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DURATION AND MODERN PHYSICS: A VERIFICATION OF THE PARADIGM SHIFT FROM ONTOLOGY OF SUBSTANCE TO THAT OF BECOMING

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ABSTRACT: *The history of Western Philosophy is populated by Substance –geared metaphysics despite the introduction of the ontology of becoming by Heraclitus. Science as ancillary to Philosophy equally witnessed a parallel boost and interpretation to the ontology of Substance with its mechanistic and certainty approach to reality. Only recently, the emergence of Modern physics; a new Physics of subatomic particles has called to question, the well established mechanistic model of science. Recently too, following the train of Science, Philosophy has come to grips with Science's new results and has made a fundamental revision of the standard tools of Philosophy. This revision is seen in the concept of 'duartion' advocated by Henri Bergson; a paradigm shift to the ontology of becoming.*

KEYWORDS: Duration, Ontology, Substance, Becoming, Paradigm Shift, Modern Physics.

INTRODUCTION

Philosophy started with wonder; a quest to develop a coherent concept of the world that summarizes reality and simplifies our experiences. Ideas are alleged to shape actions and so it matters how we think about reality, the world and ourselves. The universe was a subject of reflection for ancient philosophers. Wonder started it all. The history of philosophy gave accounts of the Ionian philosophers and how wondering about the universe, they arrived at different conceptions. They were majorly preoccupied with two basic questions: "What are things really like?" and "How can we explain the process of change in things?"

The search to answers to these questions by these Ionian Philosophers set out what can be regarded as the temperament of science. This temperament is marked by not just seeing and believing; but more importantly, critical thinking about basic questions in a mood of genuine and free inquiry. The Ionian philosophers attempted answers to the first scientific question by positing different "stuff" as what goes into the composition of things. Thales arrived at a conclusion that 'water' was the basic stuff that lay at the foundation of all physical reality. Water was the 'One' that could account for the 'Many'. Anaximander contemplating about the origin of things added the flavor of bold speculation. Unlike his master Thales, he ascribed the 'indeterminate boundless' as the primary substance out of which specific things came. This 'indeterminate boundless' made no meaning to Anaximenes, the third Ionian philosopher, as it was too vague and intangible for him. Combining Thales' notion of definite substance with Anaximander's concept of the boundless, he designated 'air' as the primary substance of all things.

The different conclusions of these philosophers about reality is not as important as the fact that they for the first time, brought to light an opinion that the diversities in reality can be explained if a single concept that underlies them is identified. This beginning of the Western philosophy by these Ionian philosophers can be seen as the origin of the Ontology of Substance.

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Heraclitus, in the history of Western philosophy is commonly recognized as the founder of the 'Ontology of becoming' approach to reality. The few remaining fragments of his thoughts are often interpreted as championing a philosophy of ubiquitous and radical flux epitomized in the slogan, "*Panta rhei*" (everything flows). For Heraclitus, "you cannot step twice into the same river…because fresh waters are ever flowing in upon you." He applied this concept of flux, not only to rivers but to every existing thing including the human soul.

Despite the introduction of this ontology of becoming concretized by Heraclitus' *Panta rhei*, the history of Western metaphysics since Aristotle focused mainly on elaborating various versions of Substance metaphysics or the Ontology of Substance. In fact, it could be said without the fear of conspicuous contradiction that the history of Western Metaphysics is the tendency towards Substance. However, interspersed in this history are pockets of the Ontology of becoming. This Process Metaphysics come partly as supplementary elements to an otherwise substance-geared theory, and partly as independent process-philosophical explorations. Whenever it blossoms independently, this process metaphysics (Ontology of becoming) regards change as the cornerstone of reality – the cornerstone of Being thought as Becoming.

The ontology of becoming is characterized by becoming. Becoming has an undertone of uncertainty. It is founded on epistemological indeterminacy and statistical probabilities. Unlike the ontology of substance whose mechanistic model is characterized by certitude, order and measurability, the ontology of becoming is rather founded on 'disorder' and 'chaos'.

The development of science as ancillary to philosophy witnessed a parallel boost and interpretation to the ontology of substance. Isaac Newton eminently enthroned the atomic theory of Democritus and codified a mechanistic worldview. The title of his famous work, the '*Mathematical Principles of Natural Philosophy*', reaffirms Galileo's confident dictum that nature is written in mathematical symbols. The formalization of scientific methods by Francis Bacon into a general mode of calculation facilitated the extension of the models and methods of mechanistic thinking beyond the natural sciences into the social sciences. Virtually, every aspect of knowledge was singing the song of mechanistic certainty; of substance ontology. The universe could then be compared to a machine and said to be "so orderly and compact, so simple in construction, that we may reckon its past and gauge something of its future with almost as much certitude as that of a dynamo or a water wheel. In its motion there is no uncertainty, no mystery." (Hayes, 1941, p.108)

Today, the emergence of modern physics is singing a new song. A new physics of subatomic particles has called into question the well-established mechanistic model of the universe. The very certainties science had apparently guaranteed has been undone by the new science. Today also, following the train of science, Philosophy has come to grips with science's new results and has made a fundamental revision of the standard tools of philosophy. This revision is what 'Process Philosophy' champions today which advocates for the ontology of becoming as the current tool of philosophy. This Ontology of becoming which is exemplified in Henri Bergson's concept of Duration *(durée*) yields a better ontological descriptions of the domains of the modern physics. With some selected theories of the modern physics and process concepts of process philosophers (with a major concentration on the concept of Duration), this research will attempt a verification of the paradigm shift from Ontology of Substance to the Ontology of Becoming.

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The Ontology of Substance

Philosophers have struggled for millennia over how best to think about human experiences of both permanence and change. There was also an issue of the relationship between Being and Becoming. As Mesle puts it, "…unchanging Being has taken priority in Western Philosophy and religion..." (2008, p.8).

The philosophical concept of substance can be characterized in two ways: generic and specific. On its generic sense, 'Substance' corresponds to the Greek '*Ousia*' which means 'being', and the Latin '*Substantia*' which means 'something that stands under or grounds things'. By this, substances are the foundational or fundamental entities of reality. They are the basic things from which everything is constructed e.g. Atoms of the atomists; Plato's Forms, etc. On its specific sense, substances are a particular kind of basic entity which contrasts mainly with properties and events as it derives from the intuitive notion of individual 'thing' or 'object'.

The concept of substance has also been associated with subject; kinds (though more scientific than philosophical); and substantial (signifying durability or permanence). According to Howard Robinson in *The Stanford Encylopedia of Philosophy*,

It seems in summary, that there are at least six overlapping ideas that contribute to the philosophical concept of substance. Substances are typified as:

i. Being ontologically basic – substances are the things from which everything else is made or by which it is metaphysically sustained;

ii. Being, at least compared to other things, relatively independent and durable, and perhaps, absolutely so;

iii. Being the paradigm subjects of predication and bearers of properties;

iv. Being, at least for the more ordinary kinds of substance, the subject of change;

v. Being typified by those things we normally classify as objects, or kinds of objects;

vi. Being typified by kinds of stuff. (Spring, 2014, Edition).

In addition to these, Robinson identified also two extra notions of Substance drawn from the ideas induced by Kant and Aristotle respectively, thus;

vii. Substances are those enduring particulars that give unity to our spatio-temporal framework, and the individuation and re-identification of which enables us to locate ourselves in that framework.

viii. The substances in a given system are those entities crucial from the teleological or design perspective of that system. 'Crucial' means that other things exist either to constitute them or to provide a context of operations for them. (Spring, 2014, Edition).

Whatever be the case, the definition of substance from the different philosophers came under one, two or more of the laid down notions.

The history of Western philosophy mainly focused on elaborating the various versions of substance ontology. In fact, one might say with Hegel that the history of (Western) metaphysics is the tendency towards substance. Going through the epoch of Western history of philosophy,

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a clear observation of both direct and indirect populated allegiance to the ontology of substance is witnessed. Given this, it would be highly unwieldy to attempt to cover the concept of substance as discussed by the philosophers. Rather a selection of major discussants on this through the epoch of history would be attempted.

Substance in the Ancient period

The Pre-Socratic philosophers, especially the Ionian philosophers fulfilled the first and sixth criteria outlined above in their notion of substance. In their search of the basic stuff of nature, Thales posited water as the basic stuff which can account for the fundamental reality. Anaximenes thought that air was the stuff, and Anaximander preferred the 'indeterminate boundless' which could transmute into the various determinate stuffs such as water, air, earth and fire.

When the atomist school founded by Leucippus and elaborated by Democritus came onboard, a determinate object called 'atoms' became the substance of the universe. Matter was viewed as constituted by inert materials atoms with permanent properties (e.g. weight). They also took the natural developments to be the macroscopic effects of atoms colliding and changing their spatial positions. These atoms at least fulfilled the first two ideas of the concept of substance and could also be likened to fulfill the sixth. The concept of 'numbers' of the Pythagoreans qualify as substance in the first criteria since all things are said to be made of numbers.

Parmenides of Elea was very radical about his unchangeability of Being. For him, Being is and non being is not. Being is uncreated, unchangeable and imperishable. Being is one and any attempt at its multiplicity is an illusion. As this Parmenides' notion of Being met with mockery and criticisms, Zeno of Elea, a student of Parmenides fashioned out four ingenuous paradoxes aimed at supporting and confirming the teachings of his master. These paradoxes: the race course; Achilles and the tortoise; the arrow; and the relativity of motion, all aimed at showing that motion is a relative concept without a clear definition and so an illusion. The persistent view by common sense that there is motion and change brought a new attempt to deal with the problem by Empedocles and Anaxagoras.

Empedocles aligned with Parmenides that Being is uncreated and indestructible but rejected his oneness of being as this would deny the reality of motion. He proffered the multiplicity of being insisting that they are still changeless and eternal. Combining the basic stuffs of the Ionian philosophers and others, he arrived at four changeless and eternal substances: water, air, fire and earth. The positive forces of 'love' and 'hate' or 'harmony' and 'discord' cause these four elements to intermingle and form the objects of our experience. Agreeing with Empedocles that the mixture and separation of these four existing substances is responsible for things coming and going out of being, Anaxagoras nevertheless rejected the idea of 'harmony' and 'discord' as the basis for the formation of the objects of our experience. He rather brought in the idea of Mind (*Nous)* as the animator of everything.

The stoics on their own part rejected the idea of incorporeal beings inhering in matter as proposed by Plato. Rather they taught that all being is corporeal infused with a creative fire called *Pneuma*. Thus they developed a scheme of categories different from Aristotle's based on the ideas of Anaxagoras and Timaeus.

Aside Anaximander and the Pythagoreans whose abstract concepts of indeterminate boundless and numbers respectively could be said to represent the ides of substance, the rest of the pre-

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Socratics had materialist account of the universe and ipso-facto of substance. Plato would reject these accounts as totally materialistic and proffered the governing principle of intelligible forms which the material objects copy. These forms are the driving principles which give structure and purpose to everything that is. Though Plato's forms are not substances in the sense of being either the stuff or the individuals out of which other things emanate, they pass as substances as they met the first two criteria for substances suggested by Robinson, which are ontological basicness and durability respectively. Thus, Plato in his world of forms aligned himself to the articulation of the ontology of substance.

The account of substance as articulated by Aristotle is found majorly in two of his works, *Categories* and *Metaphysics*. In the *Categories*, Aristotle sets out important logical distinctions between different kinds of attributes and in *Metaphysics*, he carried out a metaphysical analysis of substance in terms of matter and form. In his Categories, he defines a substance as:

> …that which is neither said of a subject nor in a subject, e.g. the individual man or the individual horse. The species in which the things primarily called substances are called secondary substances, as also are the genera of these species. For example, the individual man belongs in a species, man, and animal is a genus of the species; so these – both man and animal – are called secondary substances. (1998, p.7).

Talking about substance which is permanent and its categories or predicates which changes, Aristotle identifies nine categories that can be predicated to substance which include: "quantity (e.g. six feet tall), quality (e.g. articulate), relation (e.g. double), place (e.g. at the school), date (e.g. last week), posture (e.g. standing), possession (e.g. clothed), action (e.g. serves), and passivity (e.g. is served)." (Stumpf, 1994, p.84).

The disparity in Aristotle's two accounts has led a commentator like Graham to talk of Aristotle's two systems containing two radically different conceptions of substance. (1987). Whatever be the case, the major concern of this work is to show that Aristotle also toed the line of substance ontology and even made a connection between substance and teleology.

Substance in the Medieval period

The medieval period which was characterized by the dominance and influence of theology in philosophy had scholars like St. Thomas Aquinas, St. Augustine, Duns Scotus, William of Ockham etc. who made contributions on the discourse on substance. Aquinas following the submission of Aristotle who introduced the issue of substantial form maintained that a substance possessed only one form and its matter was the characterless prime matter. This implies that objects and what constitutes them do not possess their own forms but formed by the overall substantial form. Duns Scotus disagreed with this aspect of the hylomorphic theory. He argued that a dead person's body was the same body as had existed when that person was alive. The soul had departed, so the form which was the immortal soul could not be identical with the form of the body.

William of Ockham agreed that s substance is composed of form and matter drawing from the theory of hylemorphism. But he reversed the priorities of Aquinas by saying that the parts are actual in their own right and do not derive their actuality from the whole; rather, the whole is nothing but the sum of its parts. This line of thought opened the way to atomism and to treating the unity of wholes as a matter of convention or degree.

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Substance in the Modern period

The ontology of substance identifies metaphysical reality with substance, permanence, static, order and certitude. Rene Descartes, the father of modern philosophy is also the father of our modern substance-quality vision of reality. Drawing on Aristotle, he (Descartes) thought of the world as composed of substances. By substance, he meant concrete things like the human body, rock, stones, mind etc. In his dualism, he posited that there are two kinds of substances: Thought and Extension; the body and the mind. He went further to give some features which all substances; mental and physical have in common. First, he believed that substances exist independently of other substances. He asserts, "By substance, we can understand nothing else than a thing which so exists that it needs no other thing in order to exist." (1931, p.232). Being influenced by Catholicism which he professed till his end, he quickly pointed out that all created substances are dependent upon God, so strictly speaking this definition of substance fits God alone. Thus he concluded that created substances exist independently except for their dependence on God. The second feature of substances Descartes highlighted is unchangeability. Substances are unchanging realities that stand under their qualities and endure unchanged through the changes of those qualities.

Descartes illustrated the unchageability of a substance with a solid white wax. A piece of wax is a substance whose attributes include its shape, colour, size and scent. When thumped, it may give off a flat sound and when melted, it will become a clear liquid with none of its original qualities. Yet, we understand that the substance is still the same – wax. The 'waxness' has endured through the changes of all the qualities belonging to the wax. Thus the substance – wax, exists independently of its attributes and requires nothing but itself to exist. Such is also the definition of substance by Baruch Spinoza who insists that substance is "that which is in itself and is conceived through itself: I mean that the conception of which does not depend on the conception of another thing from which it must be formed." (Cited in Stumpf, 1994, p.250). This implies that substance has no external cause but has the cause of itself within itself. Spinoza rejected Descartes' dualism and insisted that substance is one and indivisible but has multiple attributes. God or nature (*Deus Sive Natura*) is the one true substance which existed necessarily and everything else is the mode of this one substance.

Leibniz rejected Spinoza's concept of divine substance because it confined God to what actually exists. God for him is not the actual world but contains within Himself all possibilities. Created substances exist, though they are very intimately dependent on God. In the *Discourse on Metaphysics* he says, "it is clear that created substances depend on God, who conserves them and indeed who produces them continuously by a kind of emanation, just as we produce our thoughts." (1988, p.66). For Leibniz, true substances are monads (a Greek word which signifies clarity or that which is one). They have non- material nature and each possesses its own principle of action, its own force. On the issue of change, in so far as, at all times, monads reflect the whole of reality, then they do not change. But in so far as they reflect some parts of that reality more vividly than others, depending on their position in space and time, they can be said to change.

The British empiricist, John Lock had his turn of gaze on the concept of substance. Approaching the question of substance from a common-sense point of view, he opines that substances are the solid and extended primary qualities where the secondary qualities (like colour and shape) subsist. For him, it is substance that contains the powers that give regularity and consistency to our ideas. (See Locke, 1997).

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Kant in his own philosophy made a distinction between the phenomenal and the neumenal (thing in itself). For him, the neumenal is not only unknown but unknowable. His description of the concept of neumenal somehow passes for the concept of substance. The things we know (phenomenal) are known through the a priori spectacle and so the thing in itself (neumenal) is unknowable but exists.

The Ontology of Becoming

The ontology of becoming is based on the premise that being is dynamic and that its dynamic nature should be the primary focus of any comprehensive philosophical account of reality. We attempted in the last section to expose the obsession with which Western philosophy treated reality as an assembly of static individuals whose dynamic features are either mere appearances or secondary. Today, the proponents of this ideology of the ontology of becoming are grouped as process philosophers. According to Seibt,

> While process philosophers insist that all within and about reality is continuously going on and coming about, they do not deny that there are temporally stable and reliably recurrent aspects of reality. But they take such aspects of persistence to be the regular behavior of dynamic organizations that arise due to the continuously ongoing interaction of processes. (Fall, 2013, Edition).

Though the history of Western philosophy was dominated by a research paradigm which was substance geared, pockets of the ontology of becoming as the bedrock of reality is observed. In the ancient period, the Greek theoretician Heraclitus of Ephesus is recognized as the founder of the ontology of becoming. The radical flux in his '*Panta rhei*' gained him this honour and appreciation especially as he emerged from the world and era that was obsessed with a search for the basic stuff of reality. "You cannot step twice into the same river" Heraclitus declares, "because fresh waters are ever flowing in upon you". Indeed, his student Cratylus took the argument further by saying that you can't even step in the same river once because the river changes even as we step into it, and so do we. (Cited in Mesle, 2008, p.8). Thus the radical flux of Heraclitus introduced the ontology of becoming in the substance obsessed Western history of philosophy.

Although Aristotle pitched in the camp of substance metaphysics, his distinction between *Energeia*, activity-like (going on), non-developmental process and *Kinesis*, accomplishment-like (coming about) developmental process, must be reckoned as an important contribution to the ontology of becoming. Another ancient philosopher that made allusion to the ontology of becoming was the neo-platonic philosopher, Plotinus. He introduced the thought that the dynamicity of being is the 'emanation of the divine'. However, his 'metaphor of emanation' could be analyzed as a partly supplementary element to an otherwise substance-geared theory. This is so as this emanation starts from the divine who could be likened to a stable substance.

In the modern period, though the rationalists like Descartes, Spinoza and Leibniz presented a substance metaphysics, Leibniz's 'monads' could in a way be interpreted as a process-based metaphysics. This is so as his monads are not static but endowed with an inherent 'active force' that engenders the transitions between states.

George Berkeley's starling and provocative slogan, "*esse est percipi*" (to be is to be perceived) was a move to denounce the reality of matter. Locke had argued that substance or matter acts as a substrate to the qualities we sense. But for Berkeley, the absolute existence of matter

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(unthinkable things) are words without meaning as only the sensible things that can be perceived exist. Thus, challenging the scientists of his age on the use of absolute terms in physics and pursuing the principle of empiricism, Berkeley rejected the concept of substance and indeed other abstract terms employed by science as if giving us more knowledge that we can derive from the sensible world. There is no substance anywhere which exists independently of its qualities so as to remain if the qualities were all taken away.

David Hume made this point clearer. For him, the mental self is "nothing but a bundle or collection of different perceptions, which succeed each other with an inconceivable rapidity, and are in a perpetual flux and movement." (1962, p. 259). Thus for Hume, the idea of an unchanging substantial self is a fiction. Attempting to refine the empiricism of Locke and Berkeley, Hume pointed out that if we are to believe in the notion of the unchanging self, we must have some experience of it and since we do not, it does not exist. He argued thus;

> For my part, when I enter most intimately into what I call myself, I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I never can catch myself at any time without a perception, and never can observe anything but the perception. When my perceptions are removed for any time, as by sound sleep, so long am I insensible of myself, and may truly be said not to exist (1962, p.259).

Thus, Hume enjoins us to think less of our unchanging substantial self which does not exists but to think of rivers that constantly change as analogous to the bundles of qualities composing the rest of the world and especially about ourselves. He was like saying with Heraclitus that everything changes.

The ontology of becoming received a special boost in the late 18th and early 19th century when German idealists, Johann G. Fichte, Fredrich W.J. Schelling, and George W.F. Hegel responded to Kant's transcendental idealism of unknowable '*noumena*'. The trio rather focused on the process by which the world of knowable appearances which is the most promising candidate for reality in itself is generated. Hegel for instance postulated that reality is self-unfolding dynamic structures ('*Begriffe*') which by creating continuous contrasts, results in an increasingly interrelated web of dynamic dependencies. His 'dialectics' was an attempt to work out the logic underlying the total dialectical development of reality. Hegel assumed that the process of reality follows certain principles that can be fathomed by philosophical inquiry. This is the hallmark of speculative ontology of becoming which was championed by Alfred N. Whitehead in his 'Philosophy of organism'. Whitehead's ontology of becoming which he termed process philosophy is arguably the most comprehensive descriptive metaphysical framework we have got in Philosophy. Between 1850 and 1950, philosophers like Charles S. Peirce, Samuel Alexander, C. Lloyd Morgan, and Andrew Paul Ushenko attempted a philosophical explanation of the evolution and of emergence and self-organization. With this, they contributed immensely to the paradigm shift to the ontology of becoming.

Henri Bergson had an immense contribution to the paradigm shift. He worked from an almost mystical sort of sympathetic apprehension of reality and insisted that the ontology of becoming could only be expressed by means of a highly metaphorical use of language. This is what his concept of duration *(durée*) is all about.

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Duration, Modern Physics and the Paradigm Shift

Duration, a metaphysical concept and a brainchild of the French philosopher, Henri Bergson rather appeared at a time incongruous with the exigencies of the moment. In the time it made its appearance, science and technology could be said to have flowered and counting their achievements. This period was aptly described thus;

> By the '90s one already ate machine-made food in machine-made dishes [and] wore machine-made clothes. …The flow of profits from … mechanized industry into banking and other credit reservoirs … to … ever bigger and never industrial plants, seemed to go on with mechanical precision and efficiency (Hayes, 1941, pp.96 - 99).

Indeed, modern science was reaching its most impressive heights of achievement. It was a period the celebrated poet and critic Paul Valery described as "a period completely formed [travaillee] by the sciences, in perpetual technological transformation where nothing escapes the will to innovation." (Cited in Guerlac, 2006. P.14).

However, in all these achievements, the major assumption of science was that nature consists of material objects located in space. Thus, it was held that matter,

> Is the final irreducible stuff out of which all things are formed. The model for thinking about the contents and behavior of nature was the model of a machine. All the particular things in nature were thought to be parts of a large mechanism. This meant that the behavior of each part could in time be described with mathematical exactness, since material objects moved in space in accordance with precise rules or laws. (Stumpf, 1994, p.14).

It is now clear that the concept of duration appearing at this zenith of scientific achievement is absurd. However, Bergson brought it to challenge these basic assumptions of science and to show that the scientific mode of thought is limited and is not the sole comprehensive source of knowledge.

Duration turns out to be a major theory of Bergson, metamorphosizing into phases that are not linked in a satisfactory manner. It turns out to be an all-embracing concept equivalent to the idea of being. The idea of duration appeared virtually in all his major published works: Time and Freewill; Matter and Memory; Creative Evolution etc. According to Elena Fell,

> Duration is introduced in *Time and Freewill* as conscious processes, time and motion. In *Matter and Memory*, it is presented as any manifestation of being, either material or spiritual. In *Creative Evolution*, it refers to consciousness, concrete manifestations of life, biological evolution and the universe (2012, p.11).

Ultimately, "Duration becomes synonymous with existence – with life as perpetual change and invention of novelty." (Guerlac, 2006, p.6).

Duration is becoming. It is the process in all things. Criticizing philosophers (like Plato, Descartes, Kant) who sought to interpret the world through fixed structures of thought, Bergson thought that the issue of mobility, development, becoming and thus duration was not taken seriously. To think in duration is to have a true grasp of reality which gives us a more accurate notion of time as against the 'spatialized' time created by the intellect.

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When Duration appeared, science was basking in the euphoria of determinism, certainty and a fixed structure of thought. Reflecting about this period, Pullman observed that scientists unless they were prepared to contradict themselves, really had no choice but to embrace determinism. Thus he asserts that, "A science that is not deterministic would be no science at all." (1998, p.293). In spite this, Bergson insisted that his concept of duration "lay in the direction in which physics would tend sooner or later." (Cited in Guerlac, 2006, p.40). Indeed, sooner, history vindicated Bergson.

In Physics, the mechanistic or deterministic worldview was codified by Isaac Newton. He systemized the experimental method of Galileo and generated universal laws of nature. Thus, "Newton legislates the passage from observed phenomena to universal laws of motion: the laws of inertia, of equal action and reaction, and of acceleration as proportional to force." (Cited in Guerlac, 2006, p.18). These laws of motion are deep tendencies to view physical processes as reversible. It is against this view that Bergson affirms a dynamic ontology of irreversible time.

As science swayed, it was only obvious that its method of gaining knowledge through observation was to be applied to other fields of inquiry besides mathematics and natural sciences. The Positivism championed by Auguste Comte attempted this application. Today, we are so embedded in ideologies of Positivism that we hardly recognize them. In the views of Ernest Renan, having a scientific explanation of the different of the different hierarchies of knowledge is a testimony that 'reason must govern the world'. Thus, "only science can furnish the basis in reality necessary for life." (Guerlac, 2006, p.22). Both Renan and Comte in the spirit of Positivism attempted to organize humanity scientifically. The field of experimental psychology in the social sciences advanced swiftly in this positivist approach to knowledge. Behaviorism and Associationist psychology emerged at this period and established the 'dual aspect theory' for the relations between mind and brain. With these developments, Taine advocated that the methods of scientific psychology could now be applied to the human soul. He declares;

> Science approaches at last and approaches man; it has gone beyond the visible and palpable world of stars, stones and plants, to which it had been contemptuously confined – it now challenges the soul, armed with exact and piercing instruments whose precision and whose reach have proved themselves over three hundred years of experience. (Cited in Pilkington, 1976, p.219).

This idea is in support of Gustav Fechner who is credited with the invention of the theory and techniques of psychometrics which is the foundation of modern neurosciences. In this invention, Fechner compares psychic measurement to measurement in physics and astronomy, and this is where science tries to touch the soul. This idea of Fechner is vigorously pursued today in the cognitive sciences and in research concerning artificial intelligence. By this, science is made to be pushed to its ultimate limits to create ultimate humanism. Humanism is the dream of complete human mastery of the world. Even the religion of the future will be pure humanism, that is, the cult of everything human.

However, for Bergson, Fechner's clinical and theoretical project has some philosophical implications namely, the assumption that mental events as such can be measured. This for Bergson threatens the reduction of a human person into a mere body, construed mechanistically along the lines of Descartes' human machine. Life processes for Bergson therefore, can only be known through a metaphysical method which he called intuition. Commenting on Bergson's

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invitation to philosophers to embrace intuition, Bertrand Russell accused Bergson of reasoning like the cosmic poets. He says of him, "When his philosophy will have triumphed, it is supposed that argument will cease, and intellect will be lulled to sleep on the heaving sea of intuition." (1914, p.36). There was also a palpable fear by the church that the notion of duration would put into question the traditional idea of God. But in all these, Bergson and his theory of duration is vindicated as there are today, new theories in which direction Physics has tended. This new direction of Physics is closely related to the theory of duration. Some of these theories include:

1. Quantum mechanics
2. The uncertainty principle
3. Thermodynamics
4. Theory of big bang in astrophysics
5. Theory of hidden variable proposed by David Bohm in quantum mechanics
6. Theory of fractal genesis in studies of complexity.

Quantum Mechanics

Quantum mechanics is a branch of physics relating to the very small. It results in what appears to be some very strange conclusions about the physical world. At the scale of atoms and electrons, many of the equations of classical mechanics which describe how things move at everyday sizes and speeds, cease to be useful. In classical mechanics, objects exist in a specific place at a specific time. However, in quantum mechanics, objects instead exist in a haze of probability; they have a certain chance of being at a point A, another chance of being at point B and so on.

The origin of quantum mechanics cannot be attributed to any one scientist. Rather, multiple scientists contributed to a foundation of three revolutionary principles that gradually gained acceptance and experimental verification between 1900 and 1930. These principles have to do with Quantized properties; particles of light and waves of matter. In quantized properties, certain properties such as position, speed and colour can sometimes only occur in specific set amounts, much like a dial that 'clicks' from number to number. This challenged a fundamental assumption of classical mechanics which said that such properties should exist on a smooth, continuous spectrum.

On particles of light, contrary to 200 years of experiments showing that light behaved as a wave; much like ripples on the surface of a calm lake, light is seen to sometimes behave as a particle. Light behaves similarly in that it bounces off walls and bands around corners, and that the crest and troughs of the wave can add up or cancel out. Added wave crests results in brighter light, while waves that cancel out produce darkness.

On waves of matter, matter can also behave as a wave. This is against the 30 years experiments showing that matter (such as electrons) exists as particles.

With experiments that proved the quantum mechanics, it could be aptly described as the 'crisis of the sciences'. This crisis is aptly explained by Suzanne Guerlac when she echoes;

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> We have come full circle from the certainty widely shared in the 1880s, when it was confidently assumed that there were no mysteries left in the world, to a sense of overwhelming uncertainty during the 1920s and '30s. (2006, p.37).

With this new discovery, certitude; causality; determinacy and indeed all the tools of modern science are destroyed. According to one historian of science, "What quantum mechanics did…was to assert that classical causality was irrevocably gone." (Pais, 1986, p.212).

The Uncertainty Principle

In 1927, Heisenberg made another major contribution to quantum physics. He reasoned that since matter acts as waves, some properties, such as an electron's position and speed, are 'complementary', meaning there's a limit to how well the precision of each property can be known. Heisenberg's uncertainty principle reasoned that the more precisely an electron's position is known, the less precisely its speed can be known, and vice versa. This uncertainty principle applies to everyday-size objects as well, but it is not noticeable because the lack of precision is extraordinarily tiny. Thus, according to Pullman, the uncertainty principle, "introduces a fundamental indeterminism, inherent in the very nature of the universe." (1998, p.293).

Thermodynamics

This is a branch of physics that deals with the relationships between heat and other forms of energy. It describes how thermal energy is converted to and from other forms of energy and how it affects matter. Thermal energy is the energy a substance or system has due to its temperature. Thermodynamics has four laws: The first law states the conservation of energy in processes of energy transformation. This strengthened the closed system of classical physics. The second law, however known as the law of entropy, describes a degradation of energy in the passage to equilibrium. It suggests that the physical process of entropy is irreversible, that it progresses according to the one directional movement of lived time. This validates the reality of irrevocable time, in opposition to the classical model that upholds reversible processes due to a reliance on geometry in the mathematical formalization of the universal laws. This validates Bergson's anticipated argument that physical processes were considered in terms of space, not time. Now that physical processes are to be considered in terms of time too, the irreversibility of physical processes becomes glaring.

Theory of the Big Bang in astrophysics

The Big Bang theory is an effort to explain what happened at the very beginning of our universe. It is indisputable fact that our universe has a beginning prior to which there was nothing. According to this theory, our universe is originated from a big bang of 'singularity' about 15 billion years ago. Singularities are zones which exist at the core of 'black holes' and black holes are areas of intense gravitational pressure. After its initial appearance, it apparently inflated (the big bang), expanded and cooled, going from very small and hot, to the size and temperature of our current universe. Astrophysicists believe that the universe would collapse to singularity again during the process of 'big crunch' in far future due to persistent gravity. It is likely considered by scientists as an indefinite circular process. This is also called oscillating theory of the universe. The probability of a Big Crunch is however becoming negligible in the domain of science. Whatever be the case, our aim in the theory is to show that the universe is not of 'being' but of 'becoming'.

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CONCLUSION

When Poincare wrote in 1912 that, "A science that is not deterministic would not be science at all," (Pullman, 1998, p.293), he did not realize how obsolete such an idea would be in the nearest future. When Bergson was charged with Feminism and Irrationalism for his introduction of 'Duration' into the system of philosophy, no one realized how even the modern physics would vindicate him. Bergson himself prophesied that his conception of duration 'lay in the direction in which physics would tend sooner or later'. The theory of quantum mechanics vindicated this prophesy. Today, enlightened by the introspection of man with some scientific theories and experiments, the entire human race is realizing the need for this paradigm shift from the ontology of being to that of becoming.

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