Chapter 5

An Ontological Inquiry into the Descriptive Status of Matter in Science

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Abstract
The advent of quantum mechanics in Physics has called to question, the status of concrete, material or physical reality. Matter has been that which defines reality. Science in its method and logic has raised the status of material reality to an unprecedented height. Matter is the final arbiter on the issue of empirical reality. However, the wave-particle duality (wavicle) in quantum mechanics as well as the mathematics of strings theory and quantum gravity makes physical reality (matter) looks more like a metaphysical system rather than physical. Employing the method of critical analysis, this study engages the vexing issue from an ontological background (force, motion and change) showing the points at which matter appears to take up immateriality in the double slit experiments of quantum mechanics. A unique finding of the work is the revalidation of the age-old mind-body problem playing out in the province of quantum mechanics (in the behavior of particles to wave). Its outcome suggests that science cannot jettison the necessity of ontology in the discussion, dissemination and the workings of science for the discovery of knowledge.

Keywords: Ontology, Science, Force, Motion, Material, Immaterial, Wave, Particles, Mind, Body, Problem.

Introduction

What scientists call "matter" is generating a lot of controversy. Matter in modern science is held as that which has weight and occupy space. Going further, matter is also empty space from the perspective of space-time continuum. This has aggravated the controversy the more as matter isn't only that which can be apprehended with the senses but with mathematical projections as well. Though Berkeley was an empiricist, he posited the idea that matter is an illusion in his *Two Dialogue between Hylas and Philonus*. He never envisaged perhaps that the ontological status of the materially real will pose such a difficult challenge even as he slides into the metaphysical by introducing the mind of God into his epistemological framework.

When the atomists (Democritus, Leucippus and Lucretius) came up with the idea of the atom as the smallest indivisible particle of matter, some kind of reality akin to Spinoza's *monads*, little was it conceived that it will only take time for scientists to discover other hundreds of micro particles that are not perceptible to the direct senses moving with a speed equal to that of light occasioned by fields of force. This was known because scientists have evolved a method that has made science very fascinating and reliable with regards to knowledge attainment of nature and its processes.

The scientific method also known as induction is one built around hypotheses formulation and then theories which must match observable phenomena in nature usually beginning from the known to extrapolating the unknown. The method also thrives by observation and experimentation with data collection, testing and re-testing with the possibility of a replication by other practicing scientists with an outcome that is the same leading to objectivity in science. But the word objectivity is a problem in science just as the word, fact.

Granted that scientific knowledge provides a level of verisimilitude (truth-likeness) following Popper in terms of nearness to the truth, we still find that the scientific method cannot guarantee indubitable truth just as facts. This is perhaps

what Gould had in mind when he asserts that "in science, "fact" can only mean "confirmed to such a degree that it could be perverse to withhold provisional assent"[1]. With this background, it is undeniable that what is called scientific knowledge from its method is fraught with a lot of problems such as the true status of matter, facts, hypotheses, theories, laws, models and so on which are subject to philosophical analysis.

The Systematization of Science

The systematization project of science began around the renaissance and continued through the modern and now contemporary time. Science became an instrument for knowing, understanding and interpreting the world. With the synthesis of rationality and experimentation, the basic constituents of matter began to be identified and the unfolding process led to its justification. Thus the context of justification in science is:

> Concerned with the rational features of scientific practice, and particularly with the issue of how theories are justified, or supported by the evidence. This is open to investigation by philosophers because it covers what is rational about science…. The hypothetico-deductive account is a very well-known and much-discussed view of how science works. It meshes with the Romantic view of discovery by insisting that science works by coming up with hypotheses in some creative way and then justifies these hypotheses by testing their experimental consequences[2].

What constitutes the structure of material reality has been the utmost concern of thinkers about nature. Beginning from the Ionians down through Aristotle, substance seems separated from its accidents just as atoms seem separated from its

1 Gould, S. J. "Evolution as Fact and Theory" in *Discover* May 1981, in *Hen's Teeth and Horses' Toes,* (London: W.W. Norton, 1994).Pg. 253.

2 Steven, F. *Science: Key Concepts in Philosophy,* (London: Continuum Books, 2007). Pg. 12-13.

particles. Paul R. Durbin sets the issue at hand in perspective when he opined that "an approach to the intelligibility of the world can be mechanistic, realistic and positivistic: but what about the world itself that is being approached? The most fundamental aspect of this world as an object of science and the philosophy of science is matter. What is it? What are its components? How does it act, if at all? How is it structured, interrelated, locked together to form a world that can, because of it, be called "material"?[3]

It was Ernest Rutherford in the modern era that proved that the atom is not the smallest unit of matter. He demonstrated that an atom is mostly empty space containing a very tiny, positively charged nucleus of massive protons surrounded by a negatively charged orbiting cloud of light weight electrons[4]. Then Rutherford's student Niels Bohr suggested that orbiting electrons could jump from one orbit to another. With each jump, an electron would either give up a discrete amount (a "quantum") of energy in the form of a photon, or absorb energy in discrete quanta if it was struck with a photon.

Here we are talking about the ontological world of an atom where its constituent's parts in the forms of particles have a wave behavior that is fuzzy as well as random. This also lends credence to the fact that even inanimate objects are infused or ingrained with force or energy. The study of material reality is vastly more complex than it once seemed so that to delineate what is real becomes a gargantuan task. Christian opines in line with this point that:

> The critical distinction between what is real and what is only experiential has been entirely obliterated in physical thinking, making it virtually impossible to honor the principle that demands that we think about objects in their true contexts and not commit the error

3 Durbin, P. R. *Philosophy of Science: An Introduction,* (Newyork: McGraw Hill Book Company, 1968).Pg. 78.

4 Christian, J. L. *Philosophy: An Introduction to the Art of Wondering,* (Belmont: Wadsworth Cengage Learning, 2009). Pg. 515.

of interpreting them in terms of false functions. I once asked a physicist to tell me how physicists deal with the subject-object problem. His reply: "they just ignore it". As they must-as physicists.[5]

Mind and Matter Entanglement

The material dimension of reality often cut across the mental and emotional processes of human beings in making contact with the external world. We could also call it the psychological underpinning of human existential reality. But there is a problem if we try to subject thoughts to measurement. How can we measure thought processes? How can behaviours be predicted? What causal links can be inferred from psychological reality? This task is arduous because "it would be foolish, for example, to try to explain the concept of atom in physics solely in terms of what goes on in our (conscious and unconscious) minds without considering the actual material things that are described by this concept"[6].

The primacy of a psychological explanation in science cannot be overlooked howsoever. For the various economic, political, and historical forces are social forces, in the sense that they represent the drives and tendencies of a community or group of human beings or perhaps, of the human race as a whole. This would perhaps account for why Thomas Kuhn sees science as what a community of scientists accepts to be "normal" except anomalies are encountered. Science is therefore seen as the most complex system of knowledge with clear distinctive features. Judith Willer sees science as "all thinking which combines rational, empirical and abstractive thought. Neither catalogues of empirical facts nor rational systems such as mathematics are scientific thinking by themselves. No system of knowledge is scientific unless it connects the observational and theoretical levels"[7].

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5 Christian, J. L. *Philosophy: An Introduction to the Art of Wondering,* (Belmont: Wadsworth Cengage Learning, 2009). Pg. 506-507

6 Hutten, E. *The Origins of Science: An Inquiry into the Foundation of Western Thoughts,* (London: George Allen & Unwin Ltd, 1962) Pg..49-50

7 Willer, J. *The Social Determination of Knowledge,* (New Jersey: Prentice-Hall, 1971). Pg, 31.

The dichotomy between the method for material investigation of reality and the immaterial aspect brought together Scientists, mathematicians and philosophers to converge at Vienna in Austria. They went by the name Positivists, Logical Positivists or Logical Empiricists. Though Karl Popper refused to be called a positivist, he nevertheless contributed to the discourse of demarcation in science, a course pursued by the Logical Positivists. He avers that:

> My main reason for rejecting inductive logics is precisely that it does not provide a suitable distinguishing mark of the empirical, non-metaphysical character of a theoretical system; or in other words, that it does not provide a suitable criterion of demarcation. The problem of finding a criterion which will enable us to distinguish between the empirical sciences on the one hand, and mathematics and logic as well as 'metaphysical systems on the other, I call the problem of demarcation[8].

This demarcation project seems to be better carried out using the scientific method. With this method therefore, physical concepts can be separated from non-physical ones just like empirical realities from non-empirical ones. The scientific method therefore created hostility between physics and metaphysics in the sense that metaphysical realities became seen as nonsensical since they cannot be proven using the observable and experimental method of science. To this end, Archibong and Nkanta summarize the tenets of positivism to include: "the unity of science, the rejection of metaphysics, the language of science and the principle of verifiability. Science amidst its diversity in terms of subject matter employs the same methodology. The elimination of metaphysics on the other hand presupposes that experience and observation authenticate the scientific attitude"[9].

8 Popper, K. *The Logic of Scientific Discovery,* (London: Routledge, 2002). Pg, 11.

9 Archibong,E. I, and Nkanta, I. J. "Theories, Strict Positivism and Einstein's Postulational Method" *Sapientia Journal of Philosophy,* Vol. 5, (2015). Pg, 21

The Criterion of Real Science

Karl Popper further adopted falsifiability as a criterion for deciding whether or not a theoretical system belongs to empirical science. This becomes very necessary especially as certain theories are difficult to accept as empirical but they are empirical nonetheless. How did science arrived at the demarcation between what is empirically verifiable and what is not? Popper avers that "statements which do not satisfy the condition of consistency fail to differentiate between any two statements within the totality of all possible statements"[10]. Since empirical basic statements must be factual, Aigbodioh defines scientific facts as constituting:

> Sense-data (given) or "empirical truths" about the world. They are the raw and primitive ingredients from which scientific hypotheses, laws and theories are formulated and extracted out of experience…Newton's theory or laws about celestial mechanics (that is about the forces or dynamics of physical bodies) are said by Newton himself to be wrested…from experience by induction" and logically derived from the truth of certain observation statements….Which report facts of immediate experience[11].

Since we have been able to have a clear demarcation of empirical basic statements and non-empirical ones and have noted that empirical facts are to be observed or perceived with any of our five senses of touch, sight, hearing, smell and taste, where can we then place the concept of force for instance? Is force a concept that can be perceived with any of the senses? Can the empirical method of science be able to get to the essence or quiddity of being? Can the empirical method of science be able to exhume or perceive the ultimate nature of material reality or substance? Can the empirical method of science be able to

10 Popper, K. *The Logic of Scientific Discovery,* Pg.72-73.

11 Aigbodioh, J. A. *Philosophy of Science: Issues and Problems,* (Ibadan: Hope Publications, 1997). Pg. 35

capture what a thing is by itself without its accidents? Collingswood asserts that "that which was essentially not experienced by the senses, that which was unchangeable and in some way spiritual, became known to the Greeks as the "metaphysical"[12].

The Status of Force as a Material Reality

Force therefore following the Aristotelian distinction of substance and accident, essence and existence, act and potency, change and permanence must be so understood as having a material and immaterial, scientific and metaphysical aspects from where it can be understood and explained. Force is ontologically an abstract concept because the explanation of its reality is distinct from the study of any particular material being. Thus, if force is to be discussed as a material or physical reality, it would readily be understood that we are looking at the effect of force and not what force is in itself.

To know the concept of force whether as a material or immaterial reality swings between the systems of empiricism and rationalism of which Kant sought to reconcile through his synthetic *apriori* postulation and it is engendered by that fact that it points to being or non-being. Deductively then, being can be investigated. Clearly, the word nothingness can be extrapolated from something even in science. However, Poldony asserts that "…the layout of our galaxy and the universe itself, constitute a cosmic whole that is built on a foundation of the void or vacuum"[13].

Force therefore can be delineated as one of the perennial problems in metaphysics and it would not be out of place whether it is understood as a material reality or in the laboratory of the mind. Like thought experiments, "we recognize them when we see them as they are visualizable; they involve mental manipulations; they are not the mere consequence of a theory-based calculation; they are often (but not always) impossible to

12 Collingwood, R. G. *An Essay on Metaphysics*, (Oxford: The Clarendon Press, 1957). Pg. 19

13 Podolny, R. *The Something called Nothing: Physical Vacuum, What is it?* (Moscow: MIR Publishers, 1986). Pg.9.

implement as real experiments either because we lack the relevant technology or because they are simply impossible in principle"[14].

Force from an African Perspective

When we view the system of the modern science and that of traditional Africans, there are vast similarities and differences in methodology which can be summed up under geography and history. These two systems have their own internal logic and merit which must be understood before it can be appreciated. With respect to force, there are similarities and differences in what it is to the Africans and modern scientists. The African conceives force in hierarchy with God at the apex and minerals at the lower wrung of the ladder. One would wonder what these differences portend with regard to what is held to be reality. Are there several reality or are we being influenced by our thought systems in how we view the world or methods of arriving at knowledge? Scholarship today must incorporate an African perspective in the discussion of matter because every worldview has its own mode of apprehending reality which can be helpful to humanity.

The Scientific Worldview Unveiled

There are seven questions that are tackled in every worldview thought system and they are: What is prime reality-the really real? What is the nature of external reality, that is, the world around us? What is a human being? What happens to a person at death? Why is it possible to know anything at all? How do we know what is right and wrong? What is the meaning of human history? These questions cannot meaningfully be answered outside of a belief or thought system. For the fact that there is a universe in motion with conscious humans in it who understands the central meaning of force and the place it is accorded in our world, it becomes germane to investigate

14 Brown, J. R. *The Laboratory of the Mind: Thought Experiments in the Natural Sciences,* (London: Routledge, 2005). Pg.1.

how force as a concept holds enormous implications for some of these questions from these two thought systems. To make sense of the ensuing discussion, how the question of force is held in traditional African and modern science is imperative.

Motion and change are fundamentally the outcome of force. Where ever there is motion, force must be behind it. Where ever there is change, force can be attributed to it too. This is why in modern science motion is a change in position of an object over time. But the change to be examined here is as contrasted with permanence in metaphysics. The universe contains things that appeared to change; yet these very same things also possessed a certain endurance and permanence. In Western philosophy, Heraclius is regarded as the apostle of change. Parmenides on the other hand is so regarded as the apostle of permanence. However, it was Zeno of Elea, Parmenides student who devised some well-known logical paradoxes that supposedly demonstrated the contradiction of motion. In looking at the chart above, it is clear that some things in life are held as true based on the logic contained in a predominant worldview.

Evaluation and Conclusion

Everything in the universe can be considered to be moving since motion applies to objects, bodies, matter, particles, radiation, radiation fields, radiation particles, space, its curvature and space-time. This is a fact in science even though it may not appear so in actual experience. This is the more reason why motion is mathematically described in terms of displacement, distance, velocity, acceleration, time and speed. The universe is replete with forces as it has already been observed. These forces are constantly acting on matter creating motion and collision. Interestingly, the place of this random motion is the sub-atomic level of reality. And it is expected that if the fundamental laws operating at the level of reality is randomness, then we are supposed to experience the same effect in the macro world. Pagels notes that:

> Not only does quantum theory deny the standard idea of objectivity, but it has also destroyed the deterministic worldview. According to quantum theory, some events such as electrons jumping around atoms occur at random. There just isn't any physical law that will ever tell us when an electron is going to jump; the best we can do is to give the probability of a jump. The smallest wheels of the great clockwork, the atoms, do not obey deterministic laws[15].

Granted that events in the universe do not move close to the speed of light to necessitate randomness on a wider atomic scale, it doesn't negate the fact that all objects in the universe are in constant motion. Even when a person is sitting still in a chair, the body is moving thousands of kilometers per second. The earth is spinning on its axis, carrying us with it. The planets orbits the sun, which is a star orbiting the center of the Milky Way Galaxy. There are normal everyday motions such as a rolling ball or a moving vehicle in the midst of other motion.

Since motion is defined as the change in position of any object, motion then is responsible for the changes seen in our universe. This presupposes that as long as motion is in place, things will continually change. And as long as things are changing, then we can explain the idea of decay. Force is responsible for decay, the weak nuclear force in particular. The concept of force is also responsible for several of the familiar and unfamiliar features seen in the universe. But the interesting point is that, change of form is not the loss of energy as energy is understood in science as neither created nor can be destroyed.

Traditional Africans similarly hold the belief that force is responsible for everything we experience in the universe. It is force that sets objects in motion by energizing them. Forces can be strengthened and it can be diminutive. Mbiti opines that "this state of the ultimate diminution of being is the fate of some of the dead. It is the condition into which those who have

15 Pagels, H. R. *The Cosmic Code: Quantum Physics as the Language of Nature*, (Newyork: Bantam Books, 1983). Pg. 47.

passed over fall if they have no means of renewal through those living on earth"[16]. Everything then in the universe can be explained by the reality of force including motion, change and decay as seen in the ontological reality of force and change in the scientific systems. This makes it very clear that non-existent reality ought to be reduced to scientific affirmation as reality is bigger, deeper and higher than the scientific method of knowing. The metaphysical dimension of reality cannot be ignored as it makes for the completion of the circle of human understanding and explanation of reality. Conclusively then, matter is an enigma even in science. It may appear very easy to understand but upon a thorough philosophical assessment, it will be seen to be full of apparent contradiction. In all, that upon which science is predicated is not without its fair share of challenges that engages the critical and inquiring mind.

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16 Mbiti, J. S. *African Religions and Philosophy,* (Nairobi: Heinemann, 1969), Pg. 66.

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