Kant, the two Stages of Visual Search, Quantum Mechanics and Antimatter

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Abstract
Kant's theory of consciousness is related to quantum mechanics by his proof that the Democritos' atom is both indivisible and divisible like a photon in the two slits experiment. This paradox has been solved by Schroedinger's equation. It also leads to the conclusion that there is a collapse of the wave function in quantum mechanics. It follows from the existence of two stages, preattentional and attentional, is visual search that quantum mechanics applies also to visual perception, and the object integration is a collapse of the wave function. The integration of macroscopic objects involves the migration of features between objects. We are unaware of this due to an anticipatory selection mechanism of the perceived sensory input. This migration of features occurs also inside an atom, changing few atoms of matter into atoms of antimatter.
Keywords: Kantian ideas, quantum mechanics, collapse of the wave function, visual search, antimatter.

1 Introduction

According to Wolfe (1994) visual perception includes two stages. The first stage is preattentional and non-conscious, and during this stage the features are processed. The second stage is attentional and conscious, and during this stage the objects are integrated out of their features. Fidelman (2000) suggested that this process of object-integration is analogous and related to the collapse of the wave function in quantum mechanics. This idea is developed further in this study, and possible implications to the physical world are suggested. Physical predictions, which should be tested experimentally, are suggested

2 Kant's Theory of Consciousness and Quantum Mechanics

According to Kant there are three levels of consciousness. The first level is perception, and there are two modes of perception, space and time. Kant proved that each of these modes implies a contradiction. Therefore they cannot be related necessarily to the objective things as they are in themselves, but they must be subjective, i.e., exist only in our consciousness (Kant, 1781, 1783).

The second Kantian level of consciousness is understanding. Understanding classifies the perceived phenomena into physical experience and illusions. Only phenomena suiting several logical laws, called the categories of transcendental logic, are accepted as physical experience. Otherwise, the phenomena are rejected as illusions. However, since the experiential phenomena are presented within the subjective space and time, they too are subjective and not real "things as they are in themselves" (namely, objective things). Kant explained the rarity of illusion by introducing a pre-conscious mental force, called "creative imagination," which processes the raw sensory input, and adapts it to the categories of the transcendental logic. Kant identified the creative imagination with understanding, which processes the sensory data also before arriving at consciousness.

The third Kantian level of consciousness is pure reason, which cognizes Kantian ideas. Unlike Platonic ideas, Kantian ideas are subjective, since they are not part of experience, though they are related to experience. For example, actual infinity, i.e., an infinite set, all the elements of which are presented simultaneously, is an idea. This is due to the observation that a potentially infinite process, i.e., a temporal process in which after every step there is an immediate successor step, like the process of counting, occurs in experience. However, the actually infinite set of all the counted numbers is not a part of experience. According to Kant the logic of experience applies only to phenomena of physical experience. Therefore, it does not apply to ideas of pure reason. In fact, Kant proved that attempting to apply the logic of experience to ideas really causes antinomies. Thus Kant predicted the foundational paradoxes in mathematics, like the paradox of the set of all sets, which is related to actual infinity.

One of these antinomies is related to the following proof of Democritos that atoms exist. If a rod is divided by infinity of equal partitions, then either it disappears, or it comprises infinity of equal finite rods. Both possibilities imply contradictions. Democritos concluded that the rod comprises a finite number of indivisible atoms. Kant explained these contradictions by the observation that the division of each part of the rod into two is a phenomenon of experience. However, the actually infinite set of divisions is not part of experience, but an extension of the experiential divisions into the idea of all the possible experiential divisions. Since Democritos' proof that atoms exist depends on the assumption that the idea of actual infinity of all the divisions exists, the atom itself must be a Kantian idea, to which the logic of experience does not apply. Kant (1783) formulated the following antinomy regarding atoms. Atoms are indivisible. However, their length may be divided into two geometrically. That is, the logic of experience, indeed, does not apply to atoms. Atoms are both divisible and indivisible.

Penrose (1989, pp. 354-359) described the "archetypal quantum mechanics experiment." In this experiment a photon, which is "an atom of light," is emitted towards two slits, beyond which there is a photographic plate. If a detector of photons is placed at one of the slits, then either this detector detects the photon, or it causes the appearance of a speck on the photographic plate. This means that the photon is indivisible, and it is impossible that half a photon passes through each of the slits. However, if the two slits are open, then the photon interferes with itself. That is, it passes through both slits, which may cause, e.g., that the two parts of the photon will annihilate each other, and nothing will be registered on the photographic plate. That is, the photon is both divisible and indivisible. This contradiction is an experimental verification of Kant's antinomy. That is, the logic of experience does not apply to photons, which are atoms in the sense of Democritos. This antinomy indicates that new "quantum" logic is required, instead of the intuitive logic of experience. This new logic is established on Schroedinger's equations, according to which in the "real world" there is a superposition of two states, in each state the photon passes through one of the slits. This superposition is described by a wave function. The detection of the photon at one of the slits causes it to materialize as a particle, the location of which at one of the two slits is probabilistic. The materialization of the photon as a particle is called "the collapse of the wave function."

3 Cognitive Psychology of Vision and Quantum Mechanics

In experiments of visual search several objects, a known target and several distractors, are presented to the subjects, who are asked whether the target is present. The reaction times are measured and analyzed. The models of visual search, which are the outcome of this analysis, may be applied to understand visual perception. One such model is the Guided Search Model (GSM) of Wolfe (1994). According to this model perception include two stages. The first stage is preattentional. All the features of the presented objects are represented at the cortex in retinotopic feature-maps. Then a superposition of all the feature-maps is created, and it is called the activation map. There is evidence that the processing of the features in the preattentional stage of the GSM is performed by the right hemispheric cerebral mechanism (Fidelman, 1999b).

The second stage of the GSM is the integration of the object out of its features, and it is attentional. It occurs only when attention is applied to the location of the object. The presented objects are scanned one after another serially. According to Fidelman (1999b) this stage is performed by the analytic left hemispheric mechanism. According to Treisman & Schmidt (1982) the features are "free floating" and have no location before the object's integration. This statement is based on two findings in experiments of visual search. The first is that sometimes the subjects report detecting some features, say, the color red, but they do not know which object has this feature and its location. The second finding is the phenomenon of illusory conjunction. Sometimes when, say, a blue hat and a red ball are presented to a subject, the subject reports seeing a blue ball. The existence of illusory conjunction means that the existence of the perceived objects is merely probabilistic, since each object may be the outcome of illusory conjunction. Indeed, counterintuitive surrealistic conjunctions of features, like a scene with blue grass and green sky, or tables with noses, are rejected automatically as illusion before arriving at consciousness (Treisman & Schmidt, 1982, p. 108). Perception selects the reasonable conjunctions of features among all the possible conjunctions. This is in line with Kant's (1781, 1783) view that the creative imagination operates on the raw sensory input before it arrives at consciousness, and adapts it to the categories of transcendental logic.

There is an analogy between the two stages of visual search, the preattentional and the attentional, and the two dual cognitive models of light, the wave model and the particle model, respectively. Both the preattentional features and the waves are not localized. On the other hand, both the attentional objects and the photons, which are particles, are localized. The directing of the focus of attention to the location of the object, which causes the object-integration, is analogous to the detection of a photon at one of the slits, which causes its being cognized as a particle. That is, the collapse of the wave function is analogous to the object's integration out of its feature. It is suggested that this analogy indicates that the same neural mechanisms, which perform the visual search of macroscopic objects, involve also in the interpretation of the visual sensory input by the dual models of waves and particles. According to Posner & Raichle (1994, p. 97) positronic emission tomography (PET) experiments show that the same areas of the visual cortex, which are activated while visual input is obtained from the outer world (bottom-up activation), are activated while the subject imagines seeing objects (top-down activation). These cortical areas are the right hemispheric feature maps and the left hemispheric engrams (neural networks), which represent objects (Fidelman, 1999b). According to Treisman & Schmidt (1982) the features are not localized during the preattentional stage of visual search. Similarly, waves are not localized. In fact, the wavelength of a photon determines its color, and the color is, indeed, a feature of the photon. On the other hand, the wavelength of the photon determines its frequency, which determines its energy, which, in turn, determines (according to Einstein's relativity theory) the non-resting mass of the photon. That is, the color and the non-resting mass of the photon are, in fact, the same entity. The only difference is that the wavelength is not localized, while the mass is localized.

In order to visualize a photon as a particle, we have first to cognize it as a feature, e.g., a color. A right hemispheric feature map represents this aspect of the photon as a result of a top-down activation. At this stage the photon is not localized. In the two slits experiment it is presented as a superposition of photons located at one slit with a probability P, and at the second slit with a probability 1-P. If the photon is imagined as located at one of the slits, then the localized photon is integrated as an object (a particle). Since location is a feature of a photon, the presence of the photon at one of the slits is analogous to the object integration, which may involve the phenomenon of illusory conjunction. The combination of a photon and its location is probabilistic, as the combination of features in any macroscopic object, which may be the outcome of illusory conjunction. That is, the cognized microscopic collapse of the wave function might be interpreted as an imagined version of the macroscopic object-integration.

Einstein, Pdolski and Rosen (EPR) did no accept quantum mechanics. Therefore they formulated the following paradox, which is supposed to contradict it (Penrose, 1989, pp. 279-285). Suppose that a spin zero particle decays and emits to one direction an electron and to the other direction a positron. Since the sum of the spins remains zero, one of these particles has, say, an upward spin, and the other one has a downward spin. Suppose that a physicist at a far galaxy detects the spin and the electrical charge of one of the particles, and finds that it is an electron with an upward spin, and another physicist, light-year away, detects that the other particle is a positron with a downward spin. Before the detection the charge and the spin of each particle is probabilistic. However, when one physicist detects one of the particles, he (or she) knows at once what the other physicist detects light years away. This contradicts relativity theory, according to which no information can be delivered faster than the speed of light.

The answer of quantum theoretical physicists to this argument was that prior to the detection, the two particles comprise one system, the features of which are non-localized and entangled. Thus the detected data is about the entire system. This is exactly the situation in visual search, before the object-integration. The probability of illusory conjunction is analogous to the probability of detecting a positron instead of an electron. It is suggested that the neural mechanisms performing the two stages of visual search after a bottom-up activation by the senses, perform also the modeling of the wave function and its collapse into a particle. This modeling is due to a top down activation (reentrant). We are aware of the preattentional stage of the microscopic particles, but not of the macroscopic objects.

The migration of features in macroscopic illusory conjunction is analogous to the phenomenon of the EPR paradox. Since physicists accept the reality of EPR phenomenon, they should also accept the application of quantum mechanics to the macroscopic world, and the reality of the migration of features between macroscopic objects when the wave function representing this entanglement collapses.

4 Illusory Conjunctions, Antimatter, and the Arrow of Time

The EPR paradox concerns particles the existence of which is related to the disintegration of another particle. However, macroscopic illusory conjunction concerns objects related to each other only by their being presented simultaneously to the subject. We suggest that there is a relation between the probabilistic macroscopic illusory conjunction and the probabilistic nature of the features of the detected particle in the EPR paradox. Therefore, we must assume that a "microscopic illusory conjunction" should be possible between any two simultaneously presented microscopic particles. For example, there is non-zero probability that the electrical charges of the protons comprising the nucleus of an atom and the electrical charges of the electrons of the atom will interchange. That is, each atom is, before the collapse of the wave function, a superposition of matter and of antimatter. If particles of matter and of antimatter collide, they are annihilated, and change into photons of light. Therefore, the collapse of the wave function related to the superposition of matter and antimatter is the detection of otherwise unexplained light emitted from an aggregate of many atoms of matter.

Penrose (1989, pp. 356-359) presented a proof that while a particle may be considered as moving backwards in time before the collapse of the wave function, it cannot move backwards in time after this collapse. According to Feynman (1985, pp. 97-99) an electron traveling backwards in time is a positron. That is, if a detector detects a component of the superposition of the possible states of an electron (before the collapse of the wave function), which moves backwards in time (before the detection), it is detected as a positron. Indeed, two electrons repel each other. However, if one of them moves backwards in time, the observer, who moves forwards in time, perceives the two particles as attracting each other, since the observer perceives the movement of the electron which moves backwards in time, in the reversed order of events. That is, the moving backwards in time inverses the electrical charge of a particle.

5 Exchanging of Features between Quarks and Illusory Conjunction

The migration of features from one particle to another, which occurs in macroscopic illusory conjunction, occurs, according to the physicists, also in subatomic particles. However, unlike the cognitive psychologists, the quantum field theory physicists relate this migration to the exchange of smaller particles, which carry the features, between the larger particles (according to quantum field theory this exchange of smaller particles also causes the forces between the larger particles). Thus photons are exchanged between electrons (and/or positrons), and gluons are exchanged between quarks. For example, Feynman (1985, p. 137) described the exchange of gluons between a "red" u quark and a "green" d quark. A "red" u quark changes into "green" by emitting a "red-antigreen" gluon that is absorbed by a "green" d quark changing into "red." The "red" and "green" features of quarks are, in fact, two kinds of charges. If the "color" is being carried backwards in time, it takes the prefix "anti." The quarks and the gluons fulfill the principle of conservation of the "colored" charges.

This description is similar to the conclusion of Treisman & Schmidt (1982, p. 120) that features, i.e., colors or shapes, which migrated from one object to another one, did not leave a trace or a "ghostly replica" behind them. That is, both the colors of macroscopic objects, and the "colors" of quarks, move from one object to another leaving no trace behind them. That is, the conservation principle of physics applies also to macroscopic illusory conjunction.

However, Treisman & Schmidt (1982, p. 120) referred to another study, which had found "ghosts" when illusory conjunction occurred between local components of shapes (like a diameter migrating from one circle to another). Similar phenomena occur also in physics, e.g., when a neutron comprising two d quarks and one u quark disintegrates into a proton, comprising one d quark and two u quarks (Feynman, 1983, p. 140). The u and d features of quarks are some kinds of charges, called flavors. We may consider this disintegration as an illusory conjunction in which the feature u migrates from the u quark of the neutron to one of its two d quarks, leaving a "ghost u feature" behind. However, the d quark of the neutron emits during this process a W particle, "that changes the 'flavor' of a quark and takes away its charge – the d" (Feynman, 1985, p. 140). Thus the physical law of conservation is not violated.

The assumption that the law of conservation of features is not violated also in macroscopic illusory conjunction implies the following prediction. Suppose that a diameter of, say, a small circle, migrates to a large circle, leaving a "ghost" of itself behind. Then another small object, presented to the subject simultaneously with the circles, changes into a large object. If this prediction will suit experimental findings, this means that the principle of conservation of features applies to macroscopic illusory conjunction as well as to physics.

6 Problems Concerning Quantum Field Theory

Illusory conjunction involves the migration of features between macroscopic objects. Our hypothesis is that the same neural processes participate in the migration of features between microscopic particles and between macroscopic objects. However, the small particles, which according to quantum field theory carry features and forces between larger particles, do not make sense as an explanation of the macroscopic illusory conjunction. Therefore, we should replace the quantum field theory by another theory, which is similar to the original quantum theory, i.e., it should involve quantum entanglement of the particles that exchange features, and the collapse of the wave function resulting in the migration.

Let us consider, for example, the electrical force between particles. According to the presently accepted theory of quantum field the basic process related to electrical force is the emission of a photon by one electron and its absorption by another electron. The emitted photon causes the recoiling of the source-electron, and the transfer of momentum to the target-electron by the collision between them. The final observed outcome of this operation is the force of repulsion between the two electrons. However, during the short time between the emission of the photon and its absorption by the second electron, the existence of this photon violates the law of conservation of energy. Therefore the physicists assume that multiplication of the energy of the photon (E) and the time of its existence (t) is smaller than one quantum of this multiplication (h). ΔE designates the range in which the energy of the particle can vary, and Δt designates the range in which the existence-time of the photon can vary. Therefore, according to Heisenberg's principle of uncertainty which is:

$$\Delta E . \Delta t \geq h$$

where h is Planck's constant, the energy of the photon cannot be measured, since the time required in order to measure the energy of the photon is longer than the time of the existence of the photon. Heisenberg's uncertainty principle explains also why the electrical force decreases when the distance between the electrons increases. The increase in the existence-time of the photon (due to the larger distance that it has to travel) requires that the photon has a smaller amount of energy, in order that the multiplication of the energy with the time will remain smaller than h. Then the inability to measure the energy of the photon will not be violated.

This last theory has several weak points. The permission of undetected violation of physical laws may be controversial. Furthermore, it is a custom among the physicists (originated in the positivist philosophy of science) to consider an entity, which cannot be measured theoretically, as non-existing. For example, our inability to measure the velocity of light through the ether caused the physicists to consider the ether as non-existing. Therefore, the inability to measure the energy of the emitted photon may mean that this energy and the photon itself do not exist. Moreover, if the photon cannot be measured, then the wave function representing the state of the system between the emission of the photon by one electron and its absorption by the other one cannot collapse, and it is impossible to consider the "photon" as a concrete particle. In order to avoid these problems, we suggest an alternative explanation of the origin of the electrical force. This explanation involves a return to the original quantum theory, and considering the two electrons as comprising a quantum entangled system, all the features of which are entangled before the collapse of the wave function due to a measurement.

It should be stated that particles having electrical charges can be entangled. For example, a photon can disintegrate into an electron and a positron (Feynman, 1985, p. 116). As discussed above, if we do not assume that these two particles are entangled and non-local before detection, the EPR "paradox" is, indeed, a paradox.

Suppose that the tracks of two electrons repelling each other are detected in Wilson's cloud chamber. The tracks of the electrons do not really exist; they are only idealizations. The tracks are not continuous, but comprise discrete droplets. Each droplet of condensed water is a detection of one of the electrons. There is a force of repulsion between the two electrons and they constitute a system. Each droplet is a detection of an electron, which involves the collapse of the wave function of the system comprising both electrons, like the detection of one particle in the EPR paradox. However, in addition to the interaction between the two electrons, each of the series of detections involves also an interaction between the detected electron and the cloud of water, the outcome of which is probabilistic. Therefore, between two successive detections (by droplets) the pair of electrons exists as a wave function, namely, a quantum entanglement of the features of both electrons. The basic relation between the two electrons (without the interference of outer forces) is that measuring the change of the momentum of one electron provides us with information also about the change in the momentum of the second electron (neglecting the influence of the surroundings). These momentum-changes are equal in their absolute value, but they are in opposite directions.

Having each quantum of momentum is one of the features of a particle. Suppose that we have two particles, the momentums of which have been measured. After the measurement these two particles enter the state of quantum entanglement and then their momentums are measured again (say, by the two paths of droplets in cloud chamber). The reorganization of the features of the two particles may appear to us as a migration of quanta of momentum between the two particles, namely, that a force operates between them. Let us consider, for example, the electrical force, which appears between particles having the feature of positive- or negative-electrical charge. The basic feature of an object charged with electrical charge is that it induces a momentum, in the direction away from itself, in another object having electrical charge with the same sign. It also induces a momentum towards itself in an object having electrical charge with the opposite sign. Therefore, the electrical force may be explained by the probability to exchange quanta of momentum between the two electrons, when their state of quantum entanglement between the two measurements terminates as a result of the collapse of the wave function. This probability increases when the time between the two measurements increases.

Several assumptions are required in order to explain the empirical knowledge about the properties of electrical force. First, an electron at rest can induce momentum in other electrons electrostatically. This means that a resting electron has the feature of having "latent" quanta of momentum. Electrical force is a central force, i.e., it acts in all directions equally. Therefore we must assume that each electron includes quanta of momentum, which are vectors directed to each direction. When the electron is at rest, all the quanta directed to each direction are balanced by the quanta directed to the opposite direction. We may assume that the number of quanta directed towards each direction is finite, and its upper limit is half of the number of quanta required for the particle's attaining the velocity of light, C. That is, the sum of the absolute values of the momentums directed at each pair of opposing directions is M*C, where M is the mass of the electron. We will see that this assumption may provide an explanation of the observation that C is the upper limit of velocity of all the particles. Namely, the limited velocity of a particle is related to the limited capacity of the particle for quanta of momentum. If we want to avoid the possibility that the sum of quanta of momentum of an electron in all the directions is infinite, we should assume a quantization of the direction. That is, there is only a finite number of possible directions. All the quanta of momentum migrating within a spatial angle are represented by their resultant.

Suppose that two electrons are at rest, and a quantum of momentum directed, say, to the left (of the observer), migrates from an electron A to the other electron B, which is necessarily located left of A (as follows from the observation that the force is a force of repulsion). Then the number of quanta of momentum directed to the right, in the electron A, will be larger by one than the number of quanta of momentum directed to the left, and the electron A will move to the right. The migration of this quantum of momentum to the electron B at the left will cause it to move leftwards, since now the number of quanta of momentum directed leftwards, in B, is larger by one than the number of quanta directed rightwards. The movements of the two particles in opposite directions are in line with Newton's principle of reaction. The probability that a quantum of momentum in A directed leftwards will migrate to the left (to B) is equal to the probability that a quantum of momentum in B directed to the right will migrate to A. Therefore, we may assume that both these processes occur simultaneously. The final outcome will be the same, but the intensity of the force will be doubled. The absolute value of the sum of momentums in both directions, in each electron, does not change.

Let us assume that the two electrons, A and B, are an isolated system. The initial number of quanta of momentum in A, directed leftwards, is limited by half the number required to achieve the velocity C. This is the maximal number of leftwards-directed momentum-quanta that may migrate to B. The initial number of quanta of momentum directed leftwards in B is also half the number required to achieve the velocity C. Therefore, the upper final limit of the number of momentum-quanta in B directed leftwards is the number required to achieve C. At the same time quanta of momentum directed rightwards migrate from B to A. Therefore, at each instance of time the absolute value of the sum of the quanta of momentum directed leftwards and rightwards in A is the amount required to achieve the velocity of light, C. The same applies also to B. However, the repulsion force between the electrons diminishes together with the square of the distance between them (see below in this section). Therefore, the two electrons do not attain the velocity of light, C.

When an electron and a positron are attracted towards each other the process is similar. The only difference is that when the signs of the electrical charges are opposite, the quanta of momentum migrating from the electron to the positron cause the positron to move towards the electron, and vice versa. When the two particles are very close to each other the force of attraction increases. This means that the probability of migration of the quanta of momentum increases. According to classical physics when the distance between the two particles approaches zero, the force of attraction approaches infinity. In terms of our theory this means that all the latent quanta of momentum, directed towards the other particle, migrate from the electron to the positron, and vice versa. That is, both particles attain the velocity of light, C.

The characteristic outcome of a collision between a positron and an electron is the annihilation of both, and the emission of two "back to back" photons of light. (Feynman, 1985, p. 98, Frazer, 2000, p. 178). Let us analyze this outcome.

1) The electrical charges disappear, i.e., there is no attraction along the line connecting the two particles. This means that after the collision between the electron and the positron there are no more latent quanta of momentum in the direction connecting the two particles, the migration of which represents the electrostatic force (however, quanta of momentum perpendicular to the direction of the photons, may remain).

2) There are two "back to back" particles, moving at the speed of light. This is in line with the hypothesis that both, the electron and the positron, achieved the speed of light, which explains the lack of electrical charges and of latent quanta of momentum.

3) The resting mass of the two photons is zero, which is expected from particles moving at the velocity of light (otherwise, their energy is infinite). That is, each of the electron and the positron changed into a photon moving in the speed of light, and the sum of their resting mass and the kinetic energy of the collision changed into the energy related to the frequencies of the photons.

Empirical findings show that electrical force has the property of decreasing together with the square of the distance. This finding may indicate that the probability of the passing of a quantum of momentum from one charged particle to another is proportional to the spatial angle between the center of source particle and the perimeter of the other one. This may be due to the inclusion of more quanta of direction in a larger spatial angle. A near electron has a larger spatial angle than a far electron, and the spatial angle of an electron is proportional to the reciprocal of the square of the distance between the electrons. However, the force of repulsion between the two electrons is equal, in its absolute value, to the force of attraction between an electron and a proton. That is, the electrical force between two charged particles is proportional to the minimal spatial angle between the two particles. The reason of this last observation may be due to a principle of conservation. Namely, for each quantum of momentum that passes from a particle (say, an electron) to another (say, a proton), there is another quantum of momentum passing in the opposite direction, namely, from the proton to the electron. Thus the sum of the absolute values of the momentums directed towards two opposite directions remain equal to M*C. Therefore, though one of the spatial angles is larger, since the perimeter of the proton is larger, the mutual exchange of quanta of momentum is limited by the minimal spatial angle. A collision between an electron and a proton does not cause their annihilation, since the radius of the proton is larger than that of a positron. Therefore the electron cannon approach the proton too much, and the small minimal spatial angle prevents their mutual annihilation. However, the larger minimal spatial angle between a proton and an antiproton enables their annihilating each other, since more quanta of momentum can migrate through it.

There is another flaw of the quantum field theory, which this suggested theory avoids. The electrical charge of an electron induces an electrical field around itself. Computations based on the quantum field theory provided that the interaction between this field and the electron involves infinite energy. This infinity has been removed by artificial "renormalization." Our suggested theory may prevent this infinity, since the number of quanta of momentum "attached" to each electron is finite.

Quantum chromodynamics is an imitation of quantum electrodynamics. Therefore the above-suggested initial ideas may be extended to replace the assumption of the existence of gluons.

7 Unexplained Emission of Light by Gases

7.1 The Empirical Findings of Molchadzki (1960)

Unexplained empirical findings of Molchadzki (1960) may be in line with our theory. The purpose of Molchadzki (1960) was to obtain scintillations of light from liquid xenon due to radioactive radiation, in an aluminum-cell adjacent to a photomultiplier. The procedure of the experiment was to cool the xenon down to its freezing temperature (-112 degrees C). The cooling was achieved by connecting an aluminum rod to the cell, and plunging the second end of the rod in liquid air (-180 degrees C), and using the gradient of the temperature along the rod. Fast cooling was obtained by pouring liquid air directly on the cell.

The following phenomena occurred without the presence of a radioactive source, and when the cell was covered in order to prevent the penetration of light. These phenomena did not occur when a non-transparent partition isolated the cell from the photomultiplier. This means that the phenomena originated in the cell, and not in the photomultiplier.

A high vacuum has been maintained in the cell. The cell has been cooled gradually, and a small quantity of the gas xenon has been introduced into the cell at various temperatures. When the temperature decreased below –40 degrees C, many high pulses of light were detected during the bursting of xenon into the cell. The lower the temperature of the cell, the larger was the effect. However, there was no reaction when the temperature of the cell was higher than –40 degrees C, or when the introduced xenon was cooler than the cell.

Fast condensation of the xenon by pouring liquid air on the cell caused a very strong emission of light during the process of condensation, which terminated when all the xenon has been frozen and became solid. Heating the solid xenon and causing it to melt followed by the renewal of the pulses of light.

Similar weak effects were found when the following gases were introduced into the cell, after the cell has been cooled down to the corresponding temperatures. Kr at –110 degrees C, A at –120 degrees C, He at –50 degrees C, CO2 at –80 degrees C, N at –50 degrees C. In all these cases the number of the pulses increased considerably during a strong cooling of the cell by pouring on it liquid air.

7.2 A Suggested Explanation

The observation that the emission of light occurs during both condensation and melting of xenon means that this phenomenon is not related to the release of latent heat during the condensation of the xenon. We suggest that this effect may be due to the "realization" of the state of antimatter, which performs a superposition with the state of matter, in any atom. For each atom there is large amplitude of probability that it is in a state of matter, and very small amplitude of probability that it is in a state of antimatter. Therefore, when two molecules of gas, A and B, collide, there are the following three possibilities:

1) Both A and B are in a state of being molecules of matter
2) Both A and B are in a state of being molecules of antimatter
3) One of the molecules A and B is in a state of being matter, and the other is a state of being antimatter.

In fact, "a collision" is a superposition of all these three possibilities, i.e.; it is a quantum entanglement of all the three of them. However, if a detector of photons is present, it is entangled with the two colliding molecules, and it has the role of the detector in the two-slit experiment, or in the EPR paradox. Namely, it causes the collapse of the wave function. Therefore the detector's detecting emission of light may indicate the annihilation of matter and antimatter.

The probability that there will be an annihilation of matter and antimatter is about the multiplication of the probability that one of the colliding molecules will be in the state of being matter, and the other will be in the state of being antimatter. This probability is very small. This consideration may explain why the phenomenon occurs at all. Now we try to explain why the phenomenon occurs at low temperatures. We suggest that in the conditions of the experiment of Molchadzki (1960) the probability of the collision between two molecules of gas, one comprising matter and the other comprising antimatter, is larger than at room's temperature. The presence of the photons' detector enabled the detection of the phenomenon.

When the gas is cooled, the distance between its molecules (if the cell is open) and their velocity decrease. In the case of xenon, which is a noble gas, the molecule is a single atom. The entire atom is neutral electrically. However, suppose that two hypothetical atoms, one of matter and the other of antimatter, approach each other. Since the negative electrons of matter, and the positive positrons of anti-matter, are located at the outer shells of the atoms, when the two atoms are near each other, there may be some local attraction between them, which may bring outer electrons and positrons close to each other. If the relative velocity of the atoms is large, this attraction will not cause the collision of the two atoms. The trajectory of an atom may change into a parabola, and pass near the other atom like a fast meteorite, which does not collide with earth, since the duration of the strong attraction is short. However, if the relative velocity is small, a small distance together with the slow velocity will be sufficient to cause a collision (or, at least a friction) between the outer shells of two atoms (this effect may be stronger than the decrease in the number of near-collisions, due to decreased velocity). This situation is similar to a slow meteor, the gravitational attraction of which to earth is sufficient to divert it from its trajectory and cause its falling on earth. Let us consider an entangled system of two atoms of gas approaching each other; each atom is an entanglement of matter and antimatter. The above consideration implies that the probability of annihilation of matter and antimatter is larger when the temperature is low than when it is high.

Now we explain why the phenomenon is stronger during fast cooling of the gas. We may consider the entire volume of the noble gas, which is cooled in the cell, as one system of quantum entangled atoms. All the states of the single atoms are now states of the system. That is, for each atom, its state of being an atom of matter is now a state of the system and its state of being an atom of antimatter is another state of the system. The entanglement of the entire volume of gas may enable the "exchanging" of electrical charges between the electrons of one atom and the protons of another one. All the possible collisions between atoms are states of the system, and their number may be estimated by thermodynamics. A detection of emission of a photon from the gas may mean that an atom of matter and an atom of antimatter collided and were annihilated. Thus we may have information about the proportion of the collisions between atoms, which caused annihilation of the colliding atoms and those that did not, and estimate the number of atoms in the states of matter and of antimatter. Since this estimation concerns the entire volume of the gas, this measurement causes a collapse of the wave function of the entire system of the gas, which becomes, for an instant, a system of atoms of matter and of antimatter. Then these atoms of matter and antimatter become entangled instantly, and a new wave function is generated, having all these entangled states of the system of atoms of gas as its states (this situation is analogous to the two slits experiment, where after the detecting of the photon's passing through one of the slits it instantly becomes a wave function again). In the new wave function the proportion of the number of states of being an atom of antimatter, relatively to the number of states of being an atom of matter, is smaller than before. This is due to the observation that the number of states of antimatter is considerably smaller than the number of states of matter; therefore the annihilation of one state of antimatter and one state of matter decreases the proportion of the states of antimatter considerably. That is, the total probability of obtaining an additional annihilation, due to a collision between two atoms, is smaller.

If a gas is kept at constant temperature, after some time there is equilibrium between the number of states of matter and of antimatter in this gas. The surplus of states of antimatter, relatively to the equilibrium at this temperature, is either annihilated and changes into light, or it changes spontaneously (due to the changing of the direction in time, or equivalently, illusory conjunction) into states matter. At the state of equilibrium the effect is very small, and virtually undetected. However, during a fast cooling of the gas, the equilibrium changes, and there are more states of being atoms of antimatter which are being annihilated due to the low temperature, as explained above.

After the condensation of the xenon, the distance between its atoms becomes smaller, and the velocity of the molecules in the liquid is smaller. Therefore the phenomenon continues strongly, until the xenon freezes, and the emission of light ceases. Indeed, the movements of the atoms of solid xenon at a low temperature are very small. In the entangled system of atoms of solid xenon almost all the states of the entire system comprise atoms of matter, which may surround an isolated atom of antimatter. In this state the atoms of matter may attract the atom of antimatter to all directions equally. These attractions counterbalance each other. Therefore, in this state, this attraction does not cause the atom of antimatter to move and collide with atoms of matter. Therefore the probability of collisions of atoms of matter and antimatter in a normal state of the system of solid xenon is very small, and the effect is virtually undetected. Indeed, the melting of the xenon causes the reappearance of the pulses of light.

We have suggested that the final outcome of the cooling of the gas is a decreased number of states of atoms' being atoms of antimatter. Heating these gases necessarily reverses this process, and we may ask why. Heating adds kinetic energy to the molecules of the gas, and causes them to collide either with each other, or with the walls of the cell. These collisions (between atoms of matter) are not real contacts, since the electronic shells of the atoms repel the "colliding" molecules of gas from each other. The energy of the collision may push the molecule of gas to various directions in space. Since we do not discuss materialized molecules, but entangled states of being molecules of matter or of antimatter, Penrose's (1989) proof that particles cannot move backwards in time after the collapse of the wave function does not apply. Therefore, this space may include the moving of molecules of matter backward in time, namely, the changing of states of matter into states of antimatter.

We have suggested that the probability of a collision of molecules in states of being a molecule of matter and of antimatter is small when the gas is hot. However, this consideration does not apply to collisions between molecules of gas and the walls of the cell. However, it is possible that there is an additional effect, concerning the entire entangled system of the cell's walls and the gas, which reduces the probability of a collision between the cell's wall and a gas molecule in the state of being antimatter. According to Frazer (2000, pp. 169, 202) we do not know whether there is a force of gravity, or a force of antigravity, between matter and antimatter. That is, we do not know whether a molecule of antimatter falls downward or upward in an ordinary gravitational field. If it falls upwards, then there is some force of repulsion between a molecule of gas in a state of being antimatter, and the wall of the cell. If an atom of antimatter moves backwards in time, gravity influences it in the reversed order of events, i.e., as repulsion. This possible repulsion may influence the probabilities of collisions in the entangled system of the cell's walls and the gas, and decrease the probability that a molecule in the state of being antimatter will collide with the walls of the cell. The force of gravity is very small. Nevertheless, according to Frazer (2000, p.169) "the gravity that emerged after the Big Bang would have to have been a repulsion, enormously more powerful than the attraction we know now. Could antimatter have played a role in this 'antigravity'?" That is, it maybe that there is a repulsion between matter and antimatter, which is considerably stronger than the gravitational attraction.

The effect of Molchadzki (1960) occurs also in other gases. Nevertheless, the effect has not been detected at the atmosphere in cold regions of earth. Molchadzki (private communication) explained this lack of detection by the slowness of the process of cooling in the atmosphere. Therefore, the equilibrium between matter and anti-matter is kept, and the effect is hardly detectable.

This author concluded that elimination of matter as a result of "microscopic illusory conjunction" (the interchanging of the electrical charges of the electrons and the protons) should occur, and while wondering why it has not been detected, remembered the findings of Molchadzki (1960).

The experiment of Molchadzki (1960) did not include the measurements of the energies of the emitted photons. It is suggested that this experiment will be repeated, and the emitted energies will be measured. Thus it will be possible to determine whether the emitted energies suit the energies expected by the annihilation of matter and anti-matter.

Another phenomenon that may be explained by our explanation of the findings of Molchadzki (1960) is sonoluminescence. It is a phenomenon whereby light is emitted by gas bubbles imploded by sound waves. None of the many explanations, proposed for this phenomenon, is accepted currently, and this phenomenon is considered to be a mystery. An example of a recent publication describing this phenomenon and the theoretical difficulties implied by it is Puttleman et al. (2001).

We observe that an external force directed towards the center of the bubble pushes the molecules of an imploding bubble of gas. Therefore, there is a high probability that many molecules of gas will collide near the center of the bubble. The large number of collision may cause the annihilation of matter and antimatter, and the emission of photons. This suggested strong effect may cause secondary effects, like emission of light due to the ejection of electrons from their orbits by the high-energy photons emitted in the primary effect.

8 Discussion

We may identify Kant's pre-conscious processing of sensory data by the creative imagination which adjusts them to the transcendental logic, with the suggestion of Treisman & Schmidt (1982) that usually only reasonable conjunctions of features are integrated into objects during the attentional stage of perception. The only difference is that Treisman and Schmidt (1982), unlike Kant, meant by a reasonable conjunction, or a conjunction that make sense, expected conjunction with which we are acquainted. This means that our perception is determined by an anticipatory computational mechanism. However, our knowledge about the microscopic world is not direct. We have only readings of detecting instruments and specks on photographic plates. We analyze these data after their perception. Therefore, during the perception there is no indication that some of these data are "not logical," and the anticipatory mechanism of Kant, Treisman and Schmidt does not correct them.

Finally, this theory implies that Schroedinger's equation may be applied to understand the mechanism of visual perception. This may contribute to the mathematization of a part of cognitive psychology. Some progress in this direction has been accomplished by Perus (2001), who has arrived, simultaneously, independently and by a different method to an extension of some of the ideas presented in this study.

9 Conclusions

1) Quantum mechanics applies to both microscopic and macroscopic phenomena. However, we are not conscious to its application to the macroscopic world.
2) There is a computational anticipatory manipulation of the sensory input obtained from the macroscopic world, but not of the explanation of the sensory input related to the microscopic world.
3) The nominalist quantum field theory may be substituted by a Platonic quantum mechanical theory.
4) Atoms are in a superposition of comprising matter and comprising antimatter.

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