THE THIRD AGE OF THE UNIVERSITY

From Interpretation to Generation to Commercialization of Knowledge

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Introduction

One of the ironies of history is that three major knowledge or 'epistemological' revolutions of modern Western Civilization occurred in spite of not because of the University. Thus the Renaissance of the 15th century was the product of Artists & Humanists working outside its walls, not Scholars under its towers. Similarly the Scientific Revolution of the 17th century, or more precisely innovation of the instrumental experimental scientific method, occurred outside not inside its cloistered halls. To add salt to wound, the Industrial Revolution of the 19th century was also an epistemological revolution. It was not, however, a revolution of the mind *per se* but rather of the doing. [1] It tooled knowledge into matter/energy as function effectively granting humanity dominion over the planet. This 'applied' revolution was also initiated by dissenters who could not attend the University.

In this article I assess the thousand year epistemic evolution of the University from birth in the 11th to the 21st century. Accordingly, after the Church, the University is the oldest living institution of Western Civilization. The University is, in effect, an *overlapping temporal gestalten* (Emery & Trist 1972) woven out of a long and twisted Past. As will be demonstrated, precedent and path dependency shaped its passage to the Present and continue to influence its performance.

In this assessment I identify the mandate of the University as initially interpretation (the First Age) then generation (the Second Age) and, finally, commercialization of knowledge (the

Third Age). In conclusion, I project a probable and a preferable future for the University in the emerging global knowledge-based economy (OECD 1996). In this economy the competitiveness of nations is rooted in national innovation systems (OECD 1997) in which the University acts as nucleating agent or 'prime attractor'.

The First Age

With the fall of the Western Roman Empire in the 5th century much of the technical knowledge or 'know-how' supporting its production function was lost. Texts of the Ancients and Church Fathers that survived were squirreled away and lovingly conserved in mountain monasteries. It was to interpretation of this legacy that most clerics and subsequently secular scholars called 'Schoolmen' dedicated themselves. [2] Truth lay in the Past not in the forbidding Present or uncertain Future.

The disciplinary foundation of interpretation or transmission through teaching was the monastic order including Benedictines, Cistercians and Gregorians then later Franciscans and, much later, Jesuits (Cantor 1969). These orders were based on dogma of a doctrinaire 'father'.

After the dust of conquest had settled with the triumph of Charlemagne and establishment of the Holy Roman Empire in 800, urban life began to flourish again in the West disturbed only by Viking raids and later Crusades to the East. In response the Church shifted epistemic emphasis from the monastery to the Church 'school' in cities to train notaries, lawyers, scribes and other literate professionals required in any 'civilization'. It was from this experience that the western University arose.

Building on Byzantine and Islamic experience, *e.g.,* Al-Azhar University founded in Cairo in 975, the Western University was first incorporated as an association of students in Bologna about 1088 then of teachers in Paris about 1150. Oxford, the first English University founded in 1167, was modeled after the University of Paris (Schumpeter 1954, 77-78). Teachers and students had disciplines based on subject matter defined by the Ancients, not religious dogma. [3]

The University broke the monopoly of knowledge held by the Church. It assembled libraries of its own including works not approved by the Church. Secular monarchs granted charters defining rights, freedoms and obligations to the Crown (similar to other guilds) and cultivated it not primarily for knowledge but as a source of talent to balance the influence of the Church.

The medieval University was organized into three primary domains of philosophy, literally 'the love of knowledge': natural,

moral and metaphysical, *a.k.a*., theology. To these, the Practices or self-regulating professions of Law and Medicine were added as quasi-independent branches of applied learning. Excepting the Practices, the University taught the 'Liberal Arts', *i.e.*, knowledge suitable for the leadership elite. This included music, the only Art admitted at the birth of the University.

University disciplines were paralleled in the 'real world' by guilds practicing distinct 'mysteries' in the Mechanical Arts (Houghton 1941). To work with the mind and word was noble; to work with the hands, however, was ignoble and demeaning. This prejudice is captured in the contemporary English expression: Gentlemen don't work with their hands!

Similarly many hierarchical structures and rituals of the medieval University continue to this day. Such anachronisms include: the Bachelor & Master of Arts and Doctor of Philosophy; colleges; the robes and trencher caps; and, offices such as chancellor, dean, provost, *etc*. The word 'anachronism' highlights a salient characteristic of knowledge, *i.e.*, it exists in overlapping temporal gestalten (Emery & Trist 1972, 24) like Foucault's 'epistemes' (Foucault 1973) and Kuhn's 'paradigms' (Kuhn 1996). In effect, the Present is woven out of uneven strands, *e.g.*, of religion, politics, language, *etc*., each stretching ontologically back into their distinct Pasts. Precedent and path dependency pattern the Present. Linking back to an origin is the literal meaning of the Latin *re-ligio*. In this sense Time's Arrow runs backwards, forwards and sideways in the noösphere. [4] Such a view contradicts the concept of 'modernity' as homogenous co-temporality of all sectors of society.

Within the University constant re-interpretation of the ancient legacy gave birth to a distinct Western school of thought: Scholasticism. Lacking access to other ancient works available in the Byzantine and Islamic empires Scholasticism was based on an incomplete reading of this legacy. Nonetheless it successfully rationalized a feudal world applying the mathematics of harmony and analogy and giving birth to the 'High Middle Ages'. Everyone knew one's place. It was a dense social space. From this fitness peak, however, it soon fell.

The Black Death ravaged Europe between 1347 and 1351, two generations before the Renaissance. While mortality varied monastic communities suffered worst. The Church was decimated, *e.g.*, the papal court at Avignon was reduced by one-fourth. In general, talent in all skilled trades became scarce; wages went up; and, the social status of the individual climbed gradually breaking free of feudal chains slowly giving rise to Capitalism.

Fifty years after the Black Death the Renaissance artist/humanist/engineer/scientist, unlike medieval predecessors, signed their works inaugurating the Western 'cult of the genius' (Woodmansee 1984; Zilsel 1918) with its Humanist cry: 'Man is the measure of all things'. Among other innovations they introduced the concept of objectivity as representation (or modeling) applying the mathematics of perspective (Heidegger 1938). Most were not of gentle birth and did not attend the University. In fact, visual artists broke with the craft guilds and established their own fine arts academies outside the University (vom Busch 1985).

Any hope the University might become a generator of new rather than interpreter of old knowledge was, however, swept away, along with Humanism, [5] by the Protestant Reformation and Catholic Counter-Reformation of the 16th and 17th centuries. God again became the measure of all things and the University became an ideological instrument in a religious war that ravaged Western Europe for more than a century.

Unlike other European states, however, England split not two but three ways – Protestant, Catholic and Anglican or Church of England. It was in these troubled times that Francis Bacon in 1605 [6] called Scholars to come down from their ivory towers into the workshops of Mechanics to practice the instrumental experimental scientific method and force Nature to reveal her secrets. Fifty years later at the height of Cromwell's Commonwealth Robert Boyle provided the metaphysical rationale for this new 'experimental philosophy' placing the laws of the geosphere in stasis above and beyond human *and* divine intervention. This was the 'Latitudinalist compromise' (Jacob 1978). Its logo was Newton's clockwork universe running on the calculus of motion.

Secular *and* religious legitimacy for experimental philosophy was granted by charter to *The Royal Society of London for the Improvement of Natural Knowledge* in 1662 (Jacob 1978; Jacob & Jacob 1980). As with the Renaissance, however, this was outside the University.

After its founding the Royal Society made several attempts to realize Bacon's dream of erecting its own 'House of Experiment' (Shapin 1988). All attempts failed. Similarly, Bacon's history of the trades was never completed and quietly faded from view. This turning away from the Baconian vision was the result of certain founding members of the Royal Society known as the *virtuosi*, especially John Eveyln. Thus, Evelyn "… abandoned the history of trades, which Bacon [urged]… because of

'the many subjections, which I cannot support, of conversing with mechanical capricious persons'" (Houghton Apr. 1942, 199).

Arguably, 'gentrification' of Baconian science delayed the Industrial Revolution in England by a century. And when it finally happened in the late 18th and early 19th centuries it was inspired by forces outside the University and initiated by founders who "learned their science indirectly while pursuing their trade… and did not rely on the established system of higher education" (Senate Special Committee 1970, 21).

In England for another half century the experimental sciences were practised primarily outside the University by gentlemen scholars such as Darwin. Their success, however, led the poet Samuel Coleridge to ask the philosopher of science, William Whewell, to rename the natural philosopher. In 1833, he did so, coining the term 'scientist' (Snyder 2000).

The Second Age

While the English continued interpretation of old knowledge, the Second Age began in Germany with Wilhelm von Humboldt founding the first 'research' University at Berlin in 1809. Its mandate was generation of new knowledge.

For the new University truth lay in the Future by way of prediction. It married 'when-then' causality to the calculus of motion. The research University was a triumph of the Enlightenment or *Querelle des Anciens et des Modernes, i.e.,* the battle of the Ancients and Moderns (Kristeller 1952, 19). It answered once and for all: Who are superior: the Ancients or the Moderns? The answer: the Moderns!

In effect, this new mandate institutionalized the instrumental experimental scientific method. This, in turn, promoted 'instrumental realism' (Idhe 1991) which, like perspective in the Renaissance, fundamentally altered the way we know the world. [7] Price characterizes its cognitive impact as "artificial revelation" (Price 1984, 9).

Nonetheless, throughout the 17th century the experimental sciences existed outside the University acting like an 'emergent process' (Emery & Trist 1972, 24-37). First through concealment then parasitism, Natural Science (NS) gradually entered the University, absorbed more and more of its resources (financial and human) until finally it became the dominant domain on campus. In the process, 'natural philosophy' faded away displaced by a triumphant experimental philosophy. This new mandate spread first to the U.S. and then worldwide so that today virtually every University is a 'research' University.

In this regard, Michael Polanyi argues the University is the natural home of NS (Polanyi 1960-61, 406). In other domains new knowledge is found outside the University in a 'real' world subject to the artificial laws of the human condition. NS, on the other hand, concerns the objective unchanging laws of Nature. The controlled experimental conditions provided by the University makes it the appropriate place to generate new knowledge about Nature. Thus it became the idealized home of Polanyi's 'Republic of Science' (1962) dedicated to pursuit of knowledge-for-knowledge-sake without political or economic interference.

Usurpation of the University generated three effects: in the short run, fission; in the intermediate run, fusion; and, in the long run, political and economic intervention. In the short run the effect was epistemic fission. Organized 'normal science' began. Within a paradigm new knowledge rapidly accumulated. As anomalies piled up scientific revolution swept away the past paradigm replacing it with one more fit. Normal science then resumed until the next revolution (Kuhn 1996).

Division and specialization of labour also spawned an expanding range of sub-disciplines and specialities. Kuhn observes that: "Over time a diagram of the evolution of scientific fields, specialties, and sub-specialties comes to look strikingly like a layman's diagram for a biological evolutionary tree" (Kuhn 1990, 7-8). However, *both* theoretical, *a.k.a.*, scientific, and applied, *a.k.a.*, engineering, knowledge rapidly accumulated. As noted by Price (1965), Science works with the previous generation of Technology while Technology works with the previous generation of Science in a reiterative cycle.

Furthermore, paradigmatic puzzle-solving generates increasingly 'incommensurable' knowledge (Kuhn 1996). Such incommensurability led Price (1984) to re-coin the phrase 'invisible college' to describe the forty or fifty people in the world who can understand what is being said or written in any given NS speciality.

Fission was not, however, restricted to NS. Modern Social Science (SS) was spawned by the epistemological and technical success of NS. In effect, an old Moral Philosophy rooted in theology mutated to become SS rooted, by analogy, in NS.

Furthermore, while the mathematics of motion became embodied in the steam powered mechanics of the first Industrial Revolution, behind the scene a second less visible revolution in chemistry and electricity was underway. In both when-then causality was tempered by a probabilistic reality and the law of large numbers rather than calculus. Similarly, biology remained

the taxonomic science established by Linnaeus until Darwin and Mendel in the mid-19th century. Natural selection was then recognized as the mechanism of evolution and biology too began to build on the law of large numbers and probability (Grene & Depew 2004).

Finally, in the late 19th and early 20th century, there was a second Scientific Revolution in physics. The foundation of reality was no longer indivisible billiard balls but rather probabilistic quanta states. Here too the law of large numbers and probability rather than calculus became the foundation of a relativistic physics that unleashed nuclear technology. [8]

In the intermediate term, the success of the research University acted as a magnet fusing with other knowledge domains and Practices. To the traditional Colleges of Arts & Sciences, Law and Medicine, new colleges became attached including agriculture, commerce (accountancy), dentistry, education, engineering, kinesiology, nursing, pharmacy & nutrition and veterinary medicine. Concerned primarily with application rather than generation of knowledge, the Practices use the University as a training ground then independently license graduates.

In the case of the Arts as in 'Fine' Art, with the exception of music due to its Pythagorean connection with mathematics and literature (rhetoric and grammar), the Arts were not part of the ancient or medieval curriculum (Cantor 1969, 66-67). The Arts are 'crafts', *i.e.,* they involve experiential learning. This is epistemologically critical – knowing by doing – as in the Practices. In the Renaissance the art academy was established separate from the University (vom Busch 1985, 3). In theater and dance, there was no formal training in any Anglosphere University until the late 19th century and the Fine Arts were not finally admitted until after the Second World War (Robinson 1982). Once admitted, however, they had a dramatic effect on both the University and society in general (Toffler 1965). The traditional independent status of the music conservatory within or without the University is further evidence of the traditionally separate institutional pattern of learning pursued in the Arts.

In the long run, however, the NS take-over led to political and economic intervention. Politically, the success of the research University became evident with the Franco-Prussian War of 1870 (Fuller 2000) through WWI & WWII. Government, however, essentially let the University pursue its mandate. With the end of WWII, however, Government began to make capital grants and subsidize students. The Soviet Sputnik in 1957 further focused attention on the University. By the 1960s Government support based on student enrollment vastly expanded the University budget

shifting its mandate slightly away from generation to transmission of knowledge, *a.k.a.*, teaching.

Campus unrest during the Viet Nam War, however, caused Government to re-focus on the University as a potential threat to its authority. In response, during the 1970s Government support declined. In the 1980s Government intervened in the research process using 'challenge' and 'matching' grants to tilt research towards its social and economic concerns, *e.g.*, poverty and competitiveness.

Political intervention was paralleled by Business. This had two facets. First, post-war growth of corporate research & development boosted demand for trained personnel. Business pressed for more relevant training of students. This further shifted the mandate towards transmission specifically of vocational knowledge, *i.e.*, job-related skills.

Second, the post-war baby boom combined with public funding transformed the University from an elite to a mass market for publishing and related industries. First and second year textbooks became profitable mass market commodities. Today this market is dominated by five global media conglomerates. At the same time the University responded by maximizing class size to reduce the average cost of instruction especially of instructors. They also increasingly used part-time lecturers rather than tenured faculty to teach first and second year courses.

Furthermore, the publishing industry, spearheaded by Robert Maxwell in late 1970s, identified an internal contradiction in the relationship between the University and its professoriate – copyright. Under Common Law copyright in a work by an employee, *unlike* a patent, belongs exclusively to the employer. In the University, however, by convention and contract, copyright belongs to the professor and the professor must publish or perish.

Media conglomerates began to buy up major journals. Professors, University employees, willingly gave up copyright to be published. (In the case of textbooks, a professor retains all royalties. None flow to the University whose students buy the 'kit'.) The conglomerates thus package works made by University employees and sell them back to University libraries and students at ever escalating prices. The rising cost of journals means declining purchase of 'non-essential' learning materials. This led the Association of Research Libraries, among others, to press for new methods for publishing peer reviewed research and instructional materials.

Finally, near the end of the Second Age political and economic intervention was invited by the University itself faced

with the rising cost of 'Big Science'. In physics multi-million dollar instruments to strip away the next veil of Nature simply became cost prohibitive. Accordingly Government, Business and the University increasingly pooled resources to generate new knowledge. The Canadian Light Source at the University of Saskatchewan is an example of such an arrangement.

The Third Age

The Third Age of the University began near the end of the 20th century. In 1995 the World Trade Organization (WTO) was formed marking the end of the Market/Marx Wars. As Second World command economies melted into a single global marketplace, the First World shifted from manufacturing to knowledge. The OECD's 1996 publication: *The Knowledge-Based Economy* (KBE) formalized this transition. Then, in 1997, the OECD published a survival guide for the KBE: *National Innovation Systems* (NIS).

Until this time there was arguably no coherent national strategy for the exploitation of new knowledge for competitiveness. With NIS, however, commercialization of new knowledge generated by the University became the cornerstone. In Canada there were two primary policy thrusts.

First, Government funded a network of nonprofit endowments to speed the flow of new knowledge from the University to Business. These endowments support joint projects, host meetings, conferences and seminars as well as publish bulletins to facilitate communications across the cultural divides separating the University, Business and Government.

Second, near the end of the Second Age a 'New Economic Geography' was introduced that re-directed Government (Martin & Sunley 1996). A central feature is the 'industrial cluster' such as 'Silicon Valley'. While economies of scale and scope are available within a single firm, external economies are available only outside. High tech firms operating in the same sector benefit from physical proximity. Such clusters, in turn, crystallize around the University as a nucleating agent or prime attractor. Thus fusion with the Practices in the Second Age is paralleled by geographic concentration of knowledge-based industries around the University in the Third. The success of Government sponsored 'clusters', however, is problematic (Economist Oct. 11, 2007).

While public policy shifted the University mandate towards commercialization, another epistemological revolution was underway. This time, however, within the University itself. This is the biogenetic, genomics or bioinformatics revolution.

With the decoding of DNA a new enabling or transformative technology was unleashed. Its leaders are generally University-based (Zucker et al 1998, 293). It is they who take new knowledge and commercialize it. It is they who attract the best students. Often they establish new firms within an existing cluster or start a new cluster with the assistance of the University which shares in patent royalties. Many new biotech firms are in fact founded with the intent of selling them to large established firms (Arora & Gambardella 1990, 362).

Beyond the change in University mandate embodied in a new breed of entrepreneurial scientist, a new mathematics is also developing. Under the rubric 'bioinformatics' this new math involves combinations & permutations, compliments & substitutes, existing & emergent forms. One sub-set is the 'adjacent possible'.

Given an active environment, autonomous agents – organisms or institutions – constantly adapt, adjust and evolve or go extinct. They adapt by experimenting with mutations called preadaptations or exaptations. According to Kauffman, these come from the adjacent possible consisting "of all those molecular species that are not members of the actual, but are one reaction step away from the actual" (Kauffman 2000, 142). In the noösphere, it is those ideas which are candidates for the next stage of ideological evolution. Economic, epistemic and biological systems expand or explore the adjacent possible as quickly as possible subject to timely selection of the fit and unfit, *e.g.*, going out of business. Such timely selection is called 'early visibility' and 'fast failing' in the innovation literature (Economist October 11, 2007). If selection takes too long, then fitness declines or simply melts away.

Conclusion

In conclusion: How will the Third Age of the University unfold? What is the probable vs. preferred future?

The probable future is an extension of current trends, *i.e.*, path dependency and precedent. With respect to teaching, 'vocationalization' continues. There are no more 'Liberal Arts'. Only 'can-do' knowledge will do. With respect to research, specialization accelerates incommensurability with little cross-talk between disciplines. We know more and more about less and less. Research becomes increasingly utilitarian, *i.e.*, valued not for itself but for what it can earn. The University uses increasingly restrictive intellectual property rights to gain revenue from all new knowledge generated by its employees – the professoriate. Copyright joins patents as an asset shared between employer and employee. At the same time, researchers in 'can-do' disciplines

forge ties with Business sometimes suppressing critical knowledge until exiting the University. Researchers in 'no-can-do' fields fade away like natural philosophers. The 'ivory tower' becomes a factory producing knowledge workers and new knowledge to feed Business and the competitiveness of nations in a global knowledge-based economy.

Alternatively, the preferred future is rooted in preference. My preference is to apply lessons from the emergent fourth epistemic revolution – genomics/bioinformatics. In fact, the University is, for the first time in its history, the eye of the epistemic storm. As we learn to inject living things with human purpose we begin to appreciate that over-specialization reduces fitness defined as adaptability to a changing environment. Fitness requires flexibility and redundancy. It requires breadth and depth. It requires integration of incommensurable streams of knowledge like successful innovation in industry (The Economist Oct. 11, 2007). Arguably, the University is the natural home for such synthesis – all knowledge domains and practices are present.

In its struggle to survive as an autonomous agent, the University confronts a fitness landscape in which it must dynamically balance three mandates: (1) interpretation of *all* knowledge domains and practices; (2) generation of new knowledge as an-end-in-and-of-itself; and, (3) commercialization of knowledge – old and new - to tactically resource (1) and (2) and thereby minimize *unsolicited* political and economic intervention. This requires, however, realignment of self-interest within the University itself – administration, professoriate (including emergent entrepreneurial scientists) and students – old and new. This, in turn, however, assumes a common objective: to maintain the University as a politically and economically autonomous agent of social change in its Third Age.

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Endnotes

[1] The verb 'to know' derives from the same root *cnaw* as the verb' 'can'. In addition 'to know' has absorbed the meaning of the obsolete verb 'to wit' meaning to know by the mind. Accordingly 'to know' includes by the senses, by the experience or acquaintance, by the mind and by the doing. A knowledge-based economy therefore is not an economy of the mind but rather a 'can-do' or 'know-how' economy. In German, there are separate verbs for each meaning.

[2] Clerical scholars who explored the experimental method and the primacy of observation included Michael Scotus (1175-1234) , Roger Bacon (1214-1294), William Occam (1280-1349) and Nicolaus Copernicus (1473-1543).

[3] While not strictly Kuhnian 'normal science', this disciplinary focus permitted systematization of knowledge resulting in 'Scholasticism'.

[4] In theoretical biology there are three spheres: the geosphere of inanimate matter/energy; the biosphere of living things; and, the noösphere of human thought.

[5] During these troubling times the Humanities were, in effect, absorbed by the University under Moral Philosophy.

[6] *Of the Proficience and Advancement of Learning Divine and Humane*, published in 1605.

[7] Tooled knowledge in the form of the scientific instrument extends the human reach and grasp far beyond its natural limits. To see and touch such unseen, unreachable spaces our tools must go where no human can. They report back in numbers (digital) converted into graphic (analogue) representations – a form of codified knowledge – to be 'read' by the human eye. Observation today involves, in effect, a cyborg-like relationship between a Natural Person and an instrument, *i.e.*, Instrumental Realism (Idhe 1991).

[8] It was, among other things, this shift to probability and the law of large numbers that led Edgar Zilsel to part ways with the Vienna Circle and Logical/Empirical Positivism as well as from Betrand Russell and Logical Atomism (Raven & Krohn 2000, xxxix).