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Does the Rose-Tinted Glasses Effect in Contemporary Physics Prevent Us from Explaining Consciousness?

Abstract: *Anyone wearing rose-tinted glasses might be forgiven if s/he comes to the conclusion that the world out there is rosier than it actually is. With his Fish Story, Sir Arthur Eddington warned us how analogous illusions might have happened in our models of the physical world. His allegory describes how observer characteristics can be inadvertently assigned to the systems being observed. If Eddington's conjecture is applicable, the most fundamental properties of nature will turn out to be the construction rules of the observer who measures nature. Since no one exactly knows how the brain works and because it is the final measuring instrument that collapses the wave function at the end of von Neumann's measurement chain, it is likely that observer characteristics have been falsely attributed to physical reality and our theories of it. These errors may prevent us from understanding consciousness because they mask the actual operations of the psyche. Starting with Velmans' model of consciousness I analyse the role of cognitive models in the development of science. I then model how both the set-up of experiments and the interpretation of resulting data could be influenced to arrive at erroneous theories. Using examples I show how potential errors, due to our incomplete understanding of the conscious process, have crept into physics. These need to be corrected if we are to evolve a concept of physical reality that includes conscious experiences.*

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1. Introduction

The *observer model*, used for the interpretation of experimental results that underpin our physical theories, influences the very theories we believe to be supported by their objective observation. The foundations of contemporary physics are based upon observer models that vary from 1) no model at all, to 2) objective eye witness, and occasionally 3) quantum observer models. The first option is most prevalent. Scientific tradition strongly favours the elimination of subjective experience in its head-long quest to discover the secrets of an objective observer-independent universe. It has developed theories and methodologies consistent with this quest. As pointed out by Stapp (1993), this has left us with an objective worldview and a physics which cannot explain consciousness even in principle. Quantum theory suggests this goal is misplaced because the reality we know is not observer-independent. *It is therefore likely that traditional science has interpreted properties of the conscious observer as attributes of an objective universe in order to be consistent with its basic beliefs.* This I call the Fish Story Effect and this paper will explore the extent to which it has happened and why such errors may limit our ability to explain consciousness in scientific terms.

I will approach the problem by noting two differing concepts of reality underlying the two major periods in our western intellectual tradition. These are the Dark Ages of the first millennium dominated by the doctrines of the Catholic Church, and the rise of classical science beginning with the Renaissance which has dominated the second millennium. The differing concepts of reality underlying these two periods were already debated in the works of the Greek philosophers Plato and Aristotle, and this article will attach their names to these opposing views. The first, originally expressed in the analogy of Plato's cave, describes what we experience as shadows on the walls of a cave projected from an unobservable reality outside the cave. I am not referring to Plato's entire philosophy, but only the distinction made between what we experience and the reality that is responsible for those experiences.

In contrast, Aristotle eliminated this distinction and believed we see reality directly through the windows of our senses. This 'naïve reality' shortcut was incorporated into his natural philosophy which evolved into modern science and classical physics. Classic science treats our eye-witness experience as objective reality and perversely leaves no room for our feelings to be anything other than a configuration of objects in that reality. Quantum theory is, then, identified as a fledgling step back to a view expressed in Plato's cave analogy in which immediate experiences are distinctly separated from actual reality. I am not claiming that Plato's ideals are that reality, or that Aristotle's philosophy is limited to the 'naïve reality' assumption. I am claiming that, for Aristotle, 'the world which we experience through our senses is not, as Plato taught, a mere copy [shadow] of the real world, but is *the real world*' (Frost, 1947). In this article I am only attaching Plato's name to the idea that reality is *inferred* from direct experience of objects, and attaching Aristotle's name to the view that our direct experiences of objects are at least *representative* of reality.

Next I present several models of a cognitive being. I begin with the model proposed by Velmans (2000) grounded in the classic scientific framework. I then expand the model to accommodate the discoveries of quantum theory, which are more closely aligned with Plato's inferred reality thinking. This is followed by a further improvement in the model by using Whitehead's (1959) events rather than objects as fundamental building blocks. The cognitive process is then modelled as a feed-forward loop between sensations and their explanation.

Armed with these models of the conscious process we then see how the interpretation of major physical experiments is altered when a model of the experimenter's thinking process is included. This inclusion gives us an opportunity to examine the attributes and prejudices in the measurement and interpretation methodologies employed in order to see how theories are affected. I discuss the photo-electric effect in detail as an example. This will show how characteristics of the measurement apparatus can be inadvertently projected onto the world being measured.

Though only one example is discussed in detail, I believe the Fish Story Effect is pervasive and attention should be paid to the possibility that scientists are inadvertently discovering their own methods of enquiry. This possibility was exemplified by Sir Arthur Eddington's Fish Story. In this allegory investigators were sent out with a net, which had a two-inch grid mesh, to explore the oceans. After many trials they discovered that all the creatures found had gills and were longer than two inches. Eddington then asks, 'Which is a more fundamental conclusion to draw from these data?' — that all creatures in the ocean have gills or that they are all longer than two inches? His counter-intuitive answer is that the two-inch rule would become the more fundamental law because it encapsulates a basic characteristic of the measurement methodology, i.e. the use of a two-inch net. If the net is identified with the properties of our neural net then the lesson is obvious. The further we dig into reality with the methodologies burned into our neural net, the more likely it is we will discover the characteristics of that net. The net will filter everything and if we do not understand that this Fish Story Effect is of our own making we will get an incorrect belief of the reality we think we are examining.

Such a mistake certainly happened when classical physics conceived of physical reality as a 3D objective universe because 'that's the way we see it'. People built impressive classical theories consistent with this assumption until quantum theory showed this to be in error. Through the example outlined in this paper I hope to show how aspects of quantum theory can also suffer from the same problem. If a false projection of an observer characteristic can be identified, not only will a specific field of study be affected, but a new paradigm of an observer-inclusive physics will emerge. Such physics would greatly reduce the difficulty in finding explanations for consciousness because consciousness would be included in the physics along with the observer.

2. Plato's Modern Cave

In western traditions there are two fundamental approaches to the nature of reality. I will label these as Platonic and Aristotelian. The differences are graphically shown in Figures 1 and 2 below. As shown in Figure 1, Plato thought that the experiences of our daily lives are like the shadows on a cave projected from an ideal reality outside. Little-men-inside the cave are bound only to experience these projections. Though his example described a literal cave in the mountains wherein his prisoners were bound by ropes and chains, his allegorical message, translated into modern language, is that we little-men-inside are bound in the cave of our skull and experience the processed result of our measurement activities on a screen we call our mind. The chains holding us captive may be interpreted as some psycho-physical phenomena yet to be discovered but reasonably attributed to forces involving our brain. The bright world of ideals outside the cave is today a more scientific world of models and theories rather than the literal universe, which Plato's ideals would have us imagine. Simply stated, what is outside the cave is what we now call reality.

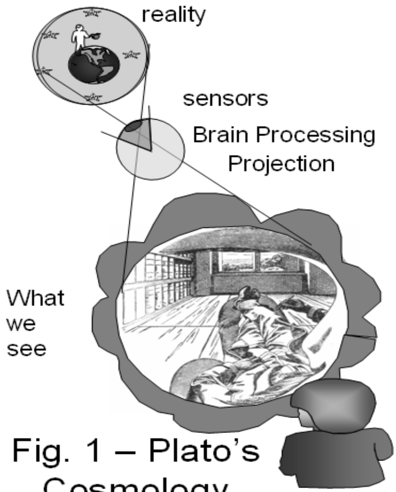

Fig. 1 – Plato's Cosmology

Figure 2 shows a little-man-inside looking from a dark cave through the opening into a bright external world. Of all the things we can see out there, some of them respond to our will and move to our command. This subset is called our body and we can use our control over it to change the appearance of reality to fit our needs and desires. Concentrating on this world outside and honing our ability to make it do what we want has been the story of scientific development ever since. The success of science is renowned. It is based on the 'naïve reality' assumption that things are *really* where they appear to be and the simplification it implies. Material success, defined by improving appearances in this outside world, is the hallmark of western progress in the second millennium. However, this was not always the case. What Aristotle sacrificed by looking directly through the entrance is the world of feelings, dreams, and imagination that still fill the darker recesses of our cave. Such a sacrifice was not immediately accepted. The Platonic belief that a reality could be imagined outside our immediate experiences provided a favourable ground for religious dominance during the first millennium. It was much easier to convince a public that spiritual powers existed beyond their everyday lives when their fundamental cosmology already contained a separate place for true reality as Plato proposed. The image of being released from one's bonds and venturing through the entrance to an ideal world is readily adapted to the promise of heaven and all the comfort it may supply. Christian, Muslim, and Nordic mythology all promise a life in heaven where happiness is guaranteed. These beliefs dominated the European continent through out the Dark and Middle Ages.

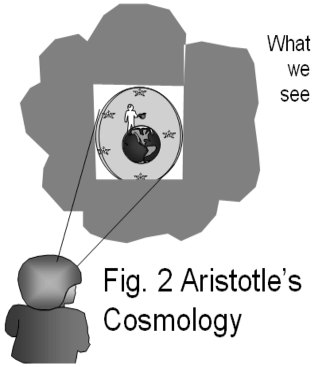

Fig. 2 Aristotle's Cosmology

The 'natural philosophy' inspired by Aristotle never vanished in the Middle Ages. However its ideas were largely limited to debate among scholars until the beginning of the second millennium, as shown in Figure 3. It is not clear what triggered the disenchantment with Catholicism at the beginning of the second millennium. Perhaps the corruption that infected the Church in Rome or the ravages of the Black Death convinced people to look beyond Platonic cosmology and embrace a more direct interaction with their reality. Historians argue about causes, but the writings of Thomas Aquinas around 1250 AD could be cited as the turning point (Cahill, 2006). His works were an updated rediscovery of Aristotelian thinking and presented natural philosophy as a candidate for Catholic doctrine. Though he was canonized only fifty years after his death, his writings were not fully adopted as gospel for another five hundred years. By this time Renaissance thinkers such as Kepler, Newton, Locke, Leibniz, and others had clearly established the dominance of 'naïve reality'-based science. Kant, however, warned us that a 'thing-unto-itself' is unknowable. I identify this unknowable, but not un-nameable, with words such as reality itself and Plato's worldview. However, the practical aspect of classical physics successfully explained everything in sight. Its success continued until the beginning of the twentieth century when it failed to account for properties of material at atomic scales and ushered in the new quantum theory which returned us to a form of Platonic thinking.

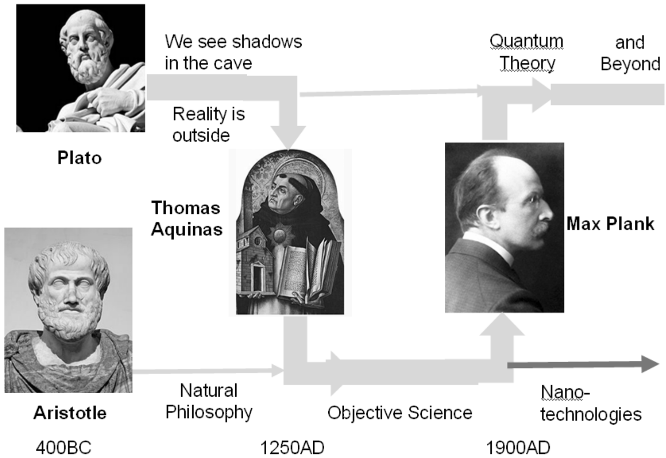

Fig. 3 – The Pendulum Swings

The turning point for this latest move is often marked by the discovery of the action quantum '*h*' by Max Plank at the turn of the twentieth century. This discovery allowed the explanation of black body radiation and encouraged further interpretations of spectral light emissions from material with the new theory of quantum mechanics. The break with classical physics was momentous. No longer were we looking at reality directly. No longer could the objects in front of our noses or even the entire objective universe with all its stars and distant masses be seen as reality itself. All the normal phenomena that twentieth-century man experiences are now interpreted as the data produced by measurement operations carried out by a wall of detectors. That wall of detectors surrounds all our measurement-based data from which science is built and, when we include the detector arrays built into our skulls, the wall completely separates us little-men-inside from the reality outside the wall.

Quantum theory is based upon the reintroduction of the Platonic cosmology into scientific thinking. As D'Espagnat (1979) pointed out, 'The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment'. The objective world we see is analogous to the projection on Plato's cave wall. Reality is outside the cave. Is it as bright and dazzling as Plato's ideal? No! Nowadays, quantum theory describes reality as waves whose amplitude squared determine the probability of interaction between the outside and our surrounding wall. Most of those interactions are absorbed by the outer walls of the cave, your skull, but through windows, made of reporting detector arrays, data are streaming in to be processed and displayed on the inner walls of our cave. An updated picture of Plato's cave is shown in Figure 4. We are inside a skull looking at what is projected on the wall. The projection has been outfitted with modern furniture and the main entrance has been outfitted with optical transmission devices, so it looks a bit like an outer chamber has been built around the inner wall of our cave. When we believed in Aristotle's philosophy, the furniture, walls, lamps, and the cat were real objects. This meant the image of the cat actually surrounded an actual cat made of bones and flesh. A modern quantum Plato would say the image of the cat is certainly a real image but it has been created with attributes of bones and flesh inside our selves by processing sensor data gathered by the detector array windows built into the wall of our skulls. The reality outside that wall is best described as an interaction probability wave, and from a large number of interactions we can calculate the useful image to project on the screen.

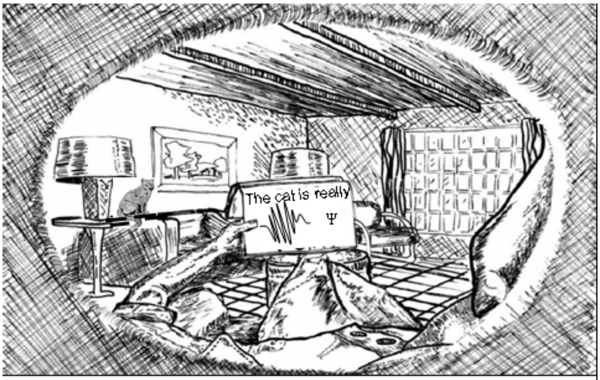

Fig 4 - Plato's Modern Cave – Baer PhD Thesis 1972AD

In the Aristotelian view such an assertion would seem to be an unnecessary complication. If the cat were really an interaction possibility then in order to let you see what created that possibility pattern your brain would have to automatically run a recognition program on the data and select a cat icon from the ideals available in one's memory, tailor it a bit to match the interaction specifics, and project it on the screen. That is a lot of work to keep in mind, and maintaining such knowledge is an efficiency drag on the daily survival activities of western man. As long as that brain functions normally the images you see are evolutionarily optimized actionable information displays that can be trusted. So why not believe these collections of perceptions are real objects in front of you? The modern Platonist would respond by acknowledging the practicality of Aristotle's philosophy but nevertheless would only consider it to be a practical shortcut that works when the assumption of a normally functioning brain is fulfilled. And furthermore, the Platonist would point out that the definition of 'normally functioning' means that the brain produces images of objects, which is a restriction we have been forced to eliminate when dealing with quantum phenomena.

This brings us back to the central question of this paper. If we trust our brain is functioning *correctly* so that what it projects on the wall is an image or token which may actually be like reality itself, then we are probably too optimistic. *Correctly* is an elusive goal. If our brain does make a mistake, however unlikely, the artefacts resulting from these errors will be assumed to be properties of reality. A reality error could have disastrous consequences. However, unless we recognize the shortcut underpinning Aristotle's natural philosophy and return to the architecture suggested by Plato, we will not have the freedom to find the root of the problem. Only Plato proposes a flow of influence from an actual reality outside to a perceptive reality inside. The flow from outside to inside when added to the reverse flow required by us to control at least some part of reality makes Plato's flow an extended processing event. Once such an extended processing event is accepted as our reality, rather than objects created in one phase of this event, then we can investigate our new-found reality for the occurrence of false projections. One of the most important confusions may have occurred during the interpretation of the photo-electric effect, which will be addressed in Section 4. Next I will present several observer models so they can be applied in the analyses of this effect.

3. A Review of the Consciousness Process

The exact details of the consciousness process are unknown. However, under the guidance of Aristotle's natural philosophy, science provides a general outline given by Velmans (2000), which is summarized in Figure 5. Light from objects in an independent universe — the object in this case being the cat — stimulates our sensors. This stimulation is processed into the images of objects we experience. These images are projected back onto the objects we see because we believe they are really there in the first place. In a nutshell this circular reasoning is based upon the 'naïve reality' assumption that things are what and where they appear to be. Once this assumption is accepted, things obviously appear in front of our noses because 'they are there' and we treat those appearances as realities for most of our lives.

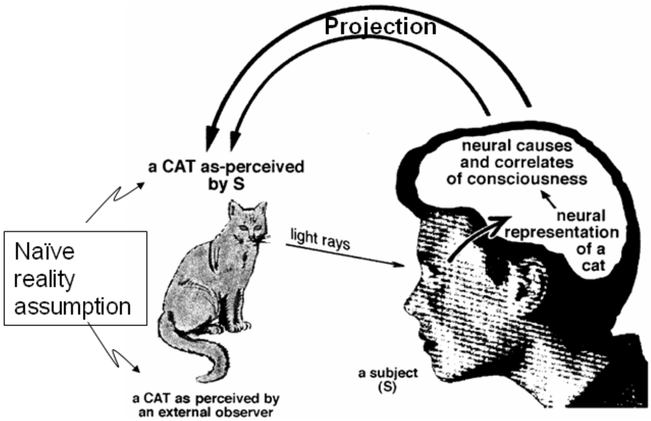

Fig 5 – Velmans' Consciousness Process

If the 'naïve reality' assumption is wrong then all we can safely say is that we have a cat experience, but whether that experience is a representation of anything at all is no more provable than any other possibility. Dreams and hallucinations that feel real happen quite frequently. Velmans, however, does leave us with a way out. He describes the original 'cat as perceived by an external observer'. This implies he believes in a consensus reality, so that we understand that we see a mental image but if a third person, or better all persons, agrees with us that image and its location can be treated as real. That's fair enough for a practical rule to guide our behaviour so that our concept of reality avoids conflicts with those of others. However, by eliminating a Kantian thing-unto-itself in favour of consensus perception, we reduce the reality of the cat to a common hallucination and ourselves to lemming believers, who will one day plunge over the cliff of our common error.

Furthermore the cat, which is here used as a stand-in for any and all objects, would certainly object to being merely an hallucination in our societal consensus. If this were true then we would be merely a consensus hallucination in the cat's society. Then the whole reality of our brain in which the neural representations, causes, and correlates that are supposed to happen would also be an hallucination leaving no real mechanism responsible for what we experience. Consensus reality may emphasize the existence of common mental images much as it emphasizes the existence of common words, but some real mechanism is still required to make the whole thing happen. Therefore, if we are to make Velmans' model of consciousness work, we must either stick with the 'naïve reality' assumption or give it up and return to the Platonic philosophy which includes a reality that may be substantially different from the experiences it causes on the screen of our cave. Such a return is forced upon us by the principles of quantum theory, which describe a corrected consciousness process as shown in Figure 6.

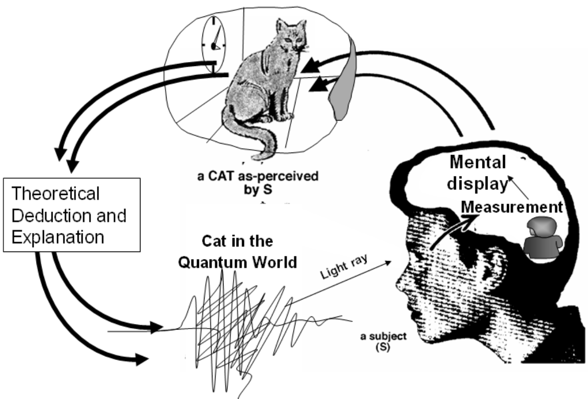

Fig. 6 – The Quantum Consciousness Process

Here we no longer assume things are what they appear to be, but define reality as a pattern of probability amplitudes which propagate like waves in a quantum reality. Using quantum logic the image of the cat is no longer projected onto an object but rather a mental screen along with all our experiences. The content of the screen then forms the input to an explanatory operation that traces the cause of our experience to deBroglie matter waves in an independent quantum world. This reintroduces a reality which, like Plato's ideal, differs markedly from the objects we see.

The cat as perceived represents the classical world of objects experienced in everyday life. The physical reality which caused the classical world to appear is described as a quantum world which interacts with a wall of detectors embedded in our skull. This wall of detectors is referred to as the Heisenberg or von Neumann cut, which separates the quantum domain from the classical world of objects. We little-men-inside the wall of sensors are looking at the result of a measurement process that is projected on the screen. What is not included in Plato's cave analogy is that we, little men, are not satisfied with simply experiencing what is projected into our cave, but go on to execute further mental processing operations that generate an explanation of what we see. These explanations are embodied in the symbols of the theory we believe accurately describes the reality outside the cave. In this case the theory is quantum mechanics and the symbols are the waves described by Schrödinger's equation.

This brings up a very important point. In Velmans' view we projected our mental image onto what we believed was reality. In the quantum view reality is outside the cave. We cannot get out to see that reality directly. The theoretical explanations are symbols which are produced within the cave and are at best *our* model contained in *our* memory of what that external reality might be like. Of course that model is assumed to be correct if the symbols of explanation can reproduce the sensations projected from the external reality outside the cave. But, this implies that Figure 6 describes an internal loop of activity happening in the cave. The explanatory process produces symbols of the external reality; it does not recreate reality outside the cave. Rather, the loop acts more like an amplifier which reinforces external sensations when these resonate with sensations produced by the model of reality held inside the cave.

3.1. The Event-Oriented Conscious Process

The previous paragraph implies that the real mechanism responsible for what we experience when we reside inside the cave acts like a loop that is stimulated from the outside by a Kantian 'Ding-an-Sich' reality we cannot experience directly. What could that reality be? To be consistent, if we are really a processing loop inside the cave then it seems reasonable to assume the same mechanisms are also present outside the cave. This leads to an event-oriented model of interacting consciousness processes as shown in Figure 7. That such a model has the property of self-consistency was first proposed in the *Journal of Consciousness Studies* (Baer, 2010), and further details have been worked out in several publications (Baer, 2011; 2013; 2014).

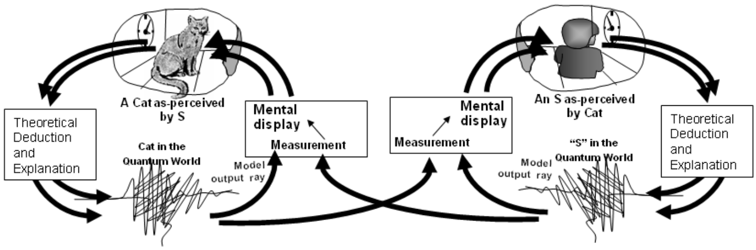

Fig. 7 – The Event Oriented Consciousness Process

What are shown in Figure 7 are two interacting mechanisms that produce their own individual experiences. In this model the reality of our existence is interacting process loops. The loops process memories into experiences and explain those experiences in memories again. The use of the quantum model to reference what is outside pays homage to the best concept of reality physics has to offer to date. A classical objective world model, or even religious world models, can be used in the loop. These have advantages in many personal situations, but cannot help us develop products at the atomic scale. Whatever model of physical reality is employed, a self-contained measurement–explanatory cycle remains as the architecture within which such models are used.

The analogy with modern computer refresh cycles is appropriate, but care must be taken to remember that we must remain inside the loop and cannot get out. The time line of the loop runs through us if we 'little-men-inside' are implemented in the circuitry of the computer refresh cycle. However, currently available computer circuitry can at best possess extremely primitive forms of consciousness differing greatly from our own. No matter how primitive, *the idea that we are self-refreshing permanent existences which adjust their internal processing activities to accommodate stimulation from an external world is revolutionary.* I am developing a full exposition of a process physics that accompanies an event-oriented worldview under the name of Cognitive Action Theory (Baer, 2016). Such physics goes beyond current quantum theory and has its origins in the writings of Whitehead (1959), who postulated that events not particles should be the basis of reality.

One step in that development is the re-examination of the physics we have inherited. We do not want to throw the baby out with the bath water but must be careful to keep those parts which make sense when events, containing some forms of primitive consciousness rather than particles, are assumed as basic building blocks. The Aristotelian shortcut collapses sensation and objective reality into a single entity. This means properties of the perceptive mechanism have been collapsed into the reality notion that is perceived. The Platonic view explicitly separates what we see from what actually is. So we need to examine our legacy of physical theories to ferret out where attributes of our measuring processes have been inadvertently projected into reality. This is the Fish Story Effect discussed in Section 1 of this paper. One of the critical experiments underpinning the development of quantum theory is the photo-electric effect, which leads to the assumption that light is composed of small particles and the doctrine of wave–particle duality. Whether the Fish Story Effect has happened in this experiment will be discussed in more detail in the next section.

4. Possible Reinterpretation of the Photo-Electric Effect

The photo-electric effect consists of the phenomenon that light, when impingent on matter, will eject electrons. The effect is used to build photo multipliers which can absorb faint light energies and produce an electric current that can be recorded. The amount of current produced depends upon the intensity of the light falling on the material. However, whether or not any electricity flows depends upon the colour or frequency of the light. Figure 8 shows a very simplified experiment designed to observe the effect. The experimental set-up includes Velmans' conscious subject with the capability of projecting what he perceives back into the reality of light he believes he is measuring.

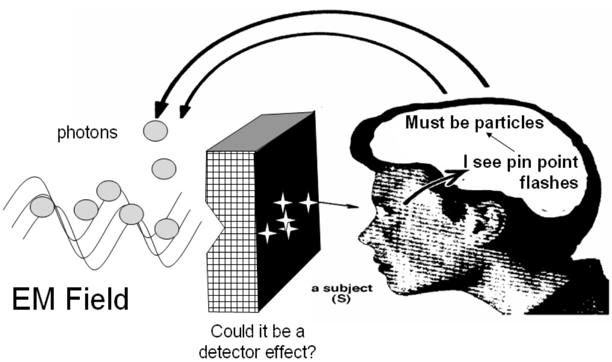

Fig. 8 – Photo electric effect experiment

The assumed physical reality in this case is an electromagnetic field of waves which hit a detector plane from the left. The detector absorbs some of the light, which ejects electrons that hit a screen and produce small flashes that are observed by the experimenter. The wall of detectors has been moved outside of the experimenter's skull so that the scientist is essentially the little-man-inside aware of the flashes. The problem confronting early investigators of this phenomenon is that a low intensity light of sufficiently high frequency (blue colour) will produce small localized flashes at random positions on the screen. If the flashes are stored on a long exposure photographic plate the pattern will conform to the intensity of light in the beam. However, the pattern is built up from small individual flashes. Since each flash is produced by the ejection of an electron from an atom in the material, we must assume that sufficient energy is localized at the atom to knock out the electron. However, the diameter of an atom is on the order of 1 Angstrom, while the wavelength of blue light is around 5,000 Angstroms. If one wanted to hit a golf ball out of the rough one needs to hit it with a club about the size and weight of the ball. If the material of the club were spread out over 5,000 ball lengths, a swing with this giant but very diffuse material would move it less than a puff of air. This dilemma was faced by experimenters 100 years ago. How can gossamer densities of energy in a wave concentrate enough force to hit an electron less than a 1,000th of its size out of an atom?

The answer is that it cannot. No more than blowing on a golf ball will make it fly to the green. Therefore the pioneers of quantum theory concluded that light must be composed of equally small or smaller particles than an atom in order to explain the electron ejection effect. Figure 8 shows an experimenter projecting these small particles, now called photons, back in front of the detector wall. So light is composed of photons. Unfortunately, this projection contradicts the fact that the very same light also bends around objects and squeezes through small openings, producing diffraction patterns that are characteristic of waves. So how was this contradiction rationalized? The pioneers of quantum theory, specifically the group that came to be known as the Copenhagen School, said light is neither a particle nor a wave, but rather acts like a particle when performing a photo-electric effect experiment, and acts like a wave when performing a diffraction experiment. In other words what reality is depends upon how one looks at it. Well that is certainly true of the mental image. Looking at a scene from different angles makes it look different. But is there no Kantian 'thing-unto-itself' reality even if we cannot know it directly?

It sounds a bit like we are falling back into the consensus trap discussed in Velmans' explanation of consciousness. So, for the Copenhagen quantum crowd, reality not only depends on the way we measure, but it is only the probability of recording an outcome of the measurement process that can be attributed to reality. The entire theory now becomes an example of a projection of measurement characteristics that Eddington's Fish Story Effect warns us about.

The attributes of reality we are expected to believe get even weirder. Particles of light are projected to exist in the electric field (EM) as shown in Figure 9 even when the light is examined with what had been a classical wave interference phenomena experiment. Since particles travel in straight lines, the light intensity pattern shown as the wavy line in front of the detector in Figure 9 can only be explained if light is a wave which interferes with itself. But, if light is made of particles, then the particle, we are told, must go through both slits and thereby interfere with itself. Thus we are told that a particle can be in two places at once. Furthermore, if we devise an experiment in which we find out through which slit the particle went, we are asked to believe that our knowledge is enough to change the pattern to one compatible with straight line propagation. In other words, our knowledge would control whether we see two bright spots behind the slits or the wavy diffraction pattern.

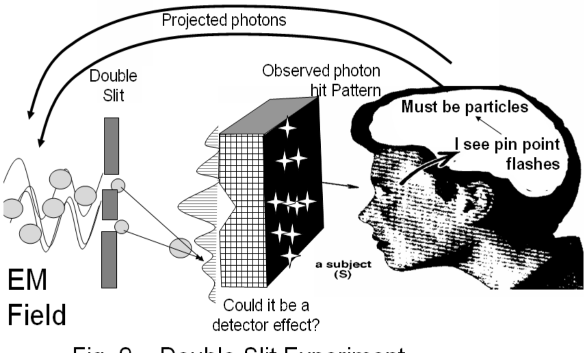

Fig. 9 – Double Slit Experiment

4.1. Alternative Explanations

As mentioned in Section 3, we are bound inside our cave and cannot get out to directly see what reality actually is. Therefore reality is always referred to by symbols which convey a feeling that gives us comfort and is consistent with what we do experience. There are many examples in human history when explanations, no matter how fanciful, become popular and are taken as fact. Once we understand how the human thinking process is involved in the interpretation of physical experiments, it becomes easy to see how artefacts of that process can produce weird properties of reality. The photo-electric effect can also be explained by fairly simple processes taking place in the detector material. *If these alternative explanations are valid, the standard explanation of the photo-electric effect is a false projection of a measurement artefact onto the reality being measured.* Such an alternative explanation was proposed by Sommerfeld and Debye (1913) under the name of loading theory. The idea is that electrons in atoms are always fluctuating due to thermal or other influences from the universe in which they are embedded. Therefore sometimes they are close to an energy threshold that is required for leaving an atom but most of the time they fall back and remain captured. For the small number relatively close to the threshold a small energy push will vault them over the threshold and apparently random emission events will happen when low intensity light is smeared out evenly across the surface.

The experimental verification of Sommerfeld's ideas was attempted by Reiter (2014). His experiment attempted to measure the energy emerging from tandem detectors using gamma rays to show that more energy was emitted as the result of multiple collusions than was in the particle before it entered the detector. The logic is straightforward. If more energy comes out than goes in it must have been stored or loaded into the atomic structure before the collisions. The extra energy stored in the atoms would be released when an impinging field disturbance pushes the atom over the threshold. Reiter reported seeing more energy coming out than going in, thus lending proof to his conjecture. Unfortunately, detector correlations were not taken into account, so this particular experiment does not conclusively prove Sommerfeld's loading theory is correct. However, there are other reasons to suspect that random energy fluctuations in detector atoms may have been falsely attributed to the intrinsic properties of quantum particles, and further experimental investigation of this effect is worthwhile.

A separate, but theoretical, analysis of the double slit experiment by Baer (2015) also suggested that the random disturbances in the detector used in such experiments could be responsible for the result. In Bohr's original visualization of an electron orbiting inside detector atoms, more energy is required to cause ejection than is available from thermal agitation. However, inertial fluctuations due to the random motion of distant masses in the universe could supply sufficient energy. Inertial forces which are responsible for fluctuations in the effective mass (m) in Newton's second law, F = m*a. Sciama's (1953) calculation showed that at very long ranges the inertial force is much stronger than relatively weak attractive gravity when the distant masses are taken into account. Sciama originally proposed a gravitational vector potential to account for inertia; however, it was later discovered that Einstein's general relativity equations also yielded a vector potential (Moller, 1972). Fluctuations in the gravitational vector potential could therefore be a detector-material-based explanation for the apparently random individual flashes and the diffraction patterns associated with the wave character of light.

Perhaps the most accessible alternative from an experimental verification perspective is the phenomenon of resonance absorbers which allow a particle to absorb more light than actually falls on it (Bohren, 1983). The phenomenon is exhibited by metallic particles at ultraviolet frequencies, nano-wires, and small transistor radio antennas. The phenomenon includes a flux capacitor coupled into a small antenna which produces a near electric field that then acts like a large antenna and pulls energy in from a larger effective area. The frequency dependence between the incoming wave and the internal structure of a potentially absorbing atom explains the colour dependence of light usually attributed to the work function in the photoelectric effect. The theoretical cost of assuming such phenomena are applicable at the atomic scale requires the abandonment of the point particle assumption of atomic and nuclear particles. This is a change that modern string theorists would probably welcome.

5. Summary

I have discussed several plausible models of the human cognitive process. In each case an immediate experience is interpreted as a symptom of a reality that is projected onto the sensation experienced. If we introduce such processing steps into physical experiments we have the possibility of differentiating those aspects of our experience that are due to our measurement and mental processing and those that are due to the reality we are trying to measure.

Modern physics is based upon the tradition that our theories of physical reality should not be dependent upon the characteristics of the human observer. This tradition is supported by the Aristotelian 'naïve reality' assumption that we are seeing things as they are. The possibility for confusion between characteristics of reality and the false projection of measurement artefacts into that reality exists. I have reviewed a number of ways that such confusion could happen. Specifically I have provided a detail account of alternative explanations which identify the possible measurement artefacts responsible. The analysis suggests that some of the current mystery and weirdness attributed to reality by quantum theory may have their origin in measurement instrument artefacts.

A further review of scientific theories which includes the conscious processes of the practitioners involved may lead to both a more accurate science and a science in which consciousness finds its natural place.

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