POPULAR CONCEPTIONS AND THE COMMUNICATION OF PHILOSOPHICAL VIEWS OF REALITY

Communitas
ISSN 1023-0556
2009 14: 57 - 70

Danie Strauss*

ABSTRACT

The aim of this article is to show that the issue is not whether there is a mutual communication between philosophy, the special sciences (scholarly disciplines or scientific disciplines) and popular conceptions, but rather whether these communications acknowledge what are actually communicated, namely philosophical views of reality. Unless this basic and inevitable mutual communication is recognised the ultimate philosophical roots of much that is floating around will not be acknowledged as such. The philosophical problem of the coherence of irreducibles receives a negative answer in monistic -isms – such as physicalism or biologism – that attempt to elevate some or other aspect of reality to be the exclusive and decisive principle of explanation of whatever there is. One may designate the underlying philosophical issue here also as that of unity and diversity. In our discussion below another issue will surface, namely the relation between continuity and discontinuity (constancy and change). These examples will serve to show that the special sciences cannot operate except upon the basis of implicit or explicit (perennial) philosophical problems explicitly or implicitly communicated from philosophy to the various academic disciplines and popular conceptions of reality. In the course of the exposition the impasse of special scientific stances (such as physicalism and neo-Darwinism) will be subjected to immanent criticism from the perspective of a non-reductionist ontology, in particular also questioning positivism as a philosophical orientation, the philosophical stance known for its denial that it is a philosophical orientation.

* Danie Strauss is Professor in the Dean's office, Faculty of the Humanities at the University of the Free State.

ORIENTATION

Although the title of this article may suggest that its main focus will be on scholarly communication and its impact upon everyday thinking, its goal is different. Of course scholarly communication certainly forms an intrinsic part of the scholarly (i.e. scientific) enterprise. The focus is on looking at some cross-cutting examples that turn out to be instantiations of the communicative links between philosophy, the special sciences or scholarly disciplines and popular conceptions.

CAN THE "EXACT SCIENCES" EXPLAIN EVERYTHING?

This mutual communication is already implicit in the previous paragraph because instead of simply referring to "the scientific enterprise" a qualifying term is employed, namely "scholarly." Popular understanding is entrenched in the view that "science" is identical with *physics*. At most mathematics will sometimes be added to the domain of the "exact sciences", alongside biology that, since the rapid development of so-called *molecular biology*, also claims to be an *exact science*. In terms of this legacy the other scholarly domains, found in disciplines such as communication science, history, economics, sociology, aesthetics or law, do not truly qualify to be designated as "sciences." At most they sometimes receive the label of "soft sciences". Since we do engage with physicalism below, we merely note in passing that 20th century mathematics gives shelter to opposing schools of thought. Stegmüller writes: "The special character of intuitionistic mathematics is expressed in a series of theorems that contradict the classical results. For instance, while in classical mathematics only a small part of the real functions are uniformly continuous, in intuitionistic mathematics the principle holds that any function that is definable at all is uniformly continuous" (Stegmüller 1969: 331; cf. Brouwer 1964: 79). Beth (1965: 89) also highlights this point: "It is clear that intuitionistic mathematics is not merely that part of classical mathematics which would remain if one removed certain methods not acceptable to the intuitionists. On the contrary, intuitionistic mathematics replaces those methods by other ones that lead to results which find no counterpart in classical mathematics."

THEORIES ABOUT EVERYTHING – RATIONALITY AS THE ULTIMATE GUIDE TO HUMAN LIFE

The (popular) idea of *exact sciences* is embedded in the conviction that human understanding ("rationality") is the ultimate guide to reliable knowledge through an exploration of factual data – tied to what became known as the "scientific method". Human rationality, supported by these exact sciences, will be able to explain whatever there is – and oftentimes it is pursued in the hope that a "theory of everything" will emerge. With reference to Einstein's thirty-year search for a unified field theory, Brian Greene, a specialist in the theory of super strings, believes that physicists will find (have found) a framework fitting their insights into a "seamless whole", a "single theory that, in principle, is capable of describing all phenomena" (Greene 2003: viii). He introduces Super String theory as the "Unified Theory of Everything" (Greene 2003: 15; cf. pp. 364-370, 385-386).

THE EQUALLY ENCOMPASSING ALL-CLAIM OF NEO-DARWINISM

In this the big Darwin year – Darwin was born in 1809 – we cannot ignore a similar claim made by neo-Darwinists, for they believe that the new synthesis erected during the thirties and forties of the previous century represents a biological theory that is also capable of explaining everything – from the big *bang up* to the accidental appearance of *human beings*. Within the context of an evolutionary epistemology Van Huyssteen demonstrates a strange fusion of different positions at once. He is in search of a new (interdisciplinary) space for the communication between theology and science. He proceeds from the assumption that evolution is a fact (Van Huyssteen 1998: 143) and that we have to "take very seriously the general conclusions and findings of general cosmology" – "that is that this universe is evolving, that all that is within it has had a common physical origin in time, and that all it contains is in principle explicable by the natural sciences" (Van Huyssteen 1998: 75). Strangely enough forty pages later we read: "And even if through natural science the cognitive dimension of human rationality is revealed as possibly our best example of rationality at work, it should not be overextended to explain everything in our world in the name of natural science" (Van Huyssteen 1998: 115)!

This inconsistency is consistent with other fundamental ambiguities present in his thought. The neo-Darwinian presupposition of *continuity* (cf. Van Huyssteen 1998: 111) and *chance* are slowly but surely substituted with a mixture of emergent evolutionistic (cf. Van Huyssteen 1998: 134, 151) and vitalistic (cf. Van Huyssteen 1998: 37, 121, 125, 127) overtones – without evincing an awareness of the fact that these positions are alternative to neo-Darwinian theory and contradict its basic assumptions. The following statements show his emergent evolutionistic position, *continuity* in ascent, *discontinuity* in existence: "Culture indeed has evolved, but the principles of culture are not the same as the principles we know from organic evolution" (Van Huyssteen 1998: 146); and in affirming the approach of Wuketits he says: "culture is not reducible to biological entities" (Van Huyssteen 1998:157). On page 130 he explicitly employs the phrase "emergent evolution".

More recently Van Huyssteen continues these ambiguities. On the one hand he refers to Darwin who stressed the continuity between species in respect of instincts or rational abilities (Van Huyssteen 2006: 81) as well as to the continuity of organic evolution from "unicellular organisms to humans" (Van Huyssteen 2006: 87). But on the other hand he discerns something unique within human cognition, culture and religious world views, something irreducible (Van Huyssteen 2006: 86-87). Emergent evolution is a philosophical stance, found within various disciplines – thus illustrating the power of comprehensive philosophical views communicated to the various special sciences and via them to everyday conceptions of the world.

Of course *physicalist naturalism* is quite widespread amongst natural scientists. Pigliucci, for example, holds a similar conviction: "No serious scientific discussion of any topic should include supernatural explanations, since the basic assumption of science is that the world can be explained entirely in physical terms" (Pigliucci 2003:

195). Divinising one aspect of creation is not considered to be a "supernatural explanation"! A sound natural scientific approach certainly will avoid (speculative) "supernatural explanations", just as much as it will avoid any reification of something within creation.

Underlying philosophical problems burdening neo-Darwinism

The *new synthesis* that emerged during the thirties and forties of the previous century proceeds from the (philosophical) conviction that *everything changes*. This basic orientation is explicit in Darwin's 1859 work *On the origin of species*. The term "change" occurs 268 times, the term "variation" 281 times, and the plural "variations" 162 times – altogether there are 711 instances in which change in some or other form is asserted. The term "constancy" appears twice and "persistent" (or: "persistently") three times.

However, leaving aside the fact that it cannot be employed to account for the origination of the first living entity, the combination of mutation and natural selection serves as the pre-supposed constants of neo-Darwinian theory. Were these two constants themselves variable, then the entire theory collapses at once. The insight that change can only be established on the basis of constancy derives from a long-standing legacy, permeating various academic disciplines (cf. Strauss 2005: 225 ff.). The pre-occupation with change created a prejudice that distorted the interpretation of the fossil record ever since Darwin's *On the origin of species* was published. However, after more than hundred years of palaeontology even neo-Darwinian palaeontologists were no longer willing to explain away the ever-present discontinuities (gaps). Kitts straightforwardly states: "Evolution requires intermediate forms and palaeontology does not provide them" (Kitts 1974: 467). To this he adds the remark: "But most of the gaps are still there a century later and some palaeontologists were no longer willing to explain them away geologically" (Kitts 1974: 467). At the same time Gould honestly pointed out: "The extreme rarity of transitional forms in the fossil record persists as the trade secret of palaeontology. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of their branches; the rest is inference, however reasonable, not evidence of fossils" (1977: 14). Eldredge, curator of the American Museum of Natural History in New York, unambiguously states: "We palaeontologists have said that the history of life provides support for the interpretation of gradual development through natural selection while all the time we knew that it was not true" (cf. Van den Beukel 2005: 105).

According to Gould the dominant theme of the palaeontological record is not change, but constancy. Types abrupty appear and then remain constant for millions of years before they equally abruptly disappear. Most species "enter the evolutionary order fully formed and then depart unchanged" (Berlinski 2003: 158).

THE SELF-INCOHERENT BASIS OF PHYSICALISM

It is not difficult to communicate the untenability of this "basic assumption" to the interested public exceeding the confines of mere specialists within the discipline of physics or what is known as the *natural sciences*. Evidently this basic assumption that everything ultimately is physical is held to be *true*. However, is it possible to specify which elementary particles, atoms, molecules or macro-molecules constitute this truth claim? Furthermore, the assumption is formulated in *language,* using certain *terms (*words) with their specific *meanings* – without providing in purely physical terms any explanation of these lingual meanings. An additional (immanent-) critical remark concerns the conditions (laws) for existing physical entities that are not identical to the entities meeting these conditions. The conditions for *being green* are not themselves *green* and the conditions for *being an atom* are not themselves *an atom*. Therefore the physical world presupposes conditions for what is physical that are distinct (and distinguishable) from these physical entities, entailing that for something physical to exist conditions are required that themselves are not physical, thus uprooting the physicalist claim that everything is physical. Finally, the meaning of what is physical cannot be explained without taking recourse to other – non-physical – modes of explanation, such as the numerical, spatial and kinematic aspects of the world. The composite concept of *physical mass* reflects the coherence between the physical and the arithmetical aspect (energy-quantity). Likewise the phrase *physical field* brings to expression the coherence between the physical and spatial aspects of reality. It is also possible to observe the quantity of energy from the perspective of the kinematic aspect and then the technical expression *kinetic energy* highlights the action capacity inherent in a moving body (cf. Maier 1949: 142). Without the foundational meaning of *uniform motion* (*constancy*) no single physical *change* (*dynamics*) can be established – clearly evinced in a more precise formulation of the well-known physical law of energy-conservation, namely *energy-constancy*.

The multi-aspectual nature of physical matter

We may now return to our initial reference to the idea of exact sciences ("objective" and neutral"), because the history of our "rational" understanding of the material world (understood to constitute the field of investigation of physics) communicates a story incompatible with the idea of sensory perception as the only gateway (through empirical experimentation). What the popular image of the *exact sciences* do not realise is that its basic assumption does not proceed from the "positive facts" but from the underlying *philosophical* view of what became known as *positivism* (to which we shall return below). This becomes abundantly clear from the history of the concept of matter. This mysterious reality designated as matter successively was explored by employing the four modes of explanation mentioned above:

- The Pythagoreans thought *everything is number* but in fact only acknowledged rational numbers, that ran into serious difficulties with the discovery of irrational numbers (*incommensurability*).
- This crisis led to the geometrisation of Greek mathematics and the subsequent metaphysics of space, including the medieval understanding of the chain of being with God, as the highest being (*ipsum esse*), on the top.
- Through the contributions of Galileo and Newton the main tendency of modern physics started to explore the kinematic mode of explanation.

- It was only by the end of the nineteenth century and the beginning of the twentieth century that physics sufficiently recognised that material entities are characterised by physical energy-operation.

Although Descartes and Newton did employ the concept of *force*, it may in general be said that modern physics since Newton is characterised by a *mechanistic* main tendency. The mechanistic view consistently attempts to reduce all physical phenomena to a kinematic perspective. However, in the course of the 19th century, modern physics already started to explore the nature of *energy*. The founder of physical chemistry, Wilhelm Ostwald, developed his so-called *Energetik* (energetics), which even influenced the later views of Heisenberg. Vogel refers to Heisenberg's work "Wandlungen in den Grundlagen der Naturwissenschaft" (Stuttgart 1949), where the latter explicitly speaks of energy as the basic stuff that constitutes matter in its three-fold stable forms: electrons, protons and neutrons (Vogel 1961: 37). Yet Ostwald's Energetik did not exert a lasting influence upon the physics of the 20th century, probably because it was attached to a specific view of continuity that is opposed to an atomistic approach. Niels Bohr in particular mentions the excessive *skepsis* found in Mach's thought regarding the existence of atoms.

The last prominent physicist who consistently adhered to the mechanistic approach was Heinrich Hertz. Soon after Hertz's death in 1894, the work in which he attempted to restrict the discipline of physics to the concepts of mass, space and time, reflecting the three most basic modes of explanation of reality, namely the modes of number, space and movement, appeared: "The principles of mechanics developed in a new context." This caused him (and Russell) to view the concept of *force* as something intrinsically *antonymous*.

The Latin designation of mass during the medieval period was "quantitas materiae" (cf. Maier 1949: 144). We therefore noted that that number (*quantitas*) plays a key role in the concept of mass for mass is a *physical quantity.* (From a biotic perspective the equivalent phrase is *biomass*. Jones, for example, refers to the fact that plants constitute 99% of the world's biomass, while fungi are estimated to have twice the total biomass of animals – cf. Jones 1998: 54).

It is remarkable to observe the power of a particular understanding of nature, communicated to subsequent generations. Although the mechanistic approach in physics reached its limits by the end of the 19th century (mainly through the discovery of irreversible physical processes), the contemporary physicist Von Weizsäcker, in his treatment of the Kantian conception of matter and his view of pure physics, still appreciates the concepts of motion and speed as the basic concepts of all genuine science! (cf. Von Weizsäcker 2002: 196). Of course one is immediately reminded of the famous statement by Kant: "However, my claim is that in every particular theory of nature only that much science is found as the amount of mathematics present in it" (Kant 1786: ix). In contrast, Einstein apparently opts for an opposite view when he says, "To the extent in which the propositions of mathematics are related to reality they are not certain and in so far as they are certain they are not related to reality" (Einstein 1921: 124).

Yet as soon as the physical aspect of reality surfaced, it opened up the way for 20th century physics to explore it as an independent mode of explanation and to arrive at an even more nuanced understanding of reality. For example, in his protophysics, Paul Lorenzen distinguishes four units of measurement reflecting the first four modes of explanation: mass (number), length (space), duration (kinematic) and charge (physical) (cf. Lorenzen 1976: 1 ff.). Weinert mentions even that usually physicists "distinguish fundamental constants from conventional units" – and he then lists the kilogramme (number), the metre (space), the second (the kinematic) and temperature (the physical) (Weinert 1998: 230; cf. Lorenzen 1989).

In particular owing to the fame of Einstein associated with his special (1905) and general (1916) theory of relativity every person, whether or not academically trained, is acquainted with the famous formula $E = mc^2$.

From these considerations it is clear that the *meaning* of the physical aspect of reality is dependent upon its *coherence* with non-physical aspects – in particular the numerical, spatial and kinematic modes of reality. This insight eliminates the existence of anything *purely physical*. The physical aspect, serving as the gateway for an understanding of reality by the academic discipline physics, loses its meaning the moment one attempts to understand it apart from the mentioned (and many other) aspects of reality.

THE IMPASSE OF POSITIVISM

At this point we have to question the way in which a particular orientation communicated a distorted image of the modern natural sciences (in particular of *physics)* to the general public. What has been communicated to popular understanding of "science" in fact is simply one (self-uprooting) philosophical orientation, briefly earlier referred to as *positivism*.

However, positivism did not realise that sensory perception relates to things and events, to the concrete *what* of experience, but that it does not give access to the terms employed in describing the how of what has been observed, for these terms actually stem from the various modal aspects of reality. And these modalities (functional ways of being) as such are never open to sensory perception. Yet, these aspects provide theoretical thinking with modal terms (aspectual terms) that are indispensable for the formation of scientific concepts and theories. As soon as the inevitability of employing modal terms is acknowledged, the Achilles heel of positivism is laid bare. The key question is whether these modal aspects could be observed in a sensory way. Can they be weighed, touched, measured or smelled? If so, it would be meaningful to speak of the weight of the numerical aspect, the softness of the spatial aspect, the colour of the kinematic aspect, the taste of the physical aspect, and so on. The answer therefore is clearly negative, for these facets are not things but aspects of things (or rather aspects within which concretely existing things function). The first step positivism had to take in order to digest "sense data" theoretically has already eliminated the restriction of reliable knowledge to sense data.

From modern physics, inspired by the theory of relativity of Einstein (building upon the contribution of Minkowski), popular accounts refer to the "space-time-continuum". This habit also reveals hidden philosophical views. Besides, *time* also does not belong to what can be observed through the senses, for we can apply the same critical questions to it: has anyone ever *seen* time? *touched* it? *smelled* it? *felt* it? or *heard* it? By introducing time as a fourth dimension Einstein gave the impression that what is physical is geometrised – just compare his idea of *curved space* as well (through gravity). Yourgrau pushes this understanding to its limits: "Time itself had been tamed – or so it seemed – by its transformation into space, into the temporal component of four-dimensional space-time. In this way Einstein turned out to be no less an ironist than Gödel. Everything is really something else: time is really space, gravity is really geometrical curvature, energy is really mass" (Yourgrau 2005: 146). With regard to the idea of a space-time continuum we note in passing that this mode of speech actually conceals the difference between mathematical space (which is both continuous and infinitely divisible) and physical space (that is neither continuous nor infinitely divisible, because it is bound to the quantum-structure of energy – cf. Hilbert 1925: 164). Bernays (1976: 37) also remarks: "Only through the contemporary development of geometry and physics did it become necessary to distinguish between space as something physical and space as an ideal multiplicity determined by spatial laws."

The work in which Yourgrau communicates to people not necessarily trained in mathematics and physics these explanations, is one amongst numberless similar contemporary works dealing with all kinds of natural scientific issues, including the disciplines of mathematics, physics and biology. They are all well-written, with simplified and lucid accounts of complex natural scientific issues. In spite of the thoroughness and well-informed nature most of these presentations they nonetheless largely lack a sufficient insight into the mostly hidden philosophical presuppositions directing the explanations put forward. Consequently they do not communicate or make sufficiently explicit what lies at their foundation.

IS PHYSICAL TIME THE ONLY TIME?

Implicitly, for example, most (natural) scientists tend to identify *time* with *physical time*. However, the first remarkable feature of what is designated as *cosmic time* by Dooyeweerd (cf. Dooyeweerd 1977-I: 28 ff.) is that it manifests itself within each modal aspect of reality in accordance with the inner nature and unique meaning of that aspect. (In a more restricted physical context Gödel also introdced the idea of *cosmic time* – cf. Yourgrau 2005: 124, 133.) What is even more remarkable, is that the history of Western philosophy (and the special sciences) implicitly reveals an insight into different modes of time without having been able to relate it to a general theory of functional modes of time. The influential Enligthenment philosopher, Immanuel Kant, generally considers time to be a form of *intuition* (Kant 1787-B: 46 ff.). Yet, in spite of this psychological one-sidedness, he also distinguishes three "modes" of time that are strictly correlated with the way in which cosmic time manifests itself within the first three cosmic modalities. His striking remark reads: "The three modes of time are endurance, succession and simultaneity" (Kant 1787-B: 219). Kant also realised that one has to distinguish between succession and causality – for although day and night succeed each other, it is meaningless to say that the day is the cause of the night, or vice versa. In the 20th century, after modern physics succeeded to transcend its mechanistic restriction, it was realised that physical time is intrinsically connected with causation, for the effect can never precede the cause. The numerical order of succession is reversible – manifested in the plus and minus directions of the system of integers, closed under the operations of addition, multiplication and subtraction. Saying that these operations are closed means that applying them to the set of integers always yields integers from the same set. When any two integers are added, multiplied or subtracted, the result is always another integer. The symmetry of any spatial configuration – allowing being turned upside down or front-backwards – shows the reversibility of the spatial time order, and the same applies to the kinematic time order, for the mathematical description of a constant movement (like the swinging of a pendulum) is equally valid in both directions (a mere switch of the sign provides a description in the opposite direction). Finally, the physical time order is *irreversible*.

Einstein explains the difference between physical irreversibility and kinematic (mechanical) reversibility:

> On the basis of the kinetic theory of gases Boltzman had discovered that, aside from a constant factor, entropy is equivalent to the logarithm of the 'probability' of the state under consideration. Through this insight he recognized the nature of courses of events which, in the sense of thermodynamics, are 'irreversible'. Seen from the molecular-mechanical point of view, however, all courses of events are reversible (1959: 43).

From another angle, the distinct manifestation of cosmic time within the first four modes is evident, particularly in the history of time measurement. It belongs to our general awareness of time: earlier and later, simultaneity, time-flow and irreversibility are well-known modalities of time. In his work on the foundations of physics, Stafleu remarks:

> This is most clearly shown by an analysis of the historical development of time measurement. Initially, time measurement was simply done by counting (days, months, years, etc.) Later on, time was measured by the relative position of the sun or the stars in the sky, with or without the help of instruments like the sundial. In still more advanced cultures, time was measured by utilizing the regular motion of more or less complicated clockworks. Finally, in recent developments time is measured via irreversible processes, for example, in atomic clocks (1980:16).

What is striking in this whole development is that different time orders are used, the one after the other: the numerical time order of succession, the spatial order of simultaneity, the kinematic time order of constancy and the irreversible physical time order, expressed in the relationship of cause and effect.

PHILOSOPHICAL PRESUPPOSITIONS

These considerations are philosophical in nature because they proceed from a more-than-special-scientific totality perspective. From this philosophical perspective an account is given both of the uniqueness and mutual coherence of different modes of explanation. It is only on this level that one can critically assess the above-mentioned remark of Yourgrau. Einstein did not really turn time into something spatial. His special theory of relativity in fact is as purely kinematic theory, explaining why the kinematic time-order of constancy is captured in the postulate regarding *c* as the vacuum-velocity of light. Einstein builds upon the insight of Plato, namely that change presupposes constancy, and in addition he further explores Galileo's formulation of the law of inertia. The core idea of Einstein's special theory is after all the *constancy* of the velocity of light in a vacuum. Although he often merely speaks of "the principle of the constancy of the speed of light," he naturally intends "the principle of the vacuum-velocity" ("das Prinzip der Vakuumlichtgeschwindigkeit" – cf. Einstein 1982: 30-31; and 1959: 54). [Einstein speaks of "das Prinzip der Konstanz der Lichgeschwindigkeit" (Einstein 1982: 32).]

It follows that Einstein primarily aimed at a theory of *constancy* – whatever is in motion moves relative to an element of constancy. It was merely a concession to the historicistic *Zeitgeist* at the beginning of the 20th century that Einstein gave prominence to the term "relativity"– for actually all movement is relative to the constant *c*.

In his general theory of relativity Einstein moved to a physical perspective exploring an expanded notion of gravity. Yet Yourgrau mentions that, in his special theory of relativity, "Einstein is said to have accomplished the geometrization of physics", while adding to that: "Similarly, in general relativity, he not only provided a new geometry for the laws of gravity, he defined gravity itself geometrically, as space-time curvature" (Yourgrau 2005: 127).

Does this mean that Einstein really returned to the spatial mode of explanation explored in Greek philosophy after the discovery of irrational numbers? At this point philosophical perspectives are decisive. If we assess the development of physics (and the concept of matter) in terms of the above-mentioned modes of explanation successively employed then the distinctive hall-mark of twentieth century physics is indeed given in its acknowledgement of energy-operation as the charactersitic feature of material entities and processes. Therefore, the *curved space* of the general theory of relativity is not the *cause* of gravity – in fact it is the *effect* of gravity. Likewise, when time is combined space (as a fourth co-ordinate) it concerns kinematic time and physical time. Within the aspect of space, in its original functional meaning, time merely appears as an order of co-existence, of simultaneity. The main point of

Einstein's theory of relativity in this regard simply states that spatial time (simultaneity) does not have an absolute meaning for it is relativised by motion. And finally energy is not simply mass for we have seen that the basic concept of physical *mass* reflects the intrinsic coherence between the physical and the numerical aspects – mass merely is the *quantity of energy* and that energy and mass are equivalent ($E = mc^2$).

The general statement of Yourgrau, namely that "time is really space, gravity is really geometrical curvature, [and] energy is really mass", is therefore *philosophically* problematic.

- As a unique dimension of reality (cosmic) time expresses itself within each modal aspect according to the nature of that aspect. But is does not mean that time essentially *is* space.
- Gravity does not depend on the curved world space. Space is curved because gravity causes it to be so. When we start to move in in a straight line, we shall eventually, owing to the curved world space, end up where we started. This enabled Einstein to hold that although the universe is *unbounded*, it is *finite*.
- Finally, the physical quantity called mass does not imply that energy *is* its mass, merely that it is equivalent to mc^2.

Although this argumentation opened up the inevitable role of underlying philosophical views, communicated via die special sciences (in this case physics) to popular conceptions, the outcome of the subordinate disputation is subservient to the overall claim, namely that philosophical views play a foundational role in communicating coherent (or sometimes incoherent) understandings of our world to the special sciences and popular understandings.

This situation is of course diametrically opposed to the stance of positivism. The formerly highly admired "scientific method", closely connected to the unverifiable principle of verification, ran stuck in the descriptive terms (sometimes designated as theoretical terms) that are not themselves open to sensory observation. The relativity of method is emphasised by Putnam: "Today, virtually no one believes that there is a purely formal scientific method" (Putnam 1982: 25).

The affinity of positivism for a physicalist view highlighted the inevitable (philosophical) choice of a particular mode of explanation, or, alternatively, the acceptance of mutually cohering but irreducible modes of explanation. The underlying philosophical issue at stake here can also be captured with reference to the *coherence of irreducibles*. A positive approach may opt for a non-reductionist ontology, i.e. a view of reality that does not aim at reducing what is truly irreducible.

The renowned physicist, Max Planck, who eventually became sharply critical of Mach's positivism, distinguishes between the real outside world, the world of the senses and the (theoretical) world of the science of physics, which he equates with the "physikalisches Weltbild" (the physical world picture) (Planck 1973: 208). The abstractions that belong to the ‘‘Weltbild‘’ are not sensorily perceptible – they embrace, according to him, the known law-conformities and concepts such as space, time and causality (cf. Vogel 1961: 149). He holds that strictly seen it is totally impossible to find any physical question which can be assessed directly through measurements without the aid of a theory (Planck 1973: 341).

Putnam, for example, holds that (positivistic) scientism and relativism are reductionist theories (Putnam 1982: 126). In respect of "phenomenalism" he remarks: "The idea that the statements of science are translatable one by one into statements about what experiences we will have if we perform certain actions has now been given up as an unacceptable kind of reductionism" (Putnam 1982: 187).

CONCLUSION

From the examples discussed we may conclude that the issue is not whether there is a mutual communication between philosophy, the special sciences and popular conceptions, but whether they are acknowledged for what they are. Unless this basic and inevitable mutual communication is recognised, the ultimate philosophical roots of much that is floating around will not be acknowledged. The philosophical problem of the coherence of irreducibles receives a negative answer in monistic -isms – such as physicalism or biologism – that attempt to elevate some or other aspect of reality to be the exclusive and decisive principle of explanation of whatever there is. One may designate the underlying philosophical issue here also as that of *unity and diversity*. In our preceding discussion another issue surfaced, namely the relation between constancy and change. In both cases it has been shown that the special sciences cannot escape from perennial philosophical problems such as these, indirectly permeating and influencing the interested non-scientific public relatively vulnerable particularly to the implicit philosophical views communicated to them through a multitude of popular scientific works available on the market.

Special scientists (and popular opinion indirectly) have two communicative options (but just one choice):

- Either they give an explicit communicative account of the philosophical presuppositions with which they work – in which case they communicate an *explicit* philosophical view of reality, or

- Implicitly (and uncritically) communicate some or other philosophical view of reality – in which case they are the victims of communicating an *implicit* philosophical view.

REFERENCES

Bernays, P. 1976. *Abhandlungen zur Philosophie der Mathematik*. Darmstadt: Wissenschaftliche Buchgesellschaft.

Beth, E. W. 1965. *Mathematical thought*. New York: D. Reidel Publishing Company.

Brouwer, L. E. J. 1964. Consciousness, philosophy, and mathematics. In: Benacerraf, P. and Putnam, H. 1964 (eds). *Philosophy of mathematics. Selected readings*. Oxford: Basil Blackwell.

Darwin, C. 1968. *On the origin of species by means of natural selection or the preservation of favoured races in the struggle for life* (1859). Edited with an introduction by J. W. Burrow. Hardmondsworth: Penguin Books. [Online]. Available at: http://www.infidels.org/library/historical/charles_darwin/origin_of_species/Intro.html [Accessed on 29/10/2005]. This version slightly differs in some respects from the Penguin edition.

Dooyeweerd, H. 1977. *A new critique of theoretical thought*. Collected Works of Herman Dooyeweerd, A Series Vols. I-IV, General Editor D.F.M. Strauss. Lewiston: Edwin Mellen.

Einstein, A. 1921. *Geometrie und Erfahrung*, Sitzungsberichte der Preußischen Akademie der Wissenschaften, First Half Volume, Berlin, pp.123-130.

Einstein, A. 1982. *Grundzüge der Relativitätstheorie*. Reprint of the 1969 Braunschweig edition (original edition 1922). Wiesbaden: Friedrich Fieweg & Sohn.

Greene, B. 2003. *The elegant universe*. New York: W.W. Norton & Company.

Hilbert, D. 1925. Über das Unendliche. *Mathematische Annalen* 1925(95): 161-190.

Jones, A. (ed.). 1998. *Science in faith. A Christian perspective on teaching science*. Essex: Romford.

Kant, I. 1786. *Metaphysische Anfangsgründe der Naturwissenschaft*. Herausgeber Wilhelm Weischdel. Darmstadt: Wissenschaftliche Buchgesellschaft.

Kant, I. 1787. *Kritik der reinen Vernunft*. (Second edition). (References to B). Hamburg: Felix Meiner edition (1956).

Kitts, D. B. 1974. Palaeontology and evolutionary theory. *Evolution* 28.

Lorenzen, P. 1976. Zur Definition der vier fundamentalen Meßgrößen. *Philosophia Naturalis* 16: 1-9).

Maier, A. 1949. *Die Vorläufer Galileis im* 14. *Jahrhundert*, Roma: Edizioni di Storia e letteratura.

Pigliucci, M. 2003. Where do we come from? A humbling look at the biology of life's origin. In: Campbell, J. A. and Meyer, S. C. 2003. *Darwinism, design, and public education*. East Lansing: Michigan State University Press.

Putnam, H. 1982. *Reason, truth and history*. Cambridge: Cambridge University Press.

Stafleu, M. D. 1980. *Time and again. A systematic analysis of the foundations of physics*. Toronto: Wedge.

Stegmüller, W. 1969. *Main currents in contemporary German, British and American philosophy*. Dordrecht: D. Reidel Publishing Company.

Strauss, D. F. M. 2005. Relativity and relativism: Historical and systematic considerations. *Acta Academica Supplementum* 2005(2): 199-231.

Van den Beukel, A. 2005. Darwinisme: wetenschap en/of ideologie? In: Dekker, C., Meester, R., and Van Woudenberg, R. 2005. *Schitterend ongeluk of sporen van ontwerp*? Kampen: Ten Have.

Van Huyssteen, J. W. V. 1998. *Duet or duel*? *Theology and science in a postmodern world*. Harrisburg: Trinity Press International.

Van Huyssteen, J. W. V. 2006. *Alone in the world*? *Human uniqueness in science and technology*. Grand Rapids: William B. Eerdmans.

Vogel, H. 1961. *Zum Philosophischen Wirken Max Plancks*. *Seine Kritik am Positivismus*. Berlin: Akademie-Verlag.

Von Weizsäcker, C. F. 2002. *Große Physiker*, *Von Aristoteles bis Werner Heisenberg*. München: Deutscher Taschenbuch Verlag.

Weinert, F. 1998. Fundamental physical constants, null experiments and the Duhem-Quine thesis. *Philosohpia Naturalis* 35: 225-251.

Yourgrau, P. 2005. A world without time. The forgotten legacy of Gödel and Einstein. London: Penguin Books.