

# The Realisation of our Species-Being in the Quantum-Digital Age

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## Introduction: A contradiction

We, as a biological species, are also a species-being as described by Marx in the early Economic and Philosophical Manuscripts of 1844, that is, a species capable of conscious reflection and collective action to change our relationship to each other and our environment, in fact a species-for-itself. However, we are presented with very important decisions and collective actions in the next one or two decades, certainly before 2045, that will determine whether or not we will be able realise our true potentialities as species-beings or else embark on a dark path to possible extinction of many species as well as our own. We are, therefore, faced with a clear contradiction. On the one-hand we are clever enough to create very powerful digital technologies that give us the possibility of making a socio-economic system based on mutuality and cooperation with each other, and sustainability with respect to the environment, perhaps the ‘pluralist commonwealth’ described by Gar Alperowitz [1]. But on the other hand we continue, blindly, to pursue the present socio-economic system based on thoughtless exploitation of humankind and the rest of nature for profit. This system has created multiple crises in society, politics, the economy, and the environment. There is a rapid depletion of resources such as water and energy, large-scale loss of biodiversity due to environmental pollution and misuse of land for profit, and climate instability with catastrophic consequences of a possible runaway global warming. There are also instabilities in the global economy due, in part, to the use of digital computer systems to create false, fictitious values, that is, the financialisation of the global economy. We have entered a period containing a triple crunch: a credit crunch; an environmental crunch; a resource crunch.

So if we are clever enough to create immensely powerful digital technologies how is it that we appear to be using them to enhance the possibility of own destruction as a species? It is even possible to create digital computer models that make realistic predictions about the coming catastrophes. I wish to address this centrally important question and propose that we require a paradigm shift in our thinking about our relationship to each other and the natural world; from what I have called the ‘Cartesian-Newtonian’ paradigm to the ‘quantum theory’ or ‘quantum’ paradigm, for short. The word ‘quantum’ is placed in single quotation marks to indicate that is not a direct application of quantum physics, say, to solving Schroedinger’s equation to obtain the states of a socio-economic system – sorry about that- but rather as a thought analogy. I will argue that this ‘quantum’ paradigm can be implemented with digital technologies and, thus, it may be possible to halt the slide to species-destruction. Hence I have called the era that we ought to start creating the ‘quantum-digital’ era. In addition to saving our species from disaster it will also mean that we can realise our true potential as a species-being that is, the real history of humanity can begin.

## What is 'Species-being'?

As is well-known this a term was used by Marx a number of times in his early writings, the Economic and Philosophical Manuscripts published in 1844 when Marx was in Paris and sometimes referred to as the 'The Paris Notebooks'. It was part of his critique of Feuerbach who introduced this term but, according to Marx, in an abstract, passive form. It is then mentioned only once or twice in the rest of Marx's work. According to Marx:

*"Man is a species-being, not only because he practically and theoretically makes the species – both his own and those of other things – his object, but also – and this is simply another way of saying the same thing – because he looks upon himself as the present, living species, because he looks upon himself as a universal and therefore free being."* [2]

*"Man makes his life-activity itself into an object of his will and consciousness. He has a conscious life-activity. He is not immediately identical to any of his determinations. Conscious life-activity directly differentiates man from animal life-activity. It is this alone that makes man a species-being. He is only a conscious being, that is, his own life is an object for his consideration, precisely because he is a species-being. This is the only reason for his activity being free activity.....Estranged (alienated) labour reverses this relationship, so that it is just because man is a conscious being that he makes his life-activity, his essential being, a mere means to his existence"*[ 3]

*"Estranged labour turns, thus, Man's species being, both nature and his spiritual species-property, into a being alien to him, into a means for his individual existence. It estranges man from his own body, as well as external nature and his spiritual aspect, his human aspect"* [4]

For Marx human essence of species-being is grounded in the human possession of consciousness both of its their own species and of its relationship to the rest of the natural world, that is, a human's capacity to 'reflect' on the world and freely choose her/his goals. But, critically for Marx, it is also the capacity to act upon the world collectively, that is, socially, which is also a fundamental feature of the human essence or species-being. Thus a human being is a being-for-itself not just a being-in-itself. But under the capitalist mode of production or, for that matter, the bureaucratic-centralist mode, humans are estranged (alienated) from their fellow humans, from the labour process, from the products of their own labour, from nature, and thus from their own species being. One should note that some writers [Dyer-Witheford (2010)] have suggested that 'species-becoming' is a better term than 'species-being' since that would emphasise that humans can constantly change their nature by their cooperative action on the world. However I shall keep to the concept 'species being' since it implies that through alienation we have not yet been able to express our true essence as humans since we first became fully human.

The concept of 'species-being' is truly fundamental to Marx's critique of capitalism as is most clearly explained by Jacob Held:

*“At the root of Marx’s ethical thought and Marxism in general, lies a conception of human essence expressed through Marx’s notion of species-being, that is, the essence of humanity as a productive, social being. This essence is realized in the social realm and is therefore dependent on interpersonal relationships, which are determined by the mode of production. Marx’s critique of capitalism stems from the fact that the mode of production is the condition for the possibility of the manifestation of human essence in virtue of the fact that it dictates the form of the most important relationship, labour, or the expression of one’s productive capacities.” [5]*

*“Marx also understood the primary activity of the human being to be the reproduction of the self via the material elements of nature through the mode of production. But for Marx, this activity is the medium through which all relationships are determined. Thus, Marx understood the ground of all inter and intrapersonal relations to be rooted in the material means of production of society. If these means of production prohibit the development of fitting interpersonal relationships and appropriate forms of life activity, namely, free conscious, productive activity, then the mode of production is detrimental to the development of the people under it.” [6]*

*“Under capitalism, one’s relation to one’s activity, products, fellow human beings, and essence are distorted. These distorted relationships prohibit the subject from actualizing her essence as a social, active being and in fact pervert her essence into a form of consumerist existence; a passive, not active life. The critical theory of Erich Fromm, and his distinction between the being and having modes of existence, is the most notable contemporary adoption of this concept. Alienation is the pathological state of people under a capitalist mode of production. Thus, Marx’s vehement opposition to capital is predicated on this conception of human essence and his concern with human well-being.” [7]*

Of course Marx did not consider other aspects of species-being which were not known to science in his time. For instance, there are the discoveries of Freud on the influence of sexuality on the conscious and unconscious life, and the origins of neuroses in the parent-child relationship shows that it not only labour that directly determines human essence. Undoubtedly these missing elements in Marx’s thinking help to explain the why his predictions of a coming world-wide unity of working people to replace capitalism did not come to be in 130 years since his death. Instead we have witnessed world wars based on nationalism and its stable-mate, racism, the immense human disasters caused by fascism and Stalinism. A number of thinkers, notably Erich Fromm (mentioned by Held above) and other members of the Frankfurt School such as Marcuse, Adorno, and Horkheimer applied the insights of Freud to Marxian thinking and, especially in Marcuse’ and Fromm’s case, to his concept of species-being, to explain not only the continued attachment of the working class to the bourgeoisie but also the appeal of fascism and Stalinism, both of which were not exactly predicted by Marx. It is also interesting and significant that Freud’s nephew, Edward Bernays, helped to found the US public relations and advertising industry that was responsible for creating the era of mass-consumption through the production of false wants and desires.

It is clear that, today, humanity's alienation, in all its aspects, especially from its species-being is far more advanced than in Marx's time. Such is our alienation from nature that we as a species are in the process of destroying the basis for the continuation of our own biological existence, as well as many other species through the destabilisation of the climate system and the wholesale pollution of the environment. We tolerate conditions of absolute poverty, malnutrition, and disease for over half of the global population. There are unbearable levels of exploitation in the new economic zones of Asia, and multiple wars for control of resources to feed the out-of-control, growth-for-growth's sake production system involving the deaths of millions of people. All of which clearly demonstrate our alienation from each other. In so-called advanced economies human mass-culture is dominated by the worship of 'celebrity' film stars, footballers and the like, that is, the living of life vicariously by fantasising about the lives of the rich and famous. The power of the mass media is used to manufacture consent for the social and political status quo, as Chomsky and Herman have explained [8]. The growing mass support for fundamentalist religions shows a deep alienation from rationality and a scientific understanding of the world that should be characteristic of our species-being. Even in scientifically advanced societies such as the USA more than 40% of the population have been persuaded that the theory of evolution is the devil's work and that the earth is only about 6000 years old. As Benjamin Barber [9] has pointed out the mass-consumerist ideology of late capitalism has produced widespread infantile attitudes amongst broad layers of the population – they must have the next good thing they have seen advertised just like a child making demands on its parents. Then there is the fact that the value of the international drugs market is second only to that of oil. The laundering of money from this officially illicit trade has given rise to 'narco-capitalism', whose funds, it is rumoured, helped to keep the City of London afloat during the 2007/8 credit crisis.

However modern capitalism has also created very powerful digital technologies that are transforming human communications and control over the productive processes on a planetary scale. This is leading in effect to a synthesis of the two earlier stages of capitalism, the Mercantilist phase centred on the communications technologies of printing and navigation, and the Industrial phase centred on control technology, the controlled release of energy from natural sources to vastly increase the productivity of labour. Molecular genetics is also a molecular digital technology created by a fusion of digital computing and control, physics and biochemistry. This bio-digital technology can lead to overcoming of human diseases and also the environmental 'diseases' caused by the profligate misuse of nature as a source of raw materials and as a sink for the detritus of the planetary production system.

### **Where did digital systems come from?**

These digital technologies have the power to transform our relationship to each other and to nature, that is, to overcome our manifold alienations, especially from our species being.

It is important to situate this revolution in information systems within the history of the universe according to the principles of Big History. One account of the latter is to view it as a sequence of information systems revolutions starting with the quantum physics information system created or made active at the Big Bang. The quantum information processes then created stable atoms and molecules eventually leading to

the creation of the digital molecular protein-DNA information system that made possible the evolution of life itself. The next stage was the creation of an information processor and controller, the brain of animals which enabled enhanced adaptation to the environment. The end-point of the evolution of the brain is the human brain stimulated by the usefulness of language and tool-making for adaptation and survival. This immensely complex organ, with about  $10^{15}$  connections, is, of course, the seat of our species-being creating our consciousness and the ability to communicate with others. It further enabled the development of other information revolutions such as speech, writing, money systems, printing, electromagnetic information systems (telegraph, telephone, radio, television) and finally the internet based on digital technologies of computer-based communications and control [10]. It is worth noting that we have in sense turned a complete circle from the brain to digital systems in that both systems combine information processing and control functions. We are perhaps also in the first stages of the fusion of these two systems, perhaps leading to a dramatic singularity in our history as a species [11].

To understand the present limitations and the negative aspects of digital technology we need to consider the dominant paradigm of thinking and acting – The Cartesian-Newtonian paradigm.

### **The Cartesian-Newtonian Paradigm**

As is well known Descartes assumed that there was a fundamental divide between mind and matter, that is, between mental and physical processes [12]. The material world was thus conceived of as a machine with mechanical laws governing its behaviour, namely, Newton's Laws of motion of matter. The mind and its processes were capable of understanding these laws through its own internal laws of reason. Nature was itself also subject to mechanical laws so that all creatures in the living world were complex machines. This dualist paradigm remains central to the bourgeois understanding of the relationship between individuals and society, and between humankind and nature in general.

As Zohar and Marshall point out, using the word 'Mechanism' as short-hand, in effect, for the Cartesian-Newtonian paradigm [13]:

*“Mechanism stresses an unbridgeable gulf between human beings and the physical world. Human consciousness has no role or place in Newton's vast world machine. As the French biologist Jacques Monod describes it, we live 'like gypsies...on the boundary of an alien world'. This sense of an alien physical realm was extended, in association with Christian influence, to the wider world of nature. Nature is perceived as wholly 'other' than ourselves, a force to be conquered and used”*

They go on to list the other characteristic features of the Cartesian-Newtonian world of Mechanism:

*“Mechanism stresses the absolute, the unchanging and the certain. Ambiguity is an enemy. Newton's absolute space-time coordinates are the framework for a fixed, predictable and rigidly law-abiding universe. Mechanistic society stresses*

*the absolute centre with power radiating outwards. It stresses fixed role-playing and rigid bureaucratic organisation.*

*Mechanism stresses hierarchy. It structures existence according to ever descending units of analysis. Molecules are more basic than neurones, atoms more basic than molecules (..and so on). We structure power and authority in the same ladder of ascending and descending authority.*

*Mechanism stresses isolated, separate and interchangeable parts. Everything in Newton's universe is ultimately reducible to so many individual atoms and the forces acting between them. Atomism encourages a model of relationship based on conflict and confrontation, on part against part. In our times Hobbes's mechanistic 'war of each man against each man' takes the form of the ultimate conflict. 'Most obviously' says Princeton's Richard Falk, 'nuclear weapons as instruments for struggle of part against part doom the whole....'*

*Atomism underlies the modern cult of the expert, the detached individual who is very knowledgeable about isolated bits of information or experience but ignorant of the whole of which these bits are a part. The parts are alienated from each other and from the whole; and the whole is subject to fragmentation. The expert is alienated from the situation or community in which s/he practises her/his expertise.*

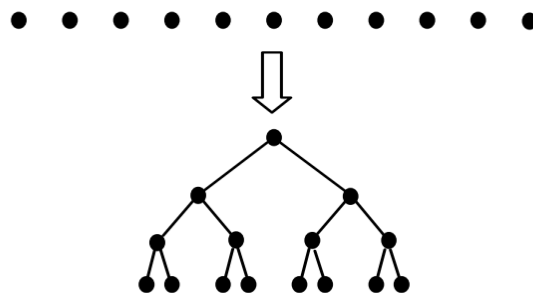
*The industrial revolution, and the mass production that followed in its wake, extended this alienation to our understanding of human beings and the nature of our labour. In the vast industrial machine ( or large corporate organisation) the individual labourer becomes a 'factor of production'[ or 'unit of resource' to use modern terminology-DH], an objectified unit in the standardised production process. His/her personal and social relationships and anything we might define as spiritual qualities are isolated from the wholly separate and rigidly bureaucratised world of work. Mechanism's employees are, as Marx pointed out, alienated both from themselves as wider beings and from the products of their own labour."*

Of course, the development of Newton's mechanics was rooted in the practical problems confronting the emergent mercantile bourgeoisie in the 17<sup>th</sup> century such as accurate navigation and the creation of monetary system for trade. This was most clearly explained in celebrated paper by the Soviet physicist, Boris Hossen [14]

The characteristics of the Cartesian-Newtonian world described above also apply to the reality created in the former Soviet Union by the Lenin/Stalin Bolsheviks who, in reality rather than in their heads, constituted themselves as a positivist elite after the ideas of Comte rather than Marx. Indeed it is the essence of the party-political structure that was the instrument for its creation and control, as shown in an earlier paper [15]. We should also note that there are elements of CN-type of thinking in the young Marx and Engels in which they talk admiringly, in the Communist Manifesto, about the role of the bourgeoisie in "The subjection of Nature's forces to man, machinery, applications of chemistry,...", and one of the communists' demands as being, "Centralisation of all instruments of production and credit into the hands of the State".

Of course the central contradiction in the Cartesian-Newtonian worldview is that it cannot account for the origin and characteristics of human consciousness. Both founders of this paradigm would have appealed to the metaphysical notion of a ‘God’ who was responsible for human feelings and consciousness, which would be seen as part of God’s creation of the individual ‘soul’. Even today, when the concept of the soul has long since been discarded as scientifically useless, the material basis of consciousness is still a matter of keen debate.

We can represent the Cartesian-Newtonian mechanistic world-view by a simple graph that conveys the essence of this outlook, as follows



### **The Cartesian-Newtonian Paradigm**

- \*Nodes are only localised
- \*Hierarchical \*Bureaucratic
- \* Alienating \* Undemocratic

This rooted-tree graph represents the partition of the world into its constituent people-particles, as well as the resulting hierarchical political and social structures of the bourgeois state, and that of its main economic players, the corporations. It is also characteristic of the state and social systems of former Soviet Union and its derivatives.

### **The Revolt against the Cartesian-Newtonian structures of Corporate Globalisation**

There is increasing widespread revolt against the globalised world created by corporate capital and its global institutions such as WTO, IMF and the World Bank. This revolt, intensified after the recent collapse of the credit system, is reflected in rapid growth of the so-called ‘Anti-Globalisation’ or ‘Anti-Capitalist’ and ‘Occupy’ movements, in the past decade or so. Those in revolt meet together at the World Social Forum, and include both secular and religiously inspired groups. However it is also clear that this movement has no radical and coherent alternative way of thinking about the world and what to do about it. Some elements adopt a New Age mystical philosophy influenced by Eastern religions or even soft versions of conventional western religions. Many have secular eco-philosophies with tendencies towards ‘NaturMystik’ or nature mysticism. There is also a dominant anti-science tendency. Science and scientists are blamed for providing the tools for corporate capital and its state representatives to develop the means to grossly exploit humanity, wreck the

environment, and create the weapons of mass destruction and for the mass repression of those who object to these activities.

There are a small number of people who adopt a fundamentalist religious or secular response to the horrors of late capitalism such as the Islamic clerical-fascist fanatics behind Al-Qaida, or various eco-fascist type movements. Such a terrorist response of course plays in the hands of the hard-line servants of corporate capital such as the leading western politicians. These gentlemen secretly welcome terrorist atrocities such as 9/11 and its smaller-scale successors - it gives them every excuse to act against, and visit terror, on their real enemies.

## **The Quantum Paradigm - an alternative to Cartesian-Newtonianism**

It should be mentioned that a number of other writers have also suggested that Quantum theory can provide a much better model or paradigm for understanding society and culture than Cartesian-Newtonianism. I refer notably to David Bohm [16], Fritjof Capra [17], Danah Zohar and Ian Marshall [13], amongst others. However, as far as the author is aware, there has not been an attempt to discuss the implementation the quantum paradigm through digital networks and instrumentation systems.

What is understood by only a very small number of the critics of modern corporate capitalism is that modern physics,<sup>1</sup> and, specifically, quantum theory, provides an alternative paradigm, or framework of thinking, that can help demolish that of Cartesian-Newtonianism in the politico-socio-economic sphere as well as that in physics itself. The works cited and quoted from above are a good starting point for those interested in reading in more depth.

### **Key Elements of Quantum Theory (QT)**

#### *Wave-particle duality*

The first thing to note about QT is that it is thoroughly dialectical theory. It contains a number of contradictory dualities most famous of which is the wave-particle duality. According to QT particles such as electrons, protons, neutrons etc can also have wave-like properties. They can give interference and diffraction patterns characteristic of waves. If a stream of electrons is fired at two closely-spaced holes in a barrier common sense tells us that as particles they will pass through either of the two holes and we would expect to find two patches on a detecting screen behind the barrier corresponding to the two groups of particles passing through the two holes. Instead we obtain an interference pattern characteristic of a wavelike phenomenon such as light. It is as if each electron 'knows' that there are two holes, not only the one it actually passes through, and adjusts its path accordingly. Similarly intrinsically wave-like phenomena such as electromagnetic radiation, for instance, light waves, can also reveal particle-like properties such as in the photoelectric effect as explained by Einstein in 1905.<sup>2</sup> Einstein also later predicted the possibility of lasers, the purest form of light waves, by, paradoxically, treating light as particles.

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<sup>1</sup> Modern Physics is an ad hoc amalgam of Quantum Theory, Special and General Relativity.

<sup>2</sup> In many ways Einstein, with this paper, was the true discoverer of quantum theory as well as Relativity in another paper published the same year, 1905.



### *Dualities of Momentum-Position and Energy-Time: The Uncertainty Principle*

Other pairs of physical properties that are quite separate or independent in the Newtonian worldview such as the position and momentum, energy and time, form contradictory dualities in QT. Attempts to measure the precise position of particle means that its momentum becomes uncertain, and vice-versa. This is the celebrated Heisenberg uncertainty principle. The same is true of energy and time. Thus concepts that are quite separate in Newtonian or classical physics become intertwined or 'synthesised' into a new, but contradictory unity.<sup>3</sup>

### *The Superposition of States*

Another paradoxical phenomenon is the existence of superposition of states. A particle or a system of particles, for instance a molecule, is said to exist in a combination of different states each of which is quite different from the others. A well-known example is that of the benzene molecule that can have two different bonding configurations. Benzene actually behaves as if it is a combination of both, and referred to as having a 'resonance hybrid structure'. Indeed this principle also applies to the motion of a particle between two points in which the actual path can be seen as a weighted combination of a large number of paths each with a different probability of occurring- the Feynman 'superposition of paths' description. No longer do we have a precise and predictable path in space and time as in the Newtonian system but, a fuzzy, un-predictable set of possible paths. There is no definite 'party-line' about how to get from A to B.

### *Probability is fundamental*

Probability, chance, uncertainty are the fundamental features of QT. In fact, the amplitude, that is, the 'height' of the wave part of the wave-particle is closely related to the probability of event taking place in a particular time interval or of a particle being found in a region of space. Gone are the certainty and predictability of the Cartesian-Newtonian worldview.

### *Virtual transitions and the state of flux in the vacuum.*

In a quantum system a particle can make virtual transitions to the states of energy or momentum when it does not have enough energy or momentum to reach that state, returning back to its original state in a time dictated by the uncertainty principle. Even so called 'empty' space or the vacuum is a seething cauldron of virtual particle-antiparticle pairs popping in and out of existence, and zero-point fluctuations of the electromagnetic field. It reveals that nothing is fixed, everything is in flux as Heraclitus realised in ancient Greece.

### *The role of the observing apparatus in the measurement process*

One of the paradoxes of QT that is still the most puzzling is the integral role of the observer or the measuring system. This is the phenomenon of the so-called 'collapse

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<sup>3</sup> Relativity also synthesises separate absolutes of space and time into relative space-time. It also creates a new synthesis of energy and matter.

of the wave-function' whenever a measurement is made. For instance, if a star emits a light-wave at the backend of the universe so that when it reaches us it will cover a sphere with a radius many billions of light years. Yet when we observe the star some of the energy in the wave collapses into a wave-packet or photon that is absorbed by the retinal pigment molecules of the eye. It is as if the observer or measuring system is somehow integral to the quantum processes. This is another example of an important difference between QT and the Cartesian-Newtonianism. As already pointed out the observer is a peripheral irrelevance in this latter system of thought.

In other words we have to live with contradictions and paradoxes; at least, that is how they appear so to us with our CN-conditioned thought processes. But what is a paradox? According to the celebrated American physicist Richard Feynman, "The paradox is only a conflict between reality and your feeling of what reality ought to be". But those feelings arise from the conditioning of a lifetime.

*Is 'consciousness' a quantum phenomenon?*

More controversially some authors, such as Zohar and Marshall [13, chapter3], Penrose [18] and others believe that QT is necessary to explain human consciousness itself. There are certainly analogues of brain behaviour in quantum systems such as spin glasses.<sup>4</sup> However I do not propose to enter this somewhat controversial domain since this would be difficult without recourse to technical arguments in physics, even if I had a definite view. What is clear is that quantum processes are essential for the existence and continuation of life, for instance, in the mechanisms of photosynthesis. Indeed, the whole of chemistry and therefore life itself depends on the quantum processes that bind molecules together and cause them to interact with radiation and other molecules. Life can, in truth, be viewed as a symphonic poem to the creative possibilities of the quantum world of matter and radiation. If matter was actually Newtonian at an atomic level then the universe would be very boring and Newton would never have been around to discover his approximation to its laws, and we to criticise him. (For further reading consult Lockwood [21])

*Local and non-local effects in Quantum Theory*

For the purposes of the alternative quantum paradigm as applied to, say, socio-economic and political systems the most important of contradictory unities found in QT is that of the phenomenon of local and the non-local effects. In many ways this is the core contradiction or paradox of QT. We have already pointed out that particles in QT seem to be aware of their surroundings even though there is no physical interaction as in the two-slit interference experiment mentioned above. It appears that they, nevertheless, 'know' of the existence of each other through the wave function. The most disturbing example of a non-local effect is that originally given as a hypothetical experiment by Einstein and his collaborators, Podolsky and Rosen, the EPR experiment, for short. If we prepare two electrons so that in their combined state

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<sup>4</sup> Zohar and Marshall even believe that the brain is a Bose-Einstein condensate, a quantum system containing a large number of a type of particle called a boson, in which all the boson particles have condensed into the same energy- state. In a real physical system this occurs either close to absolute zero or, possibly, in a pumped oscillator system, such as the dipole oscillators suggested by Froehlich [19] for biological structures such as membranes and microtubules. Marshall has even suggested that this is the basis of consciousness [20]. However, such views must be considered very speculative.

they are spinning in opposite directions [technically called zero net spin] and then we arrange for them to separate, that is, pursue divergent paths in space such that they could in principle eventually be separated by many light years. If we were to measure the spin of either particle in a chosen direction then it would have equal chance of being found rotating in that direction or the opposite direction. However **after** we have measured the spin of **one** of the particles, and, say found it to lie in our chosen direction we know that a subsequent measurement of the spin of the other particle would have a 100% chance of finding it spinning in the opposite direction. The measurement on one particle appears to affect the state of the other particle even though it might in principle be millions of kilometres away. The particles are said to have remained 'entangled'. Einstein rejected this possibility which he called 'spukhafte Fernwirkungen' or 'spooky actions-at-distance' and he became an opponent of QT for this reason, amongst others, even though he had helped to create it. However, experiments have shown that such 'spooky' effects do take place and are deeply part of QT [22]. They are the object of considerable research today, with the hope of producing unbreakable ciphers, and even quantum computers.

What is clear, however, is that, at the heart of QT is that particles are both locally connected through physical interactions with other particles and fields and non-locally connected through the wavelike aspects of quantum reality. One cannot think of a particle as a single isolated entity interacting pair-wise with other particles within range, but rather an entity that is inextricably, by its very nature, connected to the rest of the universe. It, as it were, participates in a 'universe of discourse' that defines its being. It is this aspect of QT that has a remarkable similarity to Marx's concept of 'species-being' with the capacity to "*look upon himself as the present, living species, because he looks upon himself as a universal and therefore free being*". She/he can participate in a universe of discourse and form part of the 'General Intellect' [30]

It is of course true that we do not as yet understand how this can be. We require deeper concepts that will help us to grasp how the paradoxes of QT are possible. But our inability to find these concepts to date is undoubtedly connected with the deep conditioning, to which we have been subjected, through the dominant ideology of the Cartesian-Newtonian paradigm.

## **The Quantum Theory and Marxian Political Economy**

As in quantum theory, Marxian political economy has, at its core, two dualities, which can be thought as forming two contradictory unities. They are the dual nature of labour, that is, concrete labour and abstract (universal) labour, and the dual nature of value, that is, use-value and exchange value.<sup>5</sup> These two dualities are closely related to each other, each duality forming a contradictory or antithetical unity. For Marx in his analysis of the 'commodity', which he refers to as "the economic cell-form of bourgeois society", reveals its two-fold nature due to the fact that it contains or synthesised within it both use-value and exchange-value. He then adds: "Later on, we saw also that labour, too,... as it finds its expression in (exchange) value,... does not possess the same characteristics that belong to it as a creator of use-values." [23].

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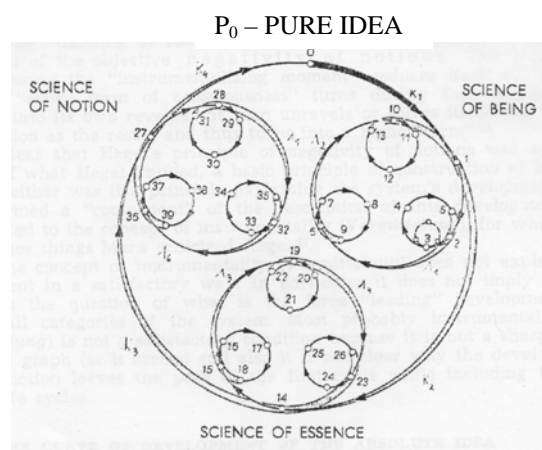
<sup>5</sup> Marx sometimes refers to exchange value simply as 'value' to differentiate it from use-value.

A thorough discussion of the dual character of the labour process and its central importance for the whole of Marxian political economy of capital, including its application to imperialism, can be found in “Karl Marx’s Great Discovery” by V. Afanasyev, A. Galchinsky, and V.Lantsov (AGL). According to AGL the relationship between the two dualities is as follows [24]:

- (1) Marx established that the commodity-producers labour has a two-fold character: on the one hand, it is concrete labour and the source of the commodity’s use-value, and on the other hand, it is abstract labour, and the source of the commodities value. Marx says: “I was the first to point out and to examine critically this two-fold nature of the labour contained in commodities” [23].
- (2) At the same time, labour is the basis of all human economic activity so that all economic phenomena...are no more than various manifestations of human labour (its functioning, results and consequences, content and socio-economic form, etc).
- (3) Since labour is the basis of all economic phenomena and acquires a two-fold character under commodity production, it follows that all economic phenomena likewise acquire a two-fold character<sup>6</sup>.

It is well known that Marx was able to discover the two-fold contradictory character of labour because he was steeped in the dialectical thought of Hegel. This is in contrast to the eminent economists that preceded him, such as Adam Smith and David Ricardo, who also accepted the labour theory of value. These thinkers, however, were formed by bourgeois empirical thought within the Cartesian-Newtonian paradigm.

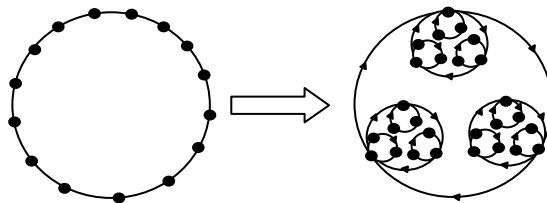
In Hegel’s thought the finite (local, immediate) is closely connected to the infinite (non-local, universal). The diagram below shows how the structure of Hegel’s dialectical logic can be represented graphically, according to Synowiecki [25]:



<sup>6</sup> AGL also elaborate all the other dualities of the socio-economic system generated by the fundamental duality of labour: the labour process -the value expanding process (creation of capital); the concentration of production- the concentration of capital; monopoly industrial capital – monopoly bank capital; money as a technical instrument of exchange- money as a general value equivalent, and so on.

Such a graph shows how the categories of this logic can be both local and non-local simultaneously. Topologically, the graph is constructed by folding a circle into sub-cycles, and sub-sub-cycles, and so on. If we imagine that such a graph constitutes a series of processes cyclically connected to form a universal process – in case of Hegel’s system of Logic [26] the coming to be or ‘concretisation’ of the pure idea,  $P_0$ , through series of divisions of the pure idea into Being (Sein), Essence (Wesen), and Notion (Begriff). In the above graph the arcs represent the instrumentalities (Vermittelungen) of the concepts. It is not proposed to delve further into the complexities of Hegel’s Logic but to ‘borrow’ its graphical form to represent the Quantum Paradigm and its various applications.

Thus, in contrast to the rooted-tree graph that represents the Cartesian- Newtonian Paradigm we can illustrate the essence of the Quantum paradigm using the following cyclical graph:



We can imagine that the arcs of the graph represent different forms of connectivity, for instance, communication pathways, so that the nodes are connected locally and simultaneously they are non-locally connected, that is each node can participate both in a local and a non-local ‘discourse’ characteristic of quantum systems.

In addition to Marxian picture of socio-economic systems, we shall give other applications of the quantum paradigm in this graphical form, for instance, to the creation of problem-solving networks of expertise to help solve the problems of ecologically-sound, that is, sustainable development, as well as the related matter of the possibility of a *global enlightenment*, in the course of which we can overcome the manifold forms of alienation and thus realise of our species-being.

### *Capitalism – a world system from its beginnings*

From his reading of Hegel, it was possible for Marx to grasp that a process that might, at first, appear local, immediate (concrete labour) can also be simultaneously part of in a non-local, universal process (abstract labour). Under commodity production it is the existence of the non-local, that is, global market for commodities that creates this universal or abstract character of labour. As Immanuel Wallerstein [27] and others have demonstrated, Capitalism was, from its inception, a ‘world system’. Labour itself was a commodity, and so African labour power (slaves) could be exchanged for the ironware products of the labour of workers employed by of the Quaker ironmasters of Shropshire (Abraham Darby & Co), through the offices of emerging British imperialism. Similarly, the products of the labour of Chinese peasants (tea) could be exchanged for the products of the labour of Indian peasants in Bengal (opium), again through the helping hand of British imperialism and its gunboats (the

Opium Wars). Thus, the recent so-called 'globalisation' is merely the final stage in a process that started with the birth of the capital system itself.

*The Importance of printing, the first ICT, for the development of capitalism*

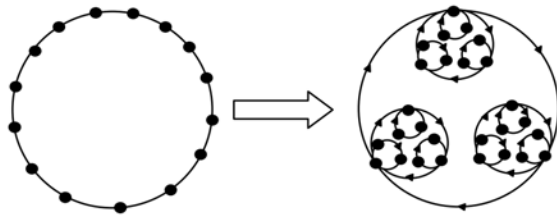
Of course to establish a universal system of exchange of commodities it is necessary to develop a system of information exchange as well as systems for transporting the goods themselves. This is the importance of the development of printing that allowed dissemination of information about the price of commodities, about the nature of the production processes, conditions of the goods prior to purchase, new techniques of production, scientific and technical developments that might help to reduce cost of production, or make possible the production of new commodities, reduce the transport times and costs, and so on. So parallel to a web of production and exchange of commodities there was a worldwide network of information exchange greatly facilitated by the invention of printing.

Of course, the creation of exchange value and the expropriation of a proportion of it by the capitalist class, that is, surplus-value, take place behind the backs of the working class. It is the fundamental source of alienation in bourgeois society. The workers must only be allowed to see one half of the process, the exchange of their labour power for wages, a very local process.

From the above discussion of the key elements of quantum theory one can see its close conceptual parallel with the elements of Marxian political economy. Both have at their centre the role of contradictory unities. The most important contradictory unity between the local and non-local processes in quantum theory can be compared conceptually to the fundamental contradictory unity of local, concrete labour and non-local, abstract labour in Marxian political economy. A similar comparison can be made for use-value and exchange-value.

We can now compare the two paradigms for Political Economy. Below is a diagram illustrating the difference, in graphical form, between the Cartesian-Newtonian paradigm and the Quantum paradigm:

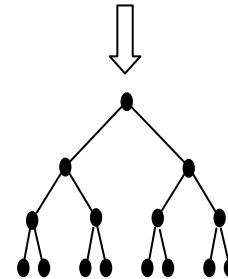
Marxian picture  
of Socio-Economic Systems



The Quantum Theory  
Paradigm

- \*Nodes are delocalised-localised
- \*Non-hierarchical \*Co-operative
- \*Non-alienating \*Democratic

Capitalist picture  
of Socio-Economic Systems



The Cartesian-Newtonian  
Paradigm

- \*Nodes are only localised
- \*Hierarchical \*Bureaucratic
- \* Alienating \* Undemocratic

Each node can be considered to represent a labour and value-producing centre involved in the production of commodities. In the capitalist account of political economy (the right-hand diagram) the system of labour and the system of values produced by labour are sets of isolated ‘particles’. Those on the lowest tier of the hierarchy, that is, the shop-floor workers, are encouraged to see themselves as a set of individuals (particles) who exchange labour for wages. The fact that extra or surplus value is created by this labour and is channelled upwards to the owners of the capital should be of no concern to the shop floor. The shop floor workers exchange their wages for use-values created by other workers in other workplaces. But they are not encouraged to see this as anything other than a set of binary transactions. The layers of nodes above the lowest tier are necessary to organise production so that these nodes also partly contribute to the overall value created. However, they also exist to ensure work-discipline and thus have a partly parasitic role essential for the capitalist mode of production.

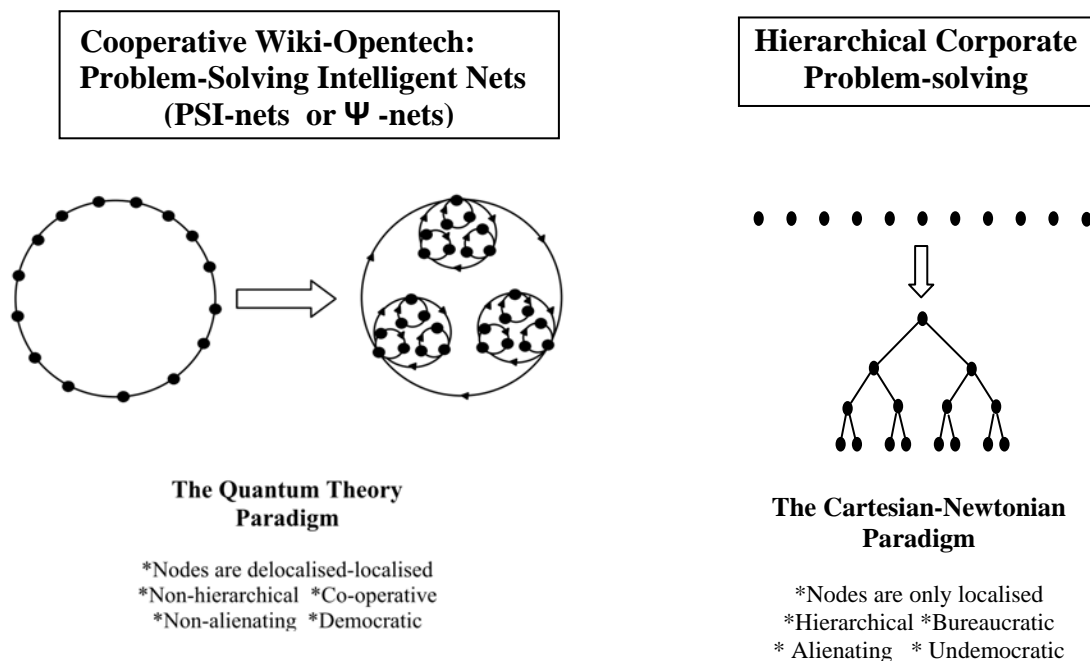
On the other hand the diagram on the left, the quantum theory paradigm, represents the account of the global capitalist productive process given by Marxian political economy. In this picture we can see that the labour and value produced at each node is connected to all other nodes through the global market exchange system to create both a global (universal) labour and global (universal) value system. Labour carried out locally becomes de-localised; value created locally becomes de-localised through the global market system of capital.

It is now possible to consciously implement a cooperative system of production within, say, a global pluralist commonwealth [1], based explicitly on the quantum paradigm using digital data-processing, communication, and control technology to connect the nodes of production together. In this system each producer or producing node can understand its relationship to all other nodes in a productive system overcoming an important form of alienation within the capitalist mode of production. We can apply this quantum-digital system to the centrally important issue of sustainable development. If the majority of the people on the planet who are still in

some stage of economic development follow the fossil fuel route pioneered by the developed world the one can be sure that a climate catastrophe will result. So it is crucially important that an alternative route using renewable energy and appropriate technologies be found. A proposal is given below for a collaborative program for development problem-solving based on mutuality and cooperation to be implemented with the quantum paradigm on digital networks.

### A Quantum Theory Paradigm for Problem-Solving for Sustainable Development

It is now possible to make explicit that which has been hitherto implicit, the unitary character of labour. It is possible for workers to understand the connection between their labour and that of others, to break through the alienated forms of consciousness. It is possible, now, not after a future seizure of state power, to set up a worldwide alliance of producers that can consciously connect their productive activities together, that can access a web of problem-solving scientific and technical expertise. The new approach to problem-solving for the production of useful technologies for sustainable development can again be illustrated and contrasted with that of the capitalist corporate model using the same diagrams:



As we can see in the QT paradigm, the circle on the right is a topological folding of the circle on the left. The nodes can be considered as problems-solvers within a **Problem-Solving Intelligent network**, that is, a PSI-net or  $\Psi$ -net<sup>7</sup>. A ‘problem-solver’ node may be an individual, group of individuals, or else some intelligent software/hardware. In this case of the  $\Psi$ -net, they can be thought of as connected by an information channel with a given bandwidth. The original set is partitioned into sub-cycles (or subsets) and further into sub-sub-cycles (sub-subsets) and so on. In such structures information about the activity at each node, the collective activity of each subset (or sub-subsets etc) or the collective activity of the complete set of nodes can be accessed by each individual node. It just requires sufficient bandwidth. With

<sup>7</sup> ‘ $\Psi$ ’ is also the usual symbol for the wave-function in quantum theory



modern technology this is in principle almost infinite (actually terabits/sec and increasing...). The important point is that relationship of each part can be *consciously* related to the whole. This helps to solve the problem of the *alienation* of the isolated problem-solver in the tree-like hierarchies of bureaucratised reason [28], as illustrated by the right-hand CN-net. In the latter, the problem-solver usually does not understand how her sub-sub-problem relates to the main problem or the other problem solving activities. Only those in the top layer have an overview.

In the right-hand CN-net all the nodes are localised since they cannot usually communicate with the totality of nodes, only with immediate neighbours in a line of control. In the case of the QT paradigm all nodes can share information with each other and are thus delocalised in the sense that it does not matter which order the nodes are in the circle or sub-circles. During a problem solving operation it can be seen that there is a sense in which nodes become partially localised as one proceeds to the inner cycles as they participate in the solution of a sub-problem or sub-sub-problem, although they never lose their non-local character since they remain connected cyclically. Thus such networks exhibit the fundamental property of local and non-local behaviour characteristic of a quantum system.

Such 'quantum'  $\Psi$ -nets can dynamically reconfigure themselves in order to attempt parallel, alternative solutions to a problem, so that the final solution may contain elements of several attempted solutions. In this way the networks can be considered to demonstrate the quantum principle of 'superposition of states'.

It is proposed that productive networks, networks of expertise, and trading networks can all be organised as  $\Psi$ -nets. The nodes may be individuals, not-for profit social enterprises, and even a small number of private companies that agree to the principles of the networks.

The alternative networks should concentrate on products suitable for sustainable development, especially so that communities in the developing world can be linked with communities in the developed world. Already people are developing such links through the fair-trading organisations. Communities in the developing world can have access to the same networks of expertise that are available in the so-called developed world. Clearly suitable products are those that increase the productivity of agriculture in a sustainable way, renewable energy products, health systems, and products for enhancing access to learning and scientific understanding. In fact, possibility of the wide-spread adoption of a scientific way of understanding rather than the coded superstitions promoted by some religions is crucially important if we are to survive as a biological species as well as achieve the realisation of our species-being

### **The Possibility and Necessity of a Global Enlightenment**

The quantum paradigm when implemented through digital ICT and special digital instrumentation has the potential to transform the cultural level of humanity through a learning revolution on a vast, global scale.

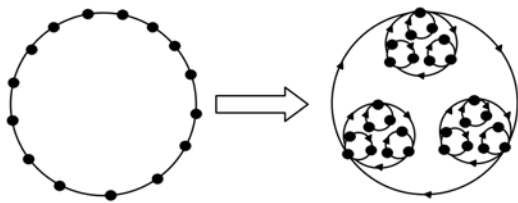
A significant factor in world politics today is the emergence of various forms of religious fundamentalism, sometimes in defence of pre-capitalist social formations as with Islamic and Hindu fundamentalism, and sometimes providing an ideological basis for a new imperialism as is the role of Christian fundamentalism in the USA.

It is difficult to accept that such primitive, superstitious beliefs can still grip the masses, despite several centuries of the advance of a scientific understanding of the world.

Nevertheless, a ‘learning revolution’ based on the advances of the digital ICT technologies can eventually lead to a ‘*Global Enlightenment*’ based on a widespread dissemination, amongst broad layers of the world population, of the critical thinking supported by experimental investigation characteristic of the scientific method of understanding the world. There is an analogy with the invention of *printing*, the ICT for the inauguration of the modern era, which led, several centuries later, to the 18C European enlightenment amongst the intellectual and social elites who were the only ones who could read and write at the time. This enlightenment took place within the ideological structures of emerging capitalism, that is, within the Cartesian-Newtonian paradigm as illustrated below. The application of this form of hierarchical reasoning led to the creation of hierarchical structures of the state and capitalist corporations as described, and supported, by Weber. [28]

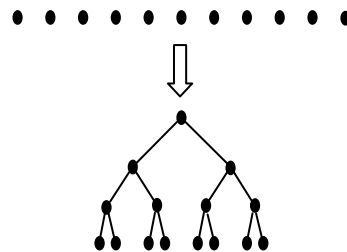
**A Global Enlightenment:**  
Through digital ICT and  
Instrumentation

**The First (18C) Enlightenment:**  
A consequence of the first ICT,  
PRINTING



**The Quantum Theory Paradigm**

- \*Nodes are delocalised-localised
- \*Non-hierarchical \*Co-operative
- \*Non-alienating \*Democratic



**The Cartesian-Newtonian Paradigm**

- \*Nodes are only localised
- \*Hierarchical \*Bureaucratic
- \* Alienating \* Undemocratic

However, a *global enlightenment*, made possible through digital ICT and digital instrumentation, can be telescoped into decades not centuries and must not, and need *not* be confined to intellectual and social elites, but to the broad mass of humanity. During the second decade of the 21<sup>st</sup> century many villages and communities in the developing world could now have access to a ‘global learning network’, mediated, say, by mobile phone technology. They would then be able to download teaching material in their own language, and interact with on-line tutors also in their own language. They could also have available computer-interactive educational technology to enhance the learning process.

Two examples of such instrumentation created by the author are shown below:

## The Physics Workstation

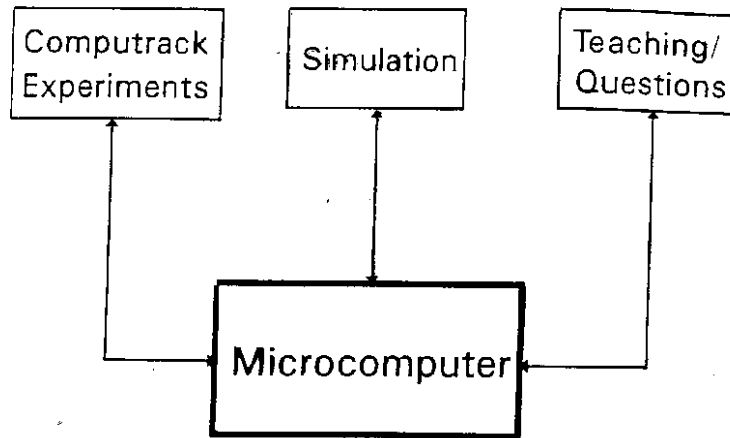


Figure 2

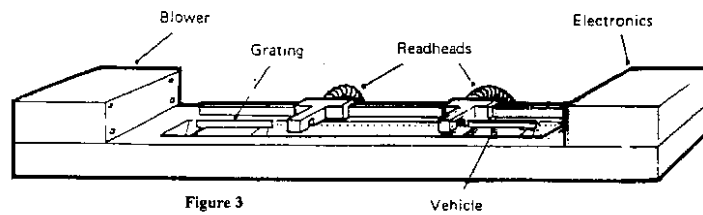
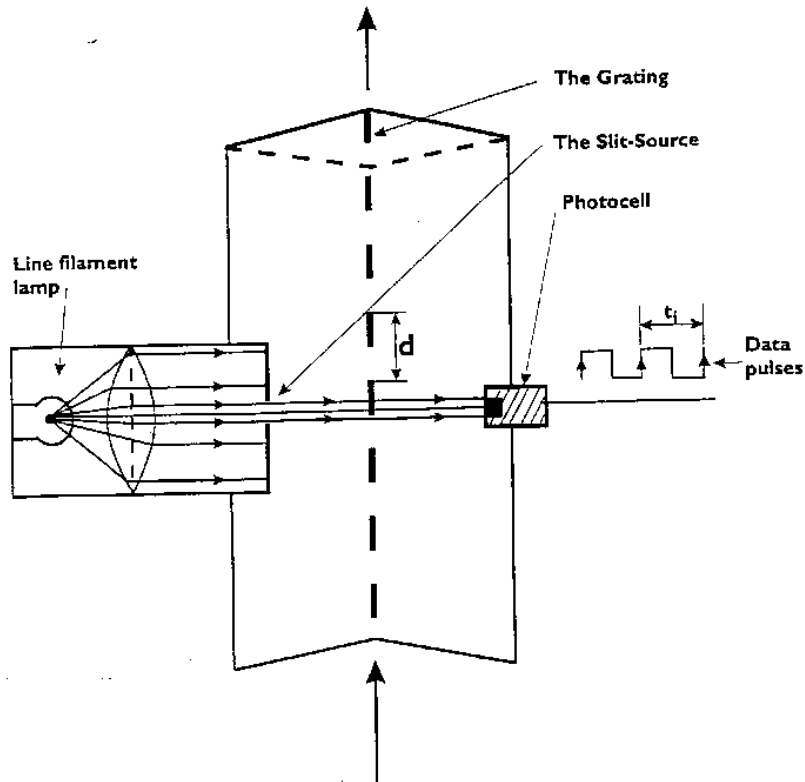


Figure 3

## Digital Instrumentation for measuring position and velocity of vehicles

### The principle of the Slit-source, Grating and Photocell method (SGP)



$$v_i = \frac{d}{t_i}$$

$$Tv_i = \sum_{j=1}^{i-1} t_j + \frac{1}{2} t_i$$

$$s_i = \sum_{j=1}^i d_j$$

$$Ts_i = \sum_{j=1}^i t_j$$

$v_i$  - the average velocity for  $t_i$   
 $Tv_i$  - the total time to the middle of  $t_i$   
 $s_i$  - the total displacement up to  $d$   
 $Ts_i$  - the total time for  $s_i$   
 $v_{is}, Tv_i$  Are the coordinates for v-t curve  
 $s_i, Ts_i$  Are the coordinates for s-t curve

Figure 4

Typical outputs from the instrumentation

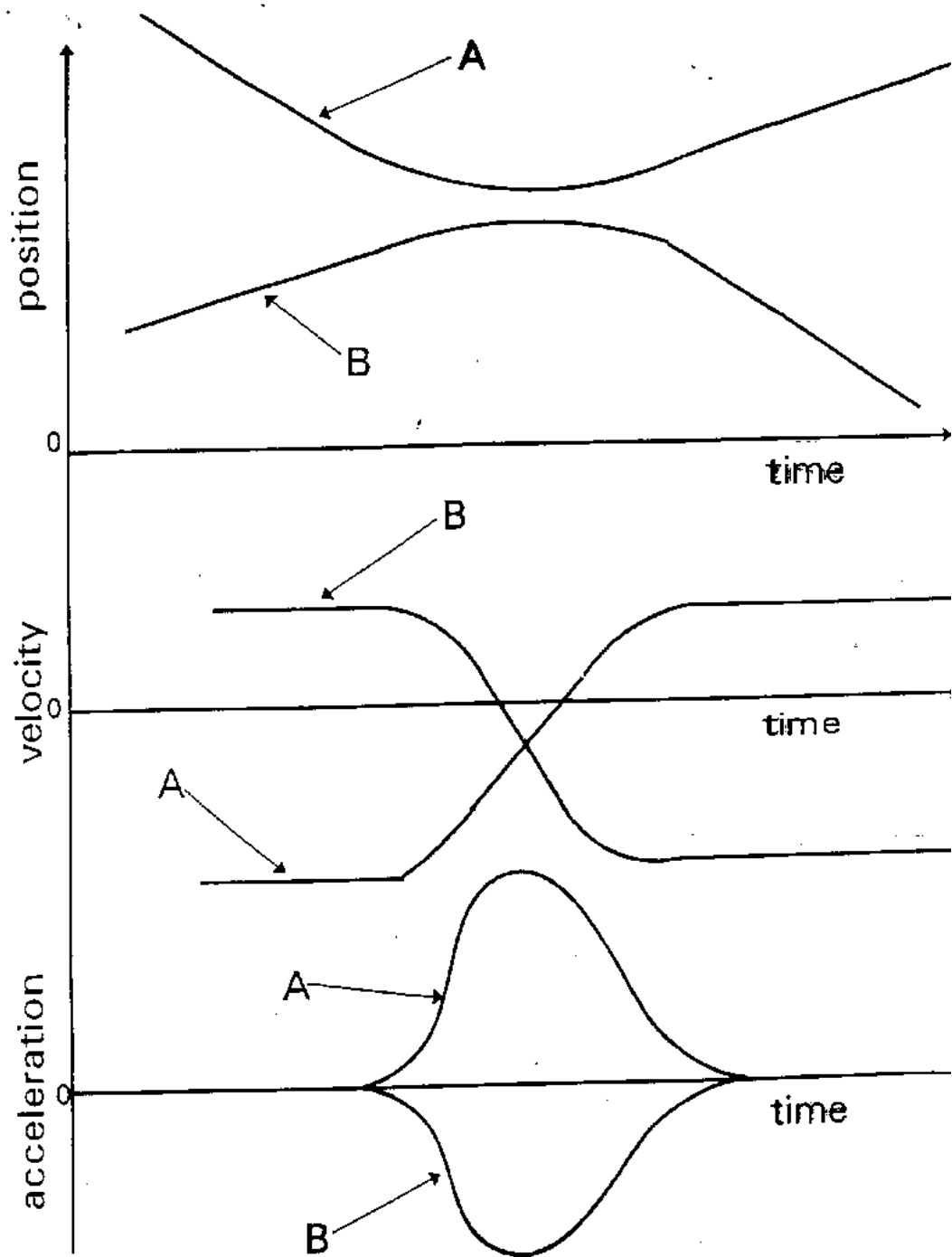


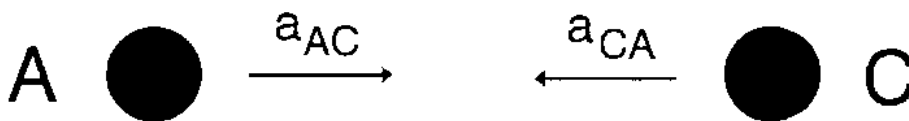
Figure 5

## Testing Newton's Laws

Bodies A and B interact with accelerations  $a_{AB}$  and  $a_{BA}$



Similarly A and B interact separately with reference body C



Experimentally it is found that the ratio of accelerations for each pair of bodies is constant at all times during the interaction, that is:-

$$-\frac{a_{AB}}{a_{BA}} = K_{BA} \quad -\frac{a_{AC}}{a_{CA}} = K_{CA} \quad -\frac{a_{BC}}{a_{CB}} = K_{CB}$$

It can also be shown experimentally that these constants are related as follows

$$K_{BA} = \frac{K_{CB}}{K_{CA}} \quad \text{Therefore: } K_{CA} a_{AB} = -K_{CB} a_{BA}$$

Choose  $m_A = K_{CA}$  and  $m_B = K_{CB}$  called the masses of A and B relative to reference body C

Therefore:  $m_A a_{AB} = -m_B a_{BA}$  that is, Newton's Laws

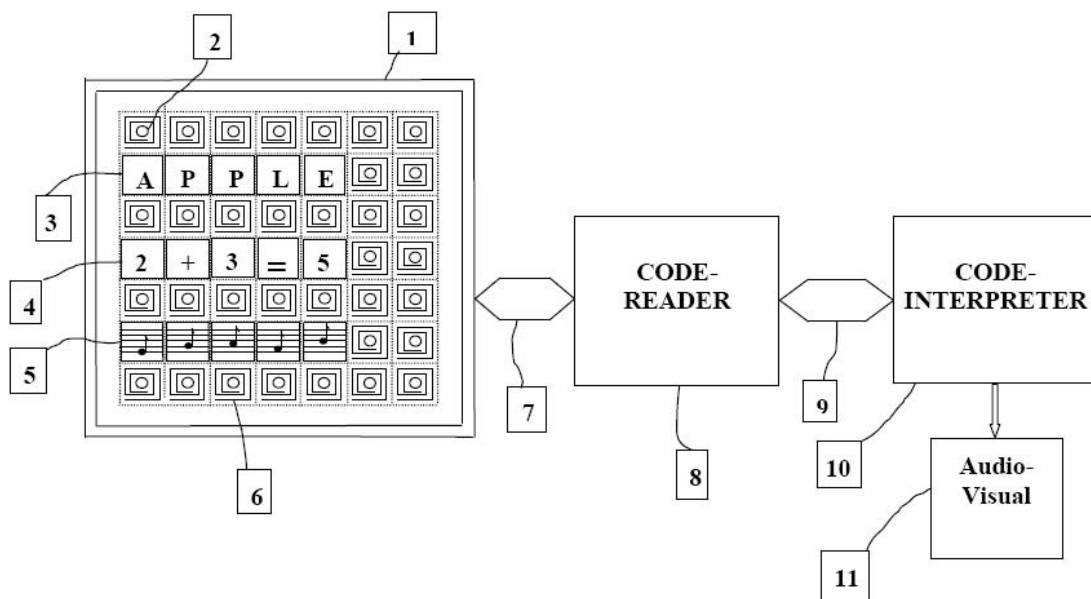
figure 6

**Computer-interactive Blocks**

**for Playful Learning**

or

**The Playful Learning Matrix**



**Figure 1**



The above devices are only a small illustration of the rich potential of digital instrumentation to overcome socially-induced learning problems. In the case of physics teaching such a device as the physics-is-fun machine helps students overcome the problems of understanding that arise due to the space-time separation between the experimental practice and the symbolic representation of the results in terms of graphs and equations. Both devices can be linked to the internet to provide feedback from



on-line tutors where necessary. There has been large increase in popular astronomy recently in the UK due to television programs fronted by a former rock musician now a professor of particle physics and by an Irish comedian, formerly a mathematical physicist. But the material basis of this interest is the availability of relatively cheap digitally instrumented telescopes that can automatically find celestial objects and capture the images for display and analysis. For a small fraction of the money spent on recent wars every community in the world could be equipped with the latest digital, internet-linked educational technology which would enable the rapid spread of scientific understanding

## **CONCLUSION: Another world is possible**

### ***Can 'quantum' Ψ-nets be a reality, or are they a fantasy?***

Is this is just a dream or fantasy? Not at all- Firstly there is the obvious example of Wikipedia. But there is an even clearer example of an informal web of cooperation in which worldwide internet-based circles of collaboration of software experts gave their time freely to develop a product that is more complex than a Boeing 747 jumbo jet. The product is superior to that produced by rival private corporations. I refer to the Linux operating system for computers, which is acknowledged to be more reliable and better performing than its corporately-produced rivals.

There are thus great possibilities for creating a world free of exploitation and the development of a sustainable production system based on mutuality and cooperation. We have to abandon the tree-like hierarchies of alienated human relationships characteristic of the Cartesian-Newtonian paradigm and instead adopt the Quantum paradigm implemented with the revolutionary digital technologies. This a route to the realisation of true species-being and thus the real history of humanity can begin.

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