Vedic Residue, Cosmic Inflation and a Unified Vision of Everything

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We present a unified vision of human knowledge, the external world and ourselves in the frame of an overall unity of Everything. Two main sources of knowledge are considered to this goal: an admittedly reductionist version of Modern Science and a few key elements of Oriental Philosophy. Our view is based on an analogy between the fundamental unity of Vedic ontology and the Grand Unification scheme of Particle Physics traced along the evolution of the Universe. Our key statement is that these two sources of knowledge describe the same ontological story of separation, from an original One down to the multiplicity of the phenomenological world. We further substantiate this vision by drawing an analogy between the Residue of the Vedic sacrifice and the post-Big-Bang cosmological Matter-Antimatter Asymmetry. We also discuss a Big-Bang analogy between the postulated field of Inflationary Cosmology (the Inflaton) and the Vedic dissolution-decomposition of the cosmic progenitor Prajapati – whose body, according to Brahmanas texts, provides the material substrate of which the Universe is built.

Keywords: Indian Philosophy, Quantum Theory, Theories of Everything, Vedic Sacrifice, Big Bang

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"Ich bin ein Teil des Teils, der anfangs alles war,
ein Teil der Finsternis, die sich das Licht gebar."
J.W. Goethe, *Faust*

"Science is much closer to myth than a scientific philosophy is prepared to admit."
P.K. Feyerabend, *Against Method*

Introduction

The present study considers the general unification trend in Modern Physics and compares it with analog approaches originated in a specific tradition of what is usually called "oriental" thought.

The use of this label is subject to debate. On the one hand, the term is commonly used, together with cognate expressions such as "Eastern thought" or "Asian philosophy," to refer to traditions of thought that flourished in Asia in different times and cultural contexts and had preoccupations similar to those of "western" philosophy, and occasionally also came into contact with it. On the other hand, characterizations of this kind are a product of eighteenth and nineteenth-century European scholarship (Said, 1979; Harrison, 2019; Asif, 2020), and easily give the misleading impression of monolithic conceptions – which is disputable both in the case of the "western" and the "oriental" traditions. In light of this, in the following pages, we shall use the label "Indian Philosophy" as a shorthand for systems inspired to the complex of beliefs, conceptions, and reasoning styles that developed in the northern Indian Subcontinent between the eighth and the second century BCE (we adopt the periodization advanced by Ganeri, 2017). This somewhat arbitrary and conventional characterization is broad enough to include Vedic wisdom and Hindu philosophical and religious thought as well as many strands of Buddhism and Jainism. However, it is also sufficiently narrow to exclude other traditions of thought, mostly religiously oriented, that developed in the same area, or are highly influential in the Subcontinent, such as Sikhism, Islamic philosophy, and Zoroastrianism.

Modern Physics is usually viewed as a product of western civilization. However, there is also ample evidence that many (western) scholars became interested in the analogies Modern Physics bears with oriental conceptions, particularly those connected with Indian philosophies. Undoubtedly, Modern Physics and the multifarious cultures of the Subcontinent have very different ontologies, viz. they diverge very much in terms of the fundamental entities they deal with, and also diverge in style, i.e., with regard to the tools they use to describe those entities. This notwithstanding, both seem to move toward a common ontological goal: a cosmological vision of the unity of Everything. According to these two sources of knowledge, the colorful, individual forms composing the world came into being from a previous "homogeneous" era, a non-differentiated state of the Universe.

Of course, the analogy itself can be treated from different perspectives. From the point of view of the history of ideas, it raises the question of how the oriental systems of thought became conceptualized in the West, and in such form influenced prominent scientists and philosophers, who in turn propagated that credo. Thus, one could even think that the asserted analogy is not but a social and cultural construct. However, others might point out that there is, indeed, a common, ancestral origin of such traditions. In fact, we are dealing here with

cosmologies that are expressed in Indo-European languages or have been developed by populations characterized by a continuous, mutual cultural exchange.

As for the present paper, we shall take an agnostic approach on this dilemma. We shall start with the minimal assumption that there is an analogy about a "Unified Vision of Everything" between Modern Physics and Indian philosophy – no matter if this is a socio-cultural construct or a real analogy. Then, we explore the significance of the analogy in itself and try to see where this coherently will bring us. In particular, we discuss a unified vision of Everything through analogies between the Vedic tradition and the evolution of Cosmology and Particle Physics. In doing this, we shall treat Vedic texts and myths only with regard to their cosmological/cosmogonic content, leaving aside questions about other possible meanings, such as moral, spiritual, symbolic, etc.

1. The unification trend in Physics

The trend towards a unified physical world picture is a long-standing one in Physics. Still, the search for unity has manifested itself in many different ways in the course of time and has sometimes brought to dramatic controversies. In fact, approaches that attempt to unify the multiplicity of the views in accordance with some common principles seem to face serious problems, since different theories of unity may disagree about what needs to be unified. For example, it is not the same to wish, with Newton and the Newtonians, that any natural process can be derived from central forces (Newton, 1687: 382-383) or to expect, with Ostwald (1892, 1902), that in due time every phenomenon in nature will reveal itself as an energy exchange.

Here we are not faced with two different unifying principles (forces against energy); rather there is a difference in kind between these two attempts. Newton did not maintain that nature was the expression of a unique underlying physical entity, the force (putting *energy* in place of *force*, this was, in fact, Ostwald's position), but that all phenomena at least in the non-living domain – gravitation, electricity, magnetism, light, chemical affinities, etc. – display an identical mode of action, thus can be investigated according to the same principles. Of course, in singular cases, the mathematics of the laws might be more complicated than for Gravitation, with forces not obeying the inverse-square law. To discover their exact ratios as well as their carriers (which might well be different) was matter of experimental physics; but essentially, in every case, we are dealing with *central* forces, all of them being proportional to the product of the quantities at play and inversely proportional to some power of the distance.

In a certain sense, this strategy – that we call *epistemic unification* – is a minimalistic approach, because it does not require that the fundamental entities a theory deals with (in this case, forces) are ontologically the same. Epistemic unification only mandates that they obey the same laws or principles, without guessing about their nature. Other attempts, such as Ostwald's, are more ambitious. Explicitly or implicitly, they require that all entities in nature are reducible to the same underlying *thing* – therefore, an appropriate name for this tendency could be *ontic unification*.

2. Epistemic versus ontic unification

It is not difficult to find appropriate examples of both efforts throughout the history of physics; they can be conceived as two poles on the same continuum, so that every theory of unification can be located at some point along the line between epistemic and ontic unification, and every theory can be said to be *more* or *less* ontic/epistemic regarding unity than another theory.

Only in rare, extreme cases we shall be faced with a completely ontic unification; in rare cases as well, we shall be confronted with theories of mere epistemic unification. In most cases, however, we have to do with mixed strategies that locally aim at an ontic unification of something but are globally committed to an epistemic form of unification or are incomplete attempts of ontic unification.

The combination of the classical theory of electromagnetism with classical gravitation provides a good example of a mixed ontic-epistemic strategy. According to the field-theoretic picture of Faraday and Maxwell, electricity and magnetism can be described as perturbations of space; such perturbation is what we call the electromagnetic field, an entity that is independent from the nature of the charges (electric or magnetic) that have produced it. Electricity and magnetism can therefore be conceived as different phenomenal manifestations of the same basic entity: the electromagnetic field, completely described through Maxwell's equations. This unification has therefore an important ontic character. On the other hand, according to the Newtonian viewpoint gravitational force is generated by masses and varies from point to point. So, we can describe the "gravitational field" as a physical quantity excited by the mass distribution, in analogy with the description of a classical electromagnetic field, with the important feature of both having the same $1/r^2$ force law (for electrostatic and gravitational fields). We produce, therefore, a kind of unified description that depends on the similar epistemic structure of the two theories (the same dependence from the distance of the sources of their respective fields). But this is by no means an ontic unification, being electromagnetic and gravitational fields two very different entities. In other words, we have a partly unified description that depends on the epistemic structure of our theories and not on the nature of the processes they describe. Moreover, with the emergence of general relativity as a deeper theory of gravitation, even this epistemic analogy was lost and Gravitation is nowadays the main example of a fundamental force being very different, also epistemically, from the other fundamental (quantum) fields: quantum electrodynamics, strong and weak nuclear Force.

In general terms, identity of formalism may hint at identity of nature – it could be that we are able to describe different things with the same formalism because, in truth, the difference is not but apparent and the things we are describing are, at some more profound level, the same thing. If this is the case, pursuing further the process of epistemic unification we can gradually extend the unification to the ontic level.

3. The Standard Model as a developing ontic unification

Following a period of proliferation in the discovery of subatomic particles during the 1950s and 1960s, as well as of theories describing them, the following decades marked the rising of the Standard Model (SM in the following). The SM is a quantum field theory based on local gauge invariance (Aitchison & Hay, 2013): mathematically expressed by means of a quantized Lorentz-invariant Lagrangian formalism. The SM organizes the fundamental particles into *fermions* (quarks and leptons, with spin ½) that interact exchanging *gauge bosons* (with spin 1), and *a scalar field*, called the *Higgs field*. The SM describes three of the four fundamental interactions that modern physics deals with, namely the weak, the electromagnetic, and the strong interactions, whereas gravitation remains the domain of general relativity, which describes it as the curvature of the space-time.

By the beginning of the 1970s, consensus was increasing that all three quantum interactions could be described by gauge quantum theories, and, in addition, based on the Glashow-Salam-Weinberg model (Weinberg, 1967) another unification was emerging – this time between

weak nuclear and electromagnetic interactions. Starting from a general idea of epistemic unification, the so-called electroweak theory was found to describe a complete quantum field, having full ontic status. The success of the unification of weak and electromagnetic forces culminated with the discovery of Z,W bosons in 1981 (Arnison et al., 1983) and the proof of the renormalization of the electroweak theory ('t Hooft, 1971). This generated the current modern view of fundamental forces, with two relativistic quantum fields (strong nuclear and electroweak) plus gravitation.

This remarkable road to unification is based on the key idea that interactions are unified at high energies – in the electroweak case, above the Z mass. From a symmetric high-energy state, properties typical of the electromagnetic interaction on the one hand, and the weak interaction on the other hand, emerge at some point when the energy decreases. This happens because of a mechanism called "spontaneous symmetry breaking", a property of theories in which the ground state does not show the symmetries of the full Lagrangian. This idea, inspired by the case of superconductivity, was advanced by Nambu & Jona-Lasinio (1961) and then applied to the SM (and its gauge invariance structure) by Higgs, Brout, and Englert (Higgs, 1964; Brout & Englert, 1964): it is generally called *the Higgs Mechanism*, predicting the existence of an observable Higgs particle. The experimental confirmation of the electroweak unification and the Higgs Mechanism came with the already mentioned discovery of the Z,W massive bosons in 1981 and with the observation of the Higgs particle in 2012 (Aad et al., 2012).

To appreciate how the unification process happened, let us abstract from the historical circumstances of how theories and models were formulated and present the situation in a somewhat simplified form. Let us imagine the two theories – one describing electromagnetic interaction, the other one for the weak interaction – each one being consistent as itself but having little to do with the other. They describe different processes, which, however, superpose and influence one another, so a unified description would be desirable simply by Occam's razor. However, these theories can hardly be joined together. Our theory for the Electromagnetic interaction (Quantum Electrodynamics, QED) preserves, in fact, a very important symmetry, called "local gauge invariance" implying that the photon, the carrier of the electromagnetic interaction, has zero mass. On the contrary, the mediators of the weak interaction (The W and Z bosons) are known to be massive. However, the Higgs mechanism outlined above suggested a way to overcome the difficulty: this is a mechanism that let emerge massive quanta from zero-mass states, while preserving gauge invariance.

In order to better illustrate the meaning of the electroweak unification, let us come back to the Newtonian distant action law as it was conceived in the eighteenth century. According to Newton's law two masses attract one another in a manner which is directly proportional to their product and inversely proportional to the square of their distance. This law can be (and in fact was) applied to electricity and magnetism as well: charges and poles at rest also attract (and repel) in the same manner. However, electricity, magnetism, and gravitation are ontologically different: they behave according to the same law, but there were no mechanisms behind them that could "transform," e.g., an electrical process *as described in Newtonian terms*, into a magnetic or a gravitational one. Therefore, in spite of the fact that we can use analogous theoretical tools (e.g., an inverse-square law), the electromagnetic and the Newtonian gravitational field remain different in nature.

In this regard, the Standard Model is essentially different: in the case of the electroweak unification, electric and weak charges are linked (by the so-called Weinberg angle). The electroweak Lagrangian therefore represents a single theory, indicating a unique electroweak

field *in the things themselves*, a state which, via a certain mechanism (when the energy is lower than the Z,W masses) effectively develops in two apparently different interactions: the weak nuclear and the electromagnetic. In other words, in the case of the electroweak interaction, the achieved *epistemic* unification is the consequence of an original *ontic* unified state.

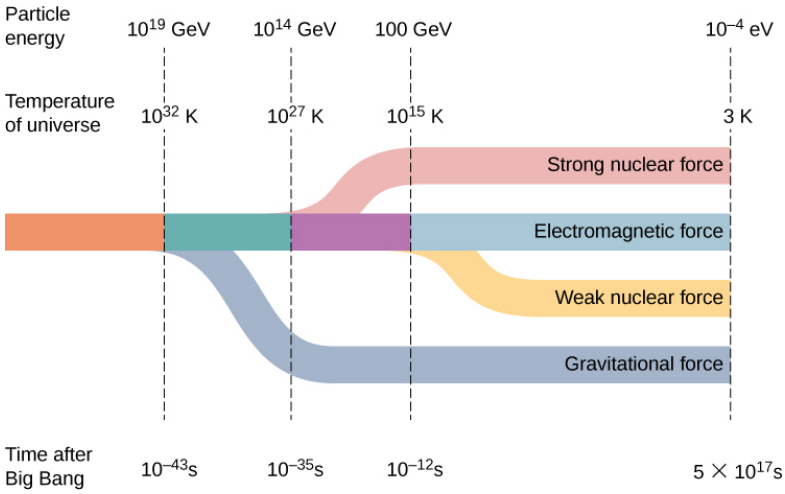

Figure 1. Interplay between fundamental forces during the evolution of the Universe, according to the most commonly accepted view. Starting from a single unified initial field, the first breaking involves Gravitation and a force acting between 10^{-43} and 10^{-35} seconds of cosmic time, called "the Grand Unification Theory", or GUT force. Other breakings of symmetry follow as the energy of the Universe is decreasing: the field that unifies weak and electromagnetic forces, between 10^{-35} s and 10^{-12} s is called Electroweak field. This last unification has been experimentally demonstrated in modern physics, as discussed in the text. (From Physics LibreTexts, Chapt. 11.8: Evolution of the Early Universe, https://phys.libretexts.org/@go/page/4956, retrieved September 10, 2021.)

4. Unification next

According to current understanding, we can assume a fundamental physical description of the particle universe based on the *two* quantum fields of electroweak and strong nuclear interactions evolving within space-time as described by general relativity. In addition, we have several candidates for more profound unifications comprising the strong and the gravitational interactions. However, we neither have a (viable) "Grand Unified Theory" of the strong and the electroweak interactions nor we have a so-called "final" Theory of Everything, for all interactions. In other words, we have three different field theories. Two of them describe two specific quantum fields (strong nuclear and electroweak), whereas a third one – general relativity – covers gravity.

We shall not discuss current attempts at grand unification theories or the candidate theories of Everything. We limit ourselves to note the crucial aspect in both attempts: the high-energy scale needed in order that ontic unification could possibly occur. In this respect, the need for high energy is twofold:

1. One should get rid of all the possible symmetry-breaking structures of the vacuum (or the ground state) to appreciate the full symmetry of a theory.

2. Increasing the energy reproduces the conditions that prevailed at the very beginning of the Universe, where symmetry was probably the highest and therefore offers a window on a fundamental aspect of all that exists. A window on the primal cosmogonic event that created our Universe.

Again, in this process, we can conceive a unifying mechanism by virtue of which we could recover a fundamental, highly symmetrical state. A state in which all was a non-differentiated Whole, governed by one sole theory featuring multiple spontaneous symmetry breakings during the evolution of the Universe, allowing to gradually step out from the whole and let the One develop into the Many.

The general tentative idea of how this happens throughout the history of the Universe is presented in Figure 1: the starting point is the creation instant when interactions are unified: it is the so-called Planck era, when the cosmic time was of less than 10^{-43} sec, also called quantum gravity era. At this time, we conjecture that the many fields were One. After this time, Gravitation and a Unified quantum field differentiated, making the one-two (gravity and the "Grand Unification Theory," GUT field).

At cosmic time 10^{-35} s, the GUT field in turn differentiated into the strong and the electroweak fields – another breaking of symmetry. The energy at that time was an amazing equivalent temperature of 10^{27} K, sufficient to maintain the electroweak unification, so that there were three field: gravitation, strong and electroweak.

Then again, because of the cosmic expansion, the energy (temperature) decreased, and reached, at 10^{-12} s, a temperature equivalent to the energy of the W, Z masses. At that point, the electroweak symmetry started to break, manifesting the four fundamental fields that we experience in our "everyday Universe": gravity, strong nuclear, weak nuclear and electromagnetism. In other words, the story of Physics fundamental fields is a story of broken symmetries that generated the Many from the One.

Therefore, the combination of modern cosmology and quantum physics provides a description of how from a single unified field, the plurality of fields characterizing our Universe emerged (and it also offers a general narrative of how that one initial state has transformed into the many fundamental particles of which the Universe is composed, from quark and leptons to the atoms).

5. Matter-antimatter asymmetry in the Universe

Typical of modern quantum field theories (like the Standard Model) is that every ordinary particle has its own antimatter partner, i.e., an *antiparticle* that is identical to the *particle* except for its discrete quantum numbers (like the electric charge; a typical example is the electron and its partner, the positron, with the same mass and opposite electric charge). Our Universe, however, appears to be entirely made of matter particles. No significant amount of it appears to be made of antiparticles: no anti-planets, no anti-stars, no anti-galaxies. Antiparticles are in fact very rare: they are produced by processes occurring in particle accelerators or in radioactive decays or by some high-energy cosmic ray accelerators. In addition, matter and antimatter cannot be easily handled together: when a particle and its own antiparticle partner collide, they annihilate producing radiation.

The Standard Model and the current cosmological picture are therefore facing the problem of explaining why matter dominates over antimatter, in fact, one of the major unsolved problems in Modern Physics. The most widespread explanation, in accordance with both the Standard Model and most cosmological models (Peebles, 1993), is that in the first

picosecond after the Big Bang, two mechanisms called *baryogenesis* and *leptogenesis* took place generating a slight asymmetry between and antimatter. For this asymmetry to form, three conditions – called the Sakharov conditions (Sakharov, 1967) – need to be satisfied:

1. A non-zero CP violation.
2. Baryon number conservation violation.
3. Interactions taking place out of thermal equilibrium due to rapid cosmological expansion.

The first two conditions refer to features of the Standard Model (they are *quantum* conditions), while the third one compares the rate of the microscopic reactions to the rate of cosmological expansion (being therefore a *quantum-cosmological* condition). These conditions could make it possible to explain (within the current theoretical frame) how, during primordial matter-antimatter annihilation, a minuscule particle-antiparticle asymmetry (at the scale of one part out of 10^{10}) was generated.

While this model is not fully substantiated with evidence (the amount of detected CP violation seems not sufficient to explain the cosmological effect), it provides a consistent framework connecting our current understanding of cosmology and particle physics. According to this view, the matter-antimatter asymmetry has been produced starting from a single, otherwise highly symmetric state. And it was this tiny asymmetry, this *residue*, that triggered nucleosynthesis and the various steps towards the formation of more and more structured and complicated material aggregates, from hydrogen atoms to stars and planets – among others the Earth with all its inhabitants. All made up of matter particles, coming from that residue.

6. The Inflationary Universe

The other key element that we will consider is the mechanism of Primordial Inflation, proposed by A. Guth, A. Linde and A. Starobinsky (Guth, 1998), also known as the Inflationary Hypotesis.

The Inflationary hypothesis solves important problems in Modern Cosmology, such as the Flatness, the Horizon and the Isotropy problems; without going into details (for which see Peebles, 1993), these problems generally emerge from observing equal properties of regions of the Universe that have never been into reciprocal causal contact. Therefore, without Inflation it would not be understandable how the Universe had reached (for instance) the present global flatness as well as its amazing level of isotropy.

While the detailed particle physics mechanism responsible for Inflation is not known, the hypothetical quantum field considered to be responsible for it, is called the Inflaton. This field features a slow-roll dynamics evolving on an almost flat potential from 10^{-36} to 10^{-33} seconds of age of the Universe. At the end of this stage, the field dissolved itself converting all of its residual potential energy into what is actually considered the beginning of the Universe: the Big Bang of energy and elementary particles.

It is generally accepted that the Hot Big Bang Model with the supplement of the Inflation (and dark matter and dark energy, see Mukhanov, 2005) is able to explain the known characteristics of the current Universe, to the point that this combination is frequently called the Standard Cosmological Model (Guth, 1998). And the initial conditions of this model include the dissolution of the Inflaton field. Its "self-sacrifice" to produce the Big Bang.

As we shall notice, the process of evolution and dissolution of the Inflaton field offers a powerful analogy with Vedic knowledge. In addition, that same dissolution could possibly

not be complete: a residual, exceedingly small remnant of the Inflaton field could explain the value of the Cosmological Constant responsible for the dynamics of 70% of the Universe: the so-called Dark Energy (Mukhanov, 2005).

7. Subject-object separation and Quantum Mechanics

If the unification trend in fundamental Physics is one of the pillars of our analogy, the other one (or another epistemological "lesson" from Modern Physics) is related to the exquisitely quantum mechanical effect that is popularly known as entanglement – actually, a close consequence of the superposition principle and the microscopic measurement process.

Quantum Mechanics in itself has a long history of being perceived as in contrast with the commonsense ansatz of local realism; in fact, since its very construction, this theory was subjected to a variety of historical criticism, culminating with the famous EPR paper (Einstein, Podolski & Rosen, 1935). While this subject is under perennial debate, there is a general consensus about Quantum Mechanics not being in agreement with the so-called realistic paradigm of a reality independent from the observer (Baggott, 2004). This is because of the formalization of local realism in terms of the Bell's Inequalities (Bell, 1987) and the subsequent demonstrated violations of such inequalities, starting with the famous Aspect experiment.

These characteristics of the theory are connected with its mathematical structure, for instance the very concept of wave function. Since the wave function lives in an abstract configurational space (and not the ordinary space), it automatically tends to interrelate different spacetime points, a statement which is true also in relativistic Quantum Field Theory. Because of these reasons, we accept the ontic hypotesis (at the quantum mechanical level) of the existence of physical quantities independently from the measurement process.

While other approaches can be considered (Aspect et al., 1982), it is our viewpoint that decoherence (Joos & Zeh, 1985) is the main mechanism to elegantly bridge the gap between the micro and the macroscopic-objective world, also basically solving what is generally called the measurement problem. In this view, at the fundamental level reality does not allow subject-object separation and also encompasses every observer's view (as a consequence, as many Theories of Everything as there are observers might exist). Decoherence then produces (through the reduction to diagonal of the density matrix) what is perceived as the commonsense world at the macroscopic level.

This subject-object non-separation at the fundamental level is, in our view, the most important lesson – at the same time epistemological and ontological – of Quantum Mechanics.

8. Indian Philosophy as a trend toward the One

Our current theories of Particle Physics and Cosmology describe the physical story of the Universe: at the very beginning (until 10^{-43} seconds) all was undifferentiated matter-energy in a superdense state (see Fig. 1); then a process of separation took place, symmetries got lost and fields (forces) as well as matter and antimatter became separated. As illustrated in Fig. 1, after the first picosecond of cosmic time, four forces emerged as independent fields, the ones that are in action today in our everyday life. The story of the Universe after these first stages has continued for about 13.8 billion years, through the generation of stars, galaxies and planets. And life itself.

In addition, during all these stages of evolution, a vast number of structures have been formed, from planets to forms of life, where the original quantum imprint was lost and classicality (and apparent realism) emerged. While we live in a mostly "decohered" world,

the pre-existence of entangled predominant non-separated quantum states in the Universe seems an unavoidable conclusion. Likely, the cosmological evolution of the Universe has proceeded from a fully entangled state to a level of higher and higher decoherence, and the current present Universe generally shows an apparently "realistic" and "decohered" structure. Leaving of course entanglement and quantum mechanical effects at the level of atomic and subatomic processes.

We emphasize here that there are *structural analogies* between these concepts of Modern Physics and specific traditions in Indian philosophy: concepts that are different by nature but hold the same functional position in their respective systems. What is the reason of these analogies, or whether there is one or more reasons, is unclear and we do not intend to advance hypotheses. For the purposes of the present study, we content ourselves to claim that very different cultures have envisaged a similar problem: to explain how the many forms composing the world can be generated from a single, non-differentiated primeval state.

First of all, subject-object (non-)separation holds true also in many traditions of Indian Philosophy, where the divide between the two is relegated to the role of an illusion, for which Arthur Schopenhauer coined the expression *veil of maya*. This is what hides deeper levels of reality where the two sides of cognition process (subject and object) are just one (Jones, 2014). According to many doctrines in Indian Philosophy, such a pristine state of unity can be re-enacted through practices such as meditation aiming to (re)join the individual Self with the ultimately, impersonal Real – the ātman with the *Brahman*, as they are conceptualized, e.g., in the *Upaniṣads*. Of course, there are such things as individual consciousness, the ego, personal thoughts and volitions, perceptions, etc. However, they are conceived as attributes that have emerged in the macroscopic world for factual reasons. As noted by Banerjee and Chatterjee:

> At the heart of Indian views with regard to the character of internal states, lies its understanding of the temporal scales associated with conscious experience … We can thus classify properties into 'fundamental' which are relevant across all [temporal] scales and 'derived' as those pertinent within a circumscribed temporal regime. Thus, (as per the Abhidhamma or Buddhist sources) consciousness (*viññāna*), volition (*cetanā*), psychic energy (*jīvitindriya*), feeling (*vedanā*), perception (*saññā*), emotional formation (*sankhāra*) and attention (*manasikāra*) are fundamental universal properties of all internal mental states regardless of the duration for which they exist, while other derived 'macroscopic' attributes such as notions of self ('I') or ego, full blown perceptual objects, thoughts by way of words and images only appear within certain temporal limits …This goes to clarify several sources of confusion in Indian systems. For example, when Buddha uses the term *anātman* 'no self', it does not mean that categorically and absolutely there is no such thing as an 'I' or ego. This would indeed make a travesty of even our everyday experiences which are definitely centered about an 'I'. It simply means that Buddha is describing a conscious cognitive process at a temporal level which is no longer supportive of an experience of 'self' and all such notions of 'I' and 'mine' have lost all practical relevance. (Banerjee & Chatterjee, 2020: 5-6.)

This, of course, does not amount to say that recovering unity is the only purpose of meditation, nor that there are no differences between traditions, schools, and phases in Indian thought (Harrison, 2019; Ganeri, 2017; Newcombe & O'Brien-Kop, 2021). However, "the unanimous view of all Indic systems appears to be that all internal states are by default conscious states or can be made conscious states" (Banerjee & Chatterjee, 2020: 5). Seen in this light, meditative techniques are means in order that what appeared unconscious can be brought into the realm of consciousness.

The re-enactment of a primordial Unity does not only concern consciousness – no matter if this is conceived as a mental state (like in the quote above) or as a "pure" substance of its own. It is also involved in Indian cosmology as this is expressed, e.g., in the Hymn of Origins of the *Rg-Veda*: "There was neither non-existence nor existence then; there was neither the realm of space nor the sky which is beyond … / There was neither death nor immortality then. There was no distinguishing sign of night nor of day. That One breathed, windless, by its own impulse. Other than that there was nothing beyond." (Maṇḍala 10.129, in Van Nooten and Holland, 1994: 554/25; see also Jones, 2014). In fact, these are tightly interrelated aspects.

A crucial concept is that of Vedic Sacrifice (*yajña*), a kind of worship that usually occurs in the form of offering oblations to the Gods in front of a sacred fire, often with the aid of *mantras*. According to the *Śruti* and the *Smṛti*, the system of *yajna* was given by the God(s) at the beginning of the world to human beings and deities like Indra, Agni, Varuna etc., as a link between them. The human beings were to satiate the gods through the sacrifices and the gods in return, would bestow, on them, rains, food and other things, needed for their prosperity.

The rituals of *yajna* (Potdar, 1953, esp. chapter 3) can be conceived as a mechanism to relate the realm of mankind with that of deities. In this sense they are, first of all, a re-activation of the primordial sacrifice through which all has been created. According to the early Vedas ("Hymn to Puruṣa," *Rg-Veda* 10.90), Puruṣa was a cosmic being that offered himself in *yajna* to (or was sacrificed by) the gods. He is said to have "a thousand heads, a thousand eyes, a thousand feet", where these metaphoric gigantic proportions indicate that he is all that there is: Puruṣa is "all this, whatever has been and whatever is to be", therefore he is also "the ruler of immortality". His cosmic body joins the immortal domain with the mortals, since "all creatures are a quarter of him; three quarters are what is immortal in heaven". Even from the "one quarter of him still remaining here … he spreads out in all directions". In the verses, Puruṣa is sometimes referred to as "the sacrifice", meaning both the sacrificial victim and the act of scarifying (see esp. verse 16: "With the sacrifice the gods sacrificed to the sacrifice"). The sacrifice was performed by the gods and consisted in the dismemberment of Puruṣa, whose effects are described in vv. 11-14:

> 11 When they divided the Man, into how many parts did they apportion him? What do they call his mouth, his two arms and thighs and feet?
> 12 His mouth became the Brahmin; his arms were made into the Warrior, his thighs the People, and from his feet the Servants were born.
> 13 The moon was born from his mind; from his eye the sun was born. Indra and Agni came from his mouth, and from his vital breath the Wind was born.
> 14 From his navel the middle realm of space arose; from his head the sky evolved. From his two feet came the earth, and the quarters of the sky from his ear. Thus they [i.e., the gods] set the worlds in order. (Maṇḍala 10.90, in Van Nooten & Holland 1994: 531/29)

The primordial sacrifice also functions as an archetype for any future ritual sacrifice (verse 16: "These were the first *dharmas*", here in the meaning of ritual laws. See, e.g., vv. 6-8: "When the gods spread the sacrifice with the Man as the offering, spring was the clarified butter, summer the fuel, autumn the oblation / They anointed the Man, the sacrifice born at the beginning, upon the sacred grass.)

In the sacrificial practice, *yajna* is carried out in various forms. It generally takes place in a space where an array of sacrificial fires are set up to ritually burn food and beverages (*agnihotra*). Combustion, or maybe the symbolic consumption of the food offered in oblation,

produces what is known as *úcchiṣṭa* (the residue), originally a Sanskrit term meaning the leavings after a certain process has occurred (particularly after a meal). As pointed out by Gonda (1975), *úcchiṣṭa* is conceived as preserving and potentially transmitting the powers of its producer, e.g., the Brahmin performing the sacrifice, the eater of a meal, or the substances themselves of which a particular *úcchiṣṭa* is the remnant. Thus, this concept plays a remarkable role in ritual as well as in everyday life of a Hindu. Whether the *úcchiṣṭa* has wholesome or harmful and "contaminant" influence depends on the relation between its producer and its consumer. Whereas the leavings of food eaten by a guru are beneficial to his followers, the opposite is generally considered harmful; the *úcchiṣṭa* of a sacrifice is beneficial insofar as it transmits the powers of the sacrificed to their users. This profound meaning is included in Hymn 7 of Book XI of *Atharva-Veda*, commonly interpreted as a praise for the remnants of an oblation:

> 1. In the úcchiṣṭa [are set] name and form, in the úcchiṣṭa [is] set the world; within the úcchiṣṭa both Indra and Agni, Everything is set together.
> 2 In the úcchiṣṭa heaven-and-earth, all existence is set together; in the úcchiṣṭa the waters, the ocean, the moon, the wind is set.
> 3 In the úcchiṣṭa [are] the being one and the non-being one, both, death, vigor, Prajapati; they of the world (*lāukyá*) are supported (ā-*yat*) on the úcchiṣṭa (AV. 11, 7, translated in Whitney, 1905, v. II, p. 643).

This eulogy follows a series of hymns extolling food in the ritual sphere and is tightly connected with the previous Hymn 3 from the same book. Here, the sacred rice-dish is told to contain the earth and the heavens, sun and moon, waters and winds, animals and vegetables (AV 11, 3, translated in Whitney, 1905, v. II, esp. p. 626). On the other hand, the above-quoted Hymn 7 has been brought in connection with the cosmogonic hymn of *Rg-Veda* 10.90 (Scherman, 1887; Deussen, 1920), where – as we have seen – Puruṣa is sacrificed in order that the world would be generated.

Despite the variety of interpretations and discussions that the two hymns have raised, commentators old and new, agree that they point to a unique quality of Vedic Sacrifice. This is seen – in accordance with following the so-called non-dualistic tradition (*Advaita Vedanta*) – as a means to recovery unity after the "fracture" that created Multiplicity from the One. From the Hymn to Puruṣa, we can extrapolate that *yajna* does not only follow oblation norms in order to earn gods' favor, rather it is a re-enactment of the primeval sacrifice through which the world in its colorful multiplicity has been created from an original state of unity in the one body of Puruṣa. Similarly, in the Hymn to the úcchiṣṭa we are told that in it all is one. Moreover, in that context *úcchiṣṭa*, the residue, acquires a cosmogonic/cosmologic value. On the one hand, *nāmarūpa* – rendered in the first verse as "name and form" – is the principle governing the formation of the individual, empirical substances; according to the Śatapatha *Brāhmaṇa*, an important commentary to the Vedic texts, the impersonal *Brahman* was able to descend again into the world through "name and form" (Stutley & Stutley, 1997: *ad vocem* "Nāman"). On the other hand, deities that are frequently associated with cosmogonic qualities are mentioned. In the above-quoted verses we find Indra, the combative lord of gods connected with strength and generative power; Agni, the god of fire related with ritual sacrifice, whose praise opens the *Rg-Veda*; and, most of all, Prajāpati, "the lord of creatures" who, similarly to Puruṣa, created the Universe through its own dissolution (Calasso, 2010) due to the *tapas*, the internal heat that is commonly conceived as being produced through ascetic practices.

9. Indian Philosophy and Modern Science: Analogies

It is now possible to clarify the main analogies between the history of the Universe (and ourselves) as told by Modern Physics and the one envisaged by Indian philosophy. The concepts of Vedic Sacrifice, the Residue and the Progenitor (Prajapati), will be – one by one – the subjects of our analogies.

9.1 The multifarious Universe from the One

The first (and the more general) is a *structural* analogy that develops itself along the history of the Universe. Since Indian Philosophy is a *Weltanschauung* of Unity, once the "veil of maya" is lifted, the deeper levels of reality (accessible by means of mystic or meditational experiences) becomes evident. There is therefore a parallel between this approach (by definition, an ontic unification) and the Unification of Forces that Modern Physics is patiently re-constructing by the means of increasing the energy in dedicated experiments.

The Vedic Sacrifice (*yajña*), discussed above, is the tool to re-construct (re-enact) the non-dual *Advaita* nature of reality by playing a role that is analogous to the Unification Theories of Particle Physics. The Universal Cosmogony and subsequent evolution consist of a story of separation among all things that were originally One. According to this view, a structural analogy is in place, leading to a common ontological description of Reality and us. The very origin of the Universe is from an undifferentiated One; this initial perfect symmetry is then broken into a multiplicity. This same story, however, can arguably be recounted in many ways, out of which we selected two, pertaining to two different traditions. On the one hand, Quantum Field Theory describes the multiplicity of particles (fields) emerging from that primordial state of unity that can be (conceptually) recovered through high-energy physics and the formulation Grand Unification Theories and the Theory of Everything. On the other hand, religious practices like Vedic Sacrifice aim at re-enacting, in the innermost life of the initiated, the pristine state of unity from which the Universe and all its individual existences was born.

This main structural analogy is also substantiated by two more specific analogies, that we call *functional* in character: the one between the Residue of the Sacrifice and Matter/Antimatter asymmetry and the one between the Dissolution of Prajapati and the role of the Inflaton field.

9.2 The Residue of the Vedic Sacrifice and matter-antimatter asymmetry

All that we know that is related to life in our Universe comes from what remains out of the primordial annihilation during the first second (more precisely, the first picosecond!). From the physical viewpoint, this residue is the imbalance between Matter and Antimatter that we described in Section 5. The realization of Sakharov conditions combined with the Physics in the early Universe produced the one-tenth of a billionth residue that is all the life-sustaining matter that we know about today.

This bears a striking *functional* analogy with the "úcchiṣṭa set the world" that we discussed in Section 8. The úcchiṣṭa, the Residue of the Original Sacrifice, therefore bears the fruits of the producer: by surviving the annihilation of all particles into radiation in the first picosecond of existence of the Universe, it is the generating principle of life. We therefore live in an Universe that was burnt as a Sacrifice almost 14 billion years ago. And we appear to be precisely this very tiny Residue.

9.3 Prajapati and the Inflaton

As we have seen, Vedic Cosmogony involves an original self-sacrifice of the Progenitor: Prajapati dissolves itself and from its decomposition the Universe comes into light. There is clearly another *functional* analogy between this powerful image and the dynamic of the Inflaton, the quantum mechanical field that has been proposed as the "generator" of the very conditions of what we call "The Big Bang" (Mukhanov, 2005).

Prajapati and the Inflaton play the same *functional* role of generation of the dynamics of the Universe: from Prajapati's mouth Agni – the God of Fire – comes, at the sound of the primeval Om syllable. Similarly, after the Inflationary Mechanism, the Inflaton dissolves itself by generating the Fire of the Big Bang, with all its elementary particles and their energy.

Conclusion

Modern Physics and Indian Philosophy speak different languages, which bring, following different lines of development, to similar epistemological consequences. The analogies we have presented are several:

1. The research for a Unified Field at high energy has a functional structure similar to the Unity concept embedded in Vedic philosophy and the Vedic Sacrifice.
2. The Residue of the Sacrifice bears a functional structure similar to the CP-violating baryogenesis and leptogenesis that generated matter (*not* antimatter) as the predominant form populating the Universe.
3. The dynamics of the Inflaton field is functionally analogous to the dissolution of Prajapati in the Rg Veda creation.
4. Even the Cosmological Constant (which contains about 70% of the current energy content of the Universe) bears a similarity with Vedic Cosmogony: it could be another form of Residue of the Sacrifice of the Inflaton field which generates the Big Bang.

We therefore suggest that these structural and functional analogies strongly indicate that modern physics is pointing to the direction of the fundamental truth expressed by the ancient Indian tradition. The Unity of Everything.

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