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THIS UNIVERSE IS THE 'BEST' OF ALL POSSIBLE WORLDS[1]
A TENTATIVE RECONSTRUCTION OF THE METAPHYSICAL SYSTEM OF LEO APOSTEL

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ABSTRACT

After presenting Apostel's views on scientific realism, I present definitions of the concepts of ontology and metaphysics. I then proceed to develop Apostel's basic ontology and his metaphysics. Apostel proposed a particular understanding of existence based on his views on causation. He also developed a view of the universe as a causal self-explaining system. I discuss and illustrate three kinds of what he calls "metaphysical deductions" that aim to deliver such a view of the universe. The most important one is the Leibnizian variational method, that should allow us to deduce the existing universe as the 'best' of all possible worlds.

1. Introduction

One can distinguish three kinds of metaphysics of science: (1) specialized subjects: the EPR-paradox in the foundations of quantum mechanics, propensity interpretations of probability theory, possible worlds realism, etc.; (2) the issue of scientific realism: do sciences describe the world and what kind of world do they describe?; (3) comprehensive and totalizing metaphysical hypotheses: materialism is an example of a metaphysical

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[1] The material in this paper was the subject of the first part of my doctoral dissertation. I thank Diderik Batens, Jean-Paul Vanbendegem, Erik Weber, Guido Vanackere and Ka Kit Wong for helpful discussions. They are not responsible for the content of this paper. Aside from Apostel's works, I draw mainly on sources from within the analytic (Anglo-saxon) tradition of philosophy.

hypothesis. Most work in analytical philosophy of science is done in the first and second category. During the eighties and nineties until his death in 1995 the Belgian logician and philosopher Leo Apostel was working on a comprehensive and totalizing metaphysical hypothesis. Although he realized his project only in bits and pieces, one can find interesting and engaging founding material for a comprehensive theory throughout his published and unpublished writings. My aim in this paper will be twofold: first, to provide and construct a general framework for metaphysical models, and secondly to elaborate this with parts of the "Apostelian" metaphysics.[2] Apostel writes that we should start in *medias res*, meaning that we should make tentative constructions while at the same time avoiding getting distracted by too much detail or epistemological and methodological worries.[3] I have written my paper in the spirit of this constructive-tentative "method".

I will now offer an overview of the rest of this article. Section 2 specifies Apostel's views on scientific realism. Section 3 is dedicated to a contemporary general conceptualization of ontology and metaphysics. Regional ontology is distinguished from basic ontology and both are distinguished from metaphysics. (Although sometimes I also use metaphysics to circumscribe the project of engaging in regional ontology, basic ontology and metaphysics as a whole). In this way I hope to obtain a framework for the construction of metaphysical systems. Section 4 discusses the concept of regional ontologies. I give some examples. Section 5 is about the notion of basic ontology. I discuss two basic ontologies: mechanicism and Apostel's basic ontology. Section 6 deals with Apostel's metaphysical hypothesis about the world as a whole. The basic idea of the metaphysical hypothesis presented in this paper is a refusal of contingency, drawing on Leibniz theory that we live in the 'best' of all possible worlds.

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[2] My paper is meant as a companion to Apostel 1995. Here Apostel presented a definitive version of the metaphysics that he was working on. In Apostel 1995 symmetry and the breaking of symmetry play a central role. I make no reference to symmetry and symmetrybreaking, because that would encumber the exposition of the main ideas in this paper.

[3] For a discussion of the methodology of world-view construction see The Worldviews Group 1994, Batens and Christiaens 1999 and Weber and Christiaens 1999.

2. Apostel's scientific realism

Many philosophers are convinced that metaphysics is determined by our scientific theories. Actually metaphysics is underdetermined by science.[4] If one nevertheless believes that science determines metaphysics, then the philosopher's role is reduced to investigating reference, truth, objectivity etc. with respect to scientific theories. Philosophers, in other words, discuss the nature and possibility of scientific realism (this is metaphysics of the second kind). Apostel discusses his view on realism explicitly and at length in two works: (a) in the second volume of Apostel 1974, (b) in the first volume of Apostel 1980b.

(a) According to Apostel, realism is the best possible of empirical hypothesises for a theory of knowledge. The empirical 'data' justifying it is the enormous success of the sciences. This is a standard argument.[5]

(b) Apostel believes in a correspondence theory of truth:[6] a theory, model or statement is true when it corresponds to reality. But a theory, model or statement is also meaningful, it leads to empirical predictions, .. How does truth relate to these aspects? The following statements define scientific realism:

(i) The truth conditions of assertions about the world are not the conditions of *meaningfulness* for these assertions. Assertions are meaningful if they are used for communication and representation by certain individuals and groups. Assertions are true when they correspond to reality. The truth conditions refer to a relation between the content of a theory and the world, the second kind of conditions refer to a relation between the knower and an assertion/theory/model. When one is engaged in diffusing a bomb, mentioning the theory of genetics is not meaningful.

(ii) The conditions under which a proposition is true are different from the conditions under which a proposition is *known* to be true. This is again because the truth conditions of the proposition are relations between the content of a theory and reality, while the second kind of conditions

[4] See for example the paper by Steven French in this volume.

[5] For a contemporary discussion about this argument see for example the papers on realism in Boyd, Gasper and Trout 1991

[6] This is probably the most important statement of realism in the work of Apostel. He is inspired by the paper 'Systematic realism', written by C. A. Hooker (Hooker 1987).

are relations between knower and assertion/theory/model. In the Middle Ages the theory about genes was not known, but that does not detract from the truth or falsity of the content of the theory, whether now or during the Middle Ages. Without specific instruments and without a particular background of previously developed theories, one cannot know genetics. The conditions for knowing about genetics were not met.
(iii) The conditions that make a theory empirical, do not necessarily coincide with the conditions under which a theory is true. From the meaning of a statement we can derive how a specific observer would see the world. A theory, model or statement can however not be reduced to the *observations* that verify it or that can be derived from it.
(iv) The *conditions for accepting a theory as true* are distinct from the truth conditions of that theory. In some cases the reason for accepting a theory as true may be its empirical success. In other cases it may be its unifying power. In still other cases epistemic values other than observation or unification may play a decisive role. The theory is not true, however, because it is empirically successful, unificatory, etc. It is true because it actually says what the world is like.
If I am a realist, I believe (the) truth is out there and I believe I can know (the) truth. I can never know, however, that I know (the) truth, i.e. I can never be sure that what I believe is true, because truth is not tied with any conceptual necessity to any human construct or capacity. In some cases though, it is possible that truth reduces to observability, meaningfulness, rational acceptability, etc.

In saying that truth is correspondence to reality, this is not meant to imply that reality should be construed in a narrow positivistic or mechanistic sense. This will become clear in subsection 5.3. Here I offer two indications of this "wider" view on reality. In chapter three of the first volume of Apostel 1974 actual entities are described as surrounded by a "cloud" of physically attainable possible world. These possible worlds are the potentialities and capacities of the entity. In another publication Apostel subscribes to pansomatism.[7]

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[7] See Apostel 1972b, p. 210.

3. Regional ontology, basic ontology and metaphysics

The terms ontology and metaphysics have different meanings for different philosophers. I will define them in this section. To do this we will have a look at the kind of questions we are trying to answer:

- What is there?
- What is being or existence?
- Why is reality the way it is?
- Why is there something and not nothing?

Depending on which question is being answered I distinguish: (1) regional ontology or domain-dependent theory of being, (2) basic ontology or domain-independent theory of being and (3) metaphysics or world-view.

(1) *Regional ontologies* answer the first question: "what is there?" for specific domains. They also say what being means in that domain (the second question). For example, in some domains a psychological theoretical entity like the ego is real (in practical situations, in psychological study, in therapy, etc.), but in other situations there is no reason to suppose the existence of an ego, only the workings of materialistic entities called neurons.[8] Thus every regional ontology contains at least two things: (1) a "definition"[9] of being that functions as a criterion of existence; (2) existents: the entities that exist according to the existence criteria.

(2) A *basic ontology* does *not* tell us immediately what the fundamental entities are. Neither does it say what kinds of entities exist. One can easily find this out prima facie by inspecting regional ontologies. A basic ontology gives a meaning to being or existence that is domain independent. Through this criterion of existence we can look at the many regional ontologies and reduce some of the multitude, i.e. decide what

[8] The mechanistic criteria of existence can be made explicit (see section 5). This is not so easy with psychological entities and properties. In principle, however, it should be possible to develop an explicit regional ontology for every domain of reality.

[9] I saying, to be is to be spatio-temporal, I already use existence in the definition, so that in a strict sense this is not really a definition.

really exists and what does not exist. For example, in the mechanistic-materialistic world-view the regions where there is an ego will be reduced, but neural activity is not reduced because it exists according to the existence criterion. So it is through the intermediary stage of the definition of existence and the application of a context-independent existence criterion to regional ontologies (and to the universe as a totality), that we decide which things to accept as existents and which things are non-beings.[10]

(3) A *metaphysical theory* answers the last two questions. It is a possible belief-disbelief system about the observable and the (as yet) unobservable to the extent that it describes totality of everything that exists with respect to its being-thus and being-there.[11] If the universe is an existent, then it is subject to the existence criterion of the basic ontology. Some important properties of totality (the general nature and structure of reality) are derived from the fact that it is subject to the existence criterion of the basic ontology. Regional ontologies are integrated in totality.[12]

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[10] Of course no metaphysical theory is complete without a theory of non-existence (a noneism). Although Apostel stressed this point, he did not explicitly develop a noneism. For noneism see Routley 1980.

[11] I use the words totality, universe, world-whole as synonyms. I also use existents and beings as synonyms.

[12] The "as yet unobservable" is there in the definition of metaphysics, because we have to be careful about positing something as unobservable. Electro-magnetic forces, atoms, phlogiston, ... were all unobservable at some time or other. Some of them are still unobservable (forces), some have become observable (molecules, atoms), and some turned out to be inexistent (phlogiston). Among the things that are not observable we can distinguish between things that will always be speculative (I cannot imagine we will ever observe God's presence with scientific instruments, even if he existed) and things that are not strictly observable, but are nevertheless pretty much scientifically accepted. Electro-magnetic fields for example, are not observable in a strict sense (one cannot observe a force field only its effects), but we do not attempt to describe them in mechanical terms, as the founder of this science attempted. Electro-magnetic forces are part of a regional ontology that has its own integrity. Criteria of observability are partly invariant with respect to context, partly dependent on what is observed. Although the so-called theory-dependency of observability is traditionally an anti-realist argument, I see no reason for this. Observation is a practical skill that is partly developed by interaction with the phenomena and objects that one wants to observe. It is an interactionist notion. The anti-realist argument is explicitly or implicitly committed to a foundational view of knowledge (i.e. the view that knowledge should be founded on a formal-procedural, socio-historically

4. Regional ontology

The contexts in which we move can be very different, generating disparate ontologies. Take a catholic physicist: on the one hand he believes in God, heaven and the angels, on the other hand he believes in a physical universe obeying physical laws. Or consider a neurologist in love. A typical neurologist will not accept the existence of a referent for poetic feelings beyond neurological activity, because of his materialistic-physicalistic ontological beliefs. But while he is in love, that is, when he is wooing her, seducing her, loving her ... , he *will* accept love as a psychic phenomenon, and (as anyone knows who has been in love) will also accept the existence of all kinds of "magical" coincidences. Even though these examples are somewhat of a caricature, they do show how easy it is to generate regional ontologies (although it is less easy to describe them). Sitting at my table I have an ontology of things with properties. Going down a river in a small boat, gaining speed, I will have an ontology of almost pure processes.

One can find several instances in contemporary analytical philosophy where regional ontologies exist next to each other. I describe one of them briefly. Two important specialized domains in the philosophy of science are the philosophy of quantum mechanics and the philosophy of space and time. The so-called paradoxes of quantum mechanics (in particular the Einstein-Podolsky-Rosen paradox and the measurement problem) seem to indicate that some components of the mechanistic basic ontology/world-view (see sections 5.2, 6.1 and 6.3) must be wrong in the quantum domain: quantum entities exhibit non-local and indeterministic behavior and are at times indeterminate with respect to their position properties. In current philosophy of science philosophy of space and time is the study of space-times of relativity theory. Space-time theories corroborate most of the principles of the mechanistic world-view (spatio-temporality, locality, determinism, etc.). In space-time reality, the central existence criterion is being part of space-time. In quantum mechanics the spatial existence of quantum entities is not so clear. Some have speculated that maybe quantum entities do not exist in space-time the way other physical entities do, and some think that quantum entities just do not exist in space

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and contextually invariant notion of observation).

at all.[13] The least one can say is that the two most fundamental theories of physics have different regional ontologies!

A further argument for the prima facie plausibility of a pluralism of regional ontologies derives from the fact that physicalistic reductionism is much more of a conundrum than anyone could have expected. Prima facie reductionism seems quite plausible. Take water for example. Water is a fluid with typical macroscopic properties. During the 19th century we found that water is composed of molecules. It is tempting to reduce water to its components. In fact the reduction of secondary properties to the scientific ontology has been the project of modernity, but has had only limited success. Of course it has had some (rather impressive) successes and maybe complete reduction will be possible in the future. Because the idea of a generalized global reduction is not a natural and certainly not a necessary consequence of the limited number of succesfull reductions, it is best looked upon as a metaphysics, hence as one possible metaphysical hypothesis among a host of alternatives. Physicalistic reductionism comprises a basic ontology (see section 5.2), a metaphysical hypothesis (see sections 6.1 and 6.3); in this context reductions of regional ontologies are carried out: for example the reduction of the phenomena of the macroscopic properties of water to microscopic mechanicistic properties.[14]

5. Basic ontology

In 5.1 I look at ways of obtaining a basic ontology and at kinds of existence criteria. In 5.2 I look at a influential basic ontology of our culture: mechanicism. In 5.3 I present Apostel's basic ontology.

5.1 The general idea

Regional ontologies are derived from the sciences and other human

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[13] See Aerts 1998 and Aerts 1995.

[14] See Boyd, Gasper and Trout 1991 for some classic papers and contemporary views. See also Gallison and Stump 1996 and Dupré 1993 for rather stronger anti-reductionist claims in analytical philosophy than the one formulated in the text.

practices. There are at least two ways of obtaining a basic ontology:
(a) Select one *preferred* regional ontology. Frequently people view the world through the ideas and habits of the practice with which they are most familiar. One might, for example, select the regional ontology of a successful theory. This is exactly what happened in the case of mechanicism: the regional ontology of Newtonian physics was selected as basic ontology.
(b) Selecting the existence criterion (or criteria) that is relatively *invariant* throughout regional ontologies. The latter method is more objecte than the first. From the invariant characteristics obtained by using the variational method one can look for a basic ontology. Many people seem to think that systems theory is such a basic ontology, because the notion of a system (a set of elements with relations between them and relations with the environment) is something that returns in every context.

The meaning that is given to existence in a basic ontology is regarded as the meaning of being in general and thus as the criterion of existence. A criterion of existence allows us to reduce some of the excessive richness of the multitude of regional ontologies. Of course one might say that everything exists. This too is an existence criterion. Any sensible philosopher will try out several basic ontologies and have several basic ontologies at the same time. It is interesting to see, however, how far one gets with a particular existence criterion. There can be more than one criterion of existence if there is more than one meaning given to existence in the ontology. Sartre, for example, distinguishes three kinds of being in his *L'être et le néant*: en-soi, pour-soi and pour-autrui.

To give one an idea of other possible existence criteria Apostel lists groups of criteria for existence:[15]
(a) *Spatio-temporal* criteria and their variants: something exists if it occupies a certain space at a certain time and has spatio-temporal relations with other existents. This is probably the most widespread existence criterion.
(b) *Holistic* criteria, other than spatio-temporal ones (the latter claims that to exist is to be part of space-time). Holistic criteria try to typify existence in terms of a totality: something exists if it is a whole, is part

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[15] See Routley 1980 (chapter 9) and Apostel 1989a (p. 211). I have modified them slightly.

of a whole, or has wholes as parts. As we will see Apostel supposes that only entities that are systems can really exist.
(c) *Relational* criteria other than spatio-temporal relations: being engaged in causal relations with other existents. This could be combined with a relational theory of spatio-temporality.
(d) *Completeness* or *determinacy* criteria: something exists if it is completely determined in some way or other in all its possible "dimensions". In a physical context this means that a variable always has a sharp value (and this condition is usually called determinateness). In quantum mechanics this condition is violated.
(e) ....
I discuss two examples of basic ontologies in more detail: mechanistic basic ontology and Apostel's basic ontology.

5.2 Example: a mechanistic-materialistic basic ontology

A mechanistic basic ontology would probably contain some or all of the following ideas:
(a) *Nomologism*: the behavior (the being-thus) of any entity can be explained by reference to abstract theoretical laws;
(b) *Determinateness*: entities exist in states and these states are defined by variables and all variables have definite values expressed by real numbers;
(c) *Spatio-temporality*: there is a space-time and everything that exists, exists in space-time;
(d) *Locality*: one cannot influence something across a space-time gap without going the space-time distance across the gap, i.e. there is no action-at-a-distance;
(e) *Mathematical realism*: physical reality is mathematical in nature;
(f) *Determinism*: if the state of a system is determined at one time, then all future and past states of the system are determined.
Probably more principles can be found,[16] also some of the principles above can be formulated in other ways, and in all likeliness not every philosopher or scientist adhering to materialism-physicalism will select all of these principles (although I suspect that either Spatio-temporality or the

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[16] For example the fact that all relations should be external relations.

combination of Determinateness and Nomologism is *the* defining characteristic of mechanism and is selected by all mechanicists). All of these principles derive from one regional ontology, namely the ontology of classical (Newtonian) physics (although initially this ontology contained action-at-a-distance).

According to the mechanistic basic ontology, something exists if it behaves in a lawful manner *and* has definite properties *and* is spatio-temporal *and* cannot exert causal actions at a distance *and* is mathematical in nature *and* behaves perfectly deterministic. Several of these existence criteria and combinations of them lead to problems. An example. When we combine Determinateness and Nomologism we get the familiar idea of *covering laws*. The idea is that there should be a fundamental law of physics for every physical happening in nature. The paradigmatic examples are of course Newton's laws, in particular his laws of motion. If we have an initial state ($\mathbf{r}_0$, $\mathbf{v}_0$) of an entity, and we obtain the formulas $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t + \frac{1}{2}\,\mathbf{a}t^2$ and $\mathbf{v} = \mathbf{v}_0 + \mathbf{a}t$ from Newton's force law, then the behavior of the entity is completely determined (t is time, $\mathbf{r}_0$ is the initial position, $\mathbf{v}_0$ is initial velocity). In general the idea of covering laws implies that for every physical entity there is a set of possible states (where every state has determinate values for the relevant physical variables) and a law that determines the changes of state. There have been quite a number of philosophers with fundamental reservations against this view,[17] the main one being: "Such a thesis needs some reason for believing it!" (Anscombe). This covering aspect of fundamental laws is only true either in an abstract theoretical model or under especially designed experimental conditions. These laws do not describe what actually happens in concrete reality; instead we have either phenomenological laws or no laws at all. The fundamental laws are only true *ceteris paribus*: they are true "all things being equal", that is if no "disturbing influences" manifest themselves. This leads to a pessimistic meta-induction on the covering capacity of the laws of science. In the next subsection we will see that Apostel rejects the idea of covering laws.

Another important criticism is directed at Determinateness. In quantum mechanics, because of the superposition principle, an entity can be in a state that does not have sharp values for all its variables. Quantum

[17] Cartwright 1983 is a classic.

mechanics also contradicts Locality (although a lot depends on the interpretation of experimental results) (see Redhead 1987, Aerts 1995 and Aerts 1998 and further references there).

5.3 Example: Apostel's basic ontology of causation and systemism

> ...I suggest that anything has real being that is so constituted as to possess any sort of power either to affect anything else or to be affected, in however small a degree, by the most insignificant agent, though it be only once. I am proposing as a mark to distinguish real things that they are nothing but power." (From Plato's *The Sophist*[18])

Apostel's underlying intuitions are distinctly different from the mechanicistic ones.[19] On the one hand Apostel is a materialist or physicalist in the following sense: the regional ontologies that carry most weight are scientific ontologies, especially the ones from physics; furthermore the level of reality described by physics (one regional ontology) is the fundamental level of reality from which all others emerge.[20] His main motivation is that a basic ontology (and the metaphysical hypothesis that is conjoined to it) should not be based on the analysis of what is given to this particular subsystem (man), because man has no intrinsic ontological privilege. On the other hand his existence criterion is not derived from physics or any other science, but, surprisingly, from the life world: his basic ontology is based on a typical feature of man.[21]. So there is a substantial tension here.

If we look at the criteria of existence from subsection 5.1 we see that Apostel's basic ontology contains holistic criteria and relational criteria: everything that exists is (i) a system and (ii) a causal nexus.[22] Let us

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[18] Quoted in Apostel 1989a.

[19] The synthesis I present is for the most part based on remarks in Apostel 1989a and Apostel 1995.

[20] He rejects mechanism, because he does not believe in the existence of covering laws.

[21] He has spent a lot of time and effort on the development of a formal praxiology, in fact an attempt at an exact description of the life world. See Apostel 1976.

[22] The concept "causal nexus" was introduced by me. I think it expresses better the essence of what Apostel was trying to say.

take a closer look at both aspects:
(i) *Causality*. A causal nexus of an entity is (a) the causal history of the entity, (b) the present causal processes it is engaged in, (c) the causal processes that constitute it, etc. One may also think of these causal systems as "forceful objects" or "powerful particulars" (Harré and Madden 1975). We will see presently that the causal relation is described analogously with the structure and nature of human action, and for this reason Apostel refers to his concept of causality as *actomorphic*.[23]
(ii) *Systemism*. An existent is always a system, which means that it is characterized by a minimal degree of self-organization, and that is also why an existing entity is a *quasi-organism*. A system is a collection of constituents (a) between which there exist relatively invariant relations (the structure of the entity), (b) that exists in an environment, (c) that possesses properties that do not supervene on the properties of the constituents.[24] The three characteristics are essential. A system will generally be characterized by more than one structure. Take a macroscopic spherical massive object. Because it is a classical physical entity a Boolean lattice of properties characterizes it. If it is a perfect sphere it is also characterized by a group of transformations that leave it invariant: rotations around any straight line through the origin, and every reflection along any plane through the origin. In Apostel's basic ontology the entity *is* these two structures, there is nothing underlying it, except possibly more structures. A system can be relatively closed and mechanical, or open and far from equilibrium. In principle it should be possible to consider all real entities (physical, biological but also psychological and social entities) as special cases of causal systems. No reduction necessary or implied in this claim: although the physical world is the basic level of reality (of totality), being is not defined according to mechanistic principles.

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[23] The neologism actomorphic is introduced in Apostel 1974 (first volume, p. 170), quasi-organism is used in Apostel 1992.

[24] See Bunge 1979 for a metaphysical systems theory that can be used in this framework. An ontology of systems defined as structures finds support in recent views on physical theories, where it is shown that theories refer to structural characteristic of the world and entities in the world: see Castellani 1998 for recent structuralist views on the entity in physics and see Ladyman 1998, French 1999 (and the contributions by French and Ladyman in this volume) for structural realism. See also Apostel 1980a.

Hence to be is to be an *actomorphic quasi-organism* or *causal system*.[25] Both concepts are important, but I will give most attention to causation. Before analyzing the actomorphic causality in more detail, I will take a closer look at the interdependence of causation and systemism. An entity can only be object and subject of causal relations if it has a minimal structure and unity. The causal relation - itself a particular structure, existing between systems and transmitting structure(s) - can only exist "inside" a system. In other words it can only exist against a background of structures. At the same time structure is invariance under specific transformations (and transformations are causal relations). A system has a certain structure thanks to the fact that it stays invariant under causal influences. The components of a system form an indivisible whole because there are stable causal interactions between these subsystems. The duality of system and causal nexus means that the systemic aspect and the causal aspect cannot be separated *in reality*. They can only be separated conceptually.[26]

In contemporary philosophy of science several proposals for a theory of causality exist.[27] I will not go into any of these theories here. Apostel developed his own theory of causality in his 1974 (volume 1). Because it is not well known, because it plays an important role in his metaphysical theory (see Apostel 1989a, Apostel 1989b, Apostel 1995 and the present paper) and because it is quite atypical for analytical philosophy of science, I will explain the main ideas.

Apostel's theory of causality is in the first place a theory about causal relations. Causal relations are specific causal facts. That this pen falls under the influence of the force of gravity generated by this particular planet at this moment in time, is a causal relation: the happening has purely contextual and unique aspects to it. The mathematical relationship known as Newton's law of gravity, is a causal law because it lacks specificity and can be instantiated by many different entities. Remember

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[25] His terminology is confusing (organized whole, organic whole, system, concretum, individual, ...) because he develops the same ideas in different theoretical schemes.

[26] One can make causal systems the truth-makers of universals, laws, essential natures, properties and many other concepts.

[27] Just consult the writings of John Mackey, Mario Bunge, David Lewis, Wesley Salmon, Wolfgang Spohn, Michael Tooley, Rom Harré, E. Madden, Erik Weber and many others.

the idea of covering laws in the previous subsection. How are laws and relations related to each other? There are at least four alternatives (see Tooley 1990, pp. 173-174):

(1) Weak reductionism with respect to causal laws: any two worlds that agree with respect to all the causal and non-causal properties of, and relations between, particular events, will also agree with respect to the causal laws;

(2) Strong reductionism with respect to causal laws: any two worlds that agree with respect to all non-causal properties of, and relations between, particular events, will also agree with respect to the causal laws;

(3) Weak reductionism with respect to causal relations: any two worlds that agree with respect to all non-causal properties of, and relations between, particular events, and with respect to all the causal laws, will also agree with respect to the causal relations;

(4) Strong reductionism with respect to causal relations: any two worlds that agree with respect to all non-causal properties of, and relations between, particular events, will also agree with respect to the causal relations.

In the example I gave (gravitation), the causal relation supervenes on a causal law and non-causal facts. Apostel chooses (1). He is definitely opposed to (3) and (4). A causal relation is a unique and irreversible process. To the extent that a causal relation becomes context-independent, repeatable and reversible, it appears as a causal law.

There is an actomorphic structure that is relatively invariant in characterizing something as a causal relation. Can we say more about this structure? Apostel analyzes human action. When looking at an action we find the following elements: actors, means or instruments, materials, goals, results.[28] According to Apostel a similar structural relationship can be found among the conditions and factors in a causal relation and this is one of the defining characteristics of a causal relation. But in the causal relation only the "actors", "means", "materials" and "results" can be found; there is no goal directedness. One might say they form a *hierarchic* structure of determinations, something well put in the following quotations (although the authors of these quotations would probably not agree with Apostel's causality concept):

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[28] See p. 203 of Apostel 1976 and pp. 168-170 of Apostel 1974 (volume 1).

> all causation is reducible to the action of forces or to some complex processes involving the action of forces. Basic causation is a structural universal the constituents of which are forces. (Bigelow and Pargetter 1990, p. 264)
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> ... the standard exemplars of causal processes are not elementary. Typically, they involve a great many micro level processes, occurring in a kind of avalanche ... the causation is direct, and involves the cumulative effect of many different causal actions. (Ellis 2000, p. 347)

The production causality or actomorphic relation can be defined as follows: *a hierarchically structured avalanche of acting forces*.[29]

I will now present a schematic representation of the causal relation and its properties.[30] The letters *p*, *q*, *r*, *s* symbolize systems or wholes. The arrow → symbolizes causal production.

I will summarize the material from Apostel 1974 (volume 1) in 16 principles.

(1) There can be more than one causal agent:

(2) There can be more than one entity figuring as material:

(3) There can be more than one result:

(4) There can be more than one structure transmitted:

(5) There can be more than one entity figuring as means:

(6) Any system will be the material for more than one causal agent, and will change accordingly: q, q', q'', q''', ...

(7) There are always causal agents that leave a system *invariant*. For any system *p* there is at least one causal system that has an effect on *p*, at least one causal system under which it stays invariant and at least one system that is the material for *p* as causal agent.

(8) Disjunctions are not allowed in the antecedent of a causal relation. They are allowed in the consequent however, expressing bifurcation. Real

[29] If one wants to stress the dynamic aspects even more, one might say: a hierarchically structuring alavalanche of acting forces.

[30] The schematic representation is inspired by the different proposals in the first volume of Apostel 1974. It is nowhere to be found in his published or unpublished wirtings as such. Not everything can be expressed in this language, but it is meant as a framework for the development of the basic ontology. See also Batens and Burghraeve 1978.

possibility belongs to basic ontology.[31]

(9) Reflexivity fails as a general property for causal production. Although Apostel should allow one instance of complete auto-production however (see section 6.1).

(10) The same is true for transitivity: when $p \to q$ and $q \to r$ then it is not always the case that $p \to r$. q screens off p from r. There may be a causal relation that combines $p \to q$ and $q \to r$. When it is the case that $p \to q$, $q \to r$ and $p \to$r then we have overdetermination: both p and q exert a force on r, while p also exerts a force on q.

(11) As a general property contra-position fails. From $p \to q$ it does not follow that $\neg q \to \neg p$. Suppose World War I was caused by the murder of prince Ferdinand. The fact that World War I did not occur does not cause that prince Ferdinand was not murdered.

(12) Symmetry is violated, except maybe in derived cases. Causal relations are irreversible most of the time.

(13) Every thing event, process or system has a cause and has an effect. There is causal determinism (everything has a cause) but not nomological determinism (this causal determination is not subsumable under a law).

(14) There is no first cause and no final effect.

(15) A causal relation with a negative antecedent is an abbreviation for a causal relation with a positive antecedent. But an event, process or system can cause an absence.

(16) The theory of causality and systems theory should be combined. One can introduce subsystems by defining a part off relation. I refer the reader to Apostel 1989a and Apostel 1976.

There is no deeper level of causal laws. This point cannot be stressed enough if one wants to understand Apostel's endeavors. The reality described with the actomorphic relations *is* basic reality. Causal physical laws are causal relations that are invariant or structural properties of the world or parts of the world.

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[31] There are different kinds of real possibility. In physics the bifurcations of a chaotic dynamic system in macroscopic reality are different from the bifurcations just before the collapse of the wavefunction in quantum mechanics. Disjunction will not be truth-functional, but more like the disjunction of quantum logic.

6. Apostel's metaphysical hypothesis

In 6.1 I apply the basic ontology of causal systems to totality. The application of the basic ontology to totality is only a first step. It has to be supplemented with the integration of the regional ontologies into the world-whole. Apostel talks about *metaphysical "deductions"*. I have found three kinds of so-called metaphysical deductions in his papers:
(1) Deductions of regional ontologies from general metaphysical principles.
(2) Transcendental arguments of the realistic kind.
(3) The variational method applied to regions of reality and to totality.
I discuss the first kind in 6.2, the second kind in 6.3 and the third kind in 6.4. I will give the examples mentioned by Apostel to illustrate each kind of metaphysical deduction. Most of them are derived from physics and are sketchy at best. A major task for the future is to write them out in more detail. The distinction between the three kinds of metaphysical deduction is based on Apostel's work, but is not to be found like this in his own work.

6.1 Basic ontology and totality

People have always had a tendency to conceptualize the universe following the science and technology of their time. When watches were invented, the universe was conceptualized as a watch (and God as a watchmaker). When steam engines and thermodynamics became popular, we could not wait to apply all of this to the universe. Now a lot of people see the universe as a computer. During pre-scientific times and afterwards, some thought of the world-whole as an organism. And of course there is the alternative that the universe is a mental entity (the Hegelian *Geist* for example). All of these options are legitimate metaphysical hypotheses and should be developed in a systematic way, so that discussion on the basis of comparisons between alternative world-views becomes possible, and less has to be accepted on the basis of blind faith and sloppy intuition.[32]

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[32] This is not to say that all faith and all intuition are bad. Every metaphysics is based on some kind of faith and intuition.

According to the view defended here, the universe is not a machine, a computer, an organism, a conscious entity or a mental entity. But it has some of the characteristics that are invariant between *Geist*, organism, computer and mechanical entity. An important step in the construction of a metaphysics is the application of the basic ontology to the universe. If the universe is an existent it must be a causal-system/actomorphic-quasi-organism. It will exhibit all the typical features of a system, including an elementary form of self-organization, without showing signs of being conscious or alive. Also, most of the 16 principles of causality apply to the world-whole. This means that the universe has no beginning and no end (since there is no first cause and no final effect). If there is a God that created everything else, then the world-whole is the sum of God and everything he created. In other words, God is part of totality. Either God created himself or he was created by something (somebody?) else. Because nothing in the universe explains itself, and to avoid an infinite regress of explanations, a God that created the universe is not allowed by the application of the basic ontology to the world-whole. However, there is one principle of causality that is not applicable to totality: the causal process constituting totality is not irreflexive. This means that the universe as a whole – i.e. as a *concrete, unique, individual* causal process - explains itself. We can situate the auto-explanation in totality qua totality itself. The application of systemism and production-causality to the universe as a whole is a major point of Apostel's metaphysics.[33]

6.2 The deduction of regional ontologies from general metaphysical principles

Feynman writes:

> What it means really to understand an equation – that is, in more than a strictly mathematical sense – was described by Dirac. He said: "I understand what an equation means if I have a way of figuring out characteristics of its solution, without actually solving it." So if we have a way of knowing what should happen in given circumstances without actually solving the equations, then we "understand" the

[33] As far as I know Apostel does not make the explicit link between auto-explanation of totality and his theory of causality with respect to reflexivity.

> equations, as applied to these circumstances. A physical understanding is a completely unmathematical, imprecise thing, but absolutely necessary for a physicist (Feynman et al., 1964, chapter 2).

In the same spirit the metaphysicist says:[34] we (as natural philosophers) understand an equation that holds for a wide variety of facts, if we understand why such an equation would have to occur in a given universe, what would be the consequence of its non-occurrence even when we are not able to deduce it strictly from premises. Further paraphrasing Feynman, Apostel points out that metaphysical understanding is unmathematical, imprecise and inexact, but absolutely necessary for the metaphysicist. The point of a scientific metaphysics is that the deduction has a conclusion that is less general and stronger than the premises. The idea is simple: think of the universe as a particular actomorphic quasi-organism; proceed by looking for general characteristics of the universe and deduce particular facts (regional facts) from these more general ones. What comes to mind is the deduction of laws of nature (physical fundamental theoretical laws). In this way the laws of nature become more plausible in a different way than by induction, cognitive criteria or criteria of usefulness that are usually the focus of philosophers of science.

I give two examples.

(1) Suppose the universe is really a system. If we simplify somewhat (a lot!) we might say that there is the level of the elements, the level of the subsystems and the level of the whole. From the fact that any system has at least these three levels, the three forces of nature should be deducible. Gravitation is the typical macroscopic force that is active at great distances. The nuclear forces are active at the level of the elements. Electro-magnetic forces are more or less level independent and make the formation and stability of subsystems possible. If there would only be attractive EM-forces the universe would be only one system. If there would be only repulsive EM-forces, there would be to few local systems and probably no global system. If the universe is to have subsystems it is necessary that forces exist that are simultaneously attracting and

34 See Apostel 1980a.

repulsing and that work at an intermediary range.[35] Philosophers and physicists should be able to bring the systemic level of description of the universe and the detailed character of the forces in the universe closer to each other.

(2) A second example is the metaphysical "deduction" of the relativity principles. The simplest one is Galileo-relativity, which states that in a closed vehicle travelling uniformly in a straight line it is impossible to deduce the external state of motion of the vehicle from the internal movements inside the vehicle. Something is a subsystem of another system if the processes in the subsystem have some degree of independence of the supersystem. One can "deduce" the relativity principles from the fact that in any rational universe, there must exist subsystems.[36]

6.3 Transcendental arguments of the realistic kind

In several places in the work of Apostel explicit reference is made or allusions are made to transcendental arguments. I will summarize the idea in this subsection.[37]

According to transcendental idealism we can never know the world as it is in itself (*an sich*). Remember Kant's reasoning. He asked: what are the necessary pre-conditions of experience? Forms and categories like space, time, causality and substance were necessary for the possibility of knowledge. He then "deduced", among others, the laws of physics (Newton's mechanical laws) from these necessary conditions of experience. Nothing is said about the world itself. Apostel, fundamentally realistic and ontological in his approach, disconnects transcendentalism from idealism and relates it to realism.

If we observe nature in a laboratory the following results can be obtained:[38] the most important fundamental physical laws do not depend on the orientation of our laboratory, they do not depend on our position,

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[35] See Apostel 1972a and Apostel 1995.

[36] See Apostel 1995.

[37] Weber and Christiaens argued in their 1999, that inference to the best explanation is the inference scheme for metaphysical argumentation.

[38] See Feynman 1965 and Apostel 1995.

they do not depend on our calculation of time or on the moment at which we measure and they do not depend on the speed at which our laboratory moves (for al movements without accelerations). Scientists point out that physical systems move according to laws that are the necessary conditions of inductive knowledge (the latter being a specific human practice). This motivated some of them to attempt a contemporary form of transcendental deduction. One tries to derive the form and content of basic laws of nature from the possibility of making measurements. Schematically we might write this as:

possibility of measurement ⇒ laws of nature

the symbol "⇒" meaning transcendental deduction. Of course we can deduce all sorts of things. Eddington for example wanted to deduce the cosmical number (the number of protons and electrons in the universe) from the principles of measurement. He writes:

> "... as soon as we become obsessed with the idea that the right way to find out about the universe is to measure things, we are committed to an analytical conception which implicitly divided the universe into $(3/2).136.2^{256}$ particles. Naturally, in the course of counting the particles, we shall arrive at a mathematical specification of that which is being counted. From this specification we can determine the observational properties of the particles, and identify them with protons and electrons. .... We have to show, not that there are *N* particles in the universe, but that anyone who accepts certain elementary principles of measurement must, if he is consistent, think there are. (Eddington 1946, p. 265)

Apostel is a realist. For him transcendentalism has to be used as an instrument for realism, not idealism. A contemporary proponent of transcendental realism is Roy Bhaskar. According to him transcendental arguments of the realistic kind give us "geo-historically relativized and domain-specific synthetic a priori knowledge of the world" (Bhaskar 1994, p. 66). If we want to relate this to the concept of regional ontology I introduced, we might say that from regional transcendental arguments of the realistic kind we obtain regional ontologies: in different regions we have transcendental reasons for inferring an existence criterion and existents.

It also seems reasonable to apply the transcendentalist arguments of the realistic kind to the universe as a whole. Given Apostel's basic ontology, this looks schematically as follows:

> possibility of causation and organic wholeness ⇒ this totality with its fundamental laws and its states

(When I write "laws of nature" I mean structural properties of the world or strong invariant causal relations.) The basic idea is this: derive from causation and systemism (= basic ontology) that only this totality (the basic laws and states of this universe) makes causation and systemism possible in all its regional diversity (= regional ontologies). This world-whole is transcendentally deduced from the basic ontology as the only possible structural background for the diversity of systems and causal relations that can take place in specific regions.

6.4 The variational method applied to regions of reality and to totality

Apostel refers frequently to the so-called variational method as a means for obtaining metaphysical insights (see for example Apostel 1989a). I will reconstruct the variational method in this subsection.

Any regional ontology S (especially the scientific ones like mechanics, electromagnetism, etc.) corresponds with a region R of reality and contains basic entities (structures, laws, properties, etc.). We proceed in the following manner:

(1) First, make a regional ontology S explicit in a coherent and systematic way.

(2) Construct alternative possible S, S', S'', ... (alternative possible theories of mechanics, alternative possible theories of electromagnetism, etc.) for any R. For example in the theory of mechanics one might consider mechanical theories where one has no second derivatives, and also mechanical theories where one has no higher derivatives than the second derivative. One can ask: why not $d\mathbf{r}/dt$ in Newton's force law? Because any change would be a disturbing factor and every equilibrium

would be static.[39]
(3) Given enough variation one might look for elements that are invariant in all the possible S, S', S'', ... and find elements that are just part of the actual S.[40] An additional procedure might be: leave everything in a S, S', S'', ... untouched, but change things this region of reality is related to.
(4) Finally one may consider different variational regions R, R', R'', ... together and apply the variational method to their union.[41] In this way it should be possible to obtain the same results for the partial totality of reality (the union of R, R', R'', ...) as for the regions of reality.[42] When considering such a union, we change something in one of its parts. Suppose we change the second derivative into a first derivative in Newton's force law. This might be compensated by a change in another part of the union, i.e. in another region. That way be obtain totalities, alternative to the actual universe.
For example we might deduce the fact that the universe necessarily contains something like a classical mechanics. No universe containing a modified classical mechanics, can exist. Hence, this procedure is complementary to what we did in section 6.1.

Before going on with the variational method I want to point out a problem the laws of nature present us with. Being a physicalist, Apostel accepts the descriptions contemporary cosmological theories give of the universe. These theories are based on general relativity (and also on quantum mechanics, but I will ignore that). Typical for these theories is that they are applied according to the covering law model. What is the main problem of a scientific metaphysics when one confers a prominent

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[39] See Apostel 1963.

[40] In fact what we are doing is familiar from the semantics of modal logic. There are links with the metaphysics of scientific laws based on Kripke semantics (see for example Bigelow and Pargetter 1990), but I will not go into this here.

[41] This kind of work can only be done by a group of people: Scientist(s) specialized in the field, philosopher(s) of science specialized in the field (there are philosophers of quantum physics, philosophers of relativity, philosophers of a specialized part of biology, etc.) and philosopher(s) that are working on the global metaphysical system. Working on one's own one can only engage in informed speculation.

[42] Remark that the basic ontology is not used.

role to fundamental laws? Physics presents us with a so-called "Zeno-universe". The universe is a block-continuum of four dimensions where change occurs in a succession of time-slices of this continuum determined by the fundamental laws. On the one hand we have the simple mathematical form that nature takes, the coincidence that the universal constants are exactly what they need to be to support life, the coincidence that the initial conditions of subsystems of the universe and of the universe as a whole, are exactly as they need to be for life and consciousness to come into being. Physicists like P.C.W. Davies have pointed out that slight variations in physical laws such as gravitation or electromagnetism would make life and consciousness impossible. The natural constants that occur in the fundamental laws of physics are so attuned to each other that even a slight change would result in the non-existence of conscious beings like man. On the other hand, the initial states of fundamental laws do not determine the laws and these do not determine the initial states. An infinite set of possible initial conditions may satisfy the physical laws.

We want to answer the two metaphyical questions – "why is the world the way it is?" and "why this world and not another?". An easy way out is to suppose there is a creator. The most plausible model of the universe as a whole (see Hawking 1988), gives no reason to believe in a creator in the traditional sense, which confirms our metaphysical reasoning in 6.1. But as long as we keep thinking along the lines of the dichotomy of initial conditions and laws, the universe cannot be uniquely determined without some kind of creator. We face an inconsistency between the demand for auto-explanation and the duality between laws and states. We want to find that particular world that is the only one that could actually exist: this means that in some or other the states must presuppose, imply, ... the laws and the laws must presuppose, imply, ... the states.

Let us have a closer look at the nature of theories of variation and at what one can do with them. The mathematical theory of variation answers questions like: "what form should a fluid have if the total surface of the fluid is a minimum?" The answer is: the form of a sphere. "What form should a closed line have, if the surface it encloses should be a maximum?" The answer is: the form of a circle. Similar examples like these ones can be offered. Extremum-principle are usefull in physics. The nature of the extremum-principles in physics is well put by d'Abro:

> The common characteristic of these principles is to assert that a physical system evolves from an initial to a final state in such a way that an appropriately selected magnitude (depending on the nature of the system) will exhibit the property of an extremum. (d'Abro 1951, p. 257).

I will give a paradigmatic example from physics. The work done equals the length of the displacement and the amount of force: $A = F d\mathrm{r}$. A permanent force field is one where the forces do not change in direction or change in amount. A conservative force field is one where energy is conserved. Suppose we have a particle that moves in a permanent and conservative force field. It will have a definite amount of kinetic energy T and a definite amount of potential energy V. The difference $T - V$ is called the Lagrangian L. The Hamiltonian action S is the amount Ldt. If a particle moves from A to B, then the total action is the integral

$$S = \int_{t1}^{t2} L.dt.$$

Hamilton's principle says that when you compare the path the particle actually took to go from A to B in time interval $t2 - t1$ with other possible paths to go from A to B in the same time interval, you will find it is an extremum with respect to S. For a more detailed discussion I refer the reader to the physics literature: this example can be found in almost all textbooks on classical physics.

This method can play a role in metaphysics, which is is also where it came from: as far as I know the idea of an extremum originated in the work of Leibniz. The German philosopher wanted to know if God had any choice when he created the world. Imagine God contemplating the set W of possible worlds. God could of course have created any world he wanted, but what good would it do, if that world could not exist, because it was lacking in essential properties or was unbalanced? God had to create the world that satisfied a certain extremum-principle, i.e. he created the world that was *an extremum among possible worlds*. Worlds have two general characteristics: they can be ordered, structured, lawful, or they can be diversified, pluralistic, and chaotic. An extremum can be a maximum or a minimum. So a universe can be a maximum or minimum with respect to order and a maximum or minimum with respect to diversity. According to Leibniz the existing world (the only world that could exist) is a maximum both with respect to order and diversity. More specifically, it is a balance between the maximization of order and the maximization of diversity:

> What he [Leibniz] adds is exactly to establish these two long-prominent aspects of the world's perfection as jointly operative and mutually conditioning criteria joined with a single two-factor standard of the perfection of a possible world. What is specifically characteristic of Leibniz is the idea of combination and balance of these factors in a state of mutual tension. (Rescher 1981, p. 7).

How does all this relate to the contemporary context? There are three possibilities:

(a) There are covering laws and there is one superlaw unifying all other fundamental laws, that governs the behavior of all entities in the world. The idea is that the one superlaw will unify all other laws, the way for example the theory of electro-magnetism unifies electrical and magnetic phenomena. Recall the Zeno-universe. The simple mathematical laws are an expression of *order*. A universe with a maximum of order will have one superlaw that contains all other laws, and makes it possible to specify one initial condition to determine the total history of the universe. The basic ontology of mechanicism makes this the most plausible hypothesis for totality.

(b) In a universe with a maximum of diversity, there will be a large multiplicity of laws, and every combination of a state with a law is unique. The universe is completely disordered, i.e. there is no purveying structure to the world, only unique and irreversible causal processes. This means that in the latter kind of universe the notion of law, looses its meaning. There are no causal laws, only causal relations. The universe does not start from an initial state followed by a succession of states determined by a superlaw, because there is no such thing as an initial state for the whole of the universe. There is only the multiplicity of causal relations. The universe has no beginning and no end. In this universe the systemicity of the universe is lost.

(c) There is a patchwork of laws: laws are in fact invariant causal relations, and these invariances can vary. The Leibniz principle suggests that the actual universe will be somewhere in between the two extremes. In this universe the causal laws will not be subsumable under a superlaw. At best there is an orderly fashion in which they fit together, i.e. they form a patchwork of laws.[43]

Given the fact that there is a certain amount of order (expressed in the patchwork of fundamental physical laws), why *this* patchwork of laws and *these* states? Why *this* world and not any other world? Suppose we look at the set of possible universes *W*. Consider our world *w* (the world with a specific set of states and a specific patchwork of physical laws). We can obtain other worlds by variations in the initial conditions and by variations in the physical laws and the way they fit together. The universe could have started of in a different way. The universe could have had different laws of nature and these laws could have been ordered in different ways. Apostel proposes the following procedure:

> let us consider those laws that are compatible only with one initial condition (or with very few), and those initial conditions that are compatible with only one (or a few) set of laws (Apostel 1989a, p. 299).

How are we to understand this proposal? We could make two lists of subsets of *W*:
(a) All subsets of *W* where every world in one subset has the same initial patchwork state but a different patchwork of laws,
(b) All subsets of *W* where in each subset all worlds have the same patchwork of laws but different initial patchwork conditions.
Here we return to (4) at the beginning of this subsection: every union determines a world in *W*. I gave the example of a change in Newton's force law and of its effect. With respect to changes in the states, we might for example consider a universe with infinite radius. This would pose problems for the law of gravitation.

One might consider this procedure is trivial, because the same worlds will automatically appear in both lists. Apostel's procedure is not a purely extensional one. This should already be evident given the account of a law of nature in this paper. The critique presupposes the existence of superlaw, and it also presupposes that laws are basic (options (3) in section 5.3). We are working with a patchwork of laws: specific

[43] For more on the metaphysics and epistemology of the disorder of the world: see Cartwright 1999, Dupré 1993 and Galison and Stump 1996.

constructions, not a superlaw that allows one simple initial condition. There is no simple state space for this patchwork of laws. A causal relation becomes a law if in certain respects and to a degree it becomes invariant. There will always be respects in which it has a strong degree of uniqueness, irreversibility and contextuality. The basic concept is that of a causal relation. If we bear these facts in mind, we realize that it will in fact be very difficult to obtain the same worlds in both lists. Each world is unique.

One has to ask: does there exist a subset where all worlds have the same initial patchwork state and the same patchwork of laws and that is the only subset in both lists. In other words, are there worlds where everything fits together so neatly and so consistently that it is the necessary outcome of Apostel's procedure? The Leibniz-principle suggests it should be possible to obtain the actual universe *w* as the sole member of this subset. [44]

To conclude, we may say that the construction of the metaphysics comprises three steps: (1) applying the basic ontology to totality, (2) unifying and integrating the regional ontologies in accordance with the basic ontology, (3) applying the variational method, i.e. look for the 'best' possible world, the only world that can actually exist.

7. Final remarks

The variational method and the Leibniz-principle are at the heart of Apostel's metaphysical hypothesis. Systems theory and his own particular theory of causation are at the heart of his ontology. It is through the variational method and the selection of the best possible world according to the Leibniz-principle, that the nature and existence of totality we are living it, becomes less arbitrary, less contingent. To avoid misunderstandings: the notion 'best' is not meant in an everyday moral or aesthetic sense, although there are implications for value theory and

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[44] The existing cosmological model that is most plausible for this metaphysics is the model that Hawking discusses in *A Brief History of Time*: "The universe would be completely self-contained and not affected by anything outside itself. It would neither be created nor destroyed. It would just BE." (Hawking 1988, p. 136). For further discussion see the paper Smith 1988 and the discussion of this paper in Apostel 2000.

action theory.[45]

What we have here is a huge program that very likely cannot be carried out to its full completion. One reason for this is that we will never be sure about the regional ontologies. A naïve realism is out of the question (see section 2). A "metaphysical turn" implies engaging ourselves in metaphysical construction, bracketing our methodological and epistemological worries. We make no naïve realist claims about the metaphysical systems we thus obtain.

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[45] See Apostel (1995).

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