TEN WAYS TO KNOW
THE KNOWLEDGE-BASED ECONOMY

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Abstract

Today one hears much about the so-called 'knowledge-based economy'. Yet in economic theory such an economy is a contradiction in terms - an oxymoron. Knowledge is a public good, a good for which a natural market does not and cannot exist. To address this dilemma I circumambulate what is meant by knowledge using a ten facetted interdisciplinary projection: economics, biology, comparative terminology, culture, epistemology, law, linguistics, morphology, psychology and lastly ideology, specifically the last ideology standing – market economics. Understanding what we mean by knowledge is a critical first step in realizing human resource and regional economic development public and private policy objectives within the context of a global knowledge-based economy.

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Introduction: Economics

Today one hears much about the so-called 'knowledge-based economy'. Yet in economic theory such an economy is a contradiction in terms - an oxymoron. Knowledge is a public good, a good for which a natural market does not and cannot exist. A contrast with a private good is in order.

A private good is excludable and rivalrous in consumption. If one owns a car one has lock and key to exclude others from using it. And when one drives the car no one else can drive it, that is, driving is rivalrous. A gross example is an apple. I buy it excluding you from that particular apple and you cannot eat it after I have - rivalrous.

A public good, on the other hand, is not excludable nor is it rivalrous in consumption. Consider knowledge. Once something is known (especially if it is published, a term deriving from the Latin

meaning 'to make public') it is hard to exclude others from learning it and if another does it does not thereby reduce the knowledge available to you.

How can you have a market if the good being sold can be easily appropriated and its appropriation does not reduce one's inventory? As will be seen below it is only through Law – contract and statutory – that a market and therefore a knowledge-based economy can exist. And this is a market only for new knowledge created by statute, *e.g.*, copyright, patent, registered industrial design and trademark, or, protected by secrecy. It is therefore a market born of government. Put another way, without government there can be no knowledge-based economy.

I say a market for 'new' knowledge because the vast, vast majority of knowledge resides in the public domain where it is freely available to any and all. Thus knowledge protected by intellectual property rights eventually falls into the public domain which is a virtual space where, as Isaac Newton noted, we all "stand on the shoulders of giants". Put another way, what begins as a public good is converted by Law into private property bought and sold for a limited time before again becoming a public good when it enters the public domain to fertilize the imagination of generation onto generation.

Biology

The philosophy of biology offers at least four insights into the nature of knowledge. First, knowledge can be defined as orientation of an organism in an active environment. Every organism lives in an active environment consisting of:

> *invariants*, *e.g.*, the river, ocean, sky, mountains, seasons, *etc.*, and,
>
> *affordances*, *e.g.*, predator, prey, possible mates and/or symbionts (Grene & Depew 2004).

Environmental invariants become subsidiary or 'tacit' to focal awareness of affordances. In this view, it is tacit integration of subsidiary and focal awareness into a gestalt whole that constitutes knowledge (Polanyi Oct. 1962).

Second, the philosophy of biology highlights sharing knowledge between species through co-evolution, *e.g.*, the hummingbird's bill and orchid blossom co-evolve to match perfectly. To drive the point home, on the inside of your elbow you will find some 182 species of microbes. In fact a whole new science is emerging: the human microbiome - the study of microbes that live in and on people (*Infectious Disease News*, July 1, 2008). Given that

human beings depend on their microbiome for essential functions including digestion, a person is really a super organism consisting of one's own cells and those of all associated symbiotic bacteria. In fact, bacterial cells outnumber human cells by 10 to 1, meaning a person is, in a sense, a minority in one's own body. This new science may have significant implications for future human space travel, among other things. Conceptually co-evolution or symbiosis mitigates Darwinian survival of the fittest and the so-called 'selfish gene'. It may, in fact, be the dominant evolutionary fact of life other than death (Chartrand 2007).

Third, the philosophy of biology highlights the difference between specialization and fitness. In economic terms competitiveness means realizing competitive advantage, *e.g.*, doing what one does best and buying what one does worse, *a.k.a.*, specialization. This can, however, reduce the fitness of a Nation-State, corporation or worker to adapt to environmental change. De-industrialization or rather de-manufacturing of the West is arguably an example of reduced fitness during the first phase of the knowledge-based economy. The human environment and fitness landscape is, of course, much more subtle and complex than that of an amoeba as explained below under *Culture*.

Fourth, organisms do not just adapt to their environment, they also adapt the environment to their purposes. Ants do it with colonies; bees with hives; beaver with lodges. Humanity does it with technology. Technology enframes and enables Nature to serve human purpose (Heidegger 1954).

Put another way, technology is a biological imperative. In effect, it constructs a distinct human ecology growing ever more distant from Nature as the knowledge explosion continues to expand. Consider coming home from the office in a car, unlocking the door to the house, turning on the lights, making supper using appliances, watching television, checking one's email then driving to the local mall to shop. All is technology; all becomes background environmental invariants to our way of life. Technology enframes and enables us, defines and patterns life in the human ecology. And physical technology is knowledge, tooled knowledge to be precise, as explained below under *Morphology*.

Comparative Terminology

Knowledge can be appreciated in comparison with related terms. These include:

Information: consisting of data, facts, bits or bytes. With commercial innovation of the computer in the 1950s

there began the 'Information Revolution' generating huge quantities of information threatening to overwhelm decision-makers;

Knowledge: consisting of organized, systematized and retrievable information. With the development of relational data basing beginning in the 1960s the information explosion was gradually tamed as subsequently was the Internet in the late 1990s with innovation of efficient search engines;

Understanding: valuing the meaningfulness or usefulness of an accelerating body of knowledge in virtually every field of human endeavour; and,

Wisdom: exercising sound judgement in choosing between alternative means and ends.

In 1966 economist Kenneth Boulding (1966) noted 'information' can be quantified and manipulated by number of 'bits & bytes' but knowledge has no unit measure. He suggested 'a wit'. Consider two messages of equal 'bit & byte' size, one a telephone conversation between two teenage girls in Saskatoon and the other between the Presidents of the United States and Russia. Quantitatively they are the same; qualitatively very different. Knowledge is qualitative and contextual and feeds on itself.

Since then, of course, there has been the personal computer, Windows 95, the Internet, Google, Facebook and a vast new industry called data mining. All are fueled by mathematical algorithms generating a phenomenal growth of knowledge defined as organized, systematized and retrievable information. We can, however, only hope for a revolution in human understanding and wisdom. In the 400 years since the Scientific Revolution humanity has become master of its home planet. In the last 109 years we learned to fly. It is less than 50 since we landed on the Moon. We've come a long way, very fast!

Culture

As noted above under *Biology*, the human environment is much more subtle and complex than an amoeba's. In fact the polymorphous diversity of human culture vastly exceeds that of ant colonies, beehives or beaver lodges.

> For our part, we have no trouble acknowledging the existence of a human nature, characterized by a species-specific array of highly plastic and variable traits, which, just because they are plastic, forbid easy normative conclusions about what behaviors,

> practices, institutions, laws, moral codes, and so forth are "natural." (Grene & Depew 2004, 335)

From birth the perceptions of the infant then child and finally adult are saturated by a specific culture with its indirect perceptions of the environment through tools, language and pictures (Grene & Depew 2004, 357-8). These become environmental invariants to the individual. I explicitly treat language below under *Linguistics* and tools under *Morphology*.

If knowledge is orientation in an active environment then cultural knowledge is critical to survival.

> Our minds are certainly adapted to deal … by way of ideas… because the tie that binds us to the cultural world as agents, caregivers, competitors, speakers, and thinkers affords us direct (rather than representational) access to the environments in which we act responsively and, ultimately, responsibly. (Grene & Depew 2004, 339)

As I practice cultural economics (a recognized sub-discipline) constrained maximizing or economic behaviour takes place within the context of culture and law. Failure to account for culture gets you into the cannibal's cooking pot, failure to account for law gets you into jail. Neither is a maximizing outcome. I treat law as it relates specifically to knowledge below under *Law*. In general, however, in cultural economics law is treated as a varying cultural artifact defining what is property, *i.e.*, what can be bought and sold and under what terms and conditions.

Why do the English and Japanese drive on the left? It is because Napoleon never reached them (McLuhan & Fiore 1968). Why are images of women censored in Islamic cultures? Knowledge of such cultural norms and customs are crucial to survival of the individual yet vary significantly between Nation-States. They form the cultural tectonic plates identified by Samuel P. Huntington in his seminal 1993 article "Clash of Civilizations?". They include Muslim, Confucian, Hindu and Buddhist societies as well as the secular/Christian West and the secular/Orthodox East.

Economist Ekkehart Schlicht notes that "customs, habits, and routines provide the bedrock for many economic and social formations yet our understanding of the processes that underlie the growth and decay of customs is very limited. The theory of social evolution has hardly commenced to evolve" (Schlicht 2000, 33). With globalization proximity of tectonic cultures become closer, tolerance of difference and understanding more critical.

Epistemology

There are three domains of knowledge distinguished by their methodologies, objectives and tolerance of difference through time. They are:

Natural & Engineering Sciences (NES) – the hard experimental sciences;

Humanities & Social Sciences (HSS) – the soft human sciences or sciences of the artificial (Simon 1969); and,

The Arts – literary media, performing & visual arts.

Knowledge in the Natural & Engineering Sciences is fact-based and subjected to objective, value-free testing in which replicability is the criterion. It is concerned with objective truth, understanding and manipulation of the physical world. It exhibits decreasing tolerance through time for difference and error as old knowledge is progressively and reductively displaced by the new, *i.e.*, NES knowledge progresses vertically up the ladder of time.

In fact the word Science derives from the Latin *scire* "to know" which, in turn, derives from *scindere* "to split", *a.k.a*. reductionism. Similarly in Greek what was Logic became Reason in Latin from *ratio* as in to calculate. In economics I call this calculatory rationalism – doing things by the numbers.

Arguably, the success of the NES in generating new knowledge can be attributed to three factors. First is the Pythagorean Effect, *i.e.*, exploitation of the cognate relationship between mathematics and the world of matter and energy. Second is the Instrumentation Effect, *i.e.*, scientific instruments generate evidence not requiring intermediation by a human being and provide readings at, above and below the threshold of native human sensibilities. In effect, this lends metaphysical legitimacy to the NES. Scientific instruments realize the Platonic "belief in a realm of entities, access to which requires mental powers that transcend sense perception" (Fuller 2000, 69). Furthermore, the language of scientific sensors realizes another ancient Greek ideal, that of Pythagoras, by reporting nature by the numbers. Third is the Puzzle-Solving Effect of 'normal science' (Kuhn 1996) which permits vertically deep insight into increasingly narrow questions, *i.e.*, depth at the cost of breadth of vision.

When applied for utilitarian purposes, NES knowledge generates physical technology, *i.e.*, the ability to manipulate matter and energy to satisfy human want, needs and desires. The impact of the experimental method in the NES has been impressive in evolutionary terms. In the twenty generations since the Scientific

Revolution we have literally enframed our planet enabling ourselves of its bounties, making them ready at hand to serve our purpose from the deepest oceans to the outer reaches of the solar system.

It should be noted that traditional reductive science of controlled experiments is giving way to emerging inter-disciplinary 'synthetic' sciences such as ecology and climatology. These draw evidence from both the hard and soft sciences and use extremely complex mathematical models to put things together (synthesis) as opposed to breaking them down into smaller and smaller parts – reductionism.

Knowledge in the Humanities & Social Sciences (HSS) is value-based and subjected to mixed value-free/normative testing in which historical context plays a critical role. Experimental testing on human subjects is not ethically tolerated – any longer. It is synthetic in that it seeks reconciliation between objective and subjective truth. It exhibits shifting tolerances through time as old knowledge is often recycled in a pedagogic spiral to which new knowledge is added. New knowledge therefore does not necessarily displace old knowledge and revisionism is common, *i.e.*, seeing old things in new ways as well as seeing new things in old ways.

The limited success of the HSS in generating new knowledge compared to the NES can be attributed to the absence of the Pythagorean, Instrumentation and Puzzle-Solving Effects noted above. First, while there may be some relationship, there is no apparent cognate relationship between mathematics and human behaviour. Second, HSS evidence – in its collection, compilation and analysis - is subject to intermediation by human beings all along the evidence trail limiting objectivity. Third, with the pedagogic exception of the Standard Model of market economics, there is no generally accepted paradigm in any HSS discipline corresponding to 'normal science' that, according to Kuhn, is required for efficient puzzle-solving.

When applied, HSS knowledge generates organizational technology, *i.e.*, the ability to shape and mold human personalities, communities, enterprises, institutions and societies. This includes the entrepreneurial and managerial knowledge to combine capital, labour and technology into intermediate and final goods and services to satisfy human want, needs and desires. It more generally involves management and organization of the firm and Nation-State. It addresses questions of how to motivate workers and managers and how to marry them with financial capital as well as physical plant and equipment. The search for the best in organizational technology is

sometimes called *In Search of Excellence* (Peters & Waterman 1982). In effect, the HSS provide the epistemological basis for governance.

Knowledge in the Arts is concerned with subjective truth; a search for *kosmos* or the right ordering of the multiple parts of the world (Hillman 1981). It is holistic in its aesthetic contemplation or gestalt. Testing is purely personal and subjective: 'It works for me!' It tends towards increasing tolerance of differences, styles and tastes. It is value laden, not value free. New knowledge in the Arts does not displace the old. Shakespeare still speaks, Bach still plays and even Tutankhamen still sits proudly on his throne before us today. Thus modern creators compete not just against each other but against the best that have ever been!

Unlike physical and organizational technologies, however, design technology primarily affects the demand-side of the economic equation. In effect, design technology involves the use of the Arts to manipulate the emotional responses of consumers (see *Psychology* below). In this sense, Art is the technology of the human heart appealing to emotion not reason. It is much more sensitive to culture, custom and tradition than physical technology.

Aesthetic design is fundamentally different from technical or functional design such as a more efficient automobile engine. It contributes 'elegance' defined as simple but effective or "the best looking thing that works". If a consumer does not like the way a product looks, he or she may simply not try it. In effect, design technology involves marrying aesthetic to utilitarian value.

Beyond consumer goods, the Arts play a critical role in advertising and form the research & development arm of the entertainment industry. It is generally forgotten that within the ecology of capitalist realism, advertising is the lubricant of the market economy. And advertising, to a great extent, is the application of the literary, media, performing and visual arts to sell goods and services. Actors, dancers, singers, musicians, graphic artists, copywriters, and editors are all employed to sell everything from fruit to nuts; from cars to computers, from beer to toilet paper.

Law

While economics is poor at prediction it is extremely good at *ex poste* rationalization, *e.g.*, it cannot accurately predict the Depression but can explain it very well after the fact. Thus intellectual property rights (IPRs) have evolved over the course of centuries (Chartrand 2011) but as economist Paul David: observed, they have not been created "by any rational, consistent, social welfare-maximizing public

agency" (David 1992). The resulting regime is "a Panda's thumb", *i.e.*, "a striking example of evolutionary improvisation yielding an appendage that is inelegant yet serviceable" (David 1992). Paralleling development of IPRs is the evolution of multilateral and national cultural property rights (CPRs) discussed below (Chartrand 2009).

In economic theory, IPRs today are justified by market failure, *e.g.*, when market price does not reflect all benefits to consumers and all costs to producers, *e.g.*, pollution costs. These are known as external costs and benefits, *i.e.*, external to market price.

IPRs, in this view, are created by the State as a protection of, and incentive to, the production of new knowledge which otherwise could be used freely by others (the so-called free-rider problem). After all knowledge is a public good. In return, the State expects creators to make new knowledge available and that a market will be created in which it can be bought and sold. But while the State wishes to encourage creativity, it does not want to foster harmful market power. Accordingly, it builds in limitations to the rights granted to creators. Such limitations embrace both Time and Space. They are also granted only with full disclosure of the new knowledge, and only for:

> *a fixed period of time, i.e.*, either a specified number of years and/or the life of the creator plus a fixed number of years; and,
>
> *fixation in material form, i.e.*, it is not ideas but rather their fixation or expression in material form (a matrix) that receives protection.

Eventually, however, all intellectual property (all knowledge) enters the public domain where it may be used by anyone without charge or limitation. In other words a public good first transformed by law into private property is transformed back into a public good. Growth of the public domain is, in fact, the historical justification of the short-run monopoly granted to creators of intellectual property.

Even while IPRs are in force, however, there are exceptions such as 'free use', 'fair use' or 'fair dealing' under copyright. Similarly, national statutes and international conventions permit certain types of research using patented products and processes. And, the Nation-State retains the sovereign right to waive all IPRs in "situations of national emergency or other circumstances of extreme urgency" (WTO/TRIPS 1994, Article 31b), *e.g.*, following the anthrax terrorist attacks in 2001 the U.S. government threatened to revoke Bayer's pharmaceutical patent on the drug Cipro (BBC News October 24, 2001).

Statutory IPRs include:

Copyrights - protecting the expression of an idea but not the idea itself;

Patents - protecting the function of a device or process but only after disclosure of all knowledge necessary for a person normally skilled in the art to replicate the device or process;

Registered Industrial Designs – protecting the aesthetic or non-functional aspects of a device; and,

Trademarks – protecting the name, reputation and good will of a Maker, Legal or Natural, as well as Marks of Origin such as Okanagan Made.

Contractual rights to knowledge include Know-How and Trade Secrets. These take the form of non-disclosure and/or confidentiality clauses in commercial contracts as well as contracts of employment.

However, while all knowledge eventually enters the public domain some of it, in effect, is nationalized to become 'cultural property', *i.e.*, part of national or even global patrimony. It then becomes subject to domestic market restrictions as well as export and import controls of varying severity in the form of cultural property rights (CPRs). It is important to note that it is not the content or function of a work that becomes cultural property but rather the 'original' matrix in which it is fixed, *e.g.*, a Guttenberg Bible or Faraday's first electric motor of 1821.

The modern concept of cultural property was birthed by Henri 'Abbe' Grégoire (1750–1831) during the height of the French Revolution. His success can be judged relative to the fact that:

> Public responsibility for the conservation of artifacts of historic or aesthetic value is now acknowledged everywhere. One way or another the state will ensure preservation of a Stonehenge or a Grand Canyon as well as a great many lesser cultural icons. (Sax 1990, 1142)

Commissioned by the National Convention in 1794, Grégoire, produced three reports, the first of which was entitled: *Report on the Destruction Brought About by Vandalism, and on the Means to Quell It.* Grégoire coined the term 'vandalism'. In effect he asked:

> Why should caring for paintings, books, and buildings be a concern of the nation? Why, especially in a republic that was beginning radically

> anew, should monuments redolent of the values of the old regime be respected? (Sax 1990, 1144)

He framed his answer, in Republican terms, by asking in turn: What does the spirit of liberty require? He offered three answers:

> First, that liberty is only realized where the talent and creative energies of the individual flourish. Second, that only where tolerance for difference and respect for creativity exist can that flourishing occur. And third, that the pursuit of knowledge and repudiation of ignorance are essential to a process where talent and creativity will blossom. (Sax 1990, 1155)

Two qualifications are needed to the above description of Law as it relates to knowledge. First, rights of creators vary significantly between Anglosphere Common Law and European Civil Code traditions. Thus under the Civil Code artists/authors/creators enjoy imprescriptable moral rights, *i.e.*, they cannot be signed away by contract. This includes employees. Such rights are viewed as human rights based on the Kantian convention that original works are extensions of their creator's personality. Where in the Anglosphere moral rights are recognized, *e.g.*, in Canada, they remain subject to waiver if not outright assignment to a proprietor. This reflects among other things the Anglosphere legal fiction that Natural and Legal Persons enjoy the same rights. Imprescriptible rights significantly enhance the bargaining power of individual creators, an increasingly important question in a knowledge-based economy characterized by increasingly contract and self-employment rather than a life long employer.

Second, in the course of the current digital revolution content is being converted from analogue to digital format. By this act a new term of copyright begins for each new fixation. There has also been an outbreak of 'patent wars' where instead of an incentive to creativity, legal protection becomes a weapon in market competition. A similar development is taking place with respect to 'copyright abuse' by rights holders.

Linguistics

Martin Heidegger observed that "All ways of thinking, more or less perceptibly, lead through language in a manner that is extraordinary" (Heidegger 1954, 3). For his part Michael Polanyi noted:

> Words used in speech and, more particularly, nouns, verbs, and adjectives, are used like pointers to designate things they mean… Owing to the partial transposition of this experience to a distance… this object becomes in effect what we mean by our utterance. (Polanyi Oct. 1962, 605)

In English four distinct meanings lay hidden within the verb 'to know' including knowing by the:

Senses – sight & sound (distant senses - sensuous), smell, taste and touch (near senses - sensual);

Experience – been there, done that, got the T-shirt;

Mind – I think and remember and therefor I am; and,

Doing – can do, know how, experiential knowledge, learn by doing.

Etymologically the English verb 'to know' veils meanings expressed by four separate verbs in German *wissen*, *kennen*, *erkennen*, and (in part) *können*; and in French by two, *connaître* and *savoir*. The economy of English is both a blessing in terms of ease of use and a curse in clouding nuanced meaning. For example, the aboriginal peoples of the Arctic have specific names for different types of snow. This is part of their traditional ecological knowledge or TEK. Arguably each human language has a distinct sense of what constitutes knowledge. This includes written and non-written languages that have already died out and those currently dying out. Arguably, a unique nuanced meaning of knowledge dies with each. Their knowledge or orientation in an active environment is lost to humanity forever.

Morphology

Form, according to Francis Bacon, is "the real or objective conditions on which a sensible quality or body depends for its existence" (OED, form, n, 4 c). There are three material forms or matrixes into which knowledge is fixed. These include:

Codified with meaning fixed in matter/energy;

Tooled with function fixed in matter/energy; and,

Personal with thought, memory and reflexes fixed in neurons, nerves and muscles of the flesh and blood Natural Person.

Codified knowledge is fixed in an extra-somatic (Sagan 1977), *i.e.*, out-of-body, matrix as meaning. Sender and receiver must share the code if the message is to convey meaning from one human mind

to another. Furthermore, the communications media into which codified knowledge is fixed generally has no function other than to communicate meaning, *i.e.*, the matrix is non-utilitarian. For example, a book may be a good read but makes a poor door jam, or similarly, a CD may yield beautiful music but serves as a second-rate coaster for a coffee cup.

Tooled knowledge, on the other hand, is also fixed in an extra-somatic matrix but as function. Unlike a work of art that is appreciated for what it is, a device or process is valued for what it can do, *i.e.*, the matrix into which knowledge is fixed has utilitarian function.

Tooled knowledge takes two forms – hard and soft. Hard tooled knowledge is the physical instrument or process that manipulates matter/energy. As a scientific instrument tooled knowledge extends the human reach and grasp far beyond the mesoscopic level of daily life to the micro- and macroscopic worlds of electrons, quarks, galaxies, the genomic blueprint of life, *et al.* To see and manipulate matter/energy in such unseen, unreachable spaces and places our tools must go where no human can. They generally report back in numbers (digital) converted into graphics (analogue) to be red by the human eye. Modern scientific observation thus involves a cyborg-like relationship between a Natural Person and an instrument. This constitutes 'Instrumental Realism' (Idhe 1991). It provides what Galileo called 'artificial revelation' (Price 1984).

Soft tooled knowledge, on the other hand, refers to standards, *e.g.*, 110 vs. 220 volt, as well as programming software, operating instructions and 'manual' techniques to optimize performance. In effect, tooled knowledge is the physical technology by which humanity enframes and enables Nature to serve its purpose.

Personal knowledge is fixed in a Natural Person as neuronal bundles of memory and reflexes of nerve and muscle, *e.g.*, of the athlete, brain surgeon, carpenter, dancer, sculptor or technician. In this case, the matrix is a Natural Person. Some personal knowledge can be codified; some tooled; but some inevitably remains 'tacit', *i.e.* inexpressible yet sometimes visible in performance (Polanyi Oct 1962). Ultimately, however, all knowledge is personal (Polanyi 1962). Without a Natural Person to decode a work or push the right button codified and tooled knowledge remain sterile artifacts without meaning or function. And, of course, books, computers and corporations can't 'know' - only the Natural Person.

With respect to Law, codified knowledge is protected by copyright, registered industrial design and trademark. As cultural

property, codified knowledge is protected as original literary and artistic works including monuments and antiquities. Tooled knowledge is protected by patent and as cultural property in the form of historically important artifacts such as scientific instruments, machines, tools and other physical artifacts. Personal knowledge is protected as the know-how of a Natural or, by legal fiction, a Legal Person under Common Law. With respect to CPRs, personal knowledge is recognized in 'Living Treasures' in many Asian nations and under the 2005 *UNESCO Convention on Intangible Cultural Property* (Chartrand 2009).

Traditional and intangible cultural property together with Living Treasurers constitutes a Nation's 'patrimony' to which some contemporary work and workers are added with the test of Time. These three forms of cultural property taken together with private intellectual property and the public domain constitute the national knowledge-base.

Psychology

Psychology's 'knowledge about knowledge' is dyadic with a physical foundation of knowledge on which is mounted psychic faculties for its acquisition. The first can be called 'hardware'; the second, 'software'. Alternatively, the brain inclusive of the central nervous system is 'wetware' (Rucker 1988), a neologism distinguishing biological or carbon-based artifacts (natural or genetically modified) from silicon-based computer systems or 'dryware'. I first review findings from cognitive psychology concerning wetware and cognition, *i.e.*, physically how do we know, and then examine analytic psychology's model for the acquisition of knowledge.

It was only in the 20th century that wetware was meaningfully addressed by neurophysiology, *i.e.*, the study of the brain and nervous system. In simple terms, the human brain has developed through three evolutionary stages. First came the so-called Reptilian Brain whose nature was the subject of Carl Sagan's *The Dragons of Eden* (1977). Sometimes called the 'rectilinear or R-structure' it includes the brain stem and its specialized extensions such as the medulla oblongata. It receives sensations from the nervous system – voluntary and involuntary - and regulates the involuntary system. Second, overlaying this primitive brain is the Mammalian Brain or cerebellum with its distinctive lobes – left/right, front/back. Finally, like wrapping paper enfolding the previous two, is the cerebral cortex, the grey ridged matter sometimes called 'the human brain' but which we,

as a species, share with both the higher primates and cetaceans such as whales and dolphins.

Put another way, the human brain is a collection of dedicated modular units each adapted to deal with a particular set of problems. There are distinct modules for color vision, locomotion, language-acquisition, motor control, emotional recognition, *etc.* Each module developed through natural selection (Grene & Depew 2004, 340) complimented by coevolution (Kauffman 2000).

In this regard, research over the last hundred years has revealed a lateralization of higher brain functions or faculties. In the simplest, and least controversial terms: the left lobe is responsible for speech; the right lobe for pattern recognition, the front or temporal lobes for reasoning; the back or occipital lobes for visualization. The latter involves not just physical sight but also imagination, *i.e.,* "that faculty of the mind by which are formed images or concepts of external objects not present to the senses" (OED, *imagination*, 3).

The creative process appears to be rooted in the lateralization of brain function. The left hemisphere is primarily responsible for cognitive activities relying on verbal information, symbolic representation, sequential analysis, and on the ability to be conscious and report what is going on. The right hemisphere, on the other hand, functions without the individual being able to report verbally, and is concerned with pictorial, geometric, timeless and nonverbal information (Hansen, 1981, 23). In this regard, noted systems theorist Geoffrey Vickers wrote:

> I welcome the recent findings of brain science to support the common experience that we have two 'styles of cognition', the one sensitive to causal, the other to contextual significance. I have no doubt that the cultural phase - which is now closing - restricted our concept of human reason by identifying it with the rational, and ignoring the intuitive function, and thus failing to develop an epistemology which we badly need, and which is within our reach - if we can overcome our cultural inhibitions. (Vickers, 1977)

More recently research has shown that not just knowledge but intentional human action displays a gestalt-like quality. Thus intentional decision is preceded by emotional assessment (Freeman 2000). Again a combination of context and focal awareness is at play.

Then there are psychological ways of knowing, for example, those identified by Carl Jung and applied in industry and the public sector using The Myers-Briggs Type Indicator®. Thus we know by:

Thinking - interpreting what is perceived;

Intuition – perceiving possibilities inherent in the present;

Feeling - judging what something or someone is worth, and,

Sensation - perceiving immediate physical reality

Thinking and feeling are decision making faculties. In this sense, both are rational. Thinking uses logic leading to the Sciences. Feeling uses aesthetics leading to the Arts which I call 'the technology of the heart'.

On the other hand, Intuition and Sensation are a-rational in that neither explains or judges. Intuition generates what futures studies calls 'no-knowledge' - knowing but not knowing how one knows - one simply 'knows' (Jantsch 1967). Sensation especially those arising from the near or sensual senses of touch, taste and smell tend to overwhelm all others. This is why the ancient Greeks pursued logic to distance themselves from the thrall of physical sensation. Similarly the need to distance ourselves from the sensual is the root of the Fine or Beaux Arts birthed by Baumgarten's 18th century philosophy of aesthetics - the science of sensuous knowledge balancing logic as the science of intellectual knowledge (Kristeller 1952, 34).

Conclusion: Ideology

In conclusion I treat a final form of knowledge – ideology. If technology *cum* Heidegger (1955) enframes and enables us as physical beings within the human built environment then ideology enframes and enables us as mental beings within local, regional, national and global communities of ideas. An ideology becomes an environmental invariant subsidiary background against which the foreground of consciousness, *i.e.*, affordances, is tacitly interpreted. It is this enframing and enabling of minds within systems of ideas that forms what theoretical biology calls the noösphere, *i.e.*, "that part of the world … [of] conceptual thought… as opposed to the geosphere, or nonliving world, and the biosphere, or living world (Encyclopedia Britannica 2003). This is the world of knowledge. In it ideology acts much like Kuhn's paradigm of normal science (Kuhn 1996). It allows focus within an accepted framework. This has been compared to searching for one's keys under the street lamp because that is where there is light. An ideology is like the lamp post. Beyond its glare is the unthinkable, unknowable, off the chart where there be dragons!

Like Kuhn's paradigms anomalies build up until there is a shift. However, ideologies once adopted by an individual or society are hard to change. In fact one definition of ideology is: A systematic scheme of ideas, usu. relating to politics or society, or to the conduct of a class or group, and regarded as justifying actions, esp. one that is held implicitly or adopted as a whole *and maintained regardless of the course of events*. (OED, 4, *italics* added).

The word 'ideology' thus has many meanings today (Gerring 1997) but was coined simply enough by Condillac, a contemporary of Adam Smith, to mean 'the science of ideas' (OED, *ideology*, 1a). Separation of Church and State was critical to both American and French Republican Revolutions. Creation of a secular 'science of ideas' to counter the awe and mystery of religious and metaphysical thought and ritual was part of the French revolutionary agenda designed to overthrow an Ancient Regime of subordination by birth. Put another way, ideology is an explanation of the way the world works without a god; theology is an explanation of how it works with one. It should be noted that the word 'theory' derives from the Greek meaning a god's eye view.

In his April 25, 2005 'State of the Union' address to the Duma, Vladimir Putin, President of the Russian Federation, called the collapse of the Soviet Union in 1989 "the greatest geopolitical catastrophe" of the twentieth century (BBC April 25, 2005). Whether true or not, this event, accompanied by the nearly synchronistic conversion of Communist China to market economics marked the end of the Market/Marx Wars which had raged and divided the world for almost a century and a half beginning with publication of the *Communist Manifesto* by Karl Marx and Frederick Engels in 1848.

The Communist Revolution failed. The Republican Revolution survives. The Republican Revolution was about the political rights of the citizen no longer subject of some Crown. The Communist Revolution was about the economic rights of the worker no longer a disposable asset of capitalist enterprise. Today, with the exception of North Korea and a wavering Cuba, no Nation-State subscribes to economic Marxism while the People's Republic of China struggles to reconcile private property and the marketplace with the political clarity of Leninism and the Party as vanguard of the revolution (Polanyi 1957, 480). In this view, conversion is distasteful but necessary as a temporary detour on the road to perfect communism and the withering away of the State. Nonetheless, virtually all Nation-States are either current or expectant members of a World Trade Organization (WTO) rooted in the ideology of the market.

A world divided and threatened with nuclear winter for almost half a century now rallies around the last ideology standing – market economics with its political and legal corollaries of popular democracy and private property. The way the world works under perfect competition (as opposed to perfect communism) is a positive sum game governed by a transcendent market in which no one player – consumer or producer - can influence the outcome. Assuming the absence of market failure there is also, ironically, as in perfect communism, no role for the State. Pursuit of self-interest led by the 'invisible hand'' (Rothschild 2001) of the marketplace means everyone wins.

Like Communism with its *Communist Manifesto* (1848) and *Das Kapital* (1867), market ideology arose in two stages, first with the Republican Revolution of the late 18th century. This established the political economic principles of *laissez faire* and *laissez passer*. Let them make what they want and work where they want without reference to the preferences of princes and kings. This was the age of Adam Smith's *The Wealth of Nations* (1776) and, coincidentally, of the American (1776) and then French (1789) Revolution.

The second stage, the Marginalist Revolution, began in the 1870s with the marriage of Newton's calculus of motion and Jeremy Bentham's felicitous calculus – the calculus of human happiness. It came to fruition in the 1920s with the work of Alfred Marshall. It shifted the focus of economics – Classical and Marxist – from the distribution of national wealth among 'classes' to the efficiency of the atomized individual consumer and producer. It established the 'X' of market Supply and Demand as the spot where consumer happiness and producer profit is maximized subject to budgetary and cost constraints resulting in the greatest good for the greatest number. In many ways the Marginalist Revolution caught Economics up to the politics of the Republican Revolution. This is captured in terms such as 'consumer sovereignty' and 'dollar democracy'. The individual, not the class, became the focus.

This is not, however, the end of ideology (Bell 1960) nor of history (Fukuyama 1992). Now that the fog of war has dissipated, it is time to reconsider both victor and vanquished. Glorification of 'us' and demonization of 'them' are by-products of war - hot, cold and ideological while reflection and reconciliation ought to be the by-products of peace. Arguably both political and economic rights are required to realize human potential. However, to the victor go the spoils.

Ideologies are arguably analogous to organisms capable of adaptation, growth, mutation, recombination and symbiosis. They therefore exhibit "avalanches of speciation and extinction" (Kaufmann 2000, 216). This metaphor of avalanches of change has been extended by Kauffman from molecular biology or genomics to the economy or what he (2000) and Kenneth Boulding (1966) call the 'econosphere'. Kauffman draws a parallel with Joseph Schumpeter's description of technological change as the "gales of creative destruction" (Kauffman 2000, 216; Schumpeter 1950, 81-86). Kauffman also suggests application to the growth, mutation and development of human culture and knowledge. Consider the mutating flavours of Capitalism. According to Steven Pearlstein (2012) these include robber baron, corporate or managerial, State, entrepreneurial, worker, shareholder and financial capitalism. Each has had its day in the sun with financial capitalism remaining in vogue despite the Great Recession of 2008. Arguably its persistence highlights how belief in an ideology can be "*maintained regardless of the course of events*".

With respect to avalanches of change it should not be surprising that just as the former Second World of centrally planned economies melted into a single global marketplace, the economies of the First World shifted from a foundation based on manufacturing to one based on knowledge (OECD 1996). This was accompanied by transition to financial capitalism (knowledge-based) and de-industrialization or rather de-manufacturing of most developed Nation-States excepting Germany, Japan and the Nordic countries. It also, of course, saw China become the workshop of the world.

Similarly, it should not be surprising that as the knowledge-based economy emerged the definition of knowledge itself underwent a scientific revolution (Kuhn 1996). First, as noted above under *Epistemology*, traditional reductive science of controlled experiments is giving way to emerging inter-disciplinary 'synthetic' sciences such as ecology and climatology. Second, the old philosophy of science modeled on the 'when-then' causality of physics (Grene & Depew 2004, 95) is increasingly being displaced by causality by purpose or by design (Chartrand 2006) - natural purpose in biology and human purpose in works of aesthetic, intellectual and technological intelligence (Aldrich 1969). The emerging science of genomics represents a marriage of natural and human purpose and arguably provides the base metaphor for the next stage of the knowledge-based economy.

Put another way the mechanical metaphor that dominated the manufacturing economy is giving way to the biological metaphor. Put

yet another way the technological imperative driving Marxist analysis of economic development and Schumpeterian creative destruction is increasingly recognized as a biological imperative in this age of the knowledge-based economy.

Postscript

I became an economist in my first year of study in 1968. While Paris students rioted and American cities burned I was presented with the Solow residual: Y = *f* (K, L, T) which reads national income (Y) is some function (*f*) of capital (K), labour (L) and technological change (T). At the time it was claimed that over the last one hundred years 25% of growth of national income was attributable to changes in the quantity and quality of capital and labour and 75% to technological change but we have no idea of why something are invented and others not; and, why some things are successfully innovated and brought to market and other are not. The Solow residual was, and remains to me, *the measure of our economic ignorance*. It should be noted that ignorance means lack of knowledge. Any discipline that admitted 75% of its subject was unknown needed help and I became an economist.

Subsequently I learned that technological change in economics means the impact of new knowledge on the production function of firm or nation. The nature of knowledge, however, was not and still is not usually considered; only its quantitative impact on the production function. Put another way, economics has limited knowledge about knowledge. My career has been and remains dedicated to gaining such knowledge and this paper represents a summary of some of my findings to date.

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