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Bill Nelson

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The Hidden Connections.

Integrating the Biological, Cognitive, and Social Dimensions of Life into a Science of Sustainability.

Author: Fritjof CAPRA.

Introduction.

As a nine year old boy, in 1962 my Primary school teacher, Mr Harry McKeown, told me and a classroom full of wide-eyed boys that *'..there were more stars in the sky than there was grains of sand on every beach in Ireland..'*. Immense as that statement was we had no problem relating to it as the school was right beside the sea. So close in fact that the spring high tides washed into the school yard from Dublin Bay. That piece of information spurred an interest in space and the universe that has fascinated me since. In all I've read concerning that subject, I've come across nothing to contradict my school-teacher's assertion concerning the stars in the sky. Only later did I realise that the same statement comes very close to quantifying infinity. In many ways our teacher was a visionary and helped us think beyond the ordinary and attempt to understand the nature of life by using our everyday surroundings, the sea, forests, mountains, family, friends, animals, birds and last but not least, learning.

The Hidden Connections by Fritjof Capra brought to mind many prompts from life experience previously learned and tucked away for future reference. In a nutshell the book takes the reader from a single cell organism all the way to the current state of the world. Between those two fairly enormous categories Fritjof Capra probes and prompts and teases out, via a labyrinthine path, a course so profound that it uncovers in the reader many extreme emotions, from admiration to disgust, at the facts and how they are presented.

The Hidden Connections, a critique.

The early chapters of the book brought me back to my days as a student in college where I was training to be a laboratory technician. Although my speciality was

physics and electronics my course included biology, chemistry and biochemistry as minor subjects. Throughout the learning many concepts of single cell development including transportation, bacteria, mitosis, meiosis, proteins, nucleic acids and of course the famous discoveries of ribonucleic acid (RNA) and de-oxy ribonucleic acids (DNA) were taught. And while reading his chapter on the Nature of Life I found myself in familiar territory if also somewhat broken by a distance of over 20 years. Nevertheless Fritjof Capra brings the reader, in an abinitio way from basic cell theory through to life defined in terms of DNA, the foundation of cellular identity by cell boundaries or membranes, self-generation via metabolism and repair, primary and secondary cellular networks involving food as building blocks and another form of metabolism which assists in epigenetic networks.

As he teases out the new order we learn about evolution through the theory of autopoiesis and dissipative structures. These structures are one-way interchangeable in that while autopoietic systems are dissipative not all dissipative structures are autopoietic systems. Dissipative structures seem to exist in an inanimate matter that began before the emergence of living cells, or in a pre-biotic evolution. In dealing with this area Fritjof Capra calls on the work of Alexander Oparin, who described this pre-biotic phase as *'molecular evolution'* in 'Origin of Life'[1] .
More laterally this phenomenon is described as compounds with increasing molecular complexity and with emergent novel properties evolving into life. In other words molecular activity causing a transfer from inanimate to animate evolution. Along with this evolution comes information transfer and the important role of the basic elements of the Periodic Table [2], Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorous, Sulphur.
To support the beginning of life, as we accept it, a watery environment or H2O is essential. Although a quantum leap from pre-biotic to the theory of evolution as

[1] Published in 1929. Fritjof Capra refers.

[2] Periodic Table of the Elements. (History) Heys, H.L. Physical Chemistry, George Harrap & Co. 4th Ed. London. England 1970.

espoused by Charles Darwin[3] it may be worth calling to mind at this point a Darwin observation, as written in the Origin of the Species on evolution. *'…..with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth,……these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us….whilst this planet has gone cycling on according to the fixed laws of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved….'*

Considering the amount of research which has gone into attempting to discover this leap from non-living molecules to living cells the extract from Darwin's Origin of the Species may seem very simplistic however it was his concept of evolution that started the quest for solutions that in many ways have not been fully answered even to this day.

Although Capra under the principle that energy can neither be created or destroyed attempts to explain the importance of light to molecules the absorption of which converts light energy into electrical energy leading to chemical energy. Membrane bound vesicles in pre-biotic evolution need these pre-energy stages to develop and compete in order to evolve. (Darwinian dynamic).

To explain basic cell theory Capra uses the work of biologist Harold Morowitz's [4]work where a strong statement defines the most crucial step in pre-biotic evolution… *'It is the closure of a (primitive) membrane into a 'vesicle' that represents a discrete transition from non-life to life'* .

A chemical soup of molecules comprising fatty and oily substances called lipid vesicles become ideal candidates for proto cells out of which the first living cells evolved. Morowitz maintains the first proto cells formed about 3.9 billion years ago when the planet had cooled down, shallow oceans and the first rocks had formed , and carbon had combined with the other fundamental elements of life to form a great

[3] Keynes, Randal, Creation: The true story of Charles Darwin. John Murray (Publishers) 2001, London, UK.

[4] Morowitz, Harold. Beginnings of Cellular Life. Yale University Press. 1992.

variety of chemical compounds. Paraffin's (long hydrocarbon chains) were among these compounds and along with water and various dissolved minerals led to lipids.

These spontaneously formed closed vesicles, and thus began the transition to life.
The final step in the emergence of life from proto cells was the evolution of proteins, nucleic acids and the genetic code, much of which is still quite mysterious.
About 100 million years after the cooling earth and development of proto cells the essential characteristics of today's bacterial cells became evident. Either a single cell or a population of cells emerged as the universal ancestor from which all subsequent life on Earth descended. Darwin's survival of the fittest philosophy must have pre-dominated as the universal ancestor survived (while others didn't) to weave a planetary bacterial web thereby suppressing other possible life forms. Ergo, all present life has descended from a single clone.
During the first 2 billion years of biological evolution, in which bacteria and other micro-organisms seem to have been the only planetary life forms, bacteria continually transformed the Earth's surface and atmosphere and established the global feedback loops for self regulation of the Gaia system[5] (Although Morowitz says life is a property of planets rather than of individual organisms which broadens the theory somewhat of the single clone).
In evolution then, bacteria are able rapidly to randomly mutate and possibly changing large chunks of their genetic material on a daily basis thereby allowing them to adapt instantly to environmental changes. Drug resistance being a case in point and showing the way to so-called advanced genetic engineering and global communications technologies by a matter of many billions of years.
So how did we get from bacteria and micro-organism evolution to the human species? This majestic unfolding did not proceed through gradual change alone over time. Symbiosis, or the tendency of different organisms to live in close association with, or inside, one another. In fact, long periods of evolutionary stability have been

[5] Lovelock, James. Healing Gaia, Harmony Books, NY. 1993 and Margulis, Lynn. From Gaia to Micocosm. Lecture at Cortona Summer school, 'Science and the Wholeness of Life' August 1998 (unpublished)

punctuated by sudden and dramatic transitions. Fossil records demonstrate that changes were caused, not only random mutations (Darwin) but by mechanisms where the creation of new species through symbiosis may have played a key role. (Ref Microcosm by Margulis)… *'Over a long view of Geological time, symbiosises are like flashes of evolutionary lightening.'*

Repeated occurrences of catastrophes also seem to preface intense periods of change, growth and innovation. The evolution of mammals followed the world's worst mass extinction ever seen, 245 million years ago. And another catastrophe 66 million years ago cleared the way for the evolution of the first primates, followed by the human species, albeit at the expense of the elimination of the dinosaurs.
So we have come from inanimate to animate to single and multi-cell structures and bubbles bound by membranes, through to RNA and DNA, genetic information message carriers and storage, the need and use of energy for minimal life and the application of physics and chemistry of proto-cells. A continuous pattern of self generating networks of evolutionary creativity, mutation (adaptation) gene trading and symbiosis through which life unfolded for over 3 billion years from universal bacterial ancestors to the emergence of human beings.

Capra states the central task of the book is to extend the understanding of the nature of life to the human social dimension. This means we need to include the understanding of the mind and consciousness in our understanding of living systems.

The creation and existence of the World and it's Universe have been the discussion of many philosophers and psychologists within different themes. In the context of the spirit as the breath of life, Capra quotes the Benedictine monk David Steindl-Rast[6] who described *'spiritual experience as moments of heightened aliveness'* and the experience of our spirit as *'the fullness of mind and body..'* And Abraham Maslow

[6] Steindl-Rast, David. 'Spirituality as Common Sense'. The Quest. Theosophical Society in America, Wheaton, Ill., vol. 3, no. 2, 1990

states that *'Aliveness felt during such a 'peak experience' involves not only the body but also the mind'*. We can go much further back in history to get the ideas of such influential philosophers as Plato[7] (-427 to –347 BC) and Aristotle[7] (-384 to –322 BC). Plato explained the formation of the World as the work of an artist God while Aristotle whereas not rejecting Plato's observation, made a distinction between two Worlds: The Celestial World, perfect, composed of circular, and eternal movements and The Terrestrial World, a changing world, of birth and death. A more modern philosopher, Spinoza[7], identified God as Nature. Great thinkers since time began have attempted to define a spiritual relationship with our immense surroundings and many more will inevitably discuss and debate, as Capra says, *'the central awareness in these spiritual moments is a profound sense of oneness with all, a sense of belonging to the Universe as a whole'*.

Within ourselves we seem to have the ability to comprehend and compartmentalise our body and mind reactions to the stimuli of our surroundings. Man's influence on the landscape we occupy may be defined and described in great detail in a very practical sense using Sociology, while the Universe's influence on mankind needs mind and consciousness and a good deal of philosophy to understand even the tip of the iceberg.
Nevertheless many of us will apply whatever knowledge we possess in order to come to terms with infinite space. In applying that knowledge, however limited or expansive, we are forced to think. Descartes[7], (*Discourse 1637 and Meditations 1641*) gave food for thought to many philosophers when he announced: *'Cogito ergo sum'; 'Je pense donc je suis' (I think therefore I am)* and making a parallel with cognition and with to be and existing *'Je suis, j'existe' (I am, I exist).*

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[7] Le Point. Philosphie. Testez vous. No 2. Juillet/September 2010. Paris. (Same source Plato and Aristotle)

[7] Le Point. Philosphie. Testez vous. No 2. Juillet/September 2010. Paris. (Same source Plato, Aristotle, Spinoza and Descartes).

The exact relationship between brain and the mind has yet to be scientifically and medically established, however that is irrelevant to most people who simply deal with their circumstances, vis-à-vis the universe, within the mental capacity to which they have been endowed. Understanding our surroundings can be accommodated by limiting our sphere of operation. If we are satisfied with a limited sphere then we will be more than likely satisfied with understanding our immediate surroundings. Widening our orbit generally means expanding our thinking horizons. Factors such as education, family and socio economic groupings tend to dictate our range of acquired knowledge. Many of us are content enough to remain within our comfort zone of knowledge and career to satisfy our basic needs. Spirituality in the form of established religions can often satisfy the need to delve into the world of mystery. Many religions are taken at face value by their followers and those who practice. The wonder of a God never seen but who exists through literature also written by those who have never seen but who believe has filled a vacuum for those who are happy to extend the mystery of a God to include the mystery of the universe.

For those who have the benefit of a liberating education or who are endowed with natural higher intelligence (for example by genetic make-up) and wish to understand more and want to think a little more deeply should start by staring continuously at a clear sky at night free of un-natural light pollution. Without doubt, if we stare long enough we will see a meteorite. However, even if we do not witness this wonderful event we will definitely see stars twinkling in the distance. If we think long enough we will understand that perhaps the twinkling star is already expired and the light emitted has outlived the source, such is the distance in light years, that it has travelled (186,000 miles/300,000kms per second). When we think that 1 light year = 6×10^{12} miles or 9.5×10^{12} kms. The nearest star to us is 4.3 light years away and the brightest star Sirius is 8.8 light years. The stars we see around us in the sky at night belong to our Galaxy, a system of stars which our Sun is one member. It is estimated there are

10^{11} stars in our Galaxy alone. About 3,200 of these are near enough to be distinguished on clear nights without a telescope in our hemisphere.[8]

The most commonly held belief is that the Universe was born about 13.7 billion years ago in a gigantic explosion.-The Big Bang theory.[9] There is, however, a respectable idea that the Big Bang spawned not only the Universe in which we live but an infinite number of parallel universes. Andrei Linde, a Russian cosmologist, proposed in the 1980s that our universe may just be one in an infinitely large number of parallel universes, most would not be suitable for life, but many would.
We know the Universe is expanding: all the galaxies in the sky are moving away from each other[10]. Light from the most distant galaxies that we can see has been travelling for most of the age of the universe, about 15 thousand million years, before reaching us, and over the huge volume of the visible universe a steady, uniform expansion is taking place.

So food for thought indeed if we are trying to understand the beginning of the universe and condense it into the beginning of the earth and the beginning of life on earth.

As the earth is embedded in our galaxy it is difficult to envisage it properly without looking from the outside in. Astronomers have achieved the image of our galaxy as a flat disk by looking at Andromeda, 2 million light years away (Herchel, 1738-1882). Seeing the massive stellar congestion in our galaxy and observing the comet activity, (Hale-Bopp, Kahoutek, as recent examples) we can readily understand how the earth

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[8] Hey. J.S. The Radio Universe, 2nd ed. Pergamon Press, UK 1971.

[9] Reville, W. Prof. Science Today; We are not alone: the mystery of the parallel universes. Irish times March 2, 2006.

[10] Pease, Roland. Nature Times news service. 1988. Seeing our cosmos as one of many mini-universes. Irish Times. Oct 4th 1988.

would have experienced the catastrophic, life altering events of 245 and 66 million years ago that re-directed our development.

Consciousness studies tend to centre around analysis and observation and Sigmund Freud made a life study of psychoanalysis to unearth suppressed emotions. Neuro-reductionists theorists Patricia Churchland and Francis Crick tended to reduce consciousness to neural mechanisms. Other schools of study are described as 'functionism' and 'mysterians'. The former asserts that mental states are defined by their 'functional organisations' while the latter purports that consciousness is too deeply mysterious for human intelligence to unravel. An emerging school of thought is that of 'neurophenomenology' (Edmund Husserl) in which disciplined examination of experience will be allied to with the natural sciences. This has resonances in many established religions who espouse meditation and contemplative traditions as a means of probing the mind (Hinduism, Buddhism, Christianity).

The consciousness field of study is wide and varied with many untested and unproven hypotheses whereas Fritjof Capra believes the conscious experience is an expression of life, emerging from complex neural activity.

Looking at neural activity, more recent studies put conscious experience as an emergent property of a particular cognitive process (Francisco Varela, Gerald Edelman and Giolio Tononi).

An interesting example used is to think of the neural process in musical terms of noise, synchronisation, melody, subsiding into cacophony then another melody emerges. A practical musical experience I had with severe stroke victims in a hospital in Dublin involved singing songs to patients, many of whom were paralysed in body and speech, until they heard a familiar song, at which point they could sing along but when the song ended they reverted to their paralysed state. The sing-song was a voluntary act by singers and musicians as entertainment and not as therapy prescribed by the medical staff of the hospital. However many stroke victims whose mobility and brain function improved with time came back to thank the musical performers for their contributions to their healing as, patients maintained the music retraced the path

in their brains and memories to re-cognition.[11] The speaking words eventually came back but could have been restricted due to lack of physical movement and the words only manifested themselves with combined and more precise physical expressions.

The use of sign language by chimpanzees is evidence of a comprehensive understanding of thought processes being transferred to a physical characteristic medium to ensure accurate communication. The many near similarities of DNA, skeleton, brain, tool use, vocal tract and social behaviour makes comparisons of chimpanzees with humans valid enough for research purposes. It also extends the theory of tool-making into technology as it would be a normal evolution and obviously always has been for humans. With increased manual dexterity came increased tongue dexterity and speech evolved some 200,000 years ago. Humans have continued to develop highly specific language forms and indeed many different languages to communicate. Initially these languages developed in communities that may have lacked external influence so remained pure. Island communities, mountainous populations, lack of ability to travel, etc. Increased travel over time ensured external influences cross populated language. Evidence suggests that in specific areas certain patois exists as a melange of different languages. EG; The Basque country in the Pyrenees is situated between France and Spain and the language is like neither French or Spanish but also more laterally reflects both cultures.

Descriptive expressions too have entered popular culture to more accurately describe an act or process, EG. To glance at something in the English language is to *'Throw an eye on it'* and in French it is exactly the same *'Jeter un coup d'oeil'*. Everybody knows that we are not literally *'throwing an eye'* but the expression gives a literal and pictorial view and extension of the words to describe the act of glancing at something. The interesting aspect is that the literal expression traversed two, and maybe more, languages. The similarities between some different languages cannot be overstated. In

[11] The Royal Hospital, Donnybrook, Dublin 4, Ireland. Circa 2000-2004. Weekly Singing sessions. Personal experience and participation

an exercise I'm carrying out myself between English and French I'm comparing words that are spelled exactly the same in both languages but sound different. Starting at the letter 'A' I currently have recorded 490 words and I'm only on the letter 'C'.[12] Even in different languages words and expressions are the manifestation of cognitive thought which comes from the embodied mind whose inspiration is to express in words, regardless of the language used, a conscious or unconscious belief.
Concerning recent advances Fritjof Capra refers to healing of the Cartesian split between mind and matter and the Santiago Theory that links mind and matter, process and structure at all levels of life to promote essential dialogue between philosophy and cognitive science to increase the understanding of human cognition.
Ffritjof Capra's aim is to develop a unified, systemic framework for the understanding of biological and social phenomena. In so doing he calls on pattern of organisation and structure which he modifies to more general concepts of form and matter in an attempt to synthesise his new scientific understanding of life. He almost challenges philosophical advances in that since Aristotle's four causes or perspectives, more than 2000 years ago are still used to analyse reality. However when exploring social theory he quotes many sociologists including Auguste Comte who moved sociology from social physics to give the science more relevance by description.
Capra also puts huge importance in linking the biological structure of an organism and the material infrastructure of society by characterising successive epochs of human civilization in terms of their technologies, namely: the Stone Age, Bronze Age, Iron Age, Industrial Age and the Information Age, thereby increasing the understanding of biological and social life.

In following what he entitles 'Life and Leadership in Organisations' Capra hoped to further extend his linking via complexity and change through metaphors in management and social networks. He studied the living organisation, learning from life and the importance of organisational learning. Different kinds of leadership and its ability to bring life into organisations. The new economy however may invert the

[12] Collins French-English Dictionary and personal notebook.

beneficial effects of the social and organisational life in that it is over-dependent on advanced and communication technologies to produce wealth in global financial networks.
Capra makes a powerful statement when he quotes Manuel Castells: *'…the social, cultural, and political rejection by large numbers of people around the world of an Automaton whose logic either ignores or devalues their humanity…'*

Throughout Part Two of the book Capra analyses the Challenges of the Twenty-first Century and attempts to finish on a promising note vis-à-vis sustainability by holding a mirror up to biological systems, thought processes and flows of energy and matter to respectively correspond to networks of communications in social systems, chemical processes and flows of information. He stresses that even 'enlightened capitalists' are concerned that global capitalism in its present form is ecologically and socially unsustainable and that its highly volatile nature has huge self destructive potential. Many financial and economic academics are decrying 'market fundamentalism' and believe it is as destructive as any other kind of fundamentalism.

Global capitalism seems to have grown out of a new order of economic globalisation espoused co-incidentally with the establishment of the World Trade Organisation (WTO) and the liberalisation of 'free trade'. The initial aspirations of continuous growth for all became a myth as it became obvious that we live in a world of finite resources. Disillusionment, social disintegration, teetering democracy, deeper poverty and deterioration of the environment are emerging as the results of unbridled financial recklessness.
A lack of real understanding of the effects of globalisation, the full impact of the information technology revolution and the rise of global capitalism where capital moves rapidly in real time through global financial networks always thirsting for the next investment opportunity. This complex and turbulent financial and world economic environment has led to whole countries facing potential bankruptcy (Greece, Ireland, Portugal and Spain) with massive loans coming first from established banks and then billions of euros in bail-out loans from the International Monetary Fund (IMF) and the European Central Bank (ECB). Having first

encouraged rampant and uncontrolled investment in these countries ultimately creating an economic bubble they are now forced to prop up the same countries in the hope that with severe austerity the loans will eventually be repaid.

The social, cultural and ecological impact of expected continuous growth has yet to be fully realised but the impact if all countries in the developing world reached the level of the developed world then the environmental damage would be inestimable. Power and culture are transformed by the information revolution and they sit now in the hands of the powerful technological networks the liberalisation of which must be controlled in a time-lapse fashion if we are to see normally monitored development.

Allied to the somewhat wayward development of globalisation comes the increased concentration on genetic engineering. Instead of racing ahead with pre-conceived ideas on genetic determinism biotechnologists should start with the desire to learn from nature rather than control her. Nature can be mimicked and is used successfully and in a neutrally harmless way through ‘biomimicry’. The Earth Summit in 1992 identified a possibly sinister philosophy in the use and development of biotechnology and considered that where there are threats of serious or irreversible damage that cost effective measures should be put in place, even at the risk of uncertainty, to prevent environmental degradation.

Unfortunately, despite the warnings, cloak and dagger investment and research has been taking place, particularly in the field of genetic modification. This type of research has been proven to be more driven by financial gain than real ethical scientific discoveries and there is evidence to suggest that the ‘primacy of the gene’ philosophy is losing ground. When we see the biotechnology advantages in following nature, rather than trying to lead her, it is inconceivable that respectable and educated scientists could ever consider any other path. Imagine being involved in trying to emulate a spider’s web (gram for gram 5 times stronger than steel), or studying the complex structures of photosynthesis (in the development of solar cells), or studying the blue mussels ability to secrete glue underwater that sticks to anything!

In an article recently in the New York Times, James Carroll[13] looked at nature and the lessening human relationship. He said: *'..As humans came to know so much we lost our grip on the knowledge with which we became human.…Imagining that we no longer needed nature, we ourselves became the great threat to nature. …Through ambitions of unlimited growth, consumption, competitive manufacture and self expanding technology, we humans have become a mechanism for extinction. When we stopped noticing Earth, we began to destroy it…. Intimate awareness of nature and its cycles was an ancient mode of survival. But survival is at issue again. Noticing the length of light (June 21), revelling in the Sun's achievement, rejoicing in Earth's perfect balance, honouring the summer solstice-loving it: This is how we became human, and it is how we stay human'.*

Capra feels biotechnology is a turning point and he scripts the development of genetic engineering for both good and ill. The race to map the human genome and the emergence of the conceptual revolution in genetics and the remarkable stability of the gene leads to more questions than answers. Synthesis of proteins, direction of information flow from genes both contestable and enshrined in the Central Dogma (Francis Crick) is attempting to simplistically describe processes designed over millions of years by nature. Relatively simple for bacteria but increasingly more complex for the higher orders of being and nowhere near being explained. Science will always try to discover by experimentation but is it wise to interfere or copy perfection? The biology and ethics of cloning, hailed initially as a scientific miracle then debate and controversy surrounded the secret experiments and possible eventual end-game.

Biotechnology in agriculture, for whatever good it may have done, has spawned the expression 'Genetic Modification' and an equally associated company 'Monsanto', both of which have entered into popular culture as derisory influences the negativity of which could take years to overcome. The ecological alternative however gives us hope. Known as 'Organic Farming', 'sustainable agriculture', or ' agro-ecology' is

[13] Carroll, James. NY Times Global edition, Knowledge and Destruction, Tuesday June 21, 2011.

slowly sweeping the farming world. I recently saw an article in a French newspaper where a 'boulanger' (baker) is opening a chain of organic bakeries in Paris. Thereby giving end-user outlets to farmers and other suppliers of organic raw materials. The once tiny or non-existent sections of supermarkets and out-door markets catering for organic products has grown steadily to compete admirably with the non-organic products. In time the aspiration is that the tiny and eventually non-existent sections will be exclusively reserved for non-organic products.

To make sense of the degradation of the environment and society and the possible recovery that could be at hand Capra gives some convincing examples of how modern technology can be used. The internet can be used for global reach to mobilize the network of concerned scientists and activists to raise awareness in relation to climate change for example. Civil society needs to sit up and take notice in a responsible way to reject out of hand the attempted domination and control of nature. NGOs now take a more active role in openly criticizing State bodies who favour big business against the interests of the environment or local indigenous industry and in so doing take an active political role suitably adept at voicing global concerns. World-wide there are dozens if not hundreds of these institutes of research and learning whose activities are supported financially by philanthropists and voluntary public donations which allows their activities to abound unencumbered by state control or the threat of funding suspension. These organisations are contributing to giving a new meaning to the term globalisation and re-shaping values in a way that suggest alternatives to economic globalisation.

For some time now there is a growing resistance to genetically modified foods and the groundswell came literally from the ground up. Starting with farmers in India and spreading to the powerful European consumers. These movements are putting pressure on governments to put human health and welfare before corporate profits. Concentrating on the maintenance of the environment is key to allow the other human and social benefits to flow.

In certain cases the earth has been very forgiving as the banning of CFCs have demonstrated in relation to the Ozone layer but the problem is we do not know exactly the damage caused by previous reckless behaviour as the cycles of influence are long

and slow. Slow too is the USA in coming on stream with conservation measures adapted by protocol in Europe and many other countries.
Unfortunately big business rules supreme still in many decisions concerning the protection of the global environment. Why for instance do many multi national companies who have set up in the developed world then close factories and facilities and move lock, stock and barrel to developing countries? The short answer is they move to take advantage of the lax laws concerning manufacturing, pollution and labour. Why is this allowed? So-called respectable companies increase their shareholders wealth while at the same time leave established communities devastated by unemployment when they leave and are féted in developing countries for creating new employment. There seems to be no restrictions for this practice by International laws. Even within the European communities a recent pull-out by Dell from Ireland left 1200 people unemployed while moving their manufacturing plant to Poland. Until International communities establish a code of practice for this re-location behaviour there will never be a unilateral improvement and stabilization of social conditions.
There are however moves afoot to improve sustainability to the extent that there have been established six principles of Ecology as guidelines to sustaining life. Capra quotes and lists them as: 1. Networks, (boundaries of identity and communication). 2. Cycles, (continual flows of matter and energy), 3. Solar energy, (transformed into chemical energy by photosynthesis), 4, Partnership, (co-operation by exchanges of energy and resources), 5, Diversity, (resilience through bio-diversity), 6, Dynamic balance, (optimum values achieved by flexibility).
A recent example of one of the basic tenets and of biomimicary is the development of artificial leaves that develop energy from water, sun, and CO2 (Carbon Dioxide)[14]. (Gary Brudvig, professor of Chemistry, Yale).
Without doubt this is groundbreaking technology and although in its infancy and producing only minute amounts of energy it is at least going in the right direction.
Solar energy has been the ultimate in renewable and sustainable energy and has been providing the source of all earth based forms of natural energy for billions of years

[14] Des Feuilles artificielles reproduisent la photosynthése. Anne Eisenberg. New York Times, (Offert par Le Figaro) 24 juin 2011. (Weekly edition in French as supplement to Le Figaro)

without interruption. Photovoltaic cells are now common-place in many countries and supplying the national grid with electricity. Wind energy is also prevalent although not as efficient as solar power it still occupies a useful place and the technology employed is probably slightly ahead of solar energy generation. It is only a matter of time before a transition occurs to more eco-friendly and efficient energy production processes. Great strides are being made in hydrogen energy and the recent disaster in Japan with nuclear power, and Germany's new policy of becoming nuclear free increases the competition and race for alternative forms of energy.

Conclusion.

This book deals in a comprehensive with way the rights and wrongs of the use of science, natural and learned, to get the planet to where we are today. Many of the examples given of the applications of man-made science were very depressing, the development of GMO being a case in point. However the book and indeed Capra himself in his activities (Centre for Ecoliteracy in Berkely) makes every effort to end the discourse on a very positive note. The application of science, scientists and research for the good of humanity is an ethical theme that he espouses. He is enthusiastic about the transition to 'The Hydrogen Economy' and an article picked up recently in the Irish Times details where Opel, the German car manufacturer have being testing it's HydroGen4 and hopes to have a model on sale by 2015.[15]

Other examples that would fit with the scientific progress Capra likes to see is research being carried out in Trinity College Dublin and Dublin City University into the beneficial effects of parasitic worms in humans.[16] Instead of always wiping out parasitic worms with antibiotics, etc, researchers are looking to discover the worms molecular structure to identify how they survived for millennia in human hosts by avoiding the hosts immune system and perhaps playing a part in controlling conditions that now exist in the human (Asthma, Multiple Sclerosis, Crohn's disease), all of which are modern diseases.

[15] McAleer, Michael. Opel Banking on Hydrogen Future. The Irish Times. Wednesday June 8th 2011.

[16] AHLSTROM, Dick. Science Today. Opening a good can of worms. The Irish Times, June 2 2011.

Stem cell research has raised an ethical issue due to the fact that embryonic cells are used thereby destroying the embryo. However not all research involves embryos. A promising approach to curing disease is under development using newly discovered Induced Pluripotent Stem Cells (IPSC) to develop effective new drugs. (Stephen Hall, March 2011, Scientific America)[17]. The discovery points out that there are actually three types of stem cell: adult, embryonic and IPSC. The IPSC approach is to recreate various human diseases in a laboratory so effectiveness of potential drugs can be tested. This approach is now in use experimentally to model dozens of illnesses, including many blood disorders such as sickle-cell anaemia and Parkinson's disease. Although not as flexible in their use and applications as embryonic cells, experiments with IPSC are much more ethically acceptable.

Research of almost any kind nowadays however depends largely on the processing power available to scientists. Computer technology has improved dramatically in the past ten years and is continuing to evolve at a massive rate. Supercomputers are now so advanced that they can squeeze a model of the entire universe inside them or predict the occurence of freak waves or can be used in bioinformatics in experiments that run genetic comparisons.[18] Supercomputers are giving us a glimpse of worlds far beyond our imagination. The most powerful supercomputer in Europe s called 'Jugene' and is based in Germany. Scientists from all over the world earn computing time on Jugene to further their experiments started in their home countries. Jugene harnesses the computing power of 288,000 modern desktop computers.

The development of 'Nanotechnology', a term used to describe making things small.[19] This however may be understatement because if we try to imagine how big the Sun is, an object that is about 1.4 billion metres across. It is huge but we can put it in perspective because we can grasp an inkling of its size. Now if we scale back in the other direction moving past smaller and smaller objects until we get the same distance down to one billionth of a metre. (A sugar molecule is one nanometre, a billionth of a metre long). This type of research is science at its best because by producing this type

[17] REVILLE, William, Science Today. Stem cell research gets new horizon. Irish Times, May 5, 2011.

[18] BORAN, Marie. Science Today. To infinity and beyond. Irish Times, May 12, 2011.

[19] AHLSTROM, Dick. Science Today. Big plans for small science. May 19, 2011.

of materials technology that can be used in computing, smaller, faster and less energy consuming, all research is benefiting. Ireland is doing very well in this field, currently ranked eighth of 162 countries in materials science by Thomson Reuters.

The use of Nuclear power as electricity generation is a very sensitive issue following the earthquake and tsunami in Japan. Capra himself having initially been enthusiastic about it eventually decides the risks are too high. Much was written in the immediate aftermath of the earthquake about the Fukumshima Daiichi plant. The Wall Street Journal[20] tells about Futuba, once home to 7,000 residents, is one of eight towns forced to evacuate the day after the March 11 earthquake. Futuba Mayor Katsutaka Idogawa said it will be years before the residents of his town can return.

Shortly after the disaster The New Times detailed a strange series of stock purchases through Hong Kong banks of the Tokyo Electric Power Co.[21] Panicked investors were dumping Tepcos (Tokyo Electric) shares at prices nearly half their normal price and at the same time they were being bought by unknown buyers. Within a month the Government had a reconstruction plan in place and Tepcos share price rose again to almost pre-earthquake rates. So was this just shrewd investment or a deeper belief that nuclear power is not quite ready to be decommissioned?

An article in the Irish Times recently gives another point of view.[22] It deals with the most serious accident in the history of nuclear power at Chernobyl in 1986 and despite the devastation it caused locally, the scientific evidence indicates that the health effects were very small (United Nations Sub Committee on the Effects of Atomic Radiations (Unscear) Report, 2011. It also mentions that the life-cycle analysis of the carbon dioxide output of nuclear power shows that it only emits 4% of the warming greenhouse CO2 of coal-fired power. (Oko Institute, Germany).

Some countries rely heavily on nuclear power and it will not be easy to replace it as a source of energy. France, for example, produces 81% of its electricity by nuclear

[20] WAKABAYASHI, Daisuke, Eerie hush descends on nuclear zone. The Wall Street Journal, Tuesday, A.pril 19, 2011.

[21] BRADSHER, Keith and TABUCI Hiroko. Who would buy into ravaged atom plant? The Global Edition of the New York Times. Tuesday, April 19, 2011.

[22] REVILLE, William. Science Today. Despite the high-profile accidents, we need nuclear power. Irish Times. Thursday, April 21, 2011.

power and has no plans to replace it.[23] (There are also, however, many sites in France under construction with solar panels for electricity generation).

Some interesting experiments in medieval farming techniques are on-going in Ireland. From information[24] received from Dr. Eamon Slater (NUI Maynooth, Sociology Dept), it can be seen that farming techniques in northern Europe enjoyed considerable success and satisfactory yields long before chemical fertilizers became known.
Ridge farming, (A form of raised bed of soil) was common place and fieldwork in Ireland recently suggests *that ridging can bring clear ecological benefits over level fields, such as increased soil organic matter and the suppression of crop disease.* They also permit natural drainage and avoid damage by ice. Also weeds and other vegetation that grow on the beds are turned back in and supplement fertilization. It also demonstrates that specific placement of fertilizers (usually animal manure by integration of crop and livestock) is far more effective and efficient that mass spraying of whole fields.
Although small in scale, experiments, research and publications of these kinds are all helping us to realise that past techniques, used in consort with nature have managed to sustain the planet and its continuous population for millions of years.
We need to use science to produce its ethical best for all concerned. Closer collaboration of scientists needs to take place. Recently scientists from the USA and Russia working together discovered and registered 2 new elements to add to the periodic table. [25] Whereas the discoveries are extremely important, more important is the fact that collaboration took place between scientists from different countries with a common goal and target.
No action or reaction on Earth can be taken in isolation. We know the effects of pollution in relation to climate change. We are all stakeholders in the planet's

[23] EDF (Electricity de France) statement on each invoice to consumers 2010).

[24] Bell & Watson, A History of Irish Farming 1750-1950. Four Courts Press, Dublin. 2008.
O'Sullivan & Downey, Post Medieval Fieldscapes. Archaelogy Ireland. Autumn 2008.

[25] Briefly Americas. New York. Scientists register 2 new elements. The New York Times. Friday, June 10, 2011.

resources and all of us are only given charge of the environment for a finite period until we hand it over to the next generation. None of us would want to be blamed by our great grandchildren for handing them their inheritance in a worse state than we received it from our forbears. Every tiny bit we do as individuals helps, and it starts with simply something like not wasting water in our own homes to turning off lights that are not necessary. How many people, for example, never unplug a mobile telephone charger? A very small power output of about 4 watts during charge and it even drops to less than 1 watt while idle but it generates heat and it is a considerable waste of energy if it is multiplied by a million.

The culture of waste needs to be foremost in every consumers mind if we are to turn the tide of sustainability. We need to think of others instead of only ourselves. National laws need to be superseded by International laws. Protocols agreed by sovereign governments need to be acted on and not dictated to by derogations from individual states before the ink is dry on the agreements. Sectional interests by individual states need to be put aside for the common good.

By integrating the biological, cognitive, and social dimensions of life into a science of sustainability in a responsible way may prove that the connections mentioned by Capra may not be hidden after all.

References

[1] Published in 1929. Fritjof Capra refers.

[2] Periodic Table of the Elements. (History) Heys, H.L. Physical Chemistry, George Harrap & Co. 4th Ed. London. England 1970. [1] Published in 1929. Fritjof Capra refers.

[3] Keynes, Randal, Creation: The true story of Charles Darwin. John Murray (Publishers) 2001, London, UK.

[4] Morowitz, Harold. Beginnings of Cellular Life. Yale University Press. 1992.

[5] Lovelock, James. Healing Gaia, Harmony Books, NY. 1993 and Margulis, Lynn. From Gaia to Micocosm. Lecture at Cortona Summer school, 'Science and the Wholeness of Life' August 1998 (unpublished)

[6] Steindl-Rast, David. 'Spirituality as Common Sense'. The Quest. Theosophical Society in America, Wheaton, Ill., vol. 3, no. 2, 1990

[7] Le Point. Philosphie. Testez vous. No 2. Juillet/September 2010. Paris. (Same source Plato and Aristotle)

[7] Le Point. Philosphie. Testez vous. No 2. Juillet/September 2010. Paris. (Same source Plato, Aristotle, Spinoza and Descartes).

[8] Hey. J.S. The Radio Universe, 2nd ed. Pergamon Press, UK 1971.

[9] Reville, W. Prof. Science Today; We are not alone: the mystery of the parallel universes. Irish times March 2, 2006.

[10] Pease, Roland. Nature Times news service. 1988. Seeing our cosmos as one of many mini-universes. Irish Times. Oct 4th 1988.

[11] The Royal Hospital, Donnybrook, Dublin 4, Ireland. Circa 2000-2004. Weekly Singing sessions. Personal experience and participation

[12] Collins French-English Dictionary and personal notebook.

[13] Carroll, James. NY Times Global edition, Knowledge and Destruction, Tuesday June 21, 2011.

[14] Des Feuilles artificielles reproduisent la photosynthése. Anne Eisenberg. New York Times, (Offert par Le Figaro) 24 juin 2011. (Weekly edition in French as supplement to Le Figaro)

15.McAleer, Michael. Opel Banking on Hydrogen Future. The Irish Times. Wednesday June 8th 2011.

16 AHLSTROM, Dick. Science Today. Opening a good can of worms. The Irish Times, June 2 2011.

17 REVILLE, William, Science Today. Stem cell research gets new horizon. Irish Times, May 5, 2011.

18 BORAN, Marie. Science Today. To infinity and beyond. Irish Times, May 12, 2011.

19 AHLSTROM, Dick. Science Today. Big plans for small science. May 19, 2011.

20 WAKABAYASHI, Daisuke, Eerie hush descends on nuclear zone. The Wall Street Journal, Tuesday, A.pril 19, 2011.

21 BRADSHER, Keith and TABUCI Hiroko. Who would buy into ravaged atom plant? The Global Edition of the New York Times. Tuesday, April 19, 2011.

22 REVILLE, William. Science Today. Despite the high-profile accidents, we need nuclear power. Irish Times. Thursday, April 21, 2011.

23 EDF (Electricity de France) statement on each invoice to consumers 2010).

24 Bell & Watson, A History of Irish Farming 1750-1950. Four Courts Press, Dublin. 2008.
O'Sullivan & Downey, Post Medieval Fieldscapes. Archaelogy Ireland. Autumn 2008.

25 Briefly Americas. New York. Scientists register 2 new elements. The New York Times. Friday, June 10, 2011.