SUBSTANCE

(Extended version of paper presented/discussed at Kingston Philosophy Café on 29 November 2017)

"Beware that you do not lose the substance by grasping at the shadow."
Aesop (c. 550BC) *Fable of the Dog and the Shadow*

1. SCOPE OF THIS PAPER

1.1 This paper examines, *inter alia*, the following:

- how equating material substance with *extension* led French philosopher René Descartes (1596-1650) to deny the possibility of a vacuum and to assert the infinite extension and divisibility of matter;
- the argument of the English philosopher John Locke (1632-1704) that the idea of material substance represents "an uncertain supposition of we know not what" and that its essential attributes include more than just extension;
- the belief (associated in particular with Descartes but maintained by many other philosophers) that, in addition to material substance, there exists *immaterial* substance comprising *mind/thought*;
- the problems raised by *mind-body dualism* and varieties of *idealism*;
- the place, if any, that modern physics finds for the concept of substance and the extent to which it remains problematic for our understanding of the universe and all therein (including perceiving conscious beings such as ourselves);
- the nature of *consciousness* and *intentionality* and the relationship between the *physical* and *social* worlds we inhabit and variously observe.

2. DESCARTES ON SUBSTANCE, EXTENSION, POSITION, MOTION AND TIME

Substance has *independent* existence. Its existence is evidenced by its *attributes*. It has a *principal* attribute which constitutes its *essence*. There are *two* types of substance: *corporeal* (body/matter) and *thinking* (spirit/mind), their respective essences being *extension* and *thought*.

2.1 Descartes states: "By *substance* we can understand nothing other than a thing which exists in such a way as to depend on no other thing for its existence" [PP 1.51]. He accepts that 'existence' itself is not an observable quality (unlike, for example, shape or colour) and that the existence of any substance is discovered only by observing its attributes because: "nothingness possesses no attributes or qualities. It follows that, wherever we find some attributes or qualities, there is necessarily some thing or substance to be found for them to belong to; and the more attributes we discover in the same thing or substance, the clearer is our knowledge of that substance"[PP 1.11]. "If we perceive the presence of some attribute, we can infer that there must also be present an existing thing or substance to which it may be attributed"[PP 1.52]. He argues that, whilst any attribute may evidence the existence of a substance, "each substance has one principal property which constitutes its nature and essence and to which all its other properties are referred. Thus extension in length, breadth and depth constitutes the nature of corporeal substance; and thought constitutes the nature of thinking substance"[PP 1.53]. In this way Descartes identifies two distinct types of substance: *extended* substance (body/matter) and *thinking* substance (spirit/mind). Their existence, according to Descartes, depends upon nothing but God who constitutes as an eternal, infinite and uncreated spirit.

Matter is not just extended. It *comprises* extension.

2.2 For Descartes, extension and thought *comprise* substances. Body is not just something that is extended. It *comprises* extension. Mind is not just something that thinks. It *comprises* thought. "Thought and extension can be regarded as constituting the natures of intelligent substance and corporeal

substance; they must then be considered as nothing else but thinking substance itself and extended substance itself – that is, as mind and body. In this way we will have a very clear and distinct idea of them"[PP 1.63]. "There is no real distinction between space, or internal place, and the corporeal substance contained in it; the only difference lies in the way in which we are accustomed to conceive of them"[PP 2.10]. Using the example of a stone, Descartes maintains that once all 'non-essential' qualities such as hardness, colour and weight have been stripped away "nothing remains in the idea of the stone except that it is something extended in length, breadth and depth. Yet this is just what is comprised in the idea of a space – not merely a space which is full of bodies, but even a space which is called 'empty'"[PP 2.11].

A vacuum is impossible. Matter extends infinitely.

2.3 The argument that extension *constitutes* matter clearly raises a problem. If three-dimensional space is essentially all there is to matter then 'empty' space is as much matter as 'filled' space, there being no obvious distinction between the two. Descartes meets this problem only by rejecting the possibility of empty space (i.e. of a vacuum) and by asserting the infinite extension of matter. "The impossibility of a vacuum, in the philosophical sense of that in which there is no substance whatsoever, is clear from the fact that there is no difference between the extension of a space, or internal place, and the extension of a body"[PP 2.16]. "What is more, we recognise that this world, that is, the whole universe of corporeal substance, has no limits to its extension ... for, as has already been shown very fully, the idea of the extension which we conceive to be in a given space is exactly the same as the idea of corporeal substance" [PP 2.21].

Matter is *Infinitely divisible.*

2.4 Descartes believes not only that matter *extends* infinitely but also that it is infinitely *divisible*, on the basis that anything that is extended can be sub-divided in thought or by God. "We also know that it is impossible that there should exist atoms, that is, pieces of matter that are by their very nature indivisible. For if there were any atoms, then no matter how small we imagined them to be, they would necessarily have to be extended; and hence we could in our thought divide each of them into two or more smaller parts, and hence recognise their divisibility" [PP 2.20].

Although infinitely divisible, matter is *corpuscular* i.e. it exists in the form of *particles*.

2.5 Descartes, it is important to emphasise, does not deny that matter exists in the form of minute particles or 'corpuscles'[1]. He just denies that any are *indivisible* and, for this and three other reasons, rejects the 'atomic theory' of the Greek philosopher Democritus (c. 460-370 BC). Descartes explains that this rejection "has never been based on the fact that his [i.e. Democritus'] philosophy deals with certain particles so minute as to elude the senses, and assigns various sizes, shapes and motions to them; for no one can doubt that there are in fact many such particles". The reasons for the rejection, Descartes states, are the following. "First, Democritus supposed his corpuscles to be indivisible – a notion which leads me to join those who reject his philosophy. Secondly, he imagined there to be a vacuum around the corpuscles, whereas I demonstrate the impossibility of a vacuum. Thirdly, he attributed gravity[2] to these bodies, whereas my understanding is that there is no such thing as gravity in any body taken on its own, but that it exists only as a function of, and in relation to, the position and motion of other bodies. And lastly, Democritus did not show how particular things arose merely from the interaction of the corpuscles" [PP 4.202].

[1] 'Corpuscularianism', the belief that matter consists of minute particles or 'corpuscles', gained popularity in the seventeenth century and was espoused not only by Descartes but also, in different ways, by the philosophers Thomas Hobbes (1588-1679) and John Locke (1632-1704) and by the scientists Robert Boyle (1627-1691) and Isaac Newton (1642-1727).

[2] Before Newton developed the concept of gravity as a universal attractive force, the term 'gravity' was generally used to refer to the tendency for 'heavier' bodies to move 'downwards' in search of their 'natural place' (a phenomenon which Descartes relates to the motion of different types of matter).

The different characteristics of different types of matter are due to differences in the *motion* and consequent *size* of their constituent particles.

2.6 Descartes believes that the widely varying characteristics of matter (including its ability to appear in the form of different solids, liquids and gases) can be attributed to differences in the size, shape and motion of its component corpuscles. "The matter existing in the entire universe is thus one and the same, and it is always recognised as matter simply by virtue of its being extended. All the properties which we clearly perceive in it are reducible to its divisibility and consequent mobility in respect of its parts; ... any variation in matter or diversity in its many forms depends on motion" [PP 2.23]. He identifies three distinct kinds of matter or *elements*. "The first element is made up of matter which is so violently agitated that when it meets other bodies it is divided into particles of indefinite smallness ... The second is composed of matter divided into spherical particles which are still very minute when compared with those that we can see with our eyes, but which have a definite fixed quantity and can be divided into other much smaller particles. The third element ... consists of particles which are much bulkier or have shapes less suited for motion. From these elements ... all the bodies of this visible universe are composed. The sun and fixed stars are composed of the first element, the heavens from the second and the earth with the planets and comets from the third" [PP 3.52].

Position and motion are *relative* concepts.

2.7 The position of bodies is regarded by Descartes as relative to that of other bodies, not absolute. He states that "in relation to different bodies we may say that the same thing is both changing and not changing its place at the same time" and gives the example of a sailor who is stationary with respect to his ship but in motion relative to the shore [PP 2.13]. Descartes argues that there are no "genuinely fixed points to be found in the universe" and that "nothing has a permanent place, except as determined by our thought" [PP 2.13].

***Two* senses of 'motion' can be distinguished.**

2.8 The concept of 'change of position' is clearly linked with that of 'motion'. Descartes distinguishes two senses of the word motion, the 'ordinary' and the 'strict' or 'proper'. He defines motion in its *ordinary* sense as simply "*the action by which a body travels from one place to another*" [PP 2.24], recognising that in this sense a body may be considered to change its place relative to some bodies but not to others. He defines motion in its *strict* sense as "*the transfer of one piece of matter, or one body, from the vicinity of the other bodies that are in immediate contact with it, and which are regarded as being at rest, to the vicinity of other bodies*" [PP 2.25]. On this basis, the motion of a body is identified purely in relation to adjoining bodies in respect of which it clearly does change position. Descartes recognises, however, that where such change of position occurs it is a matter of choice as to which body is considered to move. "For transfer is in itself a reciprocal process: we cannot understand that a body AB is transferred from the vicinity of a body CD without simultaneously understanding that CD is transferred from the vicinity of AB ... In the case of two contiguous bodies being transferred in opposite directions, and thus separated, we should say that there was just as much motion in the one body as in the other" [PP 2.29]. However, in order not to "clash with our ordinary way of speaking", he argues, we regard one body as stationary and the other as moving. Thus, the motions of terrestrial bodies are identified in relation to the earth regarded as a body at rest.[3]

[3] Isaac Azimov (an eminent scientist as well as science fiction writer) makes this point in *Understanding Physics* (1966) when explaining Newton's Three Laws of Motion, the first of which states that: *A body remains at rest or, if already in motion, remains in uniform motion with constant speed in a straight line, unless it is acted upon by an unbalanced external force*. "In Aristotle's time the earth was considered a motionless body fixed at the centre of the universe. The notion of 'rest', therefore, had a literal meaning. What we ordinarily consider 'rest' nowadays is a state of being motionless with respect to the surface of the earth. But we know (Newton did too) that the earth itself is in motion about the sun and about its own axis. A body resting on the surface of the earth is therefore not really in a state of rest at all. In fact, the whole problem of what is really meant by 'rest' and 'motion' forced a new view of the universe in the form of the 'theory of relativity' advanced by Albert Einstein in 1905."

A body may undergo many motions in addition to its proper motion.

2.9 Descartes recognises that whilst "each body has only one proper motion, since it is understood to be moving away from only one set of bodies, which are contiguous with it and at rest" it can "also partake in countless other motions, namely in cases where it is a part of other bodies which have other motions" [PP 2.31]. He gives, as an example, a watch in the pocket of someone on board a ship. The parts of a watch are in 'proper' motion relative to each other but also share the motions involved as the person walks about the ship which is being tossed on the waves as it cuts through the sea which in turn moves together with the whole earth. "Now all the motions will really exist in the wheels of the watch, but it is not easy to have an understanding of so many motions all at once, nor can we have knowledge of all of them. So it is enough to confine our attention to that single motion which is the proper motion of each body" [PP 2.29]. He further recognises that even 'proper' motion may combine more than one identifiable motion, giving as an example a carriage wheel which has "a circular motion about the axle and a rectilinear motion along the line of the road" [PP 2.32].

All motion involves a 'circular' flow of bodies.

2.10 Having ruled out the existence of empty space into which bodies can move, Descartes considers that all motion must involve a 'circular' flow of bodies i.e. not necessarily circular in shape but in the form of a *circuit*. "A body entering a given place expels another, and the expelled body moves on and expels another, and so on, until the body at the end of the sequence enters the place left by the first body at the precise moment when the first body is leaving it" [PP 2.33]. Building upon this notion of the circular flow of bodies and employing the analogy of a whirlpool in a river, Descartes suggests a model of the solar system in which the planets, carried along by surrounding 'celestial matter', orbit the sun. He speculates that the planets will move more swiftly the closer they are to the sun, that some may revolve on their own axes and that their orbits may be elliptical rather than circular. "In a river there are various places where the water twists around on itself and forms a whirlpool. If there is flotsam in the water we see it carried around with the whirlpool, and in some cases we also see it rotating about its own centre; further, the bits which are nearer the centre of the whirlpool complete a revolution more quickly; and finally, although such flotsam always has a circular motion, it scarcely ever describes a perfect circle but undergoes some longitudinal and latitudinal deviations. We can without difficulty imagine all this happening in the same way in the case of the planets, and this single account explains all the planetary movements that we observe" [PP 3.30].

The 'quantity of motion' in bodies depends upon their *size* and *speed*.

2.11 Descartes regards the *quantity* of motion present in moving bodies as determined by their size and speed. "Thus if one part of matter moves twice as fast as another which is twice as large, we must consider that there is the same quantity of motion in each part" [PP 2.36]. The concept of motion employed here by Descartes goes beyond that of mere change of position and bears a resemblance to that of *momentum*. It refers, however, to size rather than mass and to speed rather that velocity (momentum being the product of mass and velocity, the latter involving direction as well as speed). An obvious problem is raised by the relativity of motion. In the 'ordinary' sense of motion at least, a body will be static relative to some other bodies but moving in different directions and at different speeds relative to others. The 'quantity of motion' it is deemed to contain will thus depend upon the particular relative motion under consideration.

The totality of motion in the universe is *fixed*.

2.12 Although recognising the relativity of motion and believing matter to extend infinitely, Descartes finds meaningful the concept of a fixed and finite amount of motion within the universe. He argues that, although motion can be transferred between different parts of matter, its overall quantity was determined at the creation of the universe and remains absolutely fixed. "In the beginning he [God] created matter, along with its motion and rest; and now, merely by his regular concurrence, preserves the same amount of motion and rest in the material universe as he put there in the beginning ... [Motion] has a certain determinate quantity; and this, we easily understand, may be constant in the universe as a whole whilst

varying in any given part. Thus ... if one part slows down, we must suppose that some other part of equal size speeds up by the same amount" [PP 2.36]. Descartes' assertion that the totality of motion within the universe remains fixed resembles the 'law of conservation of momentum' which asserts that the total momentum within an isolated system of bodies always remains the same.[4]

Motion is merely a *mode* of things that move, not a separately existing 'something'.

2.13 Although Descartes refers to 'an amount of motion' he does not appear to regard motion as anything distinct from 'things moving' i.e. not as an independently existing 'something' (such as a 'force') which causes bodies to move. "I want to make clear that the motion of something that moves is, like the lack of motion in a thing which is at rest, a mere mode of that thing and not itself a subsistent thing, just as shape is a mere mode of the thing which has shape" [PP 2.25].

Time is a mode of duration.

2.14 *Speed* (i.e. the *rate* at which a body change its position relative to that of another) involves the concept of *time*. Descartes regards time as a mental construct whereby we express the *duration* of things in terms of motions (e.g. the apparent motions of the sun and the stars) which we take to be 'regular'. "For example, when time is distinguished from duration taken in its general sense and called the measure of movement, it is simply a mode of thought. For the duration which we understand to be involved in movement is certainly no different from the duration involved in things which do not move ... But in order to measure the duration of all things, we compare their duration with the duration of the greatest and most regular motions which give rise to years and days, and we call this duration 'time'" [PP 1.57]. For Descartes, duration is simply an attribute of anything "which exists and endures" [PP 1.56]. Continued existence appears to him as a form of miracle evidencing the existence of God. "The fact that our existence has duration is sufficient to demonstrate the existence of God ... For the nature of time is such that its parts are not mutually dependent, and never coexist. Thus, from the fact that we now exist, it does not follow that we shall exist a moment from now, unless there is some cause – the same cause which originally produced us – which continually reproduces us, as it were, that is to say, which keeps us in existence" [PP 1.21].

3. LOCKE'S ANALYSIS OF 'OUR COMPLEX IDEAS OF SUBSTANCES'

Locke argues that 'matter' is a supposed substratum of our sensory 'ideas'.

3.1 The English 'empiricist' philosopher John Locke appears to expound a form of dualism, although there is some ambiguity in his position.[5] He argues that once external things have impinged upon our senses, "some motion must be thence continued by our nerves or animal spirits by some parts of our bodies to the brains or the seat of sensation, *there to produce in our minds the particular ideas we have of them*" [ECHU 2.8.12]. According to Locke, what minds perceive are *ideas*, either of *reflection* (about the mind's own internal workings) or of *sensation* (about external things or stuff). However, if all that minds perceive through the senses are ideas (such as shapes, colours, textures, tastes, smells and sounds), the

[4] The law of conservation of momentum was first expounded formally by the English mathematician John Wallis (1616-1703) in 1671, 21 years after the death of Descartes and 16 years before the publication in 1687 of the *Mathematical Principles of Natural Philosophy* in which Newton sets out his Three Laws of Motion. The law of conservation of momentum both implies and is implied by Newton's third law (which can be summarised as: '*For every action, there is an equal and opposite reaction*').

[5] At one point, Locke countenances the possibility that 'matter', if suitably configured, might have the power 'to perceive and think'. "We have the ideas of *matter* and *thinking* but possibly shall never be able to know whether any mere material being thinks or no; it being impossible for us, by the contemplation of our own ideas, without revelation, to discover whether Omnipotency has not given to some systems of matter fitly disposed, a power to perceive and think, or else joined and fixed to matter so disposed a thinking immaterial substance: it being, in respect of our notions, not much more remote from our comprehension to conceive that God can, if he pleases, superadd to matter a faculty of thinking, than that he should superadd it to another substance with the faculty of thinking …" [EHU 4.3.6]

existence of 'substance' or 'matter' can be only *inferred*. Locke accepts that the idea of substance can signify only "an uncertain supposition of we know not what ... which we take to be the substratum or support of those ideas we do know" [ECHU 1.4.18]. "The mind being … furnished with a great number of the simple ideas conveyed in by the *senses* … takes notice also that a certain number of these simple ideas go constantly together; which being presumed to belong to one thing [and] not imagining how these simple ideas can subsist by themselves, we accustom ourselves to suppose some *substratum* wherein they do subsist and from which they do result; which therefore we call *substance* [ECHU 2.23.1]. Locke regards some sensory ideas (solidity, extension, figure, motion, rest and number) as relating to the *primary* qualities of things (i.e. features they *really* possess) and others (e.g. colours, sounds and tastes) to their *secondary* qualities (i.e. powers to produce various sensations in us by virtue of their primary qualities) [ECHU 2.8.9-10]. Locke appears confident that material substance, in spite of being an "uncertain supposition of we know not what", does actually exist and that we know something about its nature by virtue of ideas relating to its primary qualities.

We distinguish particular *sorts* of substance on the basis of their observed qualities, assuming that these flow from an existing '*something*'.

3.2 Apart from a *general* idea of substance, Locke argues, "we come to have the idea of *particular sorts of substances* by collecting such combinations of simple ideas as are, by experience and observation of men's senses, taken notice of to exist together and are therefore supposed to flow from the particular internal constitution or unknown essence of that substance. Thus we come to have the ideas of a man, horse, gold, water, etc... only we must take notice that our complex ideas of substances, besides all these simple ideas they are made up of, have always the confused idea of *something* to which they belong, and in which they subsist: and therefore, when we speak of any sort of substance, we say it is a *thing* having such or such qualities..." [ECHU 2.23.3].

Body cannot be *equated* with extension.

3.3 Although Locke includes extension as one of the primary qualities of matter, he rejects Descartes' *equation* of body with extension. The fact that body is necessarily extended, he argues, does not make it the *same thing* as extension. Three essential attributes of body, he suggests, are *solidity*[6] (resistance to simultaneous occupation of the same space by more than one entity), *separability* (the ability to be divided into discrete entities) and *moveability* (the ability of such entities to change relative position). None of these attributes, he argues, are possessed by mere spatial extension. "First, extension includes no solidity, nor resistance to the motion of body... Secondly, the parts of pure space are inseparable one from the other so that continuity cannot be separated, neither really nor mentally ... Thirdly, the parts of pure space are immovable, which follows from their inseparability ... Thus the determined idea of simple *space* distinguishes it plainly and sufficiently from body since its parts are inseparable, immovable and without resistance to the motion of body" [ECHU 2.13.12-14].

A vacuum is thus possible.

3.4 As body does not *comprise* extension, Locke argues, space without matter (i.e. a vacuum) is *conceivable* and would be rendered impossible *only if* matter were infinite in extent. To dismiss the possibility of a vacuum, moreover, would be to limit the power of God. "Those who assert the impossibility of space existing without matter must not only make body infinite but must also deny a power in God to annihilate any part of matter"[7] [ECHU 2.13.21]. Locke's rejection of the identification of body with mere

[6] Locke makes it clear that 'solidity', in his use of the word, characterises gases and liquids as much as so-called 'solids'. "He that shall fill a yielding soft body well with air or water will quickly find its resistance: and he that thinks that nothing but bodies that are hard can keep his hands from approaching one another, may be pleased to make a trial with the air enclosed in a football". [ECHU 2.4.4]

[7] Descartes, of course, *does* "make body infinite". Rather than "deny a power in God", however, he appears to think that God designed a universe in which body and space are the same thing (both comprising extension) and that a vacuum (space without body) is therefore simply a contradiction in terms. To remove body is to remove space. "If someone asks what would happen if

extension (and thus of the basis for Descartes' belief in the infinite extension of matter and the impossibility of a vacuum) was consistent with emerging scientific thought in the second half of the seventeenth century. The mantra of Aristotelian and medieval philosophy that 'nature abhors a vacuum' had come under challenge, especially following the experiments of the German scientist Otto von Guericke (1602-86) involving the evacuation of air from metal containers (most famously from two metal hemispheres which teams of horses were then unable to pull apart – see page 31).

4. SUBSTANCE AND MODERN PHYSICS

Descartes and Locke exemplify *divergent* approaches to gaining knowledge about the world. Locke regards 'corpuscularianism' as providing the only *intelligible* hypothesis regarding the nature of matter.

4.1 Descartes was a *rationalist* who believed that indubitable knowledge of the world could be obtained through a process of *reasoning*. By contrast, Locke was an *empiricist* who, whilst recognising the need to construct theories, believed that they must always be founded upon and tested against *evidence* supplied, ultimately, by our *senses*. In discussing the basis for our knowledge of the material world he instances "the corpuscularian hypothesis, as that which is thought to go furthest in an intelligible explication of the quality of bodies" and suggests that "the weakness of human understanding is scarce able to substitute another which will afford us a fuller and clearer discovery of the necessary connection and co-existence of the powers which are to be observed united in several sorts of them". He recognised, however, that much remained mysterious. Referring to the particles of water, he comments: "let but a sharp cold come and they unite, they consolidate, these little atoms cohere and are not, without great force, separable. He that could find the bonds that tie these heaps of loose little bodies together so firmly, he that could make known the cement that makes them stick so fast one to another, would discover a great and yet unknown secret". An equal mystery, he acknowledges, is what holds together the cement itself as well as "the least particle of matter that exists" [ECHU 2.13.21]. Any advancement in understanding, he goes on to argue, will always depend upon observation and experiment. "Experience is that which, in this part, we must depend on"[ECHU 4.3.16].

Modern atomic theory has evolved out of 'corpuscularianism'. It provides a model of the structure of matter that helps explain the wide variation in the types of substance to be found in the world.

4.2 Through observation and experiment, the primitive 'corpuscularian hypothesis' of Locke's time has evolved over the centuries into modern *atomic theory*. Although atoms are no longer considered indivisible, they and their various combinations still provide the basis for explaining how and why substances (e.g. iron and water) differ. The concept, traceable back to Ancient Greece and earlier, of *elementary* matter has been retained and applied to a relatively small set of substances (92 occurring naturally) that cannot be divided or transmuted *chemically* into other substances. "The introduction of this concept [i.e. of a chemical *element*] was a first and most important step toward an understanding of the structure of matter. The enormous variety of substances was at least reduced to a comparatively small number of fundamental substances, the 'elements', and thereby some order could be established among the various phenomena of chemistry. The word 'atom' was consequently used to designate the smallest unit of matter belonging to a chemical element, and the smallest particle of a chemical compound could be pictured as a small group of different atoms. The smallest particle of the element iron, for example, was an iron atom, and the smallest particle of water, the water molecule, consisted of one oxygen atom and two hydrogen atoms" [Heisenberg, 1962].

God were to take away every single body contained in a vessel, without allowing any other body to take the place of what had been removed, the answer must be that the sides of the vessel would, in that case, have to be in contact. For when there is nothing between two bodies they must necessarily touch each other." [PP 2.18]

A model of the atom based upon its *sub-division* into protons, neutrons and electrons helps to explain why different substances vary so widely in their physical and chemical properties.

4.3 The identification, by the early 20th century, of *sub-particles* within atoms led to the 'planetary' model of the atom (see page 30), associated with Danish physicist Niels Bohr (1885-1962), in which negatively charged *electrons* occupy fixed orbits or 'shells' (representing different energy levels) around a *nucleus* which accounts for almost all of the atom's mass and which comprises positively charged *protons* and uncharged *neutrons*. By absorbing or releasing a given *quantum* of energy an electron can jump from one orbit to another. The number of protons in the atom determine the type of element it forms (e.g. the number of protons in atoms of hydrogen, oxygen, iron, gold and uranium are 1, 8, 26, 79 and 92 respectively). The configuration of electrons in the outer shells of atoms determine their propensity to combine with other atoms (e.g. by sharing electrons). It explains why, within given temperature ranges, different substances exist as solids, liquids or gases and why, under 'standard conditions', some very massive elements (e.g. radon with 86 protons) exist as gases whilst some much less massive (e.g. carbon with just 6 protons) exist as solids. Already, it can be seen, the theoretical model of the atom, although based upon experimental evidence delivered ultimately via our senses, takes us very far from the world of our everyday sensory experience. Developments in particle physics, quantum mechanics and relativity theory take us yet further into conceptual realms that are profoundly counter-intuitive.

***Quarks* are now considered the building blocks not only of protons and neutrons but of many other sub-atomic particles. All particles have *anti-matter* counterparts.**

4.4 Protons and neutrons are no longer considered elementary/indivisible particles but to be composed of *quarks* (first postulated in the 1960s) which come in six 'flavours' and which (currently at least) *are* considered indivisible. As explained by Rooney (2011), "protons and neutrons are examples of *hadrons*, all of which are made up of either three quarks (*baryons*) or one quark and one anti-quark (*mesons*)... There are around 40 known or predicted types of baryon and around 50 known or predicted types of meson. They have bizarre names , such as 'double charged bottom Omega' (a baryon of unknown mass or duration). Some are very short-lived (if they exist at all) – such as the delta baryon, which lasts only 5.58×10^{-24} seconds. (That means it would take around 30 times as many delta particles as there are stars in the universe to last for a single second). The first mesons to be discovered were kaons and pions, found in cosmic rays in 1947." Anti-quarks are examples of *anti-matter*, first predicted by Paul Dirac (1902-84) in the late 1920s. All particles are now considered to have anti-matter counterparts. "Anti-particles are general features of nature and exist for all particles, including bosons, not just the fermions described by the Dirac equation[8]. The modern theory of anti-particles ... gives equal status to particles and anti-particles, the latter no longer being simply the 'absence' of particles." [Martin, 2011]

The number of sub-atomic particles considered to exist has *proliferated*. Can they all be reduced to a single type of substance which we might label *energy* or *universal matter*?

4.5 The table on page 30 shows the range of elementary particles currently identified in the 'standard model' of particle physics. Apart from quarks they comprise *leptons* (particles, including electrons and neutrinos, which – unlike quarks – do not experience the *strong* force) and *bosons* which act as 'force carriers' (photons for the *electro-magnetic* force, *gauge bosons* for the *weak* force and *gluons* for the *strong* force). Martin (2011) argues that the quest to understand the nature of matter has always been "driven by the twin aims of simplicity and the desire to understand and explain an increasing range of phenomena in terms of a decreasing number of assumptions." The trend in particle physics, however, appears to have been a *proliferation* in the range of sub-atomic particles which, in the light of experimental evidence, are deemed to exist. Werner Heisenberg (1901-76), a leading figure in 20th century quantum mechanics, recognises this trend, arguing that it appears "at first sight to lead away from the idea of the

[8] Bosons are particles with an integer value of spin, such as photon, gluon or pion. Fermions are particles with half-integer value of spin, such as the proton or electron. Spin relates to the intrinsic angular momentum of particles, given in multiples of half-integer units of Planck's constant, h (key to the interpretation of *quantum* phenomena).

unity of matter, since the number of fundamental units of matter seems to have again increased to values comparable to the number of different chemical elements." He goes on to say, however, that "this would not be a proper interpretation. The experiments have at the same time shown that the particles can be created from other particles or simply from the kinetic energy of such particles, and they can again disintegrate into other particles... therefore, we have here actually the final proof for the unity of matter. All the elementary particles are made of the same substance, which we may call energy or universal matter; they are just different forms in which matter can appear." He likens this view to that of the Greek philosopher Aristotle (384-322 BC). "If we compare this situation with the Aristotelian concepts of matter and form, we can say that the matter of Aristotle, which is mere 'potentia', should be compared to our concept of energy, which gets into 'actuality' by means of the form, when the elementary particle is created" [Heisenberg, 1962]. But are we made any the wiser by postulating a universal substance and equating it with energy? And what do we *mean* by 'energy', and the related concept of 'force', anyway?

Everyday experience provides us with a *primitive* notion of force and energy. *Scientific investigation* into their nature and how they relate to substance/matter, however, has proved conceptually challenging.

4.6 A *primitive* notion of force/energy arises inevitably from human experience of, for example: the light and heat of the sun; the power of wind and flowing water; the impact of moving bodies upon one another; the transformative effect of fire; magnetic attraction and repulsion; the pull of gravity; the exertion felt when trying to lift/move things or otherwise act upon the physical environment. Significant *scientific* understanding of the nature of forces and energy based upon *experimental* evidence has been gained only over the last few centuries (the term 'energy', in its modern scientific sense, was first used in 1807 by English scientist Thomas Young who also cited the *interference patterns* displayed by a split beam of light as evidence of its *wave*-like nature). The 18th century view that some types of energy are substances in their own right ('phlogiston' being a substance released when things burned and 'caloric' a substance that permeated things and made them hot) was soon abandoned. Major issues remained, however, including the relationship between 'energy' and 'matter' and whether light should be regarded as wave-like or particle-like in nature. The particle view was strengthened at the beginning of the 20th century when German scientist Max Planck (1858-1947) found that a workable mathematical model of the wavelength/colour of light emitted by heated 'black body' substances required that the electromagnetic energy involved be released in discrete 'packets' or *quanta*. German physicist Albert Einstein (1879-1955) applied Planck's idea of quanta to explain the 'photoelectric effect' i.e. how photons of light at certain wavelengths contain enough energy to cause a flow of electrons from some metals – the basis for photoelectric solar power generation.[9] Einstein went on, in his special theory of relativity published in 1905, to provide a model of reality that allows for *all* matter to appear in either a wave-like or a particle-like form. This follows from the *equation* of energy with mass multiplied by the speed of light squared (the famous $E = mc^2$). It implies that "energy *is the same* as matter but in a different form." [Rooney, 2011] Particle/wave duality is now accepted as a universal reality. "All particles behave as waves and conversely, all waves behave as particles. This is true for all objects, even macroscopic ones like you and me, but is only apparent at the quantum level of matter". [Martin, 2011]

Wave/particle indeterminacy challenges the notion of a physical reality existing *independently* of its observation.

4.7 A crucial problem at the quantum level of matter is *indeterminacy*. If a particle can also behave as a wave, how can its *location* be identified? The Austrian physicist Erwin Shrödinger (1887-1961), who favoured a *cloud*-like to a *planet*-like electron model, argued that all we can do is identify a *function* that expresses the *probability* that a particle will occupy a given location at a given moment. But what determines *which* will be observed – a particle or a wave? In experiments involving light passing through paired slits it appears, bizarrely, that whether particle-like or wave-like behaviour is displayed depends upon which of these is being *looked for* (i.e. which of them the experiments are designed to *detect*). Both

[9] It was for this, not relativity theory, that Einstein received his Nobel Prize for Physics in 1921.

epistemological issues (i.e. concerning the basis for our *knowledge* of reality) and ontological issues (i.e. concerning the *nature of that reality* itself) are involved here. If any act of observing alters what is being observed, then objective knowledge of the world appears impossible. When we observe something visually (whether with the naked eye or through a microscope) we assume that our act of looking has no effect upon what is being looked at i.e. that the 'direction of travel' is all one-way (involving photons of light passing from observed to observer). Although the chemical analysis of substances generally involves invasive and often destructive procedures, we assume that the effects of such procedures can be allowed for when identifying the nature of the substances concerned – these existing in whatever form they do *regardless* of being observed (almost all matter is *never* observed and for most of the history of the universe no sentient life forms have been around to do any observing). At the atomic and sub-atomic level, however, where the presence/nature of particles/waves can be detected only by their assumed interaction with *other* particles/waves, things become much more problematic as the detection process *itself* appears to determine what is detected.[10] The so-called Copenhagen interpretation of quantum theory (arrived at by Bohr and others in 1927) envisages an *either* particle *or* wave reality, our knowledge of which can be expressed only in terms of *probability*. Which aspect is observed will be affected by the nature of our observation. Such observation, in effect, *collapses the probability function* delivering a particular outcome for the particular bit of reality we seek to examine. As Heisenberg (1962) says: "The observation itself changes the probability function discontinuously; it selects of all possible events the actual one that has taken place." Clearly we are entering murky conceptual waters here and they get murkier.

The Copenhagen interpretation appears to have paradoxical, if not absurd, implications.

4.8 Shrödinger was unhappy with the Copenhagen interpretation and devised his 'cat in a box' thought experiment to illustrate what he considered its absurd implications. Together with the cat in the box is a radio-active substance with a 50% probability over an hour of decaying and emitting a particle, detection of which by a Geiger counter will release a lethal gas thereby killing the cat. When the box is opened after an hour there will be an equal chance of the cat being alive or dead. According to the Copenhagen Interpretation, however, it appears that the *actual* outcome – alive or dead – is not determined *until* the experimenter looks in the box, observes what has happened and thereby collapses the probability function. A critical issue, to which the thought experiment draws attention, is what counts as an *observation*. Does it necessarily involve *human consciousness* and, if so, consciousness of *what*? Humans cannot see sub-atomic waves/particles, only indicators on equipment designed to detect their hypothesised existence. Can detection of a sub-atomic particle by, for example, a Geiger counter *itself* count as an act of observation that collapses a probability function, regardless of whether or not any human being subsequently looks at the measuring device and interprets what it shows?

Does the *observational framework* for examining *quantum* reality have to be one defined by *classical* physics?

4.9 Heisenberg (1962) recognises that "the Copenhagen interpretation of quantum theory starts from a paradox. Any experiment in physics, whether it refers to the phenomena of daily life or to atomic events, is to be described in the terms of classical physics [which] form the language by which we describe the arrangement of our experiments and state the results." Unavoidably, he suggests, particles/waves conceived in terms of *quantum* theory have to be approached from an observational framework (including humans and their experimental apparatus) conceived in terms of *classical* physics. "Our actual situation in research work in atomic physics is usually this: we wish to understand a certain phenomenon, we wish to recognise how this phenomenon follows from the general laws of nature. Therefore, that part of matter or

[10] Russell (1925) explains the problem as follows. "When an astronomer observes the sun, the sun preserves a lordly indifference to the observation. But when a physicist tries to find out what is happening to an atom, the apparatus which is used is much larger than the thing which is observed, instead of much smaller, and is likely to have some effect upon it. It is found that the sort of apparatus best suited for determining the position of an atom is bound to affect its velocity, and the sort of apparatus best suited for determining its velocity is bound to affect its position."

radiation which takes part in the phenomenon is the natural 'object' in the theoretical treatment and should be separated in this respect from the tools used to study the phenomenon. This again emphasises a subjective element in the description of natural events, since the measuring device has been constructed by the observer, and we have to remember that what we observe is not nature in itself but nature exposed to our method of questioning."

Must the observational framework *itself* be conceived in quantum terms? This has implications for *cosmology*.

4.10 Davies (1962) questions the acceptability of Heisenberg's conclusion. "The weakness of the Copenhagen interpretation is exposed when the question 'What actually happens inside a piece of measuring apparatus when a measurement of a quantum particle is made?' is asked. The Copenhagen interpretation is that one merely treats the apparatus classically; but if instead it is treated (more realistically) as a collection (albeit large) of quantum particles, then the result is deeply worrying. The same vagueness and indeterminism that afflict the quantum particle now invade the entire system. Instead of the apparatus concretising a specific actuality from a range of potential possibilities, the combined system of apparatus + particle adopts a state that still represents a range of potential possibilities." This is a critical issue for quantum cosmologists who "attempt to apply quantum mechanics to the universe as a whole in an effort to unravel the mystery of its origin. If the entire universe is the quantum system of interest, there clearly does not exist a wider macroscopic environment, or external measuring apparatus, into which quantum fuzziness can fade away. Most quantum cosmologists reject the Copenhagen interpretation, with its need for additional epistemological machinery, and prefer instead to take the quantum formalism at face value. This means serenely accepting the full range of quantum alternatives as actually existing realities... In general, a quantum measurement involves postulating an infinity of coexisting parallel worlds, or realities."

The implications of relativity theory are counter-intuitive but unavoidable.

4.11 *Relativity* theory has major implications for observational objectivity, particularly where the 'objects' of interest (such as subatomic particles) are moving, relative to the observer, at or near the speed of light. In modern physics, if not popular imagination, the concept of an *absolute* spatial framework (or of an all-pervading 'aether' which provides the medium for the transmission of light and other electromagnetic waves) has been abandoned. Even if such a framework exists, it is clearly unobservable, displays no co-ordinates against which measurements can be made and is thus operationally irrelevant. As Descartes recognises (see 2.7), the position and motion of any body is meaningful and measurable only in relation to that of *another* body. A body has as many relative positions as there are other bodies and may thus undergo many different relative motions (either constant or accelerating). Experimental evidence[11] shows that the *measured* speed of light is *constant* (about 186 million miles per second in a vacuum) for *any* observer *regardless* of whether/how that observer is moving relative to the light's source. This is possible only if *measured* space and time can *vary* for different observers depending upon their relative motions. In relativity theory, space and time are not conceived as being independent of each other but combined together as *'spacetime'* – described by Russell (1925) as "from a philosophical and imaginative point of view, perhaps the most important of all the novelties that Einstein introduced." He argues that "relativity demands the abandonment of the old conception of 'matter', which is infected by the metaphysics associated with 'substance', and represents a point of view not really necessary in dealing with phenomena", and goes on to suggest that "all the facts and laws of physics can be interpreted without assuming that 'matter' is anything more than groups of events." However, what might constitute a single 'event' and what might bind a number of events together to form a space-time 'group', is far from clear.

[11] The Michelson-Morley experiment carried out in 1887 to measure the speed of light and the effect upon it of the earth's movement through a supposed fixed 'aether', found it to be *constant* regardless of direction of travel. It was only later after further experimentation, however, that the implications of the result were realised and the notion of an aether abandoned.

Differences between the perceptual experiences of different observers does *not* mean that they are in touch with different realities or that they somehow 'create their own reality'.

4.12 The fact that precisely what is observed (and even the order of events) may *vary* for different observers depending upon their space-time frame of reference, and that what is observed at the sub-atomic level may be affected by the method/target of the observation, does *not* mean that we thereby *create/choose* our own reality. In both relativity and quantum theory, indeed, it is emphasised that the 'observers' involved might be inanimate objects (e.g. various types of recording equipment). Russell (1925) emphasises that relativity theory does *not* maintain that 'everything is relative'. Failure to appreciate this "has led philosophers and uneducated people into confusions. They imagine that the new theory proves everything in the physical world to be relative, whereas, on the contrary, it is wholly concerned to exclude what is relative and arrive at a statement of physical laws that shall in no way depend upon the circumstances of the observer. It is true that these circumstances have been found to have more effect upon what appears to the observer than they were formerly thought to have, but at the same time the theory of relativity shows how to discount this effect completely. This is the source of almost everything that is surprising in the theory... Physicists, like ordinary people, believe that their perceptions give them knowledge about what is really occurring in the physical world and not only about their private experiences. Professionally, they regard the physical world as 'real', not merely as something which human beings dream."

Modern physics challenges our common notion of what constitutes empty space i.e. a *vacuum*.

4.13 A vacuum can be conceived only as the *absence*, within a defined space, of *anything*. Its meaning, therefore, depends upon what we count as the *presence* of *something*. In modern physics, matter and energy are deemed equivalent and thus the presence of *either* negates a vacuum. The nucleus and electrons of an atom occupy only a tiny proportion of its total volume (if an atom were increased to the size of a football pitch its nucleus would be no bigger than a grain of sand) and it might thus seem that atoms (and everything composed of them including our own bodies) consist mainly of *nothing*. However, as Martin (2012) explains, "the 'free space' in atoms is permeated by the electromagnetic fields generated by the charged particles within the atom. It is these fields that prevent us from walking through walls, although we are mostly 'nothing'." The intervening space between astronomical bodies is also deemed to be permeated by the gravitational fields they generate and passing constantly through such space are a wide range of sub-atomic particles including photons and neutrinos. Their negligible mass and absence of charge, means that neutrinos can pass virtually unhindered through anything, an estimated 100 trillion passing through each of our bodies every second. Some neutrinos are thought to be ghostly remnants of the so-called Big Bang. According to current astrophysical wisdom, the origin of the universe can be traced back about 14 billion years to a state where *nothing* existed other than a wholly unexplained 'singularity' (giving 'it' a name, of course, provides no explanation) which, following the equally unexplained 'Big Bang', became the source of all matter/energy in the universe. This is still expanding out into an infinity of nothingness (i.e. into an infinite *vacuum*), perhaps to return eventually to a singularity if there is enough matter (including 'dark' matter) in the system to provide sufficient gravitational force to overcome the expansive force of the system's energy (including 'dark' energy). Perhaps the profoundest challenge to our common notion of 'nothingness' is the possibility of the spontaneous creation and annihilation of paired matter and anti-matter particles – confounding the conventional wisdom that 'you can't get something from nothing'. This was expressed by the Roman poet Lucretius (99-55 BC) in his *De Rerum Natura* (On the Nature of Things) as "Nothing can be made from nothing". Supposedly, the 'law' of the conservation of energy means that only a *'zero-energy universe*' (where the amount of *energy* in the universe minus the amount of *gravity* is exactly *zero*) could come from nothing (assuming such a universe *is*, already, nothing). Some physicists (including Stephen Hawking) just define 'nothing' as an unstable quantum vacuum that contains no particles. Modern physics appears to have taken us into conceptual realms at least as challenging as Descartes' notion that mere extension comprises substance and that matter therefore extends infinitely, rendering a vacuum impossible.

We are far from identifying a *unified* 'theory of everything'. Some theorising generates paradoxes.

4.14 The foregoing gives a flavour of the conceptual challenges posed by particle physics, quantum mechanics and relativity theory. Much remains unclear and unresolved. Quantum theory and general relativity theory (which incorporates the effect of *gravity*) have yet to be fully reconciled.[12] According to Martin (2011), particle physics "says nothing about why forces and masses have the value they do, or anything about gravity." The postulated Higgs boson may offer some explanation of how particles acquire mass but much theorising (e.g. so-called 'string theory' and its extension 'M-theory' which allows for different universes with different laws) is highly speculative and not obviously amenable to experimental testing. Cosmologists meanwhile continue to search for an explanation of the 'dark matter' and 'dark energy', estimated to make up most of the universe but seemingly undetectable. Perhaps most challenging is the possibility of so-called 'quantum entanglement' whereby two or more particles resulting from the decay of a 'parent' particle must, *between them*, conserve the quantum properties of the original particle. This implies that measuring a property of one of the particles must instantly collapse the wave function for the same property in the other(s)*, regardless of how far apart they may be*. This opens up the possibility of instant communication at a distance but appears to contravene the principle that the speed of light cannot be exceeded. That entanglement is entailed by quantum theory was first postulated in 1935 by Albert Einstein and American physicists Boris Podolsky and Nathan Rosen. They presented it, however, as a *paradox* (named the EPR paradox after its originators) that calls into question the coherence of quantum theory itself. They did not regard entanglement as an actual possibility. Over the last few years, however, experiments have been carried out that are claimed to provide evidence of entanglement operating at over 1,000 km distance between particles.[13]

Ambiguity and uncertainty characterise our 'everyday', as much as our 'scientific', view of the world.

4.15 From the above, it might appear that modern physics is in something of a conceptual mess. Part of the problem may be that concepts and categories developed in relation to our macro-level sensory experience cannot be applied satisfactorily at the micro-level of atomic and sub-atomic phenomena.[14] Arguably, at least as great a problem is that many of our macro-level concepts are *already* infected with ambiguity and uncertainty. If the concept of substance represents, as Locke suggests, "an uncertain supposition of we know not what" (see 3.1) then the same appears at least as true of concepts such as 'energy', 'force' and 'mass'. Their uncertain nature is revealed, to an extent, by the *inter-dependent* way in which they have to be defined.[15] *Energy* (from the Greek for 'work-within') is the capacity of matter and

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[12] The problem is explained by Russell (1925) as follows. "If we try to make quantum theory accord with the general theory of relativity, then gravitation is not to be neglected, so that the curvature of space-time will depend on the whereabouts of the atoms. However, the quantum theory makes it quite clear that we cannot always know where the atoms are."

[13] In 2016, China launched the world's first quantum communications satellite (named Micius after an ancient Chinese philosopher/scientist) designed to demonstrate the feasibility of quantum communication between Earth and space and to test quantum entanglement over large distances. A report in the 16 June 2017 issue of *Science*, claimed that Micius had detected quantum entanglement involving a 2-photon pair 1,203 km apart (a distance record, so far, for identified entanglement).
See http://www.bbc.co.uk/news/science-environment-40294795

[14] Heisenberg (1962) argues that "we can never know beforehand which limitations will be put on the applicability of certain concepts by the extension of our knowledge into the remote parts of nature, into which we can only penetrate with the most elaborate tools. Therefore, in the process of penetration we are bound sometimes to use our concepts in a way which is not justified and which carries no meaning." In discussing 'language and reality in modern physics', he cites 'temperature' as an example of a concept which is perfectly meaningful when applied to substance at a macro-level but not at the micro-level of atoms and sub-atomic particles. It is meaningless to ask what is the temperature of an atom, an electron, a quark, etc.

[15] In the mks (metre/kilogram/second) system of measurement, the unit of force is a *newton* (n) defined as the 'amount' of force needed to accelerate a kilogram (k) of mass at the rate of one metre (m) per second (s) per second (s) [$n = k \times m/s^2$]. The unit of work or energy is a *joule* (j) defined as a newton of force applied through a metre of distance (in the direction of the force) and is thus mass times the square of its velocity (v) [$j = k \times m^2/s^2 = k \times v^2$]. *Mass* is the 'amount' of something and should not be confused with its *weight*, which is the gravitational force exerted upon it and which may vary depending upon its location. A kilogram of mass weighs less on the moon than on earth and free-floating in space is weightless. *Velocity*, we should note, can be measured only in relation to *something else* (e.g. planet earth) assumed *for the purposes of measurement* to be at rest (see footnote 3).

radiation to perform *work*. *Work* is the application of *force* over *distance*. *Force* is *whatever it is* that causes a body possessing *mass* to *accelerate* (in the direction of the force). *Mass* is the amount of *whatever it is* in a body that causes it to resist the effect of a force (acceleration being directly proportional to force and inversely proportional to mass). Acceleration is *rate of change* in *speed*. *Speed* is *distance* travelled per unit of *time*. Both distance and time, *as measured* by different observers, can vary depending upon their *space-time frame of reference*. *Time*, although generally conceived as a fourth dimension comparable to the three dimensions of space,[16] is meaningful and measurable only in terms of some identifiable *'event'* assumed to be both *regular* and *unchanging* (as Descartes recognises – see 2.14). Whether any event is regular and unchanging (e.g. the period of the earth's rotation/orbit) can be assessed only by comparing it with some *other* event (e.g. the swing of a pendulum or the vibration of electrons within an atom) that *is* so considered.[17] The more types of event are found, within a given space-time frame of reference, to 'march in step and to the same tune', the more confident are we that they reflect some underlying source of regularity.

Seeking to know what substance *really* is, sets off a chain of questions/answers which may prove infinite or which may come to a stop at a point where the questioning ceases to be meaningful/valid.

4.16 The impossibility, in some of the above definitions, of avoiding wording such as *'whatever it is*' demonstrates the elusiveness of the 'targets' involved. The elusiveness of 'energy', for example, was recognised by the American physicist Richard Feynman (1918-88) when he said: "It is important to realize that, in physics today, we have no knowledge of what energy *is*". Applying a *name* (be it 'substance', 'particle', 'energy', 'universal matter', 'event' or whatever) to some postulated 'thing' brings us no closer to understanding what 'it' might be, although often giving the false impression that it does. A fundamental conceptual difficulty is to imagine what might constitute a *satisfactory* and *non-circular* answer to any question concerning what something *is*. The way in which it is conceptualised may determine the possibility of any such answer. In the case of a substantial 'something', the answer is generally sought by attempting to analyse 'it' into simpler 'somethings' – thereby triggering an analytical *chain*. If we ask what is *water*, for example, the chain, on the basis of our current model of reality, will include the answers that it is composed of *molecules*, that these are composed of hydrogen and oxygen *atoms*, that these are composed of *electrons* and *nuclei*, that nuclei are composed of *protons* and *neutrons*, that these are composed of *quarks*, and so on. Reference would also have to be made to the supposed *forces* (strong, electromagnetic, weak and gravity), which serve to attract/bind particles together (the 'cement' sought by Locke – see 4.1), and to the *inter-changeability* of matter and energy. If we regard substance as infinitely divisible (as did Descartes) the chain of questions and answers becomes infinite. Stopping, as we currently do, at assumed *fundamental* particles (such as electrons, quarks and photons) brings the chain to an end but at the expense of having to accept that these simply *'are whatever they are*' and that the question of their composition has ceased to be valid.

[16] As quoted by Pinker (2007), Newton in his *Philosophiæ Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy)* (1687) attributes *absolute* and *independent* existence to both time and space, arguing that "absolute, true and mathematical time, of itself, and from its own nature flows equally without relation to anything" and that "absolute space, in its own nature, without relation to anything external, remains always similar and immovable."

[17] Traditionally, so-called Universal Time (UT) was measured by the period of the earth's rotation on its axis. Recognition that this is subject to short-term variation and long-term slowing down led to the adoption in 1952 of the 'ephemeris' second based on the period of earth's orbit around the sun. Since 1968 this has been replaced in the International System of Units (SI) by a second defined as a duration of 9,192,631,770 cycles of radiation corresponding to the transition between two energy levels of the caesium-133 atom (the number of cycles being chosen so that the 'new' second, when introduced, had the same duration as that of the ephemeris second). Non-caesium atomic clocks (e.g. so-called 'quantum logic' and 'optical lattice' clocks) are now being developed that promise even higher levels of accuracy (the holy grail being some measure of *assumed unchanging regularity* that is wholly unaffected by extraneous forces such as gravity).

As long as it *works*, why worry if modern science is conceptually challenged and sometimes paradoxical?

4.17 In spite of its conceptual challenges, modern science has been remarkably successful in enabling us to *explore* and *manipulate* our physical environment. It has enabled, for example, the capture of solar energy, the generation of nuclear power, the development and use of information technology (e.g. for telecommunications), and the diagnosis/treatment of a wide range of human diseases/ailments. For this to be the case, it would appear to be getting *something* right about the reality it seeks to comprehend. Inevitably, it often requires the use of complex and abstruse mathematics. This is not to say that the reality *itself* can somehow *consist* of 'mathematics'. Mathematics is a *language* related to a *conceptual toolkit* by means of which we *describe* and *analyse* things. A mathematical *description* of something (e.g. its extension, weight, density, temperature and relative motion) is no more the thing itself that is a *verbal* description. The same applies to any artistic/photographic representation. Monet's paintings on page 37, for example, obviously *represent*, but are not *themselves*, haystacks. It might be argued that to describe/analyse something is not to comprehend what it is *really* like and that physicists are, at best, only scraping at the surface of reality. The response of some physicists to such criticism has been characterised as: "Just shut up and do the maths. As long as it *works*, why worry?" Russell (1925) emphasises that the ultimate test of any scientific theory can only be whether its application leads to *predicted* and *perceivable* results. "The physicist, who knows nothing of matter except certain laws of its movements, nevertheless knows enough to be able to manipulate it. After working through whole strings of equations, in which the symbols stand for things whose intrinsic nature can never be known to us, the physicist arrives at last at a result which can be interpreted in terms of our own perceptions, and utilised to bring about desired effects in our own lives. What we know about matter, abstract and schematic as it is, is enough, in principle, to tell us the rules according to which it produces perceptions and feelings in ourselves; and it is upon these rules that *practica*l uses of physics depends." Heisenberg, according to Davies (1995), takes a similarly pragmatic view of the use of both mathematics and words in relation to quantum mechanics, which "is, at its core, a mathematical scheme that relates the results of observations in a statistical fashion. And that is all. Any talk of what is 'really' going on is just an attempt to infuse the quantum world with a spurious concreteness for ease of imagination... words and their associated concepts do not have absolute and sharply defined meanings. They arise through our experiences of the world, and we do not know in advance the limits of their applicability. We cannot expect to uncover any fundamental truths about the world merely from the abstract manipulation of words and concepts. For Heisenberg the fact that certain cherished words and concepts simply cannot be transported into the relativity or quantum domain is not especially philosophically objectionable."

5. THE HUMAN FACTOR: CONSCIOUSNESS, INTENTIONALITY AND THE NATURE OF WHAT WE OBSERVE

Observers, inescapably, are *themselves* part of the world they observe and seek to comprehend.

5.1 *Ontological* questions about *reality* and *epistemological* questions about how it is *known*, can arise only if there exist *beings capable of asking them*. On planet earth, the only such beings appear to be *humans*, although others may well exist elsewhere in the universe. The fundamental question for *observers* is how they relate to *what they observe*. How, if at all, can the seemingly inevitable gap between *observer* and *observed* be bridged? Heisenberg (1962) recognises that "natural science does not simply describe and explain nature; it is part of the interplay between nature and ourselves; it describes nature as exposed to our method of questioning ... it makes the sharp separation between the world and the I impossible." This applies not just to *scientific* observation but to *all* acts of observation, including those we continually make in our daily lives. Inevitably, any process of observation is affected the nature of the observer. Bizarrely, observers may feel least sure about their *own* nature – how they exist not just as *bodies* composed of the same sort of stuff and subject to the same forces as anything else in the world, but also as *minds* which experience perceptions, thoughts, feelings, intentions, memories, etc. (undoubtedly *real* phenomena), the

combination of body and mind empowering them to act as conscious *agents* who can make a difference to what happens in the world.

Resolution of the 'mind-body problem' requires a rejection of Cartesian dualism. Searle's '*biological naturalism*' offers a way forward. It involves a *'one world*' approach.

5.2 Resolving the so-called 'mind-body problem' requires a *rejection* of Descartes' division of substance into two fundamentally different kinds – *res cogitans* ('thinking substance') and *res extensa* ('extended substance'). Their supposed attributes are summarised in the second table on page 30. The allocation of mind and body to separate existential realms creates an unbridgeable gulf between the two and thus between observer and observed. A way out of the dilemma is offered, perhaps, by American philosopher John Searle (1932 -). His approach (which he labels *'biological naturalism*') involves an acceptance of what, arguably, should be obvious to us – that consciousness is as much a *potential* attribute of matter as is extension, solidity, position, motion, etc. He argues that conscious states are *higher level* features of brain systems (i.e. that "individual neurons are not conscious, but portions of the brain system composed of neurons are") and that conscious states, being "real features of the real world", can *themselves* function causally. His approach requires an escape from our traditional categorisations of 'mind' and 'matter'. "The worst mistake is to suppose that the common-sense distinction between mental states naively construed and physical states naively construed is an expression of some deep metaphysical distinction… The problem is that the terms have traditionally been defined so as to be mutually exclusive. 'Mental' is defined as qualitative, subjective, first personal, and therefore immaterial. 'Physical' is defined as quantitative, third personal, and therefore material… These definitions are inadequate to capture the fact that the world works in such a way that some biological processes are qualitative, subjective, and first personal. If we are going to keep this terminology at all, we need an expanded notion of the physical to allow for its intrinsic, subjective mental component... We do not live in several different, or even two different, worlds, a mental world and a physical world, a scientific world and a world of commonsense. Rather, there is just one world; it is the world we all live in, and we need to account for how we exist as a part of it." [Searle, 2004]

The *causal relationship* between physical and mental phenomena remains problematic. Might *panpsychism* provide a plausible account of the nature of a *universal substance*?

5.3 The relationship between physical and mental phenomena is the subject of much ongoing research, particularly in the field of *neuroscience*. Consciousness appears to be related in some way to processes taking place within the complex brains and central nervous systems of a limited range of living organisms, their *minds* comprising the *cognitive systems* involved. The relationship appears to be *two-way*. Our conscious experience is affected by our contact with a world of 'things' and 'stuff' (including *mind-altering* drugs) but at the same time we regularly make conscious decisions which result in *changes* to the world which would not otherwise occur. Any chemical/physical analysis of our bodies shows them to be composed of nothing but a limited range of substances[18], themselves composed, like *all* substances, of atoms and sub-atomic particles held together in fields of force. So far at least, particle physics and quantum mechanics have neither looked for nor found anything at the sub-atomic level that can account for the phenomenon of consciousness. It appears to be something that arises only at the *macro-level* of complexly structured brains. This view, however, is challenged by so-called *panpsychism*, which translates literally as *'mind is everywhere'* – compare this with pan*theism* which translates as '*God* is everywhere'.[19]

[18] In terms of *mass*, just six elements account for almost 99% of the human body (oxygen 65%; carbon 18%; hydrogen 10%; nitrogen 3%; calcium 1.4%; phosphorus 1.1%). Five elements (potassium, sulphur, sodium, chlorine, and magnesium) account for a further 0.85% . All eleven elements are needed for life. The remaining mass comprises trace elements, some (e.g. fluorine, iodine, iron, zinc, copper and cobalt) also life-supporting. Most of the hydrogen and oxygen atoms are combined as molecules of water. See: https://en.wikipedia.org/wiki/Composition_of_the_human_body

[19] A notable proponent of pantheism is the Jewish-Dutch philosopher Baruch/Benedict Spinoza (1632-77) who hypothesises that there exists but *one* substance (he is thus a *monist* rather than a dualist) possessing an infinity of attributes (including *thought* and *extension*) and of which all things are simply *modes*. He equates both 'God' and 'Nature' with this substance.

Goff (2017) argues that the approach of the natural sciences remains one of *'causal structuralism*' i.e. they seek to explain what something *is* by describing what it *does*. This, he claims, leads "either to a vicious regress or to a vicious circle". He cites as an example the fact that "according to general relativity theory, mass and space-time stand in a relationship of mutual causal interaction: mass curves space-time, and the curvature of space-time in turn affects the behaviour of objects with mass."[20] He concludes that "physics is restricted to telling us only about the *behaviour* of physical entities – electrons, quarks and indeed space-time itself – it leaves us completely in the dark about their intrinsic nature. Physics tells us what matter *does*, but not what it *is*." He asks "what then is the intrinsic nature of matter?" and suggests that "panpsychism offers an answer: consciousness. Physics describes matter 'from the outside', that is to say, physics gives us rich information about the behaviour brought about by mass, spin, charge, etc. But there must be more to what something is than what it does; and according to panpsychism, mass, spin, charge, etc. are, in their intrinsic nature, forms of consciousness... if we accept that physics tell us nothing about the intrinsic nature of matter, and indeed that the only thing we really know about the intrinsic nature of matter is that some of it involves consciousness, panpsychism starts to look much more plausible."

Proponents of panpsychism are apt to confuse *having* consciousness with *comprising* consciousness.

5.4 Goff acknowledges that panpsychism may seem far-fetched; that, for example, "the supposition that electrons have some form of consciousness, albeit extremely basic, is still thought by many to be just too crazy to be taken seriously." Phrased in this way, the supposition is conceptually ambiguous. The conjecture that electrons, along with all other material entities, *have* some form of consciousness represents them as things for which consciousness is an *attribute*, not as things which *comprise* consciousness. It refers to what they supposedly *do* (i.e. *experience* consciousness) rather than what they supposedly *are* and is thus open to the same criticism that Goff levels at physics. It takes substantial things (e.g. electrons, atoms, pebbles, rocks, mountains and stars) *as already conceived* and then naively imagines *their* experiencing a bit of what *we* experience when conscious. The *nature* of such experience (other than its being 'extremely basic') is not specified. What panpsychism *on its own terms* needs to demonstrate is not that all things *experience* consciousness but that they *comprise* consciousness i.e. that they *consist of nothing else but* consciousness.

Panpsychism's *equation* of substance with consciousness lacks both coherence and explanatory force.

5.5 Panpsychism's claim that all substance *consists* of consciousness is incoherent and lacking in explanatory force. No explanation is offered of how this supposed substance divides itself into *discrete* conscious entities. What forms the boundaries between them? This is as unclear as what might forms the boundaries between material objects *if* these comprise nothing but extension (Locke's objection to Descartes notion of 'extended substance' – see 3.3). What *determines* the *form* that consciousness takes e.g. whether it appears in the form of a quark, an atom, a tree, a mouse or an elephant? Why should it sometimes appear as a particle and sometimes as a wave? Does consciousness possess position and extension? If not, why should it appear in the form of a perceived world of positioned and extended objects/stuff? What is the mechanism by which *separate* 'units' of consciousness have awareness of, and communicate with, each other? Can they have *conflicting* desires? What then determines the outcome of the conflict? If, as Goff suggests, the smallest particles possess only an 'extremely basic' level of consciousness (whatever that might be) does this mean that there is a *hierarchy* of entities based upon the *amount*, or perhaps *quality*, of consciousness they contain? How does the conscious content of larger entities relate to that of the smaller ones of which they are composed? How, for example, does my consciousness as an entire human being relate to that of my left hand, spleen, individual brain cells and, indeed of all the atomic and sub-atomic particles that make up my body? And why am I totally *unconscious* of their consciousness? If my entire being *comprises* consciousness why should it *lose* consciousness either temporarily (when sleeping a dreamless sleep or if anaesthetised) or permanently (when dead)? These are just a small sample of the questions which the proponents of panpsychism abjectly fail not only to *answer*

[20] The problem of the *interdependence* of definitions has been mentioned earlier in this paper – see 4.14).

but, it appears, even to *ask* themselves. Panpsychism's postulation of consciousness as a universal substance thus lacks coherence – although, arguably, it is no more incoherent and lacking in explanatory force than other postulations of a universal substance such as Aristotle's 'potentia', Heisenberg's 'energy' (see 4.5) or Russell's 'events' (see 4.11).

Idealism, to which panpsychism appears related, shares its conceptual incoherence.

5.6 Goff attributes doubts about panpsychism in part to distrust of *idealism*, a philosophical approach to which panpsychism appears related. Panpsychism, idealism *and* dualism all share the fundamental flaw (identified above) of treating consciousness/mind/spirit as a *substance* – in the case of panpsychism and idealism, the *only* substance there is. The conceptual problems that beset idealism are perhaps best illustrated by the idealist doctrine of the Irish philosopher George Berkeley (1685-1753) who declares it "evident there is no other Substance than Spirit, or *that which perceives*" [PHK 7], that "a spirit is one simple, undivided, active being" [PHK 27] which is "indivisible, incorporeal, unextended" [PHK 141], and that "this perceiving, active being is what I call *mind, spirit, soul* or *myself*" [PHK 2]. He explains that by these words he does "not denote any one of my ideas, but a thing entirely distinct from them, wherein they exist, or, which is the same thing, whereby they are perceived – for the existence of an idea consists in being perceived" [PHK 2]. There is an obvious problem here. If perceiving, active beings such as ourselves comprise nothing but spiritual/mental substance (comparable to Descartes' 'thinking substance') and thus lack all the attributes (including *position* and *extension*) which we associate with 'corporeal substance', the existential status of the sensations, thoughts and feelings we experience becomes totally obscure. According to Berkeley, ideas are not themselves a type of substance and have no independent existence of their own. A critical problem for Berkeley and other idealists is to explain what determines our sensory experience if it does not relate to *something* existing independently of ourselves. Berkeley recognises that we do not *choose* such experience and, having ruled out the existence of material substance, can attribute it only to the implanting of sensory ideas in our minds by a supreme spirit (God). "When in broad daylight I open my eyes, it is not in my power to choose whether I shall see or no, or to determine what particular objects shall present themselves to my view; and so likewise as to the hearing and other senses, the ideas imprinted on them are not creatures of my will. There is therefore some other Will or Spirit that produces them" [PHK 29]. Many more problems beset idealism (including the nature of human *agency* in the world) rendering it conceptually incoherent. To examine them here, however, is beyond the scope of this paper.[21]

Conscious experience is an *emergent property* of highly complex structured organisms.

5.7 Rejecting as incoherent panpsychism's identification of consciousness *as* a substance and regarding it instead as a potential *attribute* of substance, leaves open the question as to what is needed for that potential to be realised (apart, of course, from the fundamental question as to what substance *is*). Which entities do or do not enjoy some form of conscious experience is a *factual* matter to be determined on the basis of *evidence*. On planet Earth, the evidence is that consciousness is confined to a limited range of complexly structured organisms possessing central nervous systems and brains. There is no evidence that *all* entities, whether *structured* (such as trees, tables and atoms) or *unstructured* (such as electrons, quarks and other elementary particles conceived as point-like and indivisible) possess consciousness. Elsewhere in the universe, there may exist very different conscious beings[22] but these would still need to be *structured* in such a way as to generate their conscious experience, the nature of which might differ as much from our

[21] They are examined in detail in a paper entitled *Stuff and Nonsense: Berkeley and Immaterialism* and briefly, in illustrated form, in *Hylas and Philonous – The Fourth Dialogue*. Both papers are freely available on the KPC website via the following links:
Stuff_and_Nonsense.pdf (e-voice.org.uk)
Hylas_&_Philonous_-_The_Fourth_Dialogue.pdf (e-voice.org.uk)

[22] Locke countenances the existence elsewhere in the universe of non-humans possessing superior faculties unknown to us. "He that will not set himself proudly at the top of all things but will consider the immensity of this fabric and the great variety that is to be found in this little and inconsiderable part of it which he has to do with, may be apt to think that in other mansions of it there may be other and different intelligent beings of whose faculties he has as little knowledge or apprehension as a worm shut up in one drawer of a cabinet has of the senses or understanding of a man" [ECHU 2.2.3].

own as, we assume, does that of non-human animals.[23] Although some people speculate that *computers* might be conscious beings,[24] the general consensus amongst neuroscientists today is that consciousness is an attribute only of brains possessing a *cerebral cortex*, its interconnections with other parts of the brain (e.g. the *thalamus*) allowing specialised sub-systems to combine into an *overall* system, of which consciousness is an *emergent* property.[25] The following quotes from three neuroscientists encapsulate a number of key points (for fuller quotes see pages 33-34).

- "The view in neuroscience today is that consciousness does not constitute a single, generalised process. It is becoming increasingly clear that consciousness involves a multitude of widely distributed specialised systems and disunited processes, the products of which are integrated in a dynamic manner by the interpreter module. Consciousness is an emergent property. From moment to moment, different modules or systems compete for attention and the winner emerges as the neural system underlying that moment's conscious experience ... A complex system is composed of many different systems that interact and produce emergent properties that are greater than the sum of their parts and cannot be reduced to the properties of the constituent parts." Gazzaniga (2011)
- "Today, most scientists and philosophers agree that ... consciousness is an emergent property of the brain as a whole, a natural consequence of millions of neurons processing information in parallel... Consciousness seems to require several areas of the *cortex* acting together in a broad network ... The identification of ... components of the brain that are necessary for consciousness ... has reinforced the idea that for an animal to be conscious it needs to possess a highly developed cortex such as our own. This is found only in mammals... In addition to the cortex, deeper, more primitive areas of the brain are also involved, although they are not in themselves sufficient to cause consciousness. Consciousness seems to require a functioning *thalamus* and cooperation between the thalamus and the cortex." Gibb (2012)
- "A complex system is composed of many different systems that interact and produce emergent properties that are greater than the sum of their parts and cannot be reduced to the properties of the constituent parts... Consciousness can be seen as an emergent characteristic generated by the joint functioning of specific areas of the huge network of neurons in our heads. Brain cells and areas have their own separate functions, but their functional links with one another jointly endow them with a new 'emergent' function. There are many examples of emergent characteristics. For instance, we know hydrogen and oxygen as gases. But when these molecules bind, a substance with entirely different characteristics emerges, namely water." Swaab (2014)

Gibb highlights the importance for consciousness of part of the thalamus known as the *centromedian nucleus* which is wired into a number of different brain regions, including the cortex. It controls levels of arousal and attention and is the target of general anaesthetics. Gibb describes it dramatically as "all that stands between us and nothingness". For a couple of diagrams showing the structure of the human brain see page 32.

'Consciousness' denotes the *states of awareness* experienced by, at the very least, human beings.

5.8 Identifying how substance must be structured if consciousness is to emerge as a property, does not in itself reveal the *nature* of that property. However, we can question its nature only by virtue of *being*

[23] Most of us attribute *some* type of consciousness to many non-human animals (although Descartes regarded them all as mere *machines*). This may not deter us from killing and eating some of them (including in the UK an estimated 10 million turkeys at Christmas) but it does at least condition how we treat them when they are alive and how we slaughter them.

[24] Dennett (1991), for example, argues that: "If the self is 'just' the Centre of Narrative Gravity, and if all the phenomena of human consciousness are explicable as 'just' the activities of a virtual machine realised in the astronomically adjustable connections of the human brain, then, in principle, a suitably 'programmed' robot, with a silicon-based computer brain, would be conscious, would have a self. More aptly, there would be a conscious self whose body was the robot and whose brain was the computer." Generally ignored by those who argue that computers are, or might become, conscious beings – experiencing, like humans and perhaps some other animals, thoughts, feelings, intentions, desires and awareness of self – are the unavoidable ethical consequences which then follow regarding their *treatment*, *rights* and eventual *killing* (i.e. when they are *scrapped*).

conscious and thus already knowing from experience what it is *like* to be conscious. The essence of consciousness is a*wareness* (of *what* is considered below). For much of our lives, of course, we exist in a state of *un*consciousness, most obviously when in a dreamless sleep. When dreaming or half-asleep, moreover, we are at best only *partially* conscious. Even when fully awake we are oblivious to, or only dimly aware of, much of our surroundings. Consciousness is thus a generic term for the widely varying *states of awareness* which are known to be experienced by humans and assumed to be experienced by at least some other animals. Consciousness is essentially an *experiential phenomenon* requiring substantial 'somethings' to do the experiencing. The noun-status of the word, however, can tempt us, as we have already seen, into viewing consciousness as itself a sort of 'thing' or 'substance'.[26]

Our conscious experiences varies widely in their *nature* and *intensity*.

5.9 The experiences associated with 'being conscious' vary significantly in their *nature* and *intensity*. They, and the mental processes involved in their production, can be grouped broadly as follows.

- *Sensory perception* of extended/positioned *stuff/objects* (such as water, rocks, trees and tables) as well as of intangible/evanescent phenomena (such as rainbows, reflections, shadows, smells, tastes, voices and music). Such awareness represents the *experiential end product* of the largely *sub-conscious*[27] processing of input received via our senses. Key to the processing is *pattern recognition* linked to the *mental models of reality* that we develop from birth. Much processing, it is important to emphasise, *remains* at the sub-conscious level whilst nevertheless triggering appropriate responses (e.g. the continuous adjustments of speed and direction made by car drivers).
- *Bodily sensations* (such as aches, pains, fevers, shivers and tingles) that vary widely in their *nature*, *intensity*, *pleasantness/unpleasantness* and *specificity of location*. Usually their occurrence can be related to identifiable internal and/or external conditions (e.g. tooth decay, indigestion, ambient temperature and contact with objects) but sometimes their source is unclear or their apparent location misleading (e.g. the 'phantom pains' experienced by some amputees). As with awareness of our surroundings, consciousness of bodily sensations is clearly affected by our mental *focus/attention*. When we are concentrating upon something else, they may pass unnoticed. Our ability, within limits, to re-direct the focus of our attention provides *some* scope at least for reducing the perception of pain (there even being cases of surgery upon *un-anaesthetised* patients who have the ability, it appears, to exercise a form of self-hypnosis).
- *Emotions/feelings* which, like bodily sensations, vary widely in their nature, intensity and degree of pleasantness/unpleasantness. They are generally triggered by perceptual, remembered or imagined experience (e.g. joy at the sight of a rainbow,[28] embarrassment at the memory of a social gaffe or anxiety at the thought of an imminent exam) but occasionally have no obvious source (e.g. a sudden and unexplained feeling of contentment or unease). Some may trigger *bodily* sensations/reactions (e.g. a quickening of the pulse or a sinking feeling in the pit of the stomach). Emotions/feelings are central to aesthetic/moral sensibility and thus to *human agency*. *Pro* and *anti* feelings about real and imagined situations influence what we do or don't *want* and thus what we strive to *achieve* or to *avoid*.
- *Memory recall* allows us to *simulate*, to an extent, previous sensory/emotional experience. In a sketchy and fragmentary way, we can simulate many of the *particular* experiences that have occurred at given

[26] 'Noun-proneness' in language can be the source of much confusion. The fact that a substantial thing (such as a human being) can be described as either *conscious* (adjective) or as possessing *consciousness* (noun) does not mean that consciousness is an independently existent 'thing' or 'substance'. In a similar way, the fact that we can describe a thing that *moves* (verb) as displaying *motion* (noun) does not mean that motion is an independently existent 'something' – as Descartes makes clear when he states that "the motion of something that moves is, like the lack of motion in a thing which is at rest, a mere mode of that thing and not itself a subsistent thing, just as shape is a mere mode of the thing which has shape" (see 2.13).

[27] Occasionally we 'catch ourselves' trying to make sense of ambiguous sensory input e.g. when viewing things at a distance, from an unusual angle or in a bad light.

[28] As expressed, for example, by William Wordsworth in his poem *My Heart Leaps Up* (1802): "My heart leaps up when I behold / A rainbow in the sky: / So was it when my life began; / So is it now I am a man; / So be it when I shall grow old, / Or let me die! / The Child is father of the Man; / And I could wish my days to be / Bound each to each by natural piety."

places/times in our lives (e.g. remembered holiday experiences) as well as *types* of experience (e.g. what it is generally *like* to see a rainbow, taste an apple, smell a rose, suffer toothache or feel anxious) – as opposed to any of their *particular* space-time occurrences. The *limited* nature of memory recall can be seen as self-defence mechanism. If previous experience could be simulated *perfectly* it would be *indistinguishable* from it, would obscure awareness of our *current* situation and would be highly confusing from the point of view of *continuity* of consciousness. Potentially, moreover, it could be excruciating (e.g. if we could simulate *perfectly* a previously experienced and agonising toothache). In practice, what gets memorised are *selective* bits of the on-going and multi-faceted experience that results from the processing of sensory and other stimuli. This processing *itself* requires memory recall, without which we are trapped in the moment – unable, for example, to make sense of changing visual signals, flows of words or music. It involves, moreover, the application – generally sub-conscious but occasionally, especially where sensory data is ambiguous, at a conscious level – of the memorised 'patterns' by which we distinguish different sorts of things or stuff (e.g. by which we recognise dog droppings on the pavement for what they are and take care to walk around them).

- Closely linked to the products of memory recall are those of *imagination*. What appear to us as memories, indeed, may be *embellished* or *generated entirely* by the imagination i.e. they may be a *false* memories (viz. the notorious unreliability of much witness evidence). The processing of sensory input itself appears to involve a substantial element of 'story-telling' (associated with left-brain activity) whereby disparate information is pieced together and gaps are filled in order to produce a seemingly coherent whole. What we call 'thinking' is essentially the process of using our imaginative faculties to *activate* and *manipulate* selected contents of the *cognitive systems* comprising our minds. Such contents include the stored *patterns/constructs* by which we conceptualise and categorise all that we experience. Although mental activity is often haphazard and experienced as 'mind-noise' (e.g. the seemingly random images and words which often come into our heads, particularly when we are daydreaming and mentally unfocussed), much is *consciously directed* towards a variety of ends, most obviously towards the *solving of problems* and the *making of choices*. This requires *imagining and exploring possibilities* and can result in the *re-formulation* of existing mental constructs (as, for example, has happened in the fields of particle physics, relativity theory and quantum mechanics).

Consciousness is essentially *inner*, *qualitative* and *subjective* in nature.

5.10 Searle (1999) recognises that "consciousness comes in a very large numbers of forms and varieties" but argues that "the essential features of consciousness, in all its forms, are its *inner*, *qualitative*, and *subjective* nature". He makes the following key points.

- Our conscious states are *inner* not only in the spatial sense of occurring *within* our bodies/brains but also because they are "internally related to each other in the sense that in order for a mental state to be that state with that character it has to stand in certain relation to other states, just as the whole system of states has to be related to the real world... The ontology – the very existence of my conscious states – involves their being part of a sequence of complex conscious states that constitute my conscious life".
- "Conscious states are *qualitative* in the sense that for each conscious state there is a certain way that it feels, there is a certain qualitative character to it. There is something that it is like to drink red wine, and it is quite different from what it is like to listen to music. In that sense, there is nothing it is like to be a house or a tree, because such entities are not conscious."
- Conscious states are *subjective* in that they possess *'first-person ontology*'. In other words, they exist "only from the point of view of some agent or organism or animal or self that has them... Only as experienced by some agent – that is, by a 'subject' – does a pain exist. Objective entities such as mountains have a third-person mode of existence. Their existence does not depend on being experienced by a subject". Searle differentiates *ontological* from *epistemic* subjectivity. The fact that conscious states *exist* as subjective phenomena does not mean that they cannot be objectively *known*.

That I *subjectively* hold a particular opinion, for example, is an *objective fact* about me that others, potentially at least, can ascertain.

***Intentionality* is a crucial feature of most conscious states. Intrinsic to the existence of such states and of their 'objects' is *duration*. Their spatial/temporal 'boundaries' may be ambiguous.**

5.11 '*Aboutness*' or, to use philosophical jargon, *intentionality* is a crucial feature of most, although not all, conscious states.[29] As explained by Searle (1999), "intentionality is that feature of the mind by which mental states are directed at, or are about or of, or refer to, or aim at, states of affairs in the world". It is "a feature possessed by beliefs and desires, hopes and fears, love and hate, pride and shame, as well as perception and intention". There is some ambiguity, it must be recognised, in the term 'states of affairs'. It has been used by philosophers and others in a variety of contexts and precisely what it is intended to denote is not always made clear.[30] Crucially, use of the word '*states*' in terms such as 'states of affairs', 'mental states', 'conscious states' and 'states of awareness' requires qualification. It should not be taken to imply that the phenomena in question are somehow *static* rather than *dynamic* in nature i.e. that they can be conceived as existing at given 'instants' of time.[31] Existence seems inconceivable without *duration*, even if this might be mind-staggeringly brief.[32] *Instantaneous* existence (meaning *duration-less* existence) appears indistinguishable from *non-existence*. All the 'objects' of human intentionality present themselves as *extended over time*. Thus, for example, both the *experience* of observing a melting snowflake and the *snowflake itself* are best conceived as time-extended 'happenings'. Even something as seemingly durable and enduring as a diamond is conceived in modern physics as subject to *ongoing change* (e.g. as the electrons within its atoms *vibrate*). Arising from such change, a key issue in identifying the 'objects' of our awareness is where to draw *spatial* and/or *temporal* boundaries. Although not exclusive to them, the problem is particularly acute in the case of *organisms* (both flora and fauna and including ourselves) whose size, shape and molecular composition may change significantly over time.[33] In practice, *spatio-temporal continuity* appears to be the only basis for regarding an organism, as *now* constituted and configured, to be the *self-same* as one observed *previously* and displaying, perhaps, very different characteristics (e.g. for identifying the tree now in our garden with the sapling we planted many years ago).

Our intentional *experiences* and their *objects* must be clearly distinguished. Our awareness of things/stuff as extended in space-time and existing independently of their observation is *primitive*.

5.12 Failure to distinguish our intentional *experiences* from their intentional *objects* combined with a lack of clarity about the *existential status* of those objects provides a source not only of conceptual confusion but, potentially, of human conflict. Our *sensory* experience is essentially one *of* objects/stuff/phenomena displaying space-time location and existing *independently* of any such experience

[29] Examples of conscious states that do *not* display intentionality are the generalised feelings of contentment, unease, anxiety, etc. that occasionally come over us i.e. feelings unrelated to any identifiable 'object' and which are thus *undirected*.

[30] In his *Tractatus Logico-Philosophicus* (1921), Austrian philosopher Ludwig Wittgenstein (1889-1951) represents the '*world*' as comprising *'the totality of facts*', 'facts' as comprising *'the existence of states of affairs*' and states of affairs as comprising *'combinations of objects (things)*'. In his later work, most notably in his *Philosophical Investigations* (1953), however, he repudiates the basic tenets of the *Tractatus*, particularly its claim that language bears a '*picturing*' relationship to the world. Grayling (1988) provides a clear and succinct summary of the radical change in position adopted by Wittgenstein between the *Tractatus* and the *Investigations* (see page 34).

[31] French philosopher Nicholas of Autrecourt (c1298-1369) suggested that time is 'granular', being made up of individual and *indivisible* 'instants'. He provides no explanation, however, of the *nature* and *content* of such 'atoms of time', what links them together, what fixes their order of succession and what determines any change in their content from one instant to the next.

[32] Although the life of the postulated delta baryon (see 4.4) is incredibly brief, both it and all other sub-atomic particles are deemed in modern physics to require at least *some* duration in order to exist at all. The existence of a *zero-duration* particle, indeed, appears to involve a contradiction in terms and thus to be inconceivable.

[33] With organisms subject to *metamorphosis* such change can be spectacular (e.g. a caterpillar's transformation into a butterfly).

(as evidenced most obviously by our inability to change them simply by an act of will[34]). We can and do, of course, regularly alter the direction and focus of our attention (e.g. the object of our attention can be readily switched from a whole tree to one of its branches to one of its leaves). We cannot, however, alter the characteristics of any such object by an act of will (e.g. we cannot *will* an oak tree to turn into an apple tree or its leaves to change colour). It is important to emphasise that perception of things/stuff (including our own bodies and their component parts) as extended, relatively positioned and existing independently of being perceived is *primitive*, realised in early infancy and *inescapable*, being *contained* within the perceptual experience itself. It is not something we 'intellectualise' or 'suppose', having *first* noted the concurrence of observed 'qualities'. Locke's suggestion (see 3.1) that we *first* "take notice" that "a certain number" of "simple ideas" (as he calls such qualities) "go constantly together" and *then* "not imagining how these simple ideas can subsist by themselves ... accustom ourselves to suppose some *substratum* wherein they do subsist and ... which therefore we call *substance*" misrepresents the nature and content of such experience and also conflates our recognition of *individual* things with their division into *types* of thing. When we see/touch an object/stuff for the first time – and thus have *no* history of the extent to which its qualities have gone 'constantly together' – we nevertheless recognise it straightaway as a substantial 'something' (whether or not we also recognise it as an example of one or more *types* of thing).

It is evident that the mental *activity* associated with our sensory experiences takes place within our brains but this does *not* mean that the *objects* of those experiences must reside there.

5.13 Our *sensory* experiences, whilst distinct from their intentional objects, appear to governed by the *position* of our bodies (*themselves* potential objects of sensory experience) relative to *other* objects. This fact was recognised by Locke who felt bound to attribute 'mobility' to 'spirits' since these clearly share the movements of the 'bodies' to which they are tied.[35] Whether or not we accept the existence of 'souls' or 'spirits', we know that our sensory experiences are affected by both the *position* and *nature* of our bodies and body parts (e.g. whether our eyes are open or shut, their direction and focus, and their physical condition). Accumulated evidence (based ultimately upon the testimony of our senses) indicates that *all* our *cognitive activity* (not just that associated with sensory experience) takes place within our brains and central nervous systems and can be altered or terminated, either temporarily or permanently, by the effect upon them of, for example, drugs/anaesthetics, physical trauma or the natural deterioration and death of their constituent cells.[36] The fact that intentionality is realised through mental activity occurring within brains, of course, does *not* mean that the *objects* towards which that intentionality is directed must be located there. I can accept, for example, that my spasmodic, fleeting, varied and *extremely* limited sensory *experience* of my right thumb arises from electro-chemical activity taking place within my brain *without* believing, which would be absurd, that the *thumb itself* is located there.[37]

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[34] Such inability poses a problem for the idealist philosopher George Berkeley. Having denied the existence of independently existing material substance, he can explain it *only* by postulating the involvement of a 'Supreme Spirit' (see 5.6). By contrast, Descartes (see 2.1) regards independence of existence as a *defining* attribute of both 'material' and 'immaterial' substance.

[35] "Spirits as well as bodies cannot operate but where they are ... Everyone finds in himself that his soul can think, will and operate on his body in the place where that is; but cannot operate on a body or in a place an hundred miles distant from it. Nobody can imagine that his soul can think or move an object at Oxford whilst he is in London; and cannot but know that, being united to his body, it constantly changes place all the whole journey between Oxford and London, as the coach or horse does that carries him" [EHU 2.23.19-20].

[36] The recognition and growing understanding of the cognitive function of the brain is a fairly recent development. Thomas Willis (1621-75), who published his *Anatomy of the Brain* in 1664, was the first to examine the brain with any real scientific rigour. In popular imagination, of course, cognitive/emotional experience is sometimes attributed to *other* parts of the body (particularly the heart) or its location is at least a matter of speculation (as illustrated in the song in Shakespeare's *The Merchant of Venice*: "Tell me where is fancy bred, / Or in the heart or in the head, / How begot, how nourished?").

[37] My visual and tactile experiences of the thumb are confined to its *surface area*. Anyone who hypothesises that the thumb *consists* of a combination of such experiences would have to conclude that there is *nothing* beneath its surface – unless they envisage (*contradicting* their implied belief that nothing exists unless *perceived*) that observing the thumb's surface magically brings into existence, in a totally unexplained way, *unobserved* sub-surface material (including blood vessels and bones).

The relationship between objects in the world and our sensory experience of them is essentially *causative.* This explains why such awareness is bound to *vary* between different observers. It does not mean that they are in touch with different realities or somehow 'create their own realities'.

5.14 Acceptance of the distinction between our sensory *experiences* and their *intentional objects* inevitably raises the question of how they *interrelate* and the extent to which the former provide reliable information about the latter. The fact that the content of our sensory experiences is not chosen by *us* (see 5.12 above)[38] suggests that it must be determined by at least *something* about the objects to which those experiences relate. What it tells us about them, of course, will depend upon how we *interpret* the information in relation to a seemingly coherent *model of reality*. Thus the scientific model of 'physical reality' which now predominates envisages an essentially *causative* relationship between our sensory experiences and their objects. It accepts that varying degrees of complexity and directness are involved and that the content of those experiences are affected not only by the objects to which they are related but also by *how* such objects impinge themselves upon our senses and the way in which this sensory information is then *processed* within the cognitive systems realised within our brains. This inevitably means that different observers will experience the world differently. *However*, as pointed out in 4.12, the fact that precisely what is observed (and even the order of events) may *vary* for different observers does *not* mean that each thereby *creates/chooses* her/his own reality. A commonplace feature of our daily lives is that the visual appearances of things *differ* between observers depending upon the angle/distance of their view, ambient conditions (see Monet's haystacks on page 37), the acuity of their eyesight and the focus of their attention. It does *not* follow from this that they see different things or that, either individually or collectively, they somehow create what they see. Indeed, the only *coherent* model of reality that accounts for such differences is one that envisages things/stuff existing independently of their observation, the sensory and cognitive experience of observers, if there are any, being determined by the type of factors mentioned above.

The objects of human intentionality vary in their existential status.

5.15 Not all the objects or 'states of affairs' (see 5.11) at which human mental states are directed have independent existence. Some, as explained by Searle (1999, 2004 and 2012), are observer-*dependent*. The objects of human intentional states may be divided into three broad types:

1. those (such as stars, oceans, trees, snails, pebbles, atoms, quarks and, indeed, our own bodies and body parts[39]) which exist *independently* of any intentional state of which they might be the object;
2. those (such as characters and happenings in literary fiction) which exist *only* as the products of human imagination;[40]
3. those (such as nation states, companies and money) which exist only as the product of human intentionality but which nevertheless have the *aura* of independent existence, condition much of our behaviour, confer 'status functions' upon individuals and may find partial expression in objects of the first type (e.g. in border fences, buildings and banknotes/coins).[41]

A crucial feature of type 3 objects is that they are necessarily the product of *collective* intentionality. This is *not* to postulate a collective consciousness distinct from the separate consciousnesses of individual people. It refers simply to the substantial *commonality* in the *content* of those individual consciousnesses achieved through human intercommunication (mainly through the use of language). Such commonality, however, is

[38] The fact that, at a sub-atomic level, whether particle-like or wave-like behaviour is observed depends upon what is being *looked for* (see 4.7) does *not* mean that *we* determine the nature of the bit of reality that we target. Once we have chosen our type of experiment what *then* follows is determined *for* us, not by us (see footnote 9). In a similar way, we can choose to let go of an object but we cannot choose that it should *then* hover unsupported in mid-air rather than fall to the floor.

[39] Each of us knows from direct experience that our own existence does *not* depend upon our bodies being the object of anyone else's, or indeed our *own*, intentionality. It is often the case that currently *nobody* is observing us or even thinking about us and our own intentionality is either inoperative (e.g. when we sleep a dreamless sleep) or directed at objects other than ourselves.

[40] Robert Buss' portrait *Dickens' Dream* (see page 35) illustrates beautifully the power of human imagination to create *fictions*.

[41] In *Sapiens: A Brief History of Humankind* (2011), Israeli historian Yuval Noah Harari describes how the ability of humans to create a social reality by cooperatively *imagining* it into existence, has enabled them to dominate the planet (see pages 35-36).

only *partial* and there can be radical differences in the conceptual frameworks of different people, resulting in disagreements about which intentional objects belong to which type. People who believe in some sort of deity, for example, would attribute type 1 status to their own chosen god/gods and type 2 status to any different ones worshipped by others. For some people, type 2 objects can seem as real as, and even be mistaken for, type 1 objects, as evidenced by their *genuine* emotional response to fictional characters portrayed in novels/dramas/TV soaps/etc. or their belief that fictional characters (perhaps Sherlock Holmes) actually do or did exist.[42] The observer-dependent nature of social reality, it is important to note, makes it inherently *fragile*, permanently *alterable* and subject at times to dramatic *change* (viz. the English, American, French and Russian revolutions).

Extension in time is required for the observation of objects or events. Memory, mental focus and the recognition of spatial/temporal 'boundaries' are key factors in determining the content of our perceptual experience. Acts of intentionality can be the *objects* of *other* such acts.

5.16 Any exercise of intentionality would appear, of necessity, to be *time-extended*. To see, touch, taste, feel, hear or just think about anything requires *duration*, however brief this might be. The time-extended nature of intentional acts and of their objects renders crucial the role of *memory* in capturing and interpreting features of the phenomena to which our fleeting sensory/cognitive experience relates. Crucial in identifying such features is the role of *mental focus*. When observing a passing bus, for example, we may focus in turn upon the whole bus, one of its windows, a passenger sitting behind the window, etc. When listening to the performance of a symphony, it may shift between individual notes, motifs, phrases, sections of the orchestra, etc. It is often the case that the spatial/temporal boundaries between observed features are *fuzzy and ill-defined*, especially when they comprise sub-divisions of more extended entities. With *visual* and *tactile* experience, *spatial* boundaries are liable to predominate. With *aural* experience, *temporal* boundaries are critical. The objects of our intentionality, it is important to note, include time-extended *events/happenings*. Furthermore, acts of intentionality can *themselves* become the objects of *other* acts of intentionality. One moment, for example, the bad driving of another road user may be the object of my anger. The next moment that anger *itself* may become the object of my attention. I may also have, as the object of my intentional state, the presumed intentional state of *another person*. We spend much of our time imagining (correctly or otherwise) what other people are thinking or feeling.

Language can help to *facilitate* thinking by providing *signs* for mental constructs. Lack of care in its use, however, is likely to result in conceptual muddle.

5.17 Although verbal and mathematical *language* provides the *vehicle* for much of our thinking, it does so only by providing *signs* for the mental constructs by means of which we conceptualise and categorise features of our experienced world (see 4.16). Problems arise, however, when we manipulate those signs without clearly bringing to mind their related constructs (some of which may *themselves* lack clarity and coherence). The Irish philosopher George Berkeley (1685-1753) identifies, as a major source of philosophical error, the failure to attend sufficiently to the "naked, undisguised ideas" behind words. If we allow ourselves to be deluded by words, he argues, “we may make infinite reasonings upon them to no purpose” [PHKi25]. Unfortunately, he fails to heed his own warning and, like many philosophers both before and after him, is seduced by their noun-status into using the words 'ideas' and 'thoughts' as if they signify types of 'object' or 'substance' (as does Descartes when he equates thought with "nothing else but thinking substance itself" – see 2.2). Thinking is essentially a *time-extended experiential activity*, any division of which into separate ideas/thoughts is to an extent arbitrary. *As a manner of speaking*, we may talk of 'having ideas/thoughts' but this does not make them objects/stuff which we somehow 'perceive'. Much thinking, it is important to emphasis, does *not* require the use of language. The use of linguistic and other signs is, of course, *essential* to *human intercommunication*, the need for which has generated and

[42] The inability of some people to distinguish fact from fiction was experienced by actor Timothy Watson who played the part of the appalling character Rob Titchener in the world's longest running soap *The Archers* (BBC Radio 4). He found himself vilified on social media and, reportedly, had to be given police protection when he opened a village fete in Suffolk in 2016.

shaped the evolution of language. Although language has arisen essentially as vehicle for *public* communication, we also use it *privately* for the *internal verbalisations* through which we conduct so much of our thinking (this, however, does *not* make it a *'private language*' i.e. a language which has been *independently* devised by an *individual* and which is *inherently* inaccessible to others).

There exists a real world that is wholly independent of how, if at all, we observe or describe it.

5.18 Searle (1999) considers the basic claim of 'external realism' (i.e. "that there exists a real world that is totally and absolutely independent of all of our representations, all of our thoughts, feelings, opinions, language, discourse, texts, and so on") as "so obvious and such an essential condition of rationality and even of intelligibility" that it is hard to understand why anybody in their right mind should wish to attack it. "Just as it does not follow from the fact that I see reality always from a point of view and under certain aspects that I never directly perceive reality, so from the fact that I must have a vocabulary in order to state the facts, or a language to identify and describe the facts, it simply does not follow that the facts I am describing or identifying have no independent existence. The fact that there is saltwater in the Atlantic Ocean is a fact that existed long before there was anyone to identify the body of water as the Atlantic Ocean, to identify the stuff in it as water, or to identify one of its chemical components as salt. Of course, in order for us to make all these identifications, we must have a language, but so what? The facts exist utterly independent of language… It is a use-mention fallacy to suppose that the linguistic or conceptual nature of the *identification* of a fact requires that the *fact identified* be itself linguistic in nature. Facts are conditions that make statements true, but they are not identical with their linguistic descriptions. We invent words to state facts and to name things, but it does not follow that we invent the facts or the things." Searle considers "that as a matter of contemporary and cultural history, the attacks on realism are not driven by arguments, because the arguments are more or less obviously feeble". The deeper reason for the persistent appeal of antirealism is that "it satisfies a basic urge to power. It just seems too disgusting, somehow, that we should have to be at the mercy of the 'real world'. It seems too awful that our representations should have to be answerable to anything but us… In universities, most notably in various humanities disciplines, it is assumed that, if there is no real world, then science is on the same footing as the humanities. They both deal with social constructs, not with independent realities. From this assumption forms of postmodernism, deconstruction, and so on, are easily developed, having been completely turned loose from the tiresome moorings and constraints of having to confront the real world. If the real world is just an invention … then let's get rid of the real world and construct the world we want. That, I think, is the real driving psychological force behind antirealism at the end of the twentieth century."

***Metaphysical/transcendental* realism is hard to distinguish from *idealism* (see 5.6).**

5.19 The German philosopher Immanuel Kant (1724-1804) appears to be a *dualist*, believing that a world exists independently of the conscious/perceptual experience of human minds. He argues, however, that those minds are pre-conditioned to interpret their experience in terms of in-built 'forms of perception'[43] which are '*a priori*' (i.e. exist *prior* to such experience, being somehow 'hard-wired' into them) not '*a posteriori*' (i.e. formed *after* and *out of* such experience) [Kant, 1781]. Such forms are *empirically real* (i.e. genuine features of our experienced '*phenomenal*' world) but *transcendentally ideal* (i.e. superimposed by our minds upon the '*noumenal*' world of 'things as they are in themselves'). Whereas Locke considers that the perceived primary qualities of things reveal something about their nature, Kant believes that *nothing* in

[43] Kant's 'forms' include space, time, causality and the concept of substance. Comparing Kant's doctrines with modern physics, Heisenberg (1962) comments that it seems "his central concept of the 'synthetic judgements *a priori*' has been completely annihilated by the discoveries of our century. The theory of relativity has changed our views on space and time, it has in fact revealed entirely new features of space and time, of which nothing is seen in Kant's *a priori* forms of pure intuition... The *a priori* concepts which Kant considered an undisputable truth are no longer contained in the scientific system of modern physics." Kant followed Newton in attributing *absolute* existence to both time and space (see footnote 15). Körner (1955) points out that this was challenged during Newton's own lifetime by German philosopher Gottfried Leibnitz (1646-1715) who held that "space … is something *merely relative*, as time is", that space is "an *order of coexistences* as time is an *order* of successions" and that to take time "to be a substance, or at least an absolute being" is "a fancy."

our perceptual experience can be taken to represent anything about the noumenal world. It remains an eternal mystery to us, an even more 'uncertain supposition of we know not what' than Locke's 'substance'. For this reason, Kant is sometimes considered a *transcendental* or *metaphysical* realist, whilst Locke is regarded as a *natural* realist. Searle (1999), however, regards Kant as essentially an *idealist*, albeit a less obvious one than Berkeley. "I believe the most sophisticated version of the idealist position is found in the philosophy of Kant, who thought that what he called the 'phenomenal world' (the world of chairs, tables, trees, planets, and so on) consisted entirely in our representations. He also thought that there actually is another world, a world of 'things in themselves', but that this world is totally inaccessible to us; we cannot even talk about it meaningfully. The empirical world (that is, the world we all experience and live in) is in fact a world of systematic appearance, a world of how things appear to us. So, on Kant's view, as on other forms of idealism, the world of tables, chairs, mountains, and meteors, as well as of space, time, and causation, is in fact a world of mere appearances. The difference between Kant and other idealists such as Berkeley is that the others thought that appearances (or, as Berkeley calls them 'ideas') are the only reality, whereas Kant thought that in addition to the world of appearances, there is a reality of things in themselves behind the appearances, of which we can have no knowledge whatever."

Things *have* qualities but it is a *category error* to suppose that they *consist* of those qualities.

5.20 For Berkeley, there is no hidden world of 'things as they are in themselves'. All the objects we perceive through our senses, he argues, are formed by our 'combining together' sensory *ideas*, or *sensations* as he calls them, – colours, textures, shapes, smells, tastes and sounds – which are being constantly fed into our minds by God. Supposedly, for example, a cricket ball *consists* of God-implanted ideas of redness, roundness and hardness which we 'combine together' to form the ball. The absurdity of all this might seem obvious. Things get even more absurd if we try to 'do Berkeley without God' and thus lose *any* explanation of the source of our sensory experience. It is patently not *us*, as we do not *choose* what we perceive. If, in any meaningful sense, we *could* 'create our own reality', why should we choose the imperfect and often brutal world that we now inhabit? What stops us from creating a reality in which our glasses are always full and where we do not get ill, old and eventually die? The ultimate incoherence of Berkeley's philosophy stems from his uncritical acceptance of Locke's doctrine that the objects of our awareness are 'ideas' (see 5.7). Warnock (1962) states: "It will surely not do to assume at the very beginning, as Berkeley does, that this extraordinary doctrine can be simply stated as 'evident' –particularly, as … its acceptance leads us straight into philosophical perplexities... In philosophy it is always good policy, when two theorists appear to offer a choice between two positions neither of which is acceptable, to consider whether, underlying the divergences between them, there may not be some dubious principle which they have in common. In this case we do not have to agree with either Locke or Berkeley *unless* we accept, as they both did, the initial supposition that in perception we are aware only of 'our own ideas'. But neither … actually produces any arguments sufficient to establish so strange a view". The things/stuff that we perceive through our senses clearly *display* observable qualities, but it is a category error to suppose that they can *consis*t of those qualities. Using the example of a red ball, Lowe (1995) argues that qualities are best conceived as "ways the ball is – literally as 'modifications' or 'modes' of the ball.[44] If it is then asked what the ball *is* over and above the sum of its qualities – what, as it were, 'remains' when these are fully taken into account – we should be tempted *neither* to say nothing else remains because the ball just *is* the sum total of its qualities, *nor* to say that something further *does* remain, in the form of an unknowable, featureless 'substratum' or 'inner core'. Rather we should reject the question altogether as involving, quite literally, a *category mistake*."

For all its uncertainty, *some* concept of material substance appears *unavoidable*.

5.21 Although Locke finds the concept of material substance to be an "uncertain supposition of we know not what", he nevertheless regards it as an *unavoidable* element of the 'model of reality' which encapsulates how we conceptualise the world of things and stuff perceived through our senses and which

[44] Descartes argues along similar lines (see 2.13) when he says "shape is a mere mode of the thing which has shape."

guides our interaction with that world. Idealist attempts to eliminate material substance in favour of an ill-defined *immaterial* substance comprising 'thought' or 'consciousness' have served only to confuse and obfuscate. Lowe (1995) argues that "Locke's successors wrought great destruction on his philosophy of substance, opening up thereby the high road to idealism – a doctrine far more deeply riddled with absurdity and confusion than anything we find in Locke's position. But to the extent that their criticisms of Locke's account are sound, they focus on aspects of that account which can arguably be jettisoned without abandoning its general thrust and its realist implications. Locke was right to defend the notion of substance: its abandonment was a disaster for the subsequent course of metaphysics which has still not properly been overcome today." A tentative conclusion of this paper is that escaping philosophical/conceptual confusion with regard to 'substance', requires "an expanded notion of the physical" which recognises its "intrinsic, subjective mental component" (see 5.2), this being an *emergent property* of physicality, *as so reconceived* (see 5.7). Locke, arguably, anticipates the possibility of something like this (albeit associated with the agency of an imagined 'Omnipotency') when he questions whether "some systems of matter fitly disposed" might possess "a power to perceive and think" (see footnote 5 on page 5).

Roger Jennings
November 2017 / February 2022

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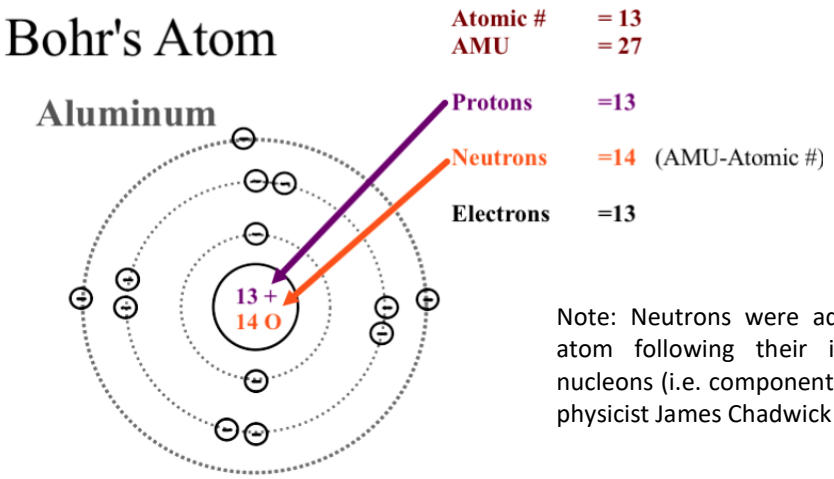
Referencing to specific sections of texts

The following abbreviations are used:

ECHU	*Essay Concerning Human Understanding*
PHK	*Principles of Human Knowledge - Part 1* [the only Part completed by Berkeley]
PHKi	*Principles of Human Knowledge - Introduction*
PP	*Principles of Philosophy*
THN	*Treatise of Human Nature*

The following examples should make clear the referencing system used:

[ECHU 2.8.12]	Book 2; Chapter 8; Section 12
[PHK 2]	Paragraph 2
[PHKi25]	Paragraph 25
[PP 1.51]	Part 1; Paragraph 51



Note: Neutrons were added to the model of the atom following their identification in 1932 as nucleons (i.e. components of the nucleus) by English physicist James Chadwick (1891-1974).

Elementary particles[1] of the 'standard model' (anti-particles not shown)

Source: Martin (2011)

Type	Name	Force			Charge	
		Experiences	Mediates	Spin	Electric	Colour
leptons	electron, muon, tauon	g w e		$^1/_2$	-1	no
	electron neutrino, etc.	g w		$^1/_2$	0	no
quarks	up, charm, top	g w e s		$^1/_2$	$+^2/_3$	yes
	down, strange, bottom	g w e s		$^1/_2$	$-^1/_3$	yes
bosons	photon		e	1	0	no
	charged gauge bosons	g w e	w	1	±1	no
	neutral gauge boson	g w	w	1	0	no
	gluons	g s	s	1	0	yes
	Higgs boson	g w		0	0	no

Forces in descending order of strength: s - strong; e - electromagnetic; w - weak; g - gravity

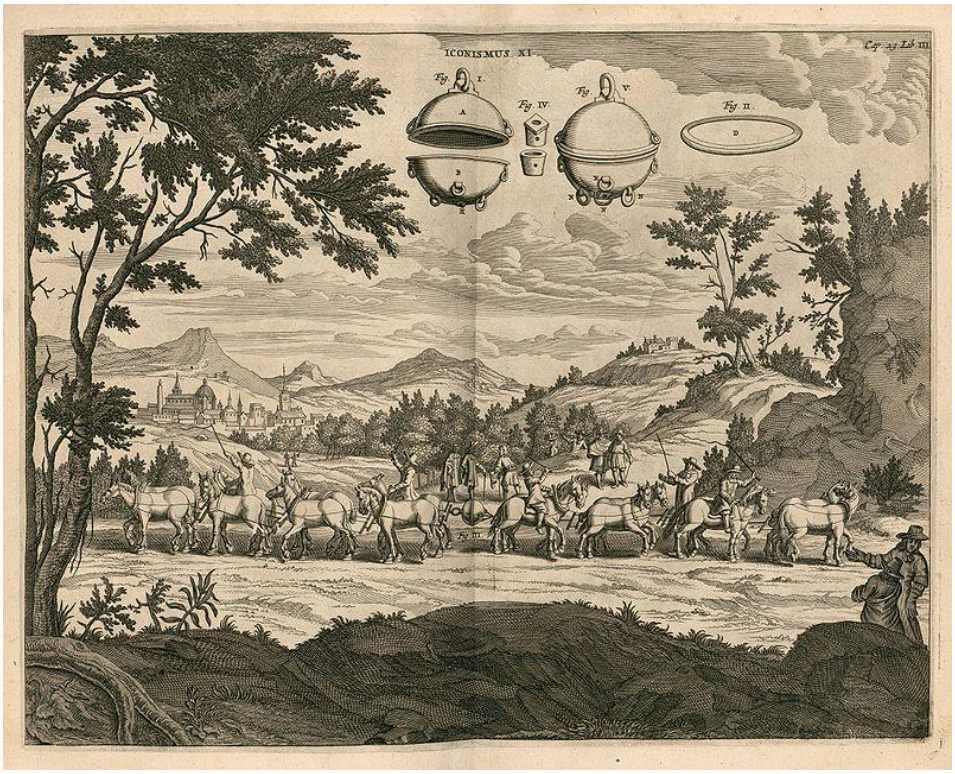
[1] Elementary particles are so-called because they are considered point-like and without internal structure.

Descartes' Substance Dualism

Source: Searle (2004)

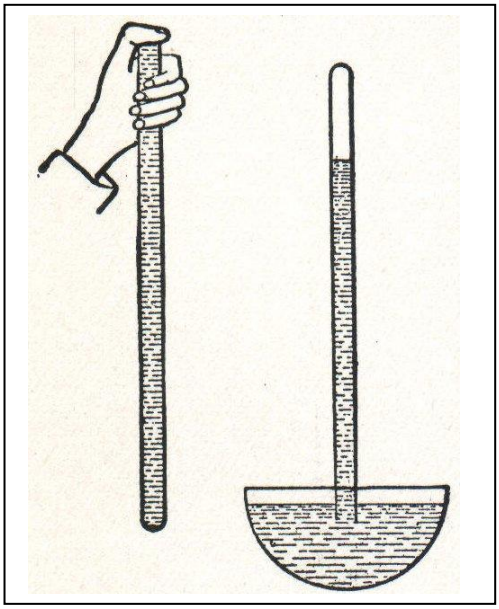
	Substances:	
	Mind	**Body**
Essence	Thinking (consciousness)	Extension (having spatial dimensions)
Properties	Known directly Free Indivisible Indestructible	Known indirectly Determined Infinitely divisible Destructible

Otto Von Guericke demonstrates the possibility of a vacuum



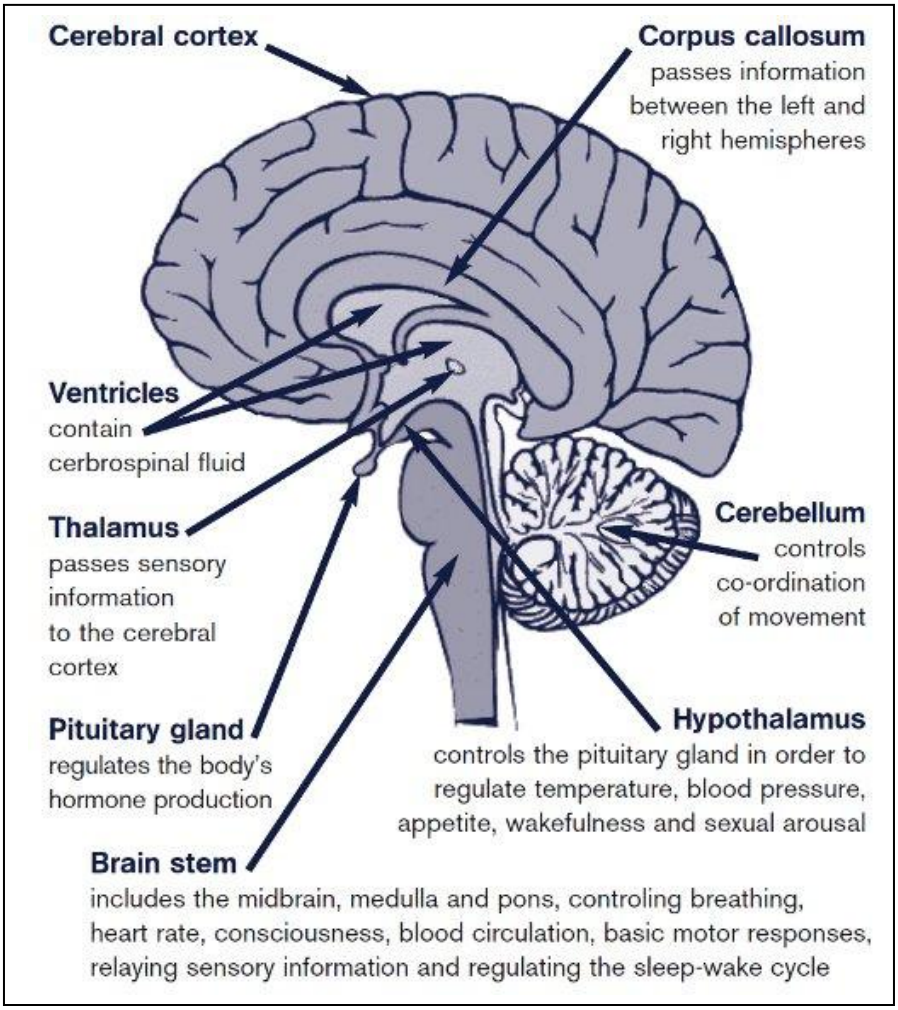
In 1654, German scientist Otto Von Guericke (1602-86) invented a vacuum pump designed to extract air from any enclosed vessel to which it was attached. In 1657, he used it to extract air from two 20-inch diameter hemispheres which, as a result, were held together by the atmospheric pressure upon them. Two teams of eight horses were unable to pull them apart. This and other experiments by Guericke served to disprove the hypothesis, generally accepted since it was expounded in his *Physics* by Greek philosopher Aristotle (384-322 BC), that 'nature abhors a vacuum'.

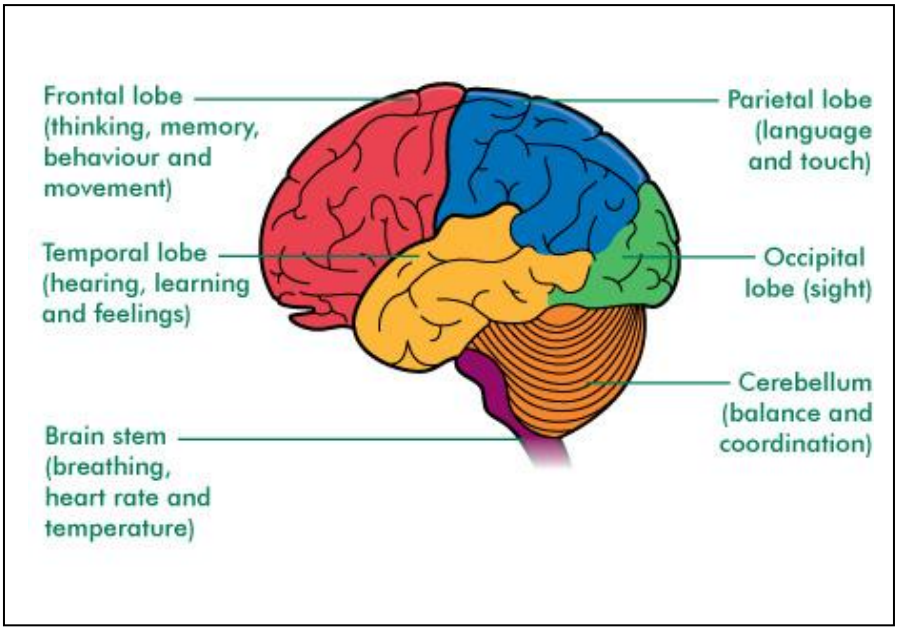
Torricelli's barometer also involves the creation of a vacuum



Italian scientist Evangelista Torricelli (1608-47) is generally credited with inventing the barometer. In 1643, he filled a metre-long tube with mercury and, temporarily sealing it at the top, inverted it into a basin of mercury. When the seal was removed, the column fell to about 76cm (supported by the atmospheric pressure on the surface of the mercury in the basin) leaving a *vacuum* at the top. Changes in atmospheric pressure cause the column to rise and fall in the tube. The *torr*, a unit of pressure used in vacuum measurements, is named after Torricelli. Although nothing could enter the space at the top of the tube to replace the falling mercury, we would now accept that it could be 'invaded' by sub-atomic particles (e.g. neutrinos) and electro-magnetic waves so that it is not strictly true to say that it contains *nothing*.

Diagrams of the Human Brain





Gibb (2012) describes how the *evolution* of brain structures is evidenced in the human brain, its component parts ranging from the primitive to the most advanced. These include:

- the brain stem or 'reptilian brain', (governing various vital functions);
- cerebellum (controlling movement and balance);
- thalamus ('gating', processing and transferring sensory information);
- hypothalamus (regulating hormone release);
- basal ganglia (coordinating fine movement);
- amygdala (generating emotional responses);
- hippocampus (associated with memory);
- cerebral cortex (described by Gibb as "the crowning achievement of brain evolution, both literally and figuratively" and associated with the 'highest' brain functions including thinking and reasoning).

What three neuroscientists say about consciousness...

Dick Swaab:
We Are Our Brains: From the Womb to Alzheimer's (2014)
"Consciousness can be seen as an emergent characteristic generated by the joint functioning of specific areas of the huge network of neurons in our heads. Brain cells and areas have their own separate functions, but their functional links with one another jointly endow them with a new 'emergent' function. There are many examples of emergent characteristics. For instance, we know hydrogen and oxygen as gases. But when these molecules bind, a substance with entirely different characteristics emerges, namely water. The question of what exactly is needed from a neurobiological point of view to enable this new characteristic, consciousness, to emerge from neural activity is something that preoccupies many brain researchers. The Amsterdam neuroscientist Victor Lamme is looking for an explanation in the functioning of neurons. His theory is that for consciousness to exist, neurons in the prefrontal and parietal cortices have to relay information back to the cerebral cortex. One of the routes involved is via the thalamus. This recurrent processing extends from the purely sensory to the motor areas. Lamme believes that the selective attention crucial to our consciousness emerges because only a few of the objects that we perceive undergo recurrent processing. So we report on the stimuli on which our attention is focussed while being unaware of the rest. There's no reason to assume that basic mechanisms like recurrent processing and attention aren't common to all animals, albeit to varying degrees. The philosopher Daniel Dennett seeks to explain consciousness as a purely bodily, chemical phenomenon, a view I share. However, he also believes that humans have a different *kind* of consciousness than animals because of the far-reaching impact of our linguistic development. I think it's more logical to assume that animals have a different *degree* of consciousness... In humans, consciousness doesn't depend on language, by the way. People whose language areas have been disabled after a stroke are still fully conscious of their surroundings and of themselves. By nodding or shaking their heads they can make considered decisions, even if they can no longer verbalise them." (p.170-171)

Michael Gazzaniga:
Who's in Charge? - Free Will and the Science of the Brain (2011)
"Phenomenal consciousness, the feeling that you have about being conscious of some perception, is generated by local processes that are uniquely involved with a specific activity... I am suggesting that the brain has all kinds of local consciousness systems, a constellation of them, which are enabling consciousness. Although the feelings of consciousness appear to be unified to you, they are given form by these vastly separate systems. Whichever notion you happened to be conscious of at a particular moment is the one that comes bubbling up, the one that becomes dominant. It's a dog-eat-dog world going on in your brain with different systems competing to make it to the surface to win the prize of conscious recognition. (p. 66)
"Years of split-brain research has made it clear that the brain is not an all-purpose computing device, but a device made up of an enormous number of serially wired specialty circuits, all running in parallel and distributed across the brain to make those better decisions. This network allows all sorts of simultaneous non-conscious processing to go on which is what enables you to do things such as drive a car. (p. 69)
"A complex system is composed of many different systems that interact and produce emergent properties that are greater than the sum of their parts and cannot be reduced to the properties of the constituent parts. (p. 71)
"The view in neuroscience today is that consciousness does not constitute a single, generalised process. It is becoming increasingly clear that consciousness involves a multitude of widely distributed specialised systems and disunited processes, the products of which are integrated in a dynamic manner by the interpreter module. Consciousness is an emergent property. From moment to moment, different modules or systems compete for attention and the winner emerges as the neural system underlying that moment's conscious experience. Our conscious experience is assembled on the fly as our brains respond to constantly

changing inputs, calculate potential courses of action, and execute responses like a street-wise kid." (p. 102)

Barry J. Gibb:
The Rough Guide to the Brain (2012)
"Today, most scientists and philosophers agree that ... consciousness is an emergent property of the brain as a whole, a natural consequence of millions of neurons processing information in parallel. It may seem astonishing that something so 'physical' as electro-biochemical processes within the brain could produce something so intangible as consciousness, but this is what happens. We just don't yet understand how. What we do know is that consciousness can be associated with particular areas of the brain. In fact, consciousness seems to require several areas of the *cortex* acting together in a broad network - the *frontal lobe* (essential for attention) and the *parietal, occipital* and *temporal lobes* towards the rear and side of the brain. The identification of these 'neural correlates of consciousness' (components of the brain that are necessary for consciousness) has reinforced the idea that for an animal to be conscious it needs to possess a highly developed cortex such as our own. This is found only in mammals. It seems that, in addition to the cortex, deeper, more primitive areas of the brain are also involved, although they are not in themselves sufficient to cause consciousness. Consciousness seems to require a functioning *thalamus* and cooperation between the thalamus and the cortex. We know this because if the *centromedian nucleus* (part of the thalamus) is damaged, a person will lose consciousness. (p 88-89)
At the far end of the spectrum of consciousness lies unconsciousness. The body can find itself in this realm by a number of routes. One of the most catastrophic ways is to remove or damage the *centromedian nucleus*, a part of the brain that is critical in keeping us conscious. Deep within the brain, forming part of the thalamus, it consists of only around 600,000 neurons and is all that stands between us and nothingness. It is wired into a number of different brain regions, including the cortex, and is directly involved in controlling levels of arousal and attention. It's here that general anaesthetics act, gently removing the person temporarily from consciousness and the perception of pain so that surgeons can perform their work." (p 107-108)

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Wittgenstein's radical change of position between his *Tractatus Logico-Philosophicus* (1927) and his *Philosophical Investigations* (1953)

Quoted from Grayling (1988)

"In the *Tractatus* Wittgenstein's position was that language has a unique discoverable essence, a single underlying logic, which can be explained by means of a structure-revealing analysis of language and the world – the 'picturing relation' – between them. The picturing relation itself rests, at bottom, on the denotative link between names and objects; names 'mean' objects. The argument of the *Investigations* is based on an explicit rejection of this view. Here Wittgenstein says that there is not one 'logic of language', but many; language has no single essence, but is a vast collection of different practices each with its own logic. Meaning does not consist in the denoting relation between words and things or in a picturing relation between propositions and facts; rather, the meaning of an expression is its *use* in a multiplicity of practices which go to make up language. Moreover, language is not something complete and autonomous which can be investigated independently of other considerations, for language is woven into all human activities and behaviour, and accordingly our many different uses of it are given content and significance by our practical affairs, our work, our dealings with one another and with the world we inhabit – a language, in short, is part of the fabric of an inclusive 'form of life'."

Dickens' Dream – the power of the imagination to create a *fictional* world

Dickens' Dream: A Posthumous Portrait of Dickens and his Characters (1875) by Robert William Buss (1804-75)
On display in Charles Dickens Museum, 48 Doughty Street, London WC1N 2LX

'Dreaming the World' - how *social* reality is created

In *Sapiens: A Brief History of Humankind* (2011), Israeli historian Yuval Noah Harari describes how humans 'dream the world' by creating and maintaining a *social reality* through their collective imagination. Its features include, amongst many others, gods, nations, governments, companies, money, property, marriage and human rights. Harari's argument is broadly the same as that of Searle (1999, 2004 &2012) who emphasises the *observer-dependent* nature of social and institutional reality. Because people's imaginings can *differ* (e.g. not everyone imagines that gods actually *exist* - see 5.15) and may *conflict*, such reality is inherently fragile and permanently alterable. Sometimes the manner of its change can be dramatic. As Searle(1999) states: "The collective assignment of status functions, and above all their continued recognition and acceptance over long periods of time, can create and maintain a reality of governments, money, nation-states, ownership of private property, universities, political parties and a thousand other such institutions that can seem as epistemically objective as geology and as much a permanent part of our landscape as rock formations. But with the withdrawal of collective acceptance, such institutions can collapse suddenly, as witness the amazing collapse of the Soviet empire in a matter of months, beginning in *annus mirabilis* 1989." Social reality can be contrasted with *physical* reality which, as Russell (1925) states, physicists do *not* regard as something dreamed up by humans (see 4.12).

The text which is the source of the following quotes from Harari can be accessed via the following link:
http://www.ynharari.com/topic/power-and-imagination/

"Sapiens rule the world, because we are the only animal that can cooperate flexibly in large numbers. We can create mass cooperation networks, in which thousands and millions of complete strangers work together towards common goals. One-on-one, even ten-on-ten, we humans are embarrassingly similar to chimpanzees. Any attempt to understand our unique role in the world by studying our brains, our bodies,

or our family relations, is doomed to failure. The real difference between us and chimpanzees is the mysterious glue that enables millions of humans to cooperate effectively. This mysterious glue is made of stories, not genes. We cooperate effectively with strangers because we believe in things like gods, nations, money and human rights. Yet none of these things exists outside the stories that people invent and tell one another. There are no gods in the universe, no nations, no money and no human rights—except in the common imagination of human beings. You can never convince a chimpanzee to give you a banana by promising him that after he dies, he will get limitless bananas in chimpanzee Heaven. Only Sapiens can believe such stories. This is why we rule the world, and chimpanzees are locked up in zoos and research laboratories.

How did Homo sapiens came to dominate the planet? The secret was a very peculiar characteristic of our unique Sapiens language. Our language, alone of all the animals, enables us to talk about things that do not exist at all. You could never convince a monkey to give you a banana by promising him limitless bananas after death, in monkey heaven. Only Sapiens can believe such fictions. But why is it important? After all, fiction can be dangerously misleading or distracting. People who go to the forest looking for fairies and unicorns would seem to have less chance of survival than people who go looking for mushrooms and deer.
Fiction is nevertheless of immense importance, because it enabled us to imagine things collectively. We can weave common myths such as the biblical creation story, the Dreamtime myths of Aboriginal Australians, and the nationalist myths of modern states. And it is these myths that enable Sapiens alone to cooperate flexibly with thousands and even millions of complete strangers. True, ants and bees can also work together in huge numbers, but they do so in a very rigid manner and only with close relatives. Wolves and chimpanzees cooperate far more flexibly than ants, but they can do so only with small numbers of individuals whom they know intimately. If you tried to bunch together thousands of chimpanzees into Wembley Stadium, Oxford Street, St Paul's Cathedral or the House of Commons, the result would be pandemonium. Sapiens, in contrast, gather there by the thousands and together they organize and reorganize trade networks, mass celebrations, and political institutions. That's why we rule the world, whereas ants eat our leftovers and chimps are locked up in zoos and research laboratories.

At the heart of our mass cooperation networks, you will always find fictional stories that exist only in people's collective imagination. Two Catholics who have never met can nevertheless go together on crusade or pool funds to build a hospital because they both believe that God was incarnated in human flesh and allowed himself to be crucified to redeem our sins. Two Serbs who have never met might risk their lives to save one-another because both believe in the existence of the Serbian nation, the Serbian homeland, and the Serbian flag. Two lawyers who have never met can nevertheless combine efforts to defend a complete stranger because they all believe in the existence of laws, justice, human rights—and the money paid out in fees. Yet none of these things exists outside the stories that people invent and tell one another. There are no gods, no nations, no money and no human rights, except in our collective imagination... The end result is that in contrast to all other animals, we Sapiens are living in a dual reality. On the one hand, the objective reality of rivers, trees and lions; and on the other hand, the imagined reality of gods, nations and companies. As history unfolded, the imagined reality became ever more powerful, so that today the very survival of rivers, trees and lions depends on the grace of imagined entities such as Almighty God, the European Union and Google."

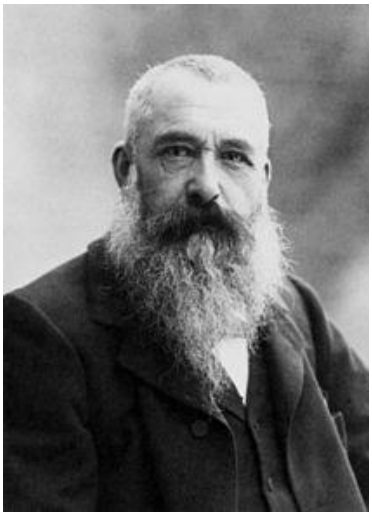
Monet's haystacks – distinguishing between *things* and their *appearances*.

White Frost. Sunrise

In the Sunlight, Morning

Midday

End of the Summer, Morning



Claude Monet (1840-1926)
[1899 photo by 'Nadar']

Evening Sun

Snow Effect, Morning

Snow Effect, Sunset

During 1890 and 1891, Claude Monet produced a series of paintings of haystacks (probably, in fact, stacks of *wheat*-sheaves) near his home at Giverny in Northern France. The purpose of the paintings, a few of which are shown above, was to explore how the appearance of things changes under different atmospheric conditions and at different times of the day and year.

Regarding substantial things as existing *independently* of how, if at all, they appear to entities (such as ourselves) capable of perception and intentionality, is fundamental to any intelligible interpretation of our sensory experience. In practice, we regard our perceptual experience as the causal result of a combination of factors and in particular: a) the *nature* of what is perceived; b) its *spatial relationship* to ourselves (e.g. the angle and distance of our view); c) the *ambient conditions* affecting the transmission of any physical 'signals' (e.g. photons of light) from it to our sensory receptors; d) the *acuteness of our senses*; e) the *focus of our attention*; f) our *mental processing/translation* of the signals received.

From the mere fact that, to a limited extent, things change in appearance as such factors change, it does *not* follow that each different appearance must relate to a different thing. Nor does it follow that appearances constitute the *objects* of our observation – if this were the case, Monet's paintings would portray not a pair of haystacks but a small selection of a potential *infinity* of different 'haystack appearances' – how they arise and how they could relate to one another being wholly mysterious. To characterise our observational experience in such a way is to evidence the same conceptual confusion as philosophers who claim, incoherently, that all we ever perceive are perceptions or that all we ever sense are 'sensations', 'sensory ideas' or 'sense data'.