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LAOZI AND QUANTUM PHYSICS

info@shantena.com, www.shantena.com

Anima mundi

The mind frame of ancient and traditional cultures has been described by the French anthropologist Levy-Bruhl as *participation mystique* (mystical participation): that is a state of mind in which the 'I', the individual identity, does not have sharp boundaries, but is merged with its environment so that consciousness and world are deeply intertwined (Lucien Levy-Bruhl, *La Mentalité primitive*, Alcan, Paris, 1922.). In these worldviews, consciousness is not an exclusive attribute of the thinking subject: it permeates everything, it belongs everywhere. The whole world is animated; it has an *anima*, a soul. In ancient Greece, e.g., springs were nymphs, trees were dryads, winds and rivers had their specific gods, etc.

In these cultures every act of everyday life, hunting, gathering, cooking, building a shelter, implies entering into relation with various forms and shapes of consciousness, entering a dialogue with the other, where this other is just as alive and conscious as oneself.

Therefore, e.g., it is essential for the hunter to talk to his prey, not just to kill it, but to win it over as food to nourish his and his family's life, just as their life one day will be food for other forms of life. In this way of looking at the world, every act of daily life is sacred: every act partakes of the awesome mystery of the circle of life. The human subject is immersed in a circle of life, which is felt as ultimately much more real than one's individual existence.

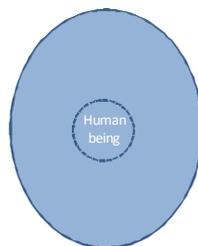


Figure 1: Anima mundi. In this and in the following pictures the large oval represents the cosmos and the blue color represents consciousness or mind. In primitive cultures consciousness permeates the whole world and the boundaries of

the "I" are permeable (dotted line): there is no sharp separation between I and world.¹

Descartes and the separation of mind and matter

While the history of the separation of the I from the world that characterizes modern consciousness is long and complex - it is the history of our culture - it may be convenient to focus just on one particular turning point, the Cartesian separation of mind and matter, which deeply influenced the development of scientific thinking in the following centuries.

Descartes tackled philosophy in what we might call a scientific perspective. Science was then beginning to take its first bold steps, and the contrast between the progressive accretion of scientific work and the eternal reworking of the same fundamental problems by philosophy must have been already evident to an inquisitive observer. Descartes set himself the task of establishing philosophy on solid ground, of identifying a foundational statement that would be true beyond any possible doubt, and found the only inescapable evidence in his own thinking process. Nothing can be stated for sure about the external world. Nothing can be stated for sure about anybody else's experience. But the existential fact that in this very moment I am thinking, that is a certainty. "*Cogito ergo sum*" was Descartes' formulation: I think, therefore I am.

This withdrawal into the inner dimension of mind necessitated the introduction of a separate category for the outer world we apprehend through our senses. Descartes was therefore brought to consider two essentially different 'substances': *res cogitans*, mind, about which we have immediate and primary evidence, and *res extensa*, matter, the external world, about which we can only reason by inference based on the input of our sense organs. He considered characteristic of the first that it is not located in space, while the external world we apprehend as having a spatial extension, whence the name *res extensa*.

The scientific paradigm and reductionism

The Cartesian separation of mind and matter sealed the estrangement of the modern human being from the world, the isolation of the 'I' in its ivory tower surrounded by inert, insensitive, extraneous *res extensa*. Historically the most significant consequence of this split was that it became legitimate for scientific enquiry to focus entirely on the world of matter in order to discover its intrinsic laws, unencumbered by any metaphysical assumptions of a mental nature (e.g., Aristotle's idea that things fall because they are attracted to return to their natural place).

This endeavour occupied the scientists over the next three centuries, and they were remarkably successful at it. So successful in fact that by the end of the 19th century

¹ The figures in this paper are inspired by drawings done by Richard Tarnas in a lecture delivered at Eranos in 2008.

the *res cogitans* part of the Cartesian equation had become expendable. In the positivistic philosophy of science any intervention of 'life force', 'spirit', 'mind', 'consciousness', etc., in natural affairs became redundant, came to be considered as mere superstition. Mind, which was once Descartes' primary evidence, became an inessential addition on top of the closed universe of the *res extensa*.

The reductionistic paradigm keeps being the dominant one today, most significantly in the biological and medical sciences. In the neurosciences, e.g., it is commonly assumed that, once we will know all there is to know about the circuitry of the brain, we will have completely explained mind, or consciousness. In other words, all fundamental causal mechanisms take place at the level of neurons, synapses, etc. Consciousness is merely an epiphenomenon, a by-product of the material processes happening in the brain.

If the world is just inert matter, the whole world is there for us to plunder. But depriving the world of a soul eventually leads to human beings losing their soul also. Then human life loses meaning and our relationship to our fellow humans becomes purely instrumental: the objectification of the world translates into the objectification of other human beings. If the world is reduced to its scientific description in terms of measurable quantities, the relationships between humans also get similarly reduced. Money, as the general abstract measurement of all material exchanges, becomes the ultimate criterion of all human exchanges. The servant becomes the master: our own invention turns around and enslaves us.

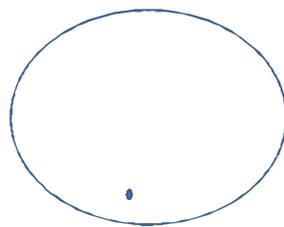


Figure 3: The modern world. Human beings are no longer at the center. Consciousness is only present in us (if at all, if it is not a mere epiphenomenon!) and it came about as a random outcome of purely biochemical processes. The universe is a vast inert assembly of matter devoid of ultimate purpose or meaning.

The quantum paradox

If demoting consciousness from primary evidence to a mere epiphenomenon of matter can be viewed as a first paradoxical development of Descartes' insight, the advent of quantum physics is a further turning point, of opposite sign and no less paradoxical nature. Because what happened is that by diving deep into the heart of matter, *res extensa*, exploring finer and finer levels of its structure, we finally were

forced to realize that... matter does not exist. Or, to state it a bit more cautiously: matter does not resemble at all our naive intuitive notion of it. At the micro level it behaves in wild ways. And, perhaps more importantly, there does not appear to be a neat separation between what we call matter and what we call mind or consciousness. The two are inextricably linked.

The history of this realization is complex and controversial. But once again it may be useful to focus just on one paradigmatic story: the story of the EPR experiment is a case in point. Its origin is linked with the Bohr-Einstein discussions in the 1930's. From the beginning experiments in subatomic physics had revealed the strange behavior of what physicists called 'particles', constituents of matter on a microscopic level. These microscopic objects could be in various places at once, could be in different states at once and exhibited an intrinsic uncertainty in their properties. They seemed to settle into a definite state, or a definite place, only when they were observed and as a consequence of the act of observation. Such a counterintuitive notion is not easily absorbed - and in fact it has not yet seeped into our day-to-day consciousness, it does not yet inform the way we think and act in the world. Some of the creators of quantum theory themselves had trouble accepting it. The most strenuous critic of the lack of realism of quantum physics was Albert Einstein, who for eight years carried on a lively debate with Niels Bohr, the main person responsible for the so-called "orthodox interpretation" of quantum physics.

In 1935 Einstein developed what he considered to be a decisive argument to prove the incompleteness of quantum physics. He devised a *Gedankenexperiment*, a thought experiment, that evidenced an implication of quantum physics known as 'entanglement', a special kind of 'action at a distance' between quantum systems that brought the counterintuitive aspect of the theory to its extreme consequences, leading to results that seemed manifestly absurd. This imaginary experiment, universally known as the EPR experiment, from the initials of Einstein and of the two colleagues, who signed the paper with him, caused quite a bit of trouble to Bohr and to the supporters of the orthodox interpretation.

The technical means available in 1935 did not permit to turn Einstein's thought experiment into an actual one, and the "EPR paradox", as it was sometimes called, lied dormant for about thirty years. In 1964 an elegant little theorem proved by the Irish physicist John Bell brought it back to the attention of the physics community. Bell's stroke of genius consisted in disregarding the physics of the experiment and focusing merely on its logical structure. He defined two essential characteristics of matter as it was conceived in classical physics (and in Einstein's thinking) as 'realism' and 'locality'. 'Realism' means that the results of observations performed on a physical system are determined only by the intrinsic properties of the system itself: if we know those properties completely, we are able to predict the result of any observation performed on the system. 'Locality' means that physical systems exist in space (Descartes considered this so central as to be the very definition of matter: *res extensa*). It must be possible to think of them as occupying a certain portion of space and interacting with other systems only through some kind of action - what physicists

call a 'signal' - propagating through space. By applying the assumption of realism and locality to the EPR experiment Bell was able to derive a certain constraint for the results. Such constraint is violated by quantum entanglement, therefore Bell's theorem provided a way to compare quantum physics with the requirements of a general local-realistic theory of matter. Quite surprisingly, an actual experiment promised to answer a philosophical question: is the world 'realistic and local'?

The experimentalists got hard to work to realize the experiment. It was performed repeatedly in the 1970's and finally and most cogently by Alain Aspect in Paris in 1980. The results fit the predictions of quantum theory perfectly and violated the constraint implied by locality and realism. What had appeared to Einstein so absurd as to manifestly discredit quantum theory turned out to be simply the way things are. Now we know that nature is not describable in local realistic terms. Our naive notion of matter (which is certainly local and realistic) does not apply on a micro scale. If we take locality and realism as definition of what we mean by a 'thing', the implication of Aspect's experiment is simply that the world is not made of things.

Of traces and reality

The next question that obviously arises is then why does the world appear to us as made of things? Why things appear to us as having intrinsic properties, being localized in space, behaving in all respects - except when we perform the cunning experiments of quantum physics - like the good old objects of classical physics? The problem raised by that question is technically known as the quantum measurement problem. It is still incompletely understood and opinions differ concerning the various proposed solutions. What I will say about it is therefore personal, it reflects the bias of my own work and would not necessarily be shared by all physicists. The phenomenon of quantum entanglement, although deeply challenging our intuitive picture of the world, is by now accepted as a fact by the physics community. People are even trying to build quantum computers based on it. But as soon as we come to the quantum measurement problem we are on much more controversial ground.

My understanding is that the problem is philosophically based. It arises from the Cartesian assumption that the world consists of two distinct substances, mind and matter. These two are actually inseparable, they jointly arise in the process of experience. What do I mean by experience? Within the entangled, inseparable quantum totality processes happen all the time that create correlations between subsystems. Some of these correlations enjoy a certain persistence, are recorded in some way, leave a trace. All our perceptions are like that. The trace can be thought of, e.g., as a neuronal state in our brain, the flickering of an impression or a memory. In quantum physics the trace would be a change of state in one of the systems involved in a 'von Neumann chain'. (A von Neumann chain would be, e.g. a micro system connected to a measuring device, connected to an amplifier, connected to a computer screen, connected to a printer - or to a human observer, etc.). From the point of view of physics the interesting point is the following: it can be shown that

the existence of a trace hides the entangled totality and makes it appear as a world endowed with objective properties.² But all our experiences of the world involve the formation of a trace, of a physical change in the world (experience happens within the world!).

Let me call an experience an 'atom of subjectivity'. But what I just stated above amounts to saying that the formation of a trace is also an 'atom of objectivity'. I.e. the observing subject and the observed object arise together in the act of experience. Before this coemergence, there is only the entangled totality: no subject, no object. In the act of experience a subject arises as 'experiencing the world' and an object arises as 'experienced world'. These two co-arise: mind and matter are co-extensive, two sides of the same coin.

Therefore, although quantum physics teaches us that the world is not made of things, the experienced world necessarily appears to us as made of things. About the world in itself of course nothing can be said. Quantum physics is only a model, a map. But what the model suggests about the 'unexperienced world' is interesting. It suggests that we cannot think of it by using the same categories that apply to the 'experienced world'. Indeed, we have no language to describe it. If we want to approach it, the metaphoric language of ancient wisdom comes closer to it than the objectifying language of our modern science.

Laozi and the Dao

Laozi's *Daodejing* is the foundational text of Daoism, dating to the sixth century BC according to Chinese tradition or to the fourth century BC according to modern scholarship. Its first chapter can be read as a lucid formulation of the co-emergence of subject and object from the primal totality that Laozi calls 'the Dao'. The emergence of a multiplicity of beings and things, standing in apparent isolation and objectivity, is what Laozi calls *ming*, 'naming': 'naming' is the mother of 'the ten thousand things'. This process of 'naming' can be understood at many levels: on a rather immediate level it can be taken to refer to the discursive mind, that reasons and analyzes and classifies and separates the undivided flux of experience. But it can be taken one step further, it can be taken to refer to the inevitable subject/object split that is implicit in the law of experience itself: by creating a trace, all experience in a sense betrays itself by creating the appearance of an objective world and of a subject contemplating it 'from the outside'.

As for the ultimate ground of reality, the Dao, the unnamed, it is ever present and ever unexpressible. It is 'unnamed' in a radical sense: it cannot be apprehended in terms of subject and object, in terms of mind and matter. But let us listen to what Laozi himself has to say.

² Shantena A. Sabbadini, *Persistence of Information in the Quantum Measurement Problem*, Physics Essays, March 2006, Vol. 19 No. 1, pp. 135-150.

***The Dao that can be told is not the eternal Dao.
The names that can be named are not eternal names.³***

On one level these first two verses say: all discourse is contingent, all representations are only conditionally valid, all prescriptive norms are relative. Whatever we can say about reality is only a map, and a map is not the territory. 'The territory', reality, is forever beyond the reach of any map we can draw, is forever beyond the speakable. Dao called Dao is not Dao. No name we can name is an eternal name. 'Name' here stands for all representations, it embraces the whole dimension of our effort to describe reality. Laozi says: names, representations, are all relative, contingent, they have meaning within the context of a certain universe of thought, they are effective in order to reach certain goals, they are goal-dependent.

But on a deeper level these two verses can be taken to refer to the process of experience itself, to the general 'law of knowing' as subjects embedded in the world. As soon as there is experience, subject and object arise. As soon as consciousness draws the distinction between self and not self, I and other, I and world, names are there, i.e. 'things' are born. The universe is a universe of things, of objects, because it is a 'named' universe. Things do not pre-exist consciousness: they emerge in the act of naming. Our modern scientific 'myth of origins' views things as primordial and consciousness as a later, perhaps accidental, addition to the scene. It goes somewhat like this: first there is the big bang, then the evolution of matter, then heavy elements are formed, then in some special circumstances organic molecules appear, then again in special circumstances life arises, and at some point in the evolution of life, perhaps in connection with a sufficiently developed nervous system, this something we call consciousness wakes up and starts looking around. That is the contemporary standard version of our story. Consciousness is a late guest who accidentally walks into the party. Ancient cultures, on the other hand, saw the whole universe as animated, they found consciousness everywhere. From this other point of view, matter and consciousness are not really two separate substances: they are two sides of the same coin.

***Without name, heaven and earth's beginning,
with name, the myriad beings' mother.***

The objective world and consciousness co-emerge in the act of experience, subject and object are two faces of the same coin. Then in the most basic sense 'names' indicate the process through which the inseparable unnameable totality of what is, the

³ *Tao Te Ching: Una guida all'interpretazione del libro fondamentale del taoismo*, traduzione e cura di Augusto Shantena Sabbadini, URRRA/Feltrinelli, Milano, 2009. English version still unpublished.

unus mundus, unfolds into subject and object, becomes conscious of itself by splitting into mind and matter, consciousness and world. In the *Upanishad* this process is described as the act by which Brahma, the creator, feeling bored with his/her eternal perfection, unity and solitude, chooses to split into the innumerable beings, to become cow and bull in order to play hide and seek with him/herself - and thus creates the world.

Of course the process of co-emergence of subject and object should not be understood as an act of creation happening at a certain moment in time, so that from then on there actually are two separate things, matter and mind. It should rather be conceived as constant creation, an act that is present in each 'atom of experience'. And in it nothing is ever created as a 'thing in itself'. The two poles, mind and matter, remain inseparable: the world only exists as world experienced by consciousness, and consciousness only exists as consciousness experiencing a world.

Therefore, ultimately, reality does not consist of things, of separately existent singular beings. Nevertheless, we live in a world of things and of individual beings: we live in a 'named' world. It could not be otherwise, because as soon as consciousness is there as subject, a world, an 'other than itself', is given as its object. The 'nameless' is the undifferentiated, the primordial unity, the *unus mundus*, the Dao. 'Naming' is the act by which out of the undifferentiated arise subject and object, consciousness and world - and thence unfold 'the myriad beings'. The act of 'naming' is 'the mother'. In her womb starts our journey of beings that experience themselves as independently existing - and to that womb our journey returns.

This is the meaning of the statement that 'in the beginning there is the Word', and for this reason in African religions the word is conceived as creative power. Beyond the universe of names there is only the nameless Dao, existence 'beyond the power of words to define'.

***Therefore ever without desire we contemplate its mystery,
ever with desire we contemplate its boundaries.***

As soon as the myriad beings arise, as soon as we exist as individuals and identify with a body, attraction and repulsion arise. This is so already for an amoeba: it seeks food and moves away from toxic stimuli. We would not be here if a long chain of evolutionary processes had not selected the same attitude in us. Desire (in a positive and negative sense, attraction and repulsion) is the law of individual existence.

Buddha framed the problem of desire in the most concise and elegant manner. Desire follows the identification with a self like a shadow: we are attracted towards what we perceive as expansion of the self, survival, pleasure, and recoil from what we perceive as contraction of the self, death, pain. But the self is not intrinsically existent: it is an illusion, a mirage, and this illusion is impermanent. Therefore,

ultimately, all desire is bound to be frustrated: we do get old, contract and die. Desire is the root cause of suffering.

The Buddhist notion of *anatta*, no self, fits very well with the world image of contemporary physics, which describes all matter/energy in terms of infinitely extended fields. Individual particles do not really exist as localized objects; they are simply localized manifestations of the fields. E.g., an electron situated here on earth and another electron located in a far-away galaxy, are not two distinct objects: they are inseparable manifestations of one and the same field embracing the whole universe. In this perspective our own body is also not something possessed of a separate, intrinsic reality: it is rather something like an 'interference pattern', temporarily formed by the superposition of a certain number of fields extending throughout the universe.

A simile here might help us: our body can be compared to a wave arising on the surface of the ocean. A wave does not consist of a travelling separate mass of water. It is simply an emergent pattern in the motion of the ocean water, a pattern that propagates more or less undisturbed for a little while, then dissolves into other emergent patterns. The ultimate reality of the wave, we might say, is only the ocean. Therefore if we imagine the wave as a self-aware being conditioned to seek its own survival as a separate entity, its desire is inevitably doomed. This is our predicament as humans, as self-aware beings: we don't exist, but we are attached to our existence. Death is the ultimate frustration of desire.

The first of Buddha's Four Noble Truths is therefore the simple statement: existence (*ex sistere*, standing outside, being an individual entity separate from the whole) is suffering. That is the starting point of Buddha's path, the path going beyond suffering. Buddha's path is not essentially different from that of Laozi or fundamentally from that indicated by all Eastern spiritual traditions. Realise the illusory nature of the self: 'you' do not exist. Realise you are not the wave, you are the sea. When this realization becomes your living experience, the identification with desire ceases. You are then free: you have gone beyond suffering.

There are therefore two ways of being in the world. Free from desire, unidentified with a self, we contemplate the mystery of this wonderful, vast, incomprehensible existence. Immersed in desire, we live the whole gamut of human passions: love, hatred, joy, sorrow... We go through all the rainbow stages of the journey through form, what Buddhists call *samsara*, the wheel of conditioned existence.

***These two arise together, but have different names.
Together we call them dark, the darkest of the dark,
the door of all mysteries.***

Laozi's way, just as the way of Mahayana Buddhism, the 'great vehicle' tradition, is not a way of asceticism and renunciation. The idea is not to leave the world in order to seek a mystical elsewhere (where else could you go?). The mystery and its manifestation, the boundless and the boundaries are two faces of the same reality. *Nirvana* (liberation, the extinction of the identification with a separate self) and *samsara* are one. The ocean and the waves are the same water.

Therefore Laozi does not say: give up being identified with the wave and identify yourself with the ocean, which is your true nature. His statement is subtler: he says 'these two arise together, but have different names'. We are asked to keep our awareness in two places at once. There is no self, yet I exist as a self. The wave is just ocean, but it keeps dancing its dance as a wave. Laozi says: live in the world of manifest reality, the world of things, the world of desire, experience not just the mystery of the boundless, but also the infinite charming and terrifying details of the boundaries. Be with form, be with desire, but remain aware of the formless, remain aware of the state that is beyond desire. Be in the world, but not of the world.