic impulse toward metaphysics is to be well-founded and its methodological prescriptions to have normative force, it is crucial that those assumptions be spelled out, refined, and justified. In short, advocates of scientific metaphysics require epistemological infrastructure. This paper supplies that infrastructure. In it, I outline my conception of suitably naturalized or scientific metaphysics in detail. I then lay out a number of candidate epistemic principles centring around the notion of theoretical constraint. I offer two arguments in support of these principles: one based on statistical likeliness and one on methodological expediency. Finally, I show how scientific metaphysics satisfies the epistemic principles on offer and is therefore preferable to its traditional rivals.

**Muhammad Ali Khalidi (York University, Canada)**                                    Friday, 10.45-11.45
*Etiological Kinds*

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. In this paper 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 I will take a closer look at some 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 some reasons that scientists may be interested 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.

**Patrick McGivern (University of Wollongong)**     Saturday, 12.00-13.00
**Elay Shech (Auburn University)**
*Fundamentality, Scale, and the Fractional Quantum Hall Effect*

We examine arguments for distinguishing between ontological and epistemological concepts of fundamentality, focusing in particular on the role that scale plays in these concepts. Using the fractional quantum Hall effect as a case study, we argue that we can draw a distinction between ontologically fundamental and non-fundamental theories without insisting that it is only the fundamental theories that get the ontology right: there are cases where non-fundamental theories involve distinct ontologies that better characterize real systems than fundamental ones do. In order to reconcile these distinct ontologies between fundamental and non-fundamental theories, we suggest that ontology must be understood as scale-dependent.

**Cruz Davis (UMass Amherst)**     Friday, 12.00-13.00
*Geometric Possibility, Supersubstantivalism, and Ideological Parsimony*

*Monistic substantivalists* believe that material objects and regions of spacetime are not two distinct kinds of fundamental of entities. For the monist, objects either are identical with regions or are somehow derivative from them. *Dualistic substantivalists* view regions and objects as distinct kinds of fundamental entities. One virtue monists claim to have is that their view is more *ideologically parsimonious* than dualism because monists can do without a primitive notion of location. In this paper I provide an argument that undercuts some of the theoretical edge that monists claim over dualists. The assumption that the monist can provide a reduction of location unique to their position rests on a false assumption about the possible structures spacetime can have. If it is metaphysically possible for two distinct regions to coincide with respect to all their significant spatiotemporal properties and relations (call these 'coincident regions'), then analyses of location unique to monism will turn out to be inadequate. Moreover, I argue that several important arguments for monism rely on the monists' ability to uniquely analyze location. So if the monists' analyses fail, then so do these arguments.

**Ezra Rubenstein (Rutgers University)**     Saturday, 10.45-11.45
*Grounded Shadows, Groundless Ghosts*

According to a radical account of quantum metaphysics which I label 'high-dimensionalism', ordinary objects are the 'shadows' of high-dimensional fundamental ontology (Albert 2013, ms-a; Ney 2015). This has been the subject of a number of criticisms (especially Maudlin 2007, ms), focused on high-dimensionalist connections between fundamental and non-fundamental. Perhaps the most interesting of these criticisms concerns 'ghosts': alternative constructions from high-dimensional fundamental ontology that are alleged to have the same credentials to be material objects as the 'shadows', making high-dimensionalist connections seem objectionably arbitrary. In response, I argue that there is no significant asymmetry between high- and low-dimensionalism here: low-dimensionalists face just the same kinds of ghosts.

**Eli Lichtenstein (University of Michigan)**  Thursday, 15.45-16.45

*How Anti-Humeans Can Embrace a Thermodynamic Reduction of Time's Causal Arrow*

Several commentators have argued that time's causal arrow is grounded in an underlying thermodynamic asymmetry. This program of thermodynamic reduction is often undertaken in a spirit of Humean skepticism that causes produce their effects, in some robust sense. Conversely, commentators amenable to stronger notions of natural necessity often take their anti-Humeanism to conflict with thermodynamic reduction. I challenge this traditional pairing of views, using Tim Maudlin as a foil. I generalize Maudlin's concept of 'production' (whereby laws of nature 'produce' the universe's later states from its initial state), and argue that the resultant generalized notion better illuminates the basic tension between thermodynamic reductionism and anti-Humean accounts of natural necessity. I conclude that thermodynamic reductionists who want to appeal to a robust notion of 'production' can insist that there are metaphysical constraints on what the sign of velocity in a given state can be, given other (including later) states' properties.

**Katherine Brading (Duke University)**  Friday, 17.00-18.00

[Keynote Address]

*How physics flew the philosophers' nest*

Physics and philosophy are today housed in separate departments and, by and large, practiced by different people using different skills and methods. As is well known, it was not always thus. Contrary to popular opinion, however, the "Scientific Revolution" of the 17th century is not when the two went their separate ways: physics remained very much a part of philosophy well into the 18th century. So when, how and why did physics fly the philosophers' nest? How, and to what extent, did physics gain its autonomy? And with what philosophical consequences? I will argue that the search for an adequate account of bodies interacting with one another – a search that lasted over 150 years and failed – resulted in profound changes in the relationship of physics to philosophy. I will talk about what this means for philosophy, and for the metaphysics of physics.

**Mark Maxwell (Yale University)**  Saturday, 15.45-16.45

*An Identity Theory of Time*

I present a view of time on which ordinary temporal relationships are to be understood in terms of identities of facts across time, and times themselves are merely the ways of describing these atemporal facts. Relations of identity between facts as described at different times are constructed using a notion of ``exact'' cause and effect, with the result that we can maintain that every time contains all that there is, with different times being merely different ways of talking about the same atemporal world. As such, time is effectively removed from the metaphysics, and becomes merely part of our descriptive apparatus.

**Andre Curtis-Trudel (Ohio State University)**  Friday, 14.30-15.30

*Implementation as Resemblance*

The received view is that computational implementation is a mapping from a physical system to a formal, set-theoretic structure. This view faces a dilemma: if implementation is just mapping, then physical computation is trivial, but if it is more than mapping, it unreasonably restricts computer scientific inquiry. This paper develops a novel account of implementation according to which physical systems implement mathematical computational devices, replete

with functional, syntactic, and semantic features. Implementation is recast as resemblance to such devices. I argue that this account avoids the dilemma: physical computation is non-trivial because few physical systems resemble any computational device, and the account is unrestrictive since it appeals only to properties endogenous to computer science.

**Jennifer McDonald (The Graduate Center, CUNY)**  Saturday, 15.45-16.45
*The Importation Problem for a Structural Semantics of Counterfactuals*
Structural causal models lend themselves to a semantics of counterfactuals. Call this a structural semantics of counterfactuals. Structural semantics has a number of limitations – such as not being able to make sense of backtracking counterfactuals and not being able to handle iterated counterfactuals where a counterfactual stands as antecedent (Briggs, 2012). However, it is thought that such a semantics at least improves on traditional similarity semantics in that it straightforwardly incorporates causal structure and avoids talk of a similarity relation between possible worlds (Pearl, 2000, 2013; Starr, 2019). This paper shows, however, that a structural analysis of counterfactuals is vulnerable to the same fundamental problem as is a similarity analysis – what Graham Priest (2018) calls the importation problem for counterfactuals. I argue that where similarity semantics relies on an unarticulated notion of similarity, a structural semantics relies on an unarticulated notion of aptness. The superiority of structural semantics depends on its ability to deliver on a principled guide to determining which model(s) is apt. But this is no small task.

**Cameron Gibbs (Grand Valley State University)**  Friday, 15.45-16.45
*Indiscernible Worlds and Uninstantiated Properties*
In denying necessary connections, Humeans hold that a property 'floats free' from its role in the laws, that is, its nomic role.  Not only could a property fail to play its actual nomic role, but a distinct property could play the same nomic role. Many object to the Humean conception of properties on the grounds that it permits there to be worlds that only differ with respect to which property is playing which nomic role.  However, I argue that in order to avoid a commitment to worlds that only differ with respect to which property is playing which nomic role, the Humean's opponent must deny the possibility of laws involving uninstantiated properties.  But this claim, when conjoined with other commitments that the Humean's opponent takes on, leads to several implausible results that undermine the objection against the Humean.

**David Baker (University of Michigan)**  Friday, 10.45-11.45
*Knox's Inertial Spacetime Functionalism*
Eleanor Knox has advanced the view that spacetime is whatever geometric structure fulfills a particular function in the laws of nature: determining which reference frames are inertial. I raise two objections to this inertial functionalism. First, it depends on a prior assumption about which coordinate systems defined in a theory are reference frames, and hence on assumptions about which geometric structures are spatiotemporal. This makes Knox's account circular. Second, her account is vulnerable to several counterexamples, giving the wrong result when applied to topological quantum eld theories and parity- and time-asymmetric theories.

**Radmila Jovanovic Kozlowski (University of Belgrade)**      Friday, 9.30-10.30
**Andrej Jandric (University of Belgrade)**

*Leibniz and Spacetime Functionalism*

In this paper we compare a new, functionalist approach to spacetime, advanced by Eleanor Knox, with Leibniz's metaphysical account, which was the most influential opposition to Newtonian substantivalism. Her account of spacetime is inspired by Brown's dynamic approach to relativity, which is typically used as as an argument for relationism, yet she uses it to defend a new kind of substantivalism about the spacetime structure, but free of the "container" picture. Spacetime is defined via its role: to determine local inertial frames in a theory. We believe that Leibniz advocated a proto form of functionalism: his position with regard to space and time is a subtle middle position between substantivalism and relationism. Moreover, the main functionalist thesis – that spacetime is nothing but an inertial frame – is already implicit in Leibniz, even though typically overlooked, and his understanding of inertial frames is very similar to that of Knox.

**Nicholas Danne (University of South Carolina)**      Friday, 15.45-16.45

*Mathematical Realism from Reflectance Physicalism*

Recent arguments for the indispensability of mathematics to science focus on empirical phenomena (the prime-numbered life-cycles of cicadas, hexagonal honeybee comb). I motivate a mathematical indispensability claim from scientific property ascription. The property that I analyze is surface spectral reflectance (SSR), the disposition of a surface to reflect pulses of light at a given efficiency per wavelength. I argue that leading accounts of SSR ignore 'harmonic dispersion', which is the inverse relationship of a light pulse's duration to its spectral bandwidth, and I conclude that harmonic dispersion renders SSR conceptually incoherent. SSR can only be reflective efficiency per wavelength by being the disposition to reflect the Fourier harmonics of light pulses, and not the disposition to reflect light pulses themselves; hence my limited mathematical realism.

**Claudio Calosi (University of Geneva)**      Friday, 15.45-16.45
**Damiano Costa (USI, Lugano)**

*The Multilocation Dilemma*

The possibility of multilocation --- of one entity having more than one exact location --- is required by several metaphysical theories such as the immanentist theory of universals and three-dimensionalism about persistence. One of the most pressing challenges for multi-location theorists is that of making sense of exact location --- in that extant definitions of exact location entail a principle called Functionality, according to which nothing can have more than one exact location. Recently in a number of promising papers, Antony Eagle has proposed and defended a definition of exact location in terms of weak location that does not entail Functionality. This paper provides the first thorough assessment of Eagle's proposal. In particular, we argue that it cannot account for (i) location of immanent universals, (ii) multi-location of mereologically changing three-dimensional objects, (iii) multi-location of mereologically complex objects, and (iv) mereologically simple but extended objects.

**Anton Killin (Mount Allison University & Australian National University)**  Friday, 9.30-10.30
*Naturalized Metaphysics of Music: Pluralism, Realism and Music Archaeology*

According to pluralism about some concept, there are multiple non-equivalent, legitimate concepts pertaining to the (alleged) ontological category in question. It is an open question whether conceptual pluralism implies anti-realism about that category. In this talk, I argue that at least for the case of music, it does not. To undermine an influential move from pluralism about music concepts to anti-realism about the music category, then, I provide an argument in support of indifference realism about music, by appeal to music archaeological research, and via an analogy with indifference realism about species licensed by paleobiological research. Discussions of conceptual pluralism and its metaphysical implications have by and large focused on biological and other traditionally 'scientific' kinds, yet scientists also investigate cultural kinds like music (among others, such as tribe and language), so it is important to see whether discussions in the biological domain are insightful when imported into the social/cultural domain.

**Maximilian Kistler (Université Paris 1 Panthéon-Sorbonne)**            Saturday, 17.00-18.30
[Presidential Address]
*Natural Grounding*

It has recently been argued that causation and grounding have much in common, and even that grounding is a form of causation. To evaluate these arguments, it is necessary to distinguish between natural and other forms of grounding. First, I explore three features that causation shares with natural forms of grounding but not with other forms. 1. Both causation and natural grounding come in specific and non-specific forms. 2. Both can be indeterminate, in two ways. 3. Both come in a deterministic and an indeterministic variant. Second, I will use these common features to characterize the difference between the metaphysics of science and general metaphysics. 1) Non-natural forms of grounding do not share the 3 features; their analysis relies on theories such as set theory or mereology, whereas the analysis of natural forms of grounding relies on natural sciences, such as chemistry or cognitive neuroscience. 2) In myth and fiction there are forms of dependence that share the structure of causation and grounding (being strict partial ordering relations that can be modeled by structural equations) without belonging neither to the category of causation nor to that of grounding.

**Veronica Gomez Sanchez (Rutgers University)**                     Thursday, 9.30-10.30
*Naturalness by Law*

The fact that green is a natural property (unlike grue) is not a good candidate for a fundamental fact. In virtue of what does it obtain? An attractive idea (endorsed by Fodor) is that green is natural because it figures in (non-fundamental) laws. In this paper, I defend this idea from a series of criticisms. Most significantly, I respond to a circularity charge: I argue that we can extend the best systems account to non-fundamental laws without presupposing anything more than the distinction between fundamental and non-fundamental properties.

**Caleb Hazelwood (Duke University)**                           Thursday, 10.45-11.45
*Niche Construction Theory: Difficulties for a Practice Approach to Scientific Metaphysics*

I formulate criteria for a practice approach to pluralism in evolutionary theory and examine its merits. I use two examples—the evolution of lactose tolerance and starch catalysis in humans—to demonstrate that Niche Construction Theory (NCT) is progressive relative to the Standard Evolutionary Theory (SET) in certain research contexts. However, a difficulty

arises for this conclusion: I demonstrate that the expansion of the concept of an evolutionary process is not necessary to accommodate the novel predictions made by advocates of NCT. In fact, the theoretical advancements made by NCT reduce to an explanation in terms of selection—an evolutionary process privileged by the SET. In other words, the standard theory is already equipped to develop the same hypotheses as NCT without having to expand its conceptual boundaries. Thus, as opposed to the practical values of each theory running orthogonal to each other—as one would expect of a pluralistic framework—the hypotheses and predictions motivated by the SET and NCT coalesce. If my analysis is correct, it calls into question whether 'pluralism' is warranted in this case, i.e., one in which two competing theories are not genuinely conceptually incompatible. This case study is of particular importance for philosophy of biology, as it may promote caution about where and when we impose pluralism on biological thought. It demonstrates the limitations of a practice approach: it is not a panacea for resolving all theoretical debates, as its advocates intend. Furthermore, the debate between these two competing evolutionary theories is riddled with legitimate puzzles — e.g., what kinds of processes are necessary for evolution to proceed — whose solutions are not expounded by a practice approach.

**John Carroll (North Carolina State University)**              Thursday, 14.30-15.30
*Non-Modal Bilking Arguments and Time Travel*
Much of the philosophical literature on time-travel paradoxes is focused on the Grandfather Paradox and the Autoinfanticide Paradox. Both David Lewis (1976) and Kadri Vihvelin (1996) formulate these paradoxes with their focus on some modal concepts. Can Tim kill his grandfather? Is Adult Suzy able to kill her younger self? My concern, however, is to consider some bilking arguments that are free of this sort of modal terminology. These non-modal bilking arguments are common in the philosophy of science literature, the popular physics literature, and the scholarly physics literature. My goal is to understand the point of these arguments and whether these arguments succeed.

**Alexander Franklin (University of Bristol)**              Friday, 9.30-10.30
*On the Autonomy of the Special Sciences*
Fodor (1997) argues that the special sciences are autonomous, but that this autonomy is mysterious and eludes explanation. Reductionist responses to Fodor tend to eliminativism about autonomy. In this paper I set out a framework for explaining autonomy. Rather than eliminating it, this establishes that the special sciences are, in fact, autonomous from more fundamental sciences, but that this is compatible with reductive explanation. I cash this out with a case study. Nerve signals are autonomous from the individual ionic motions across the neuronal membrane. In order to explain the autonomy of the nerve signal, we ought to identify the structures at the lower level which give rise to the signal's autonomy. In this case we can do just that: the gated ion channels underwrite the autonomy of nerve signals.

**Noel Swanson (University of Delaware)**              Thursday, 12.00-13.00
*On the Ostrogradski Instability; or, Why Physics Really Uses Second Derivatives*
Candidates for fundamental physical laws rarely, if ever, employ higher than second time derivatives. In their 2014 paper, "Why Physics Uses Second Derivatives," Kenny Easwaran sketches an enticing story that purports to explain away this puzzling fact and thereby provides indirect evidence for a particular set of metaphysical theses used in the explanation.

I object to both the scope and coherence of Easwaran's account, before going on to defend an alternative, more metaphysically deflationary explanation: in interacting Lagrangian field theories, it is either impossible or very hard to incorporate higher than second time derivatives without rendering the vacuum state unstable. The so-called Ostrogradski instability represents a powerful constraint on the construction of new field theories and supplies a novel, largely overlooked example of non-causal explanation in physics.

**Isaac Wilhelm (Rutgers University)**                                    Saturday, 10.45-11.45

*The Ontology of Mechanisms*

I propose a metaphysical theory of mechanisms based on the notion of causation. In particular, I use causation to formulate existence, identity, and parthood conditions for mechanisms. These conditions provide a sound metaphysical basis for accounts of mechanistic explanation, mechanistic organization, and for more restrictive theories of mechanisms.

**David Schroeren (Princeton University)**                                Thursday, 10.45-11.45

*The Ontology of Symmetry Groups*

Modern physics employs a powerful explanatory strategy: important physical facts are explained in terms of symmetry groups. For example, the fact that quantum-mechanical spin is discrete is explained by the fact that the rotation group is compact. But these explanations leave something to be desired: they seem to explain physical facts in terms of facts about the mathematical language we use to describe physical reality. To obtain a physical explanation of facts such as spin's discreteness, we need to provide an account of the purely physical entities to which the relevant symmetry groups correspond. The goal of this paper is to do just that. I develop two competing ontological hypotheses about the ontological counterparts of symmetry groups in physics and compare their strengths and weaknesses.

**Justin Tiehen (University of Puget Sound)**                             Saturday, 15.45-16.45

*Perception as Controlled Hallucination*

"Perception is controlled hallucination," according to certain proponents of predictive processing accounts of vision. I say they are right that something like this is a consequence of their view but wrong in how they have developed the idea. In this paper I advance my own analysis. In the process, I argue that the causal theory of perception should be understood in terms of a productive concept of causation, as opposed to a difference-making concept. On my view, predictive processing accounts entail that various putative instances of successful perception are instead cases of veridical hallucination because they do not satisfy the causal condition on perception, understood productively.

**Alessandra Buccella (University of Pittsburgh)**                        Saturday, 14.30-15.30

*Perceptual Constancy is Dead, Long Live Perceptual Constancy!*

The proximal sensory stimuli perception relies on are unstable and variant. Yet, we experience a stable world, thanks to a capacity known as *perceptual constancy*. Constancy is traditionally defined as the capacity to 'extract' representations of the intrinsic properties of objects from the unstable and ambiguous flux of proximal sensory information. However, in the context of color constancy, Foster (2003) argues that the available empirical evidence does not support

the idea that the human visual system in fact has such a capacity. In this paper, I argue that we should change the definition of perceptual constancy and see it as the capacity to represent constant relations within the perceptual scene instead of representing objects' intrinsic properties. Changing our understanding of constancy has many advantages, including the possibility to account for instances of constancy (especially in non-visual modalities) that don't fit the traditional definition.

**Samuel Elgin (UC San Diego)**                     Friday, 12.00-13.00
*Physicalism and the Identity of Identity Theories*
It is often said that there are two varieties of identity theory. Type-identity theorists interpret physicalism as the claim that every property is identical to a physical property, while token-identity theorists interpret it as the claim that every particular is identical to a physical particular. The aim of this paper is to undermine the distinction between the two. Drawing on recent work connecting generalized identity to truth-maker semantics, I demonstrate that these interpretations are logically equivalent. I then argue that each has the resources to resolve problems facing the other.

**Nick Huggett (University of Illinois, Chicago)**                     Thursday, 17.00-18.00
*The Physics of Memory and the Asymmetry of Past and Present*
Much of the mystery of time arises from the apparent asymmetry between the open future and the settled past. In turn, much of the difference between open and settled lies in the knowledge asymmetry: that we know so much more, so much better, about the past than future. In Time and Chance David Albert proposes that the asymmetry arises because knowable particular matters of fact are just those made likely by physical law, given uniform probability over states compatible with the 'current surveyable condition' and an asymmetric 'Past Hypothesis'. This paper presents an 'Information Gathering and Utilizing System' as a model of memory, in order to better understand the physical nature of the asymmetry, and to argue that we can in fact know more than Albert's condition allows.

**Antonis Antoniou (University of Bristol)**                     Friday, 10.45-11.45
*A Pragmatic Approach to the Ontology of Scientific Models*
Scientific models are often understood as abstract entities and an ongoing problem in the relevant literature has been to understand the exact nature of these entities, that is, their ontology. This challenge can be summarised in the question: [Q]: What are models? The ongoing reflection on the ontology of models has, unsurprisingly, led to a host of difficult and well-known metaphysical problems. The primary goal of this paper is to show that these ostensibly insurmountable difficulties stem from a false reading of [Q] as a metaphysical question and thus they should not be taken as genuine problems. Building on Carnap (1950) it is argued that [Q] is either (i) an internal theoretical question within an already accepted linguistic framework or (ii) an external practical question regarding the choice of the most appropriate form of language in order to describe and explain the practice of scientific modelling.

**Nihel Jhou (National Taiwan University)**       Saturday, 14.30-15.30
**Peter Lewis (Dartmouth College)**
*Presentness Indeterminatism*

Special relativity is often taken to rule out a workable notion of presentness. A form of presentness worthy of the name is usually thought to require the non-relative co-presentness of space-like separated events, and this requirement further implies the non-relative simultaneity of these events. Since special relativity is thought to rule out any global, non-relative simultaneity, presentness appears to be inconsistent with special relativity. However, recent work on metaphysical indeterminacy opens up a space for the reconciliation of presentness with special relativity. We propose the thesis that there is no determinate but only indeterminate co-presentness between space-like separated events, and defend the resulting account of presentness as both consistent with special relativity and adequate to the special nature of the present.

**Thomas Pashby (University of Chicago)**       Thursday, 17.00-18.00
*Quantum Non-Locality, Counterfactuals and Possible Worlds*

This paper looks at the use of counterfactual analysis to understand quantum non-locality. In some respects, my conclusion is pessimistic: I show that a recent proposal by Bigaj (2010) to derive a conflict between quantum mechanics, locality and realism is majorly flawed. In response, I propose a modified counterfactual locality condition BLOC, inspired by Mermin's Strong Baseball Principle. Overall, my conclusion is that it is better to focus attention on the possible world semantics underlying these conditions rather than the syntactic proofs that were the focus of Stapp (1997), Shimony and Stein (2003) and Bigaj (2010). Nonetheless, I contend that Einstein's argument from his Separability principle to the incompleteness of quantum mechanics assumes BLOC and that denying Separability (and its supposition of "real states") allows us to maintain BLOC along with the completeness of quantum mechanics.

**Stuart Glennan (Butler University)**
**Carl Craver (Washington University, St. Louis)**       Saturday, 9.30-10.30
*Rethinking Mechanistic Constitution*

Mechanistic constitution is the relation between a mechanism and its working parts. In this paper we argue that confusion about the nature of this relation has been exacerbated by a failure to attend to two distinctions. The first distinction is between the methods we use to establish constitutive relevance and the nature of the constitution relation itself. We show that the problems authors have found in Craver's mutual manipulability account of mechanistic constitution arise from trying to use an epistemic criterion as the foundation of an ontological account. The second distinction is between two kinds of mechanisms – mechanistic processes and acting entity mechanisms. We show that an ontological account of constitution must attend to the fact that what it is to be a working part of a mechanistic process and what it is to be a part of an acting entity mechanism are not the same.

**Benjamin Neeser (University of Geneva)**       Friday, 14.30-15.30
*Stages in Spacetime: The Languages of Persistence*

There is a view in the metaphysics of ordinary objects according to which they are time-bound stages. This view is in immediate tension with the claim that they persist. In this paper,

I consider various construals of this view and the tension it generates, across different frameworks for developing persistence theories (temporally mereology, spatiotemporal location), in particular one which is taken to be compatible with relativity theory. I criticise all extent developments of this view as unable to avoid the absurd conclusion that ordinary objects do not persist. And I provide my own version of the view, which escapes the problem. Doing so, I suggest more generally a new framework to develop persistence theories.

**Joshua Norton (UC Irvine)**                                     Saturday, 12.00-13.00

*Suppressing Spacetime Emergence*

One of the primary tasks in building a quantum theory of gravity is discovering how to save spatiotemporal phenomena using a theory which, putatively, does not include spacetime. Some have taken this task a step further and argue for the actual emergence of spacetime from a non-spatiotemporal ontology. However, in many cases, the posited conditions for emergence are rather thin – too thin in fact to guarantee spacetime's emergence. In this paper, I argue against the account of spacetime emergence presented in Huggett and Wüthrich (2013) as well as the functionalism of Wüthrich and Lam (2018). Though this paper explicitly addresses spacetime emergence, many of the arguments or issues I consider are applicable to other accounts of emergence where objects are claimed to emerge in the ``low-energy regime".

**Lu Chen (University of Massachusetts, Amhrest)**                Friday, 14.30-15.30

*Toward A Metaphysics of Nilpotent Regions*

The idea that a circle is but a regular polygon with infinitely many sides has a long tradition. This idea was made rigorous by the theory of "smooth infinitesimal analysis" (SIA), alternatively known as "synthetic differential geometry," developed by Lawvere (1980) and others, which features nilpotent infinitesimals (numbers whose squares equal zero). SIA is an intriguing alternative framework for theories of continua, and can potentially shed new light on conceptual puzzles such as Zeno's paradoxes (Bell 2008, Reeder 2015). But to realize this potential, we face a significant obstacle: the axiomatic system of SIA uses intuitionistic logic, and there is no obvious way to interpret it classically (Hellman 2006). If this is true, then classical logicians are unable to take SIA as a realistic theory of space. However, contrary to common belief, I argue that we can interpret SIA as a theory of space in classical logic. To argue for this position, I advance a new understanding of the categorical models for SIA proposed by Moerdijk and Reyes (1991).

**Mark Couch (Seton Hall University)**                            Thursday, 10.45-11.45

*Woodward on Nomological Sufficiency Accounts of Higher-Level Causation*

One of the persistent concerns in the philosophy of science are claims about higher-level causation. Despite scientists appeals to these claims, a number of concerns have been raised with how to understand them. One issue concerns understanding the notion of "higher levels" and how this should be characterized. Another issue has to do with how to understand the character of the causal regularities that are said to exist at higher levels. This paper will examine the answers to these issues recently given by Woodward (2008) and suggest an alternative approach. I will, first, consider Woodward's account of higher-level causation and his objections to nomological sufficiency accounts of higher-level causation. I will, then, explain why I think there are problems with his account and defend an alternative.

**Michael Miller (University of Toronto)** <span style="float:right">Thursday, 9.30-10.30</span>

*Worldly imprecision*

Many physical theories characterize their observables with unlimited precision. Non-fundamental theories do so needlessly: they are more precise than they need to be to capture the matters of fact about their observables. A natural expectation is that a truly fundamental theory would require unlimited precision in order to exhaustively capture all of the fundamental physical matters of fact. I argue against this expectation and I show that there could be a fundamental theory with limited precision.
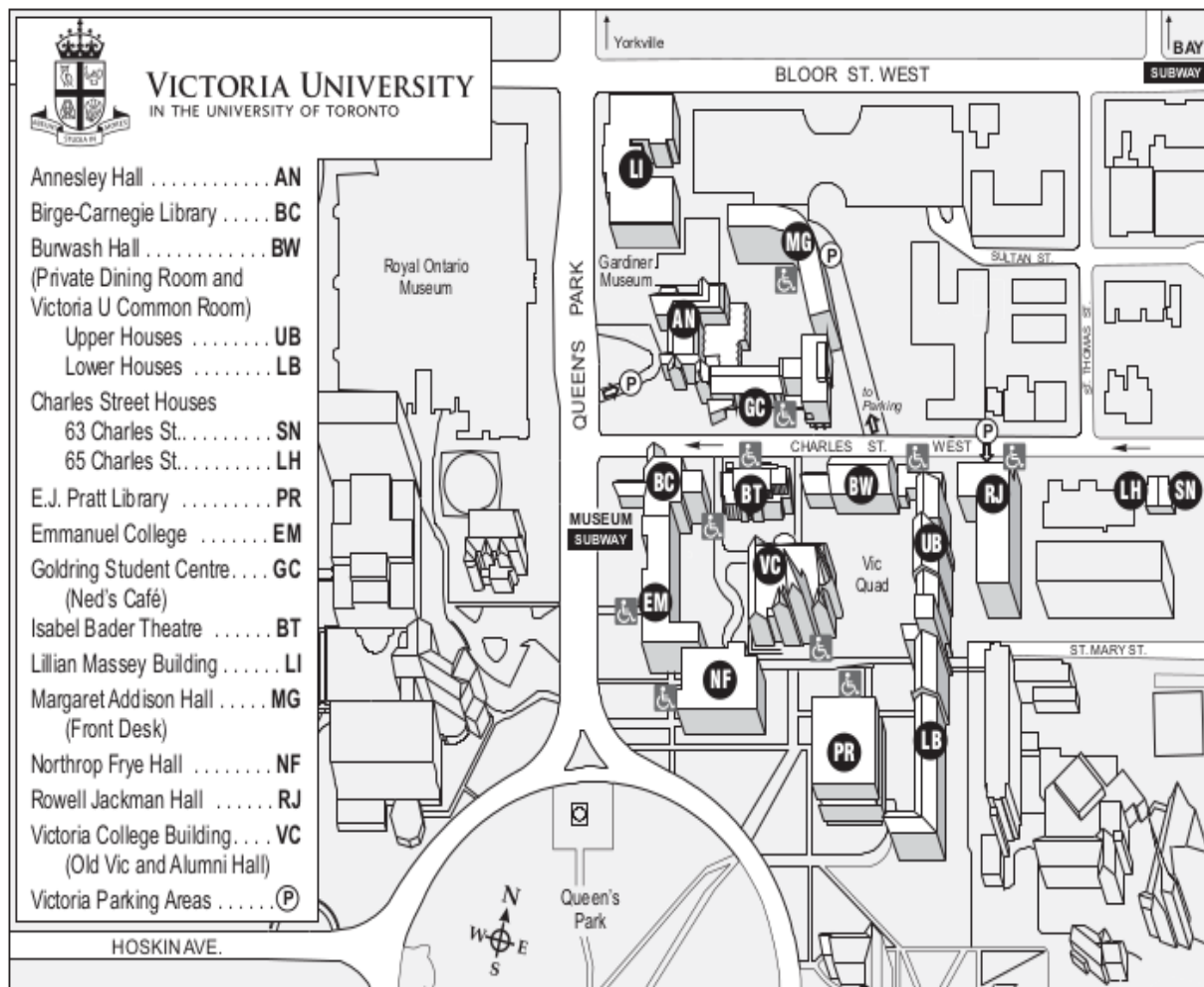
# PRACTICALITIES

- Please do not forget to return the lanyards to the reception desk at the end of the conference.

- Conference Venue:

  The conference will be held in the Victoria College building (VC), on the St. George campus of the University of Toronto.

  The street address for Victoria College, shown in the map below, is:

  91 Charles St West
  Toronto, ON M5S 2C7

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- Lunch and coffee near Victoria College:

  - Burwash Dining Hall
    On-campus dining hall, adjacent to VC. Offering an all you can eat lunch buffet including main entrée, soups, salads, pizzas and desserts for $15 (cash only).
    89 Charles St W (2 minute walk)

  - Aroma Espresso Bar
    Casual coffee shop with a variety of menu items for breakfast/lunch.
    1110 Bay St (4 minute walk)

  - Yorkville Village
    Shopping center containing a food court with a variety of options.
    55 Avenue Rd (10 minute walk)

  - Whole Foods Market
    Grocery store with a salad bar, hot food bar, bakery, sushi, pizza, and several other options for prepared food.
    87 Avenue Rd (10 minute walk)

  - Tokyo Sushi
    Local chain restaurant offering Japanese and Korean fare.
    33 St Joseph St (6 minute walk)

  - The Host Fine Indian Cuisine
    Traditional Indian cuisine featuring tandoori dishes.
    14 Prince Arthur Ave (9 minute walk)

  - Over Easy
    Classic breakfasts and lunch in a comfortable, bright location.
    208 Bloor St W (7 minute walk)

  - Sansotei Ramen
    Casual restaurant serving modern Japanese ramen dishes.
    650 Yonge St (8 minute walk)

  - Hero Certified Burgers
    Fast food hamburger restaurant
    987 Bay St (6 minute walk)

  - Mullins Irish Pub
    Traditional tavern serving classic pub fare.
    1033 Bay St (6 minute walk)

- Okonomi House Restaurant
    Japanese restaurant specializing in savoury pancakes.
    23 Charles St W (6 minute walk)

- Sorry Coffee Company
    Specialty coffee shop (located inside a Kit & Ace clothing store)
    102 Bloor St (5 minute walk)