

**An Emerging Synthesis from the cognitive, biological and social sciences concerning the evolved nature of human learning that should be used to transform arrangements for the education of young people**

Prepared by “The 21<sup>st</sup> Century Learning Initiative”  
January 2005

## **Adolescence; a critical Evolutionary Adaptation**

This Paper has been written in response to an increasing concern that formal education, especially at the secondary level, is failing to meet the needs and expectations of young people for an appropriate induction into adult life and responsibilities. This is a problem apparently common to many of the developed countries. This paper will argue that a better appreciation of the biological processes involved in human learning, and the way these interact with cultural practices, could provide the theoretical basis for a complete transformation of formal educational structures.

An analogy may help to explain this. Humans have been using their brains to think, and their stomachs to digest food, since the beginning of human times; both processes appear so normal that they are taken for granted. However in the past fifty years medical sciences have learned so

much about the human digestive system, and the significance of different kinds of food to lifestyles, that most people are living longer – not through drugs but simply through treating their bodies more sensibly. In the past ten to fifteen years biomedical discoveries about the brain and how it works, how it relates to its present and inherited environments, and the way it changes at key stages in the human life cycle, could do for human learning what the past two to three generations have done for physical well being.

It could do this not through the application of expensive new institutional arrangements, but simply by creating systems of learning that go more effectively with “the grain of the brain.” Critical to this “grain” is a transformed understanding of adolescence as an essential evolutionary adaptation of great value, rather than a social construct associated with the apparent trauma and tension of the teenage experience. However, just as better bodily health has come through many sensible day-to-day adjustments to life styles, rather than through an over dependence on medicine, so improvements in the opportunity to use “the grain” of our brain more effectively will probably necessitate more emphasis on the way society does things informally from day-to-day, rather than any extended institutional arrangements for schooling.

To those readers unfamiliar with the basic tenets of evolution, or whose understanding of psychology largely predates the 1980’s, much of the explanation that follows in this Paper will seem novel, maybe unsettling, or even wildly speculative. Rather than learning being primarily dependent on external influences, which was the legacy of the Behaviourists until well into the 1970’s, we now know that “the complexities of our minds and bodies witness a long history of subtle adaptations to the nature of the world. Human beings, with all their likes and dislikes, their senses and sensibilities, did not fall ready-made from the sky, nor were they born with minds and bodies that bear no imprint of the history of their species. Many of our abilities and

susceptibilities are specific adaptations to ancient environmental problems... (Barrow, 1995).”

Chief of those abilities and susceptibilities is the human capacity to learn.

### **Some Important Definitions**

**Before setting out an explanation as to why the proposition that Adolescence is a biological state essential to human survival, rather than a recent social construct (teenagers), it is necessary to define certain terms.**

1. **Synthesis** is the drawing together of ideas from different fields of study. It is “the coherent whole that results is considered to show the truth more completely than would a mere collection of the parts” (Encyclopaedia Britannica). Synthesis is the opposite of the dominant academic methodology of western society, namely Reductionism, which is the solution of a problem by reducing every issue to its separate parts.

2. **Adolescence**; the period of transition between childhood and adulthood; a stressful and turbulent period of sexual, physical and psychological change; the development of a mature set of values and responsible self-direction, and the breaking of close emotional ties to parents. (A contemporary observation; “the (adolescent) has no defined role of his own in society, but is caught in the ambiguous overlap between the reasonably defined roles of childhood, and adulthood. Sometimes treated as a child, sometimes expected to be an adult, s/he is uncertain how to behave. Also society serves to frustrate important psychological needs of the young person (e.g. sex and the desire for independence) thus generating aggression, or other reactions.”

3. **Evolution**; “a change from a less coherent form to a more coherent form... from the lowest living forms upwards, the degree of development is marked by the degree to which the

several parts constitute a cooperative assemblage”, explained Herbert Spencer (1884) seeking to define more clearly Darwin’s concept of transmutation (evolution) as a continuous process of gradual change from a simple into a more complex form.

4. **Adaptation**; a change by which an organism becomes better suited to its environment, and which becomes permanently “encased” in the organism’s new form so as to perpetuate the advantage.

5. **Natural selection**; “If within a species there is variation among individuals in their hereditary traits, and some traits are more conducive to survival and reproduction than others, then those traits will obviously become more wide spread within the population. The result will be that the species aggregate pool of heritable traits changes”, Charles Darwin, *The Origin of Species*, 1859.

6. **Critical Point**; a stage in the transition from one state to another which, if missed, prevents the transition from being fully completed and the organism never reaches its optimum state.

7. **History**; the past considered as a whole; **historical interpretation** – a description of events or propositions set in the context of the social/philosophical ideas prevalent at the time..

8. **Learning, Education and Schooling**; **Learning**; the process by which an individual uses new information to improve on its earlier understanding, so as to make ever wiser judgements and so improve its chances of survival; **Education**; the conscious provision of opportunities and means of encouragement to transmit knowledge, and the lessons gained from experience, from an older to a younger generation; **Schooling**; a system of recent origin designed to formally transmit knowledge, expertise and skills to a group of young people under the institutional control of a teacher acting on behalf of the greater community.

9. **Aberration**; variously described as either a “wandering of the intellect”, or a “deviation from the normal type.” In the study of optics an aberration means the non-convergence of rays

of light. (e.g. all the light you need is there, but it does not converge, and therefore you cannot actually see the picture); a development that departs, potentially disastrously, from previous practice.

10. **Intuition**; a non sequential non linear nor necessarily logical way of thought, often arising from unconscious perceptions; “an original, independent source of knowledge... designed to account for just those kinds of knowledge that other sources do not provide” (Encyclopaedia Britannica).

11. **Teenager**; a term first used in America between 1935-1940 to describe someone who was no longer a child but not yet employed in serious adult activity. First recorded in the Oxford Dictionary in 1954.

## **Section One. Where the current theories of learning have come from, and why modern society so often confuses schooling with learning.**

Since the beginning of recorded history philosophers, observing the human condition, have noted many of the complexities (the “messiness”) of human learning. Confucius observed two and a half thousand years ago; “Tell me and I forget / show me and I remember / let me do and I understand.” Sometime later the writer of the Book of Ecclesiastes, bemoaning the production of still more books, lamented that “much study wearies the mind.” St Augustine in the sixth century commented wryly “I learnt most not from those who taught me, but from those who talked with me.”

Fearful of what he saw as the weakness of the human spirit if it became too involved in practical, earthly and passionate affairs, the influential Elizabethan academic, Roger Ascham, argued in

1570 in his vastly influential book, “The Scholemaster”, that one year of study from a book was worth more than twenty years of learning from experience. Such academics saw justification for this in the earlier classical teaching of Plato for the control that this gave them over what their students learnt. Plato had argued that mankind could be divided into three groups according to whether they had gold, silver or iron in their constitutions – those with gold being the leaders, those with silver being administrators and those with iron the labourers.

To the post Reformation philosophers, as well as later school teachers, academic study was the means of perpetuating those divisions for, so they argued, only youngsters destined to rule needed access to intellectual thought uncluttered by practical concerns. John Milton, the seventeenth century poet, almost succeeded in persuading Oliver Cromwell seventy years later to abolish the Elizabethan grammar schools and replace their overly classical view of education with what he called Academies. Milton envisaged an Academy in every town of the land providing tuition in both practical affairs, and in the matters of the mind. Most people, Milton believed passionately, needed both kinds of knowledge; “though a man should pride himself to have all the tongues that Babel cleft the world into, yet if he had not studied solid things in them as well as words and lexicons he were nothing so much to be esteemed a learned man as any yeoman or tradesman.” Cromwell died early and Milton could well have been executed when Charles II returned as king for English society of the 1660’s was too busy enjoying itself to have any interest whatever in such a proposal to transform society through education. Milton’s plan was stillborn, and schooling, so well described by Shakespeare in his picture of “the whining school-boy, with his satchel and shinning morning face, creeping like a snail, unwillingly to school” remained a minority activity for perhaps as few as five percent of the population of England until less than two hundred years ago.

Yet it was little more than two hundred years ago that England led the world into the first Industrial Revolution that was to transform forever the nature of society in its own, and so many other, countries. How did this happen in such an apparently “unschooled” country? The Industrial Revolution was certainly not led by the classically-trained grammar school students, but rather by that great mass of the population, ignored by Roger Ascham and his successors, who had learnt their skills through the continuous problem-solving culture that defined the relationship of apprentice to master craftsman. Learning on the job was what ninety-five percent of the population did up to the end of the eighteenth century. Evidence would suggest that while formal schooling was very much a minority activity, nevertheless the “unschooled” mass of the population was far from illiterate. Four out of five of the soldiers in Cromwell’s New Model Army could sign their names, and the booksellers of London sold sufficient books at the turn of the seventeenth century to average two books to every household in the country. There was much reading going on in England three hundred and more years ago – and as people read, so they talked and argued. Most people saw little reason for writing things down; why should they, for the people they needed to communicate with they saw every day? Half the people who paid good money to attend a Shakespearean tragedy in the London of the 1620s, it is estimated, could not read, but they were well able to understand the subtleties of human behaviour as portrayed on the stage. Book learning alone does not necessarily define a society able to think well.

It was apprenticeship that combined the many ways of knowing into practical knowledge, and it was through apprenticeship, not schooling, that children in those pre-industrial days passed from youth to adulthood. “Apprenticeship was a system of education and job training by which important information was passed on from one generation to the next. It was a mechanism by which youths could model themselves on socially approved adults; it was an institution devised to ensure proper moral development, and a means of social control imposed upon the potentially

disruptive male adolescents. In its many functions it provided a safe passage from childhood to adulthood.”

Our ancestors several hundred years ago could not understand the reason for the turbulence of adolescence ... but they knew what to do about it. Adolescence and apprenticeship went hand in hand. A fifteenth century English ballad states “But when his friends did understand / his fond and foolish mind, / they sent him up to fair London town / an apprentice for to bind.”

Such a gutsy, robust form of learning as was apprenticeship was of no interest to those classically trained theoreticians whose prime interest lay in defining a curriculum for schools that originated in classical thought and philosophy. Quite simply such academics just didn't see anything of value in what was going on beyond their classroom walls, and it was not until the late twentieth century that the process of learning as encapsulated in apprenticeship was seen as a fit concept to study; indeed the passage quoted above was written in the late 1980s. Nevertheless two hundred years after Roger Ascham it was undoubtedly the apprentice/craftsman process of learning that gave birth to the Industrial Revolution. That Revolution needed several hundred key inventors (mainly men who themselves had served apprenticeship in various trades), but for its actual delivery it depended on the practical applied skills of tens of thousands of former apprentices – men who as master craftsmen themselves later in life called upon the experience of many years of continuously working out new solutions to old, as well as novel, problems for themselves. Men who had learnt the hard way, and were fascinated by what they did. Friedrich Engels, travelling through England with Karl Marx in 1844 recorded in his diary “I often heard working men, whose fustian jackets scarcely held together, speak about the geological, astronomical and other subjects with more knowledge than the most cultured bourgeois in Germany can possess.”



England in the late eighteenth century was a land of lively, inquisitive, energetic and practical people, but – and it is a big and tragic “but” – it was also a land where a tiny minority controlled most of the capital. These “well favoured” men were determined to preserve their form of learning as the defining point of their difference with the common man.

The Industrial Revolution, and the mass manufacturing economy that it spawned, largely destroyed the old craft ethic of thoughtfulness and personal involvement. It reduced apprenticeship by the mid twentieth century to an almost meaningless “serving one’s time.” The earlier integration of home, community and work that had characterised English society for centuries was replaced by a mass manufacturing society which took parents out of their homes, and largely left children either unsupervised, or as cheap, disposable factory labour. No longer had parents skills they thought worthwhile to share with their children, and children saw little to interest them in their parents’ boring lives. Quite simply there was no longer much for families to talk about.

Seeking both a custodial and an instructorial solution to “what to do with the children” mid nineteenth century social activists turned to the decontextualised model of the traditional, classical school as earlier defined by Roger Ascham, and still tottering along in the grammar schools with their emphasis on memory and repetition. Schooling, as established for the masses in the mid nineteenth century, was to be about abstract thought processes rather than applied skills. To this was added, at the insistence of the Churches, the responsibility for moral and ethical education.

Mass schooling soon came to resemble the techniques of the factory. As the nineteenth century gave way to the twentieth, formal education, in exchange for conforming to its processes (however uninteresting), and for learning its basic skills (that did not personally empower youngsters to think for themselves), was reasonably successful in inducting whole generations of people into a moderately comfortable society where they had little thinking to do for themselves. (Read of the antics of Mr. Gradgrind and Mr. M'Choakumchild in Charles Dickens' "Hard Times") Such a trivialisation of human expectations recompensed the lack of stimulation in adult work with wages just sufficient to purchase a way of life that now came to see its reward in what goods – manufactured by somebody else – this enabled the dumbdowned workers to purchase for their own entertainment in their "free" time. By the beginning of the twentieth century working and living had become separated in a way that the old craft ethic could never have anticipated, while by mid century the reality of youngsters too old to be treated as children but not yet in meaningful employment – "teenagers" – was apparent in England, America and some other developed countries.

Then, as the smoke stacks of the Industrial Revolution collapsed in the late 1970s, so called developed countries realised that the mass of their populations really just wasn't that developed after all. Long years of simply repeating routine skills left displaced workers with little faith in their ability to learn new skills. Most recently globalisation, assisted by ever more sophisticated information and communication technologies, has opened up world markets to entrepreneurs on a scale which, little more than a decade ago, would have seemed inconceivable. The corollary to that, of course, is that unskilled workers in developed countries now compete directly with labour in the Third World. The difference between rich and poor is now as likely to be defined by which end of the street you live in, as it is by your nationality.

“To thrive in this new economy” politicians in many lands tell their people, “We need to invest in our national creativity, our entrepreneurial skills, and higher order thinking and processing skills.” Which sounds largely right. When such politicians then go on to urge that we should all be collaborators as well as competitors, and be as concerned for the well-being of the community as we are for our individual needs, it sounds as if we are heading for a possible utopia.

However, it is how we will reach such a place that political solutions in many countries seem to be pointing in exactly the wrong direction. The devil is always in the detail.

“What we need is more schooling, longer hours, more subjects, more accountability, and higher standards”, such politicians declaim. The assumption seems to be, and has been in England since the Education Reform Act of 1988, that while the present model of schooling (five to eighteen years of age with transfer at the age of eleven) and the diminished role of the community and home, does not work as well as its advocates would wish, this is because of inefficiency. It is not the system which has to be blamed, it is the people within the system who have just not been up to the task, we are told.

It is indeed curious that this is an explanation given as frequently in Australia and New Zealand, as it is in Ottawa, Washington or London. Have all the teachers, in all these countries, just gone soft... and gone soft at the same time? Impossible as this would seem, so effectively has that message been communicated to the general public that the explanation has come to be seen as an accepted fact. And it is wrong, terribly wrong. Consequently a whole generation of teachers, governors and administrators have now been drilled in the School Effectiveness Movement; what matters now, they have been persuaded to believe, are standards, accountability, and management by objectives.

Despite mountains of legislation, and the expenditure of enormous sums of money, there is a creeping sense of fear at all levels that not only are the results (based on those factors most easily assessed) plateauing out, but that society as a whole (when measured in non material, quality of life indicators) is not significantly better off than it was before. Crime, alienation, and social decay in many different guises are obvious manifestations of what other research shows – namely that people are no happier than they were twenty or more years ago even though society as a whole is materially significantly better off. In fact we are less happy, it seems, and rates of clinical depression continue to climb. In separating out the craftsmen’s sense of pride and self esteem for “a job well done” from the quality of life available to those who conform, rather than genuinely create, it seems that we have created a society that no longer fits with the grain of the brain. Society is “out of sorts” with itself. Which has to be a significant part of the reason why so many young teachers in England resign from the profession within less than three years, and why so many headteachers seek early retirement, and why there are ever fewer applicants to replace them.

\* \* \*

All the above is, in its broadest sense, history and social commentary. It is nevertheless history that is vital to understand because the Synthesis which is emerging from research in various sciences suggests that the development of the school in the past two hundred years is, despite all its economic benefits, in human terms, an aberration. An aberration is defined as “a wandering of the intellect”, a “deviation from the normal type”, or the non convergence of that light needed to see the whole picture. Contemporary society in its attitude towards young people, has become

like an express train that has been diverted from the main line – going to the wrong place, and fast approaching the buffers. Society it seems is losing sight of what actually makes it work.

Schooling has come to emphasise in the early twenty first century, more than Roger Ascham could ever have dreamt, the triumph of the intellect over that of the applied. In so doing, this interpretation will argue, it has effectively devalued many of the skills that made us humans in the first place. Because of this (at a very deep, often subconscious level) we are losing the ability to be the all-round people that evolution has apparently equipped each of us to become. Robert Wright, one of the most respected writers on evolutionary psychology, makes the point that evolution has prepared humans to be an effective species, rather than a happy species. Humans all too often find that “to travel hopefully is better than to arrive.” A late eighteenth century Englishman, or Canadian, working on his farm, or in his shop, warehouse, or building a ship, might have struggled to make a living, but it is unlikely that he or she was depressed. In strictly evolutionary terms survival comes not to the most intelligent, nor to the strongest, but to the one who, in Darwin’s terms, “fits in best” – the one who is most adaptable, and most able to find a niche in collaboration with others. Successful living requires collaboration, as well as competition – it is this essential balance that a crude and over simplistic acceptance of the market economy has driven out of contemporary societies.

**Section Two. Synthesis.** The more humans have come to understand themselves, and the world around them, the more they have found it necessary to divide knowledge into separate disciplines. Each discipline then develops it’s own theories, and methodologies. They may broadly study the same phenomena, but from such a different perspective that no coherent picture emerges. It’s like the Hindu proverb about three blind men trying to define an elephant; the first handles its trunk and says it is a large snake; the next feels its leg and says it is a forest,

while the third feels its ear and concludes that it is a massive leaf! The magnificence of the elephant was lost because none of the blind men could comprehend the whole creature.

In terms of the explanation made in this paper it has to be noted that a critical academic bifurcation – a splitting of the ways – occurred in the 1860s following Darwin’s publication of *“The Origin of Species.”* Medical science was moderately quick in the years that followed to see in the theory of evolution an explanation for so many of the features of human anatomy and physiology that have, subsequently, resulted in treatments which have greatly improved the quality and longevity of human life. But although Darwin speculated that evolution might eventually explain many features of human behaviour through the study of the evolved nature of the brain, psychology, as the study of human behaviour, was a very new and separate discipline in the 1860’s. Nineteenth century psychologists found the concept of “evolution in mind” too radical to handle. This was tragic because, for more than a century, until well into the 1970s, psychology largely ignored any evolutionary explanations for human behaviour. This was partly because such an idea offended many people’s spiritual beliefs, and partly because of the sheer impossibility of trying to understand the microstructures of the brain until the invention of brain scanning technologies in the early 1980s.

Lacking such an appreciation of the evolved nature of the brain, psychology came to emphasise a highly behaviourist approach to human learning. Behaviourist psychology, led by J. B. Watson in the 1920s and 1930s, ignored all explanations for human behaviour that could not be observed, tested, and confirmed in a controlled laboratory environment. Drawing many of its conclusions from animal studies (Pavlov’s salivating dogs and cats) learning, Behaviourists concluded, was all about being taught. With the appropriate teaching Watson had argued, you could condition people in any way you wished. With sufficient pressure on teachers and pupils,

latter-day Behaviourists still believe, every school should be able to improve its SAT scores by a given percentage as defined by an ambitious politician. Learning, they still argue, is controlled from the outside – they see it as a response to external stimuli... sticks and carrots of a certain size (and applied to teachers, as well as pupils).

The first of the three new disciplines that need to be understood is **Cognitive Science**. Cognitive science owes its origins to a meeting at MIT in 1956 of psychologists, linguists and computer scientists who claimed that human minds and computers were sufficiently similar that a single theory –they called this a theory of computation – should guide research in both psychology and computing. Out of this theory cognitive science, as the “science of the mind”, was born. With this came the recognition that there are hidden causes of behaviour so rescuing psychology in the 1970s from the earlier, cripplingly narrow version of human behaviour that had dominated policy making for virtually half a century. A revolution in psychology was starting.

Cognitive scientists were, in the main, younger psychologists; men like Howard Gardner who introduced the theory of Multiple Intelligence (1984), and John Bruer with his influential work on “Schools for Thought” (1993). Their challenge was largely successful, and cognitive science became a major contributor to psychological theory. Such researchers were not, however, medically trained; they dealt in measurable statistical inputs and outputs, and formulated valuable conclusions about the processes that they deduced shaped each. But such researchers did not actually “touch” brains. Neurons and synapses, myelin sheathing, dendrites and neurotransmitters were on a scale with which cognitive scientists could not deal. Nor did such cognitive scientists look for explanations as to why such processes might exist – they dealt entirely in the “here and now.”

The second discipline is **Neurobiology**. Neurologists are medical practitioners who study, and operate on, the brain. Their antecedents go back to an assumption in the early nineteenth century that the study of “bumps” on the skull resulted from various kinds of brain activity (phrenology). It was the development of CAT (computerised axial topography) scans in the early 1980s, followed shortly thereafter by PET (positive emission topography) scans that first made it possible to identify the several different areas of the brain that are activated by specific thoughts or actions. Functional MRI (magnetic resonancing imagery) makes such studies even easier, faster and safer, and confirms what was earlier surmised, that even an apparently straight forward mental task requires the coordinated activity of several different parts of the brain.

“The brain is made up of anatomically distinct regions, but these regions are not autonomous mini brains; rather they constitute a cohesive and integrated system organised for the most part in a mysterious way”, wrote Professor Susan Greenfield in 1997. The welter of subsequent publications shows that the more that is discovered the more mysterious – awesome – the brain becomes. This was forcefully put by Schwartz and Begley (2002): “Human brains are only partially understandable when viewed as the product of medical processes... the mind can, through knowledge and effort, reshape the neurobiological processes...It’s a mental striving, not a deterministic physical process.”

In less than fifteen years contemporary informed opinion has moved from thinking of the brain as a mechanism, to thinking of it as an organism – a blueprint dictated by events long past but constantly reshaping itself in each individual life cycle through neuroplasticity. The brain is not a fixed entity, and nurture matters quite enormously. We design our houses, the colloquial expression has it, and they then shape the way we live. Put another way we are enormously empowered by the evolved nature of our brains, but we are constrained as well. Forced to go



against our natural way of doing things the grain becomes fractured, rough and unserviceable. We can only bend our mental processes a certain amount from the normal – that is why the analogy about society having been diverted on to a side track that ends in a set of buffers, is so important.

While cognitive science tells us much about the process of learning, neurobiology explains many of the structures in the brain that actually handle this. What neither discipline does is to explain how the brain came to be that way in the first place. This is where evolutionary studies, and especially evolutionary psychology is especially helpful.

**Evolutionary Psychology** is the most speculative of the three new “disciplines” – so much so that it is frequently not even accepted as a discipline by its two older cousins. Essentially a hybrid of the evolutionary sciences and psychology it draws extensively on biology, genetics, archaeology, anthropology, and neurolinguists as well. Since its inception in the late 1980s evolutionary psychology has caught the public’s attention for its ability to paint the “Big Picture” of human origins. All three disciplines are essential to understand the proposition made in this paper about adolescence as being a critical survival skill. A further analogy may help at this stage. Neurology is like taking very detailed static photographs, at enormous magnification, of highly specific parts of the brain. Cognitive science is more like an infra-red image showing the connections between different parts of the brain, and some of these images have movement – they are like short video clips. Evolutionary psychology is more like an epic film, a vast moving picture on an enormous screen which, while indistinct in many places, and so vast that the plot sometimes gets lost, shows how the human brain processes have evolved over time.

To understand the proposition that adolescence is a critical evolutionary adaptation essential to society's survival we need each kind of "picture." Together these disciplines take us way back into the origins of human learning that makes the explanations of men like Confucius, St Augustine and the writer of the Book of Ecclesiastes (as quoted earlier) seem like comments made in the last second of a film that started a full twenty-four hours before. Only in the last five or so years could the story set out below be told.

\* \* \*

### **Section Three. The "Big Picture" of how we humans learn, as we can now describe it.**

The human species apparently separated from the Great Apes some seven million years ago, leaving modern man still sharing ninety-eight percent of its genes with the chimpanzees. Most of this two percent difference seems to relate to our brains which appear to have grown exponentially in this time (creating in the human brain the most complex organism in the known universe). The more effectively our ancestors used their brains it seems the larger their descendants' brains became. Here is much of the reason for what earlier researchers saw as the dilemma about human learning: is it a product of genetics or of experience? If it was nature versus nurture, who won... or how many points in a hard fought fight should be allocated to each? That we now understand this conundrum better will unfold in the next few paragraphs.

Virtually all mammals give birth to their young when their brains are almost fully formed. The major exception is us humans. As the brains of our ancestors started to grow (probably some two million or so years ago) that put pressure on their skulls to get bigger. This created a painful

and devastating problem, for there is an absolute limit as to how large the woman's birth canal can get. Over time it seems evolution found a neat compromise – an adaptation (a chance ad hoc solution which eventually became encased in the human genome). Human babies are born nine months after conception but – and here is the wonder of the adaptation – with their brains only forty percent fully formed. If pregnancy was to go to its natural term it would last twenty-seven months, and the baby would never get down the birth canal. Being born so premature human babies are extremely vulnerable for it takes a further thirty months outside the womb for the brain to become structurally complete. The behaviour of most mammals is based on instincts (spontaneous, unreflective responses) successfully implanted in the young brain before birth. For humans, however, a full sixty percent of brain growth is dependent on environmental and other stimuli to which the young child is exposed during the earliest months of life. In this respect the Behaviourists were right, human behaviour is far more dependent on learning than it is on instincts – but for reasons very different to those advanced by those early psychologists.

Born so obviously helpless as is a human baby it is all the more amazing that humans have evolved to become the most dominant species on the planet. From such an apparently poor start how did our distant ancestors grow such amazing brains?

The same genes that dictate the birth of the human with such a premature brain are also responsible for empowering that premature brain to mastermind its own subsequent growth through the operation of mental predispositions (something which Howard Gardner hinted at with the theory of multiple intelligences, but never elaborated on). Predispositions are not the same as instincts. Instincts operate of their own volition; you don't have to work at them – they are literally “instinctive.” Predispositions are different, they are more like a set of metaphorical DIY guides sitting on a metaphorical bookshelf in that forty percent of the brain the child is born

with. They were written, as it were, by the successful experiences of our very distant ancestors and show the techniques they used to get the right results. They are a critical part of our evolutionary “legacy.” Just how these predispositions are transmitted we don’t yet understand. Whether any of these “guides” are actually taken off that metaphorical shelf by the individual and acted upon, depends on one key instinct – that of humankind’s insatiable curiosity. The asking of endless questions – how, when, where, why, what, who – the kind of questions that young children can use to drive their parents crazy! We are the learning species because we are compelled to ask questions when we don’t understand something.

Many researchers now suspect that there are a number of such latent predispositions. At a young age a child develops a sense of place – largely babies don’t crawl over the edge of a precipice, and they don’t learn that simply through trial and error! Very early on babies learn to decode the meaning of facial expressions. They learn to speak their native language by about the age of three (and several languages if they are living in a multi-linguistic community). Scientists now know much about this wondrous process for, it seems, a child born anywhere in the world will learn, apparently spontaneously, the language heard around it. In so doing linguistic researchers believe that a baby apparently calls upon a basic mental configuration (a kind of complex software programme) that was somehow devised by the experience of our ancestors as being the most effective way to structure concepts into words, and subsequently convey meaning to others.

This language predisposition appears to be time limited for if a child does not hear language spoken, and does not speak itself by the age of about eight, it is highly unlikely that that child will ever speak. There are other critical periods, it is being discovered, during which particular metaphorical DIY guides can be accessed; miss that time frame and the brain appears, quite automatically, to prune that potential capability.

In terms of critical time frames it is almost as if the brain has an efficient librarian systematically, but subconsciously, getting rid of unused manuals, so that other parts of the brain can expand. Any readers who found it hard to learn a foreign language later in life would have found that all those DIY guides had been destroyed... they were only available to “young” readers, and we adults can no longer access that part of the library. Adults have to learn the hard way. There are no shortcuts. All an adult can do is to envy the thirty-month-old child’s ability to learn ten new words a day – three and a half thousand words a year – with no apparent effort. Adults have to work at learning a language through endless repetition and much practice.

Cognitive scientists see language development as a key human skill, while evolutionary psychologists go further, and see language as a key survival skill. The distinction is important. The child who, out in the ancestral environment, could speak and understand what other people said, would have a higher chance of surviving than the child that did not understand the message about, say, a wolf coming around the corner. Such inarticulate children were likely to die before passing on their genes, while the successful language speaker – the learner – would live to pass on its genes. This language adaptation has become encased in the human genome. Our ability to acquire and use language is a key aspect of our humanity.

#### **Section Four. The Deep History of the Human Race – where, and when, our mental predispositions were formed**

It is now necessary to step back into the deep prehistory of the human race to see what other successful adaptations our distant ancestors evolved to enable us, their descendants, to use our

brains well. It is a story that starts hundreds of millions of years ago but can conveniently be noted, as far as humankind's separate evolution is concerned, as starting seven million years ago – nearly half a million generations back. It will take a real effort of mind to hold such a thought together as this story unfolds. To comprehend that we act as we do because of the experiences of our ancestors thousands of generations back, not simply because of our parents or grandparents, inevitably stretches our limited powers of imagination.

The story ultimately takes us right forward into an explanation for why those eighteenth century apprentice/craftsmen were able to lead England into the Industrial Revolution. It will also give substance for why this Paper argues that the roughly two hundred years of mass schooling that followed, was indeed an aberration – a wandering of the intellect – resulting in the turmoil of the non-convergence of many parts of the human psyche that actually makes so many features of modern life – not just schooling – dysfunctional. **Here is the radical thought; maybe schooling has created more problems for modern man than it has solved.**

Anthropologists and other scientists are now close to agreeing that for the greater part of those seven million years, our ancestors lived as tiny groups of wandering hunter/gathers on the savannah lands of central Africa. These were people who owned nothing, planted no crops, domesticated no animals, and for whom every day was a new struggle. The archaeological record shows that although their brains were getting steadily bigger, they appear not to have learnt much – if anything – from such day-to-day experience that enabled them to improve their lot. The axe heads they left behind showed few improvements until about a million years ago.

As a puny species it appears from evidence in the Stirkfontein caves just to the north of Johannesburg, that we humans in the earliest days were more often the hunted, rather than the

hunters. Lone families of our early ancestors often ended up as tiger food. Bones found in those caves suggest that something highly significant happened about one and a half million years ago, for the bones recovered from the cave floor reveal that, from that date onwards, it was the animal bones that showed signs of the meat having been cut from them, while the human bones that have been found are largely intact. It was as long ago as that, so evolutionary psychologists now speculate, that we humans learnt to collaborate when we went hunting. We did this not through the use of language (which came far later) but because we became sufficiently good at understanding what was going on in each others' minds that we could anticipate each others possible reactions. In short we became expert in reading peoples' faces, and understanding body language.

Most other animals have only a limited ability to do this. Empathy, evolutionary psychologists now argue, was the key skill that propelled the human species on its ever more rapid upward spiral. Faces matter to us; the eyes of very young babies search our faces for clues as to our intentions. Women, it seems, are far better than men in understanding such nonverbal expressions and feelings because, argue evolutionary psychologists, over all that time in the ancestral environment, women worked in small groups to collect fruit and berries, and chatted while they did so. Men were so busy hunting, and often out of earshot of each other, that they became better – so the same argument goes – at talking silently to themselves, than talking to each other. It is the same in 2005 – girls develop language skills more rapidly than boys; girls seem to enjoy language, whereas boys often simply “grunt.” Maybe many a modern woman would agree! Even now, in our highly technological world, it is easier to tell a lie in a letter or an e-mail, or even over the phone, than it is face-to-face. Here is another adaptation. (Incidentally if you are thinking of investing in third generation mobile phones you would probably be advised not to – most men like the anonymity of talking whilst not being seen!)

Composite evidence from several disciplines suggests that the human ability to use language started only about one hundred and fifty thousand years ago. Whatever it was that stimulated this, one amazing feature followed. Looking for an effective way to handle language the brain laid neural channels for speech along side those already well established for vision (rather like laying cable television networks along side telephone, gas or electricity services). The long-term impact of this has been significant. Although we talk in words we actually tend to think in pictures. It's why a picture is said to be worth a thousand words. It's why identity parades and photographs can convey more meaning than verbal descriptions. It's why lovers often find it hard to describe the colour of their partner's eyes, and it is why television has a broader appeal for many than radio. It is why we remember stories, more than theories – and why we so often find formal lectures and technical reports so very boring. (It is why this Paper is especially written to combine theory with anecdote... to hold people's interest for longer than would normally be the case). Any parent accustomed to reading a favourite nursery story to their children of an evening will readily recall how, thinking their child already asleep, they will cut out a few words or sentences to speed things up. Instantly the child becomes fully alert, and issues a sharp rebuke. How, the parent wonders, can a very young child do this?

Fortunately for the evolutionary psychologists there are still just a few hunter / gatherer societies in existence in remote parts of the world that help explain such behaviours. Observing such people it is immediately obvious that story telling is an absolutely critical part of such societies' existence. Night after night, year after year, the elders tell and retell the stories of their tribe. Woe betide any child whose attention wanders, for an otherwise kindly relative will so cuff the child that any thought of sleep disappears. Once the adult story teller has completed his tale one of the children will be required to tell another tale... an exact repetition of a story the child



would have heard weeks beforehand. Evolutionary psychologists believe that our ancestors have been memorising stories since we first started talking. It is why cognitive scientists are beginning to note that not only are humans natural learners, we are natural teachers as well. It was the children who retold stories accurately who not only survived, but probably established a prestige that enabled them to mate more often than the less successful storytellers. (That is a thought to meditate on!). Learning a complicated story through constant repetition would drive many an adult crazy, but to a young child to learn through constant repetition is easy and even fun. When you were rebuked for missing out a few sentences from that favourite bedtime story you have to wonder at the power of all that evolutionary experience in your child's brain.

Observing how the children of one of the last hunter / gatherer societies play is like seeing back into the nurseries of prehistoric times. The Hadza tribe in Tanzania now number less than a thousand people. They are thought to be a relict culture still functioning at a Stone Age level, most likely to have been typical of cultures forty to sixty thousand years ago. Not only is story telling a ritual practiced around the campfires each night, so also is the making of music. The Hadza sing a lot and make a kind of wind box by cupping hands together with intricate finger movements. While research on music making is still scanty, it appears probable that an ability to express emotions through music is even older than our ability to construct language, and almost as old as our empathic skills.

\* \* \*

**Then take the issue of play.** Play it seems is extremely important. Anthropologists suggest that the more complex are the cognitive processes of the species, the greater the importance of playfulness. Without play we don't go beyond the normal and the predictable. Play is about

experimenting in a moderately safe environment. Psychologists define it as “a state of optimal creative capacity.” It is about imagining alternative possibilities – as Einstein shrewdly noted, “imagination is more important than knowledge.” The word “school” comes from the Greek word “*skhole*” meaning both leisure and a lecture place; in other words a time and place where the exuberance of doing exactly what you enjoy meets the challenge of working logically – or, at least that is what school should do. Play is about learning how to correct mistakes so that, as an older person finding themselves between a rock and a hard place, the individual is not intimidated by risk. The ability to play appears to be yet another critical adaptation. “All work and no play makes Jack a dull boy”, chimed fifteenth century know-alls in the years before Roger Ascham.

The ancestral environment, the savannah on which the human race grew up, was fraught with risks. To observe Hadza men encouraging their sons to make perfect arrows was to see the best pedagogic skills ever legislated for under a government educational reform programme naturally practiced by “unschooled” men who knew that quality learning was about survival. The adult inspired the child, but never overawed it with the depth of its own knowledge. The adult never failed to praise; but it didn't over praise. The adult constantly urged the child to experiment, to test the flight path of different kinds of arrows, and then to evaluate the results. That is how we humans were learning probably forty thousand years ago.

Those tribesmen taught their sons and daughters to read the natural signs around them with a sophistication that a reader of this Paper might expect to apply to a particularly interesting newspaper editorial. Those “stone age” people used many more of their innate senses every day than do those of us whose intellectual skills are measured in terms of the computer programmes we use, but whose computers we could never actually make. Those stone age tribesmen sniff,

they sense temperature differences in a way we can't, and they make fine distinctions between shades of colour that we don't even notice. The youngest children create play-worlds of their own – where the adults live entirely in straw-covered huts hastily erected over small branches of wood the young girls make miniature toy “huts” of their own, and lift the occasional ember from the adult's fire for their own "hearth." The youngest boys endlessly experiment with their bows and arrows, occasionally wounding some of the chickens.

\* \* \*

**Of the greatest importance to such early people was the progression of their dependent child to that of autonomous adult.** This was a process that had to be completed sufficiently early to ensure that the young adult would be able to take on whatever were the responsibilities of the earlier generation before they died. While there is much evidence about the care and attention given by such people to the very young (as can easily be noted to this day in remote areas of Africa or elsewhere) there was absolutely nothing soft or sentimental about this. Amongst the nomads of the Zagros mountains of southern Iran, until very recently, adults spent much time and energy equipping every four-year-old to look after the chickens, the six-year-olds the goats, the eight and nine-year-olds the sheep, the ten-year-olds the asses and twelve-year-olds the donkeys – leaving only the bad tempered camels as needing actual adult attention! When the tribe moved everyone had a task to complete. As the child grew older so the tasks they were allocated became harder. Everyone was engaged, even if work frequently felt like play they all shared in the sense of achievement.

Such small-scale, self-contained communities depend upon the good will of their members to ensure cohesion, but such cohesion would have come at too high a cost if youthfulness lasted too

long , and there was any undue delay in reaching adulthood. **The adaptation that had earlier enabled the young to learn easily in their earliest years through intense emotional connection with older people, had to be balanced by an internal mechanism that prevented the children from becoming mere clones of their parents.** In other words unless those close bonds which had characterized the earliest years were ruptured (forcibly if necessary) the young would not grow to be adaptable to new situations. Adolescence, it is now becoming clearer, is that deep-seated biological adaptation that makes it essential for the young to go off, either to war, to hunt, to explore, to colonize, or to make love - in other words to prove themselves – so as to start a life of their own. As such the biology of adolescence aims to stop children being merely clones of their parents. It is probably a time-limited predisposition, in other words if the adolescent is prevented (by over careful parents or a too rigid system of formal schooling) from experimenting and working things out for itself, it will lose the motivation to be innovative or to take responsibility for itself when it becomes adult.

We know that the Greeks and the Romans were systematic in forcing their young (for whom they would have had deep familial love) into proving their manhood under the harshest conditions. The initiation ceremonies of native Americans and Africans served a vital task; they showed which of the boys were tough enough to take on adult roles. Those that could not brought shame to their families. Former apprentices in seventeenth and eighteenth century England were forced out of the master's workshop and had to prove, as journeymen, that they could earn their own living, and only then were they admitted to the trade guild, and allowed to charge a professional fee. Mary and Joseph's bewildered response to their twelve-year-old son engaging the law makers in Jerusalem in a three-day discussion of the Hebrew law, would have resonated with sixteenth century London merchants who often found it more congenial to swap their sons or daughters with those of a friend for a few years! Often, it seems, parents are not

well-placed to deal with truculent adolescents. Maybe there is too much of their repressed selves in the parent for them to easily accept the questioning of their own children's adolescence.

**What we do know, and what our ancestors have known for millennia, is that there is something going on in the brain of the adolescent, apparently involuntarily, that is forcing apart the child/parent relationship.** Professor Lahn of Chicago has recently argued that humans “evolve their cognitive abilities not during a few sporadic and accidental mutations, but rather from an enormous number of mutations in a short period of time, acquired through an intense selection process favouring complex cognitive abilities” (The Guardian 30/12/04). Adolescence is a most obvious period of such complex, cognitive change. Neurologists are seeking explanations for such behaviour that go beyond simply the hormones associated with adolescent sexual development. What they are discovering challenges the conventional belief held until only a year or so ago, that brain formation is largely completed by the age of twelve. Whatever happened after that, it was assumed, was due either to hormones or bad experience.

What scientists are now reporting is something very different indeed. Adolescence is a period of profound structural change in the brain, in fact “the changes taking place in the brain during adolescence are so profound, they may rival early childhood as a critical period of development,” wrote Barbara Strauch in 2003. “The teenage brain, far from being ready-made, undergoes a period of surprisingly complex and crucial development. The adolescent brain”, she concludes, “*is crazy by design.*” That is a fascinating thought. **Could “being crazy by design” be an evolutionary adaptation that actually helps the human species to survive?**

And that is exactly what a few scientists are beginning to accept. One important piece of research, that by Jay Geidd of the National Institute of Health in the U.S. has identified the

cerebellum, the inner most and possibly oldest part of the brain, as being the "least heritable" aspect of the brain. It is the part mainly concerned with social issues and deconstructing problematic relationships, but it is the cerebellum that Geidd believes changes most during adolescence. "We might find out there are things we can do...(at this stage)... to make a better brain (and that) is not through four hours a night of homework. What if we find that, in the end, what the brain of the adolescent wants is play, that is certainly possible. What if the brain grows best when it is allowed to play?"

\*   \*

Fascinating research by the eminent Chicago psychologist, Mihalyi Csikszentmihalyi (pronounced Chick-sent-me-high) looked specifically at how adolescents are best prepared for the world of work. Csikszentmihalyi is a psychologist and his findings build on his earlier studies into what is now generally called **“a state of flow”** (2000). During Adolescence, Csikszentmihalyi noticed, many youngsters find enormous satisfaction in work that both excites their intellectual and emotional interests to the point that they surprise themselves at the hardness of the tasks they willingly undertake. It seems, suggests Csikszentmihalyi, that adolescents possess a special ability (an adaptation) in doing this which significantly modifies their body chemistry, so reducing their oxygen intake and the subsequent production of those chemical by-products that normally make the individual sleepy. They move into a kind of mental over-drive. Csikszentmihalyi calls this a state of “flow.” **Csikszentmihalyi reported that the youngsters who eventually did best in adult life were those who earlier had “found school more play like than work like.”** Secondly he found that those who, as adolescents, had an involvement in an intense activity (regardless of what this might actually have been) were the ones who were far better prepared for their future adult roles than those who had good conventional work

experience, or well-defined vocational goals. “When people think back on those times when they felt most alive... chances are that it was when they had occasion to confront a task which they were only just able to master”, writes Csikszentmihalyi.

It seems counter intuitive; why should humans get so much satisfaction from struggling to do an almost impossible activity? Why do we climb mountains or attempt to break somebody else’s record? Why, indeed, are we so competitive but often not interested in the reward? ”The reason does not seem to be that we are brain washed as children or socialize to enjoy difficult things. It is more likely that we are born with a preference for acting at our fullest potential... In the development of the human nervous system a connection must have been established between hard work and a sense of pleasure, even when the work was not strictly necessary.” Perhaps, Csikszentmihalyi proposes, “enjoying mastery and competence is evolutionarily adaptive.” Quite possibly individual well being, as well as social well being, “depends to a large extent on whether as children they learnt to experience flow in productive activities.”

Which, of course, is what so much of traditional apprenticeship was all about. Unfortunately all too often it is not what contemporary secondary education is about. Thomas Hine writing in 1999 on the rise and fall of the American teenager noted “the principal reason high schools now enroll nearly all teenagers is that we can’t imagine what else to do with them.” That is a shocking conclusion by a man who spent years studying the issue. Modern society, by being so concerned for the well being of adults tries desperately to ignore the adolescent’s need to explore and do things for themselves, by giving them ever more to do in school. **It is as if modern society is trying to outlaw adolescence by over schooling children. That is not education.** There is a frightening man-made hole in the desirable experience for adolescents – there simply

are not enough opportunities for them to learn from doing things for themselves in a modern society – that will be addressed later in this Paper.

Neither Geidd, Csikszentmihalyi, nor Barbara Strauch the most recent writer on the adolescent brain, make much of the possible influence of evolutionary experience on shaping the structure of the adolescent brain, and behaviour patterns. The one issue that Strauch does pick up on is the work of Mary Carskadon a researcher in sleep patterns at Brown University who has noted that the release of melatonin in the adolescent brain results in sleep patterns very different to those of adults. She speculates that maybe it was once necessary for adolescents to stay up late to ensure the tribe's survival (teenage night watchman is a fascinating possibility!). “Maybe, at some point in our history”, she writes, “it was important for young people with good vision and strength to be more awake and alert later in the day to protect the tribe” (sleeping on well after the sun has risen) leaving the older, more sedate adults to protect the camp – early morning being the time when large predators, like teenagers, start to take their sleep. “Something is going on that makes adolescents sleep differently from younger kids, or older adults.”

\* \* \*

**So what can evolutionary psychology, and evolutionary studies in general, tell us about the possible “deep” origins of human behaviour?** Most scientists since the late 1990's are coming to accept that Homo sapiens evolved in one place – not several places – and that place was central Africa. It was the experience of learning to survive on the savannah that largely shaped our mental predispositions. For the majority of that time human intellectual growth was glacially slow. Each new generation was virtually a mirror image of its ancestors. There were no new skills to pass on, little history to talk about. Something very significant appears to have



happened about one hundred thousand years ago that put mankind's intellectual development into a kind of overdrive. Anthropologists call whatever it was graphically, "the Great Leap Forward." Suddenly, probably within only a thousand or so generations, humans became what we would call intelligent; our ancestors gained an awareness of themselves, and in so doing developed recognizable emotions. "If you prick us do we not bleed? / If you tickle us, do we not laugh? /... And if you wrong us, shall we not revenge?" declaimed Shylock in "The Merchant of Venice."

All members of our species display very recognizable emotions. In their study of how human nature shapes the choices we make from day-to-day, Lawrence and Nohria (2002) draw upon a considerable range of research to show that our behaviour patterns reflect an attempt to balance four conflicting human drives –the drive to acquire, to bond, to learn and to defend. "Human beings are driven to seek ways to fulfill all four drives because these drives are the product of the species common evolutionary heritage", he explains. They have been selected over time "because they increase evolutionary fitness – to survive and to carry on the species. The interdependence of these drives is what force people to think and chose, making us complex beings, with complex motives and complex choices." Shylock was right; be we Jews or gentiles, black or white, we all think in the same way. We each possess – in different degrees – the same emotions. We each struggle to balance conflicting drives. It is all there in the earliest stories we have inherited from times past – the problem of free will and moral judgment, as in the stories of Adam and Eve, and the murder of Abel by his brother Cain.

One recent writer, David Horrobin (2002), suggests that **the Great Leap Forward** could have resulted from the emergence of a set of genes that created schizophrenia. Schizophrenia is a devastating illness which has the most unusual side effect of producing high levels of creativity

amongst most first, second and third level relatives of those unfortunate enough to be suffering from full blown schizophrenia. Schizophrenia may be, suggests Horrobin, the yeast that turned a relatively dull species into the creative problem solvers that humans have subsequently become. Whether this was actually the reason, or one of several partial reasons, for the sudden mushrooming of creativity, we do not as yet know. But we do know of its dramatic implications. "Calling it a revolution is no exaggeration" explains Stephen Pinker (1997), "All other hominids came out of the Comic Strip B.C., but the Upper Palaeolithic people were the Flintstones. They were us. Ingenuity was the invention." David Horrobin went on to put it even more strongly. "Instead of being uniform we became diverse; instead of being relatively stable, we created constant change; instead of being egalitarian, we began more and more to differentiate from the rest with those with special skills in technology, art, religion, and psychopathic leadership."

\* \* \*

The new technologies used for DNA analysis in the last ten to fifteen years have enabled scientists to peer much further back into deep history and see with some clarity what probably happened. Before the Great Leap Forward the number of humans at any one time was probably very small –for long periods Homo sapiens might have numbered less than ten thousand people. Within the genes of those few people were encapsulated all the predispositions and adaptations accumulated over the nearly seven million years of human history. These are the very same mental processes that you are using as you try to comprehend what all these ideas mean. In all probability Howard Gardner's Multiple Intelligences, namely – linguistic and mathematical thinking, spatial analysis, musical ability, kinesthetic (touch), interpersonal and intrapersonal skills and spiritual thought – all emerged in Africa about the time of the Great Leap Forward. Certainly these varied forms of intelligence were all there amongst the Hadza, and were expressed in the art to be seen on the cave walls of the Kalahari put there maybe forty thousand

years ago by the Bushmen. In mental and anatomical terms those people had to have been very much like ourselves.

The savannah has left a big impression on us, even in 2005. Psychologists have carried out a number of controlled experiments on children and adults to discover what environments we prefer to live in. The results are interesting. Using photographs of varying kinds of landscape, each with no man-made artifacts to be seen, and no other people, it has been found that almost all children under the age of eight – in whatever culture or region they live – select the savannah as the preferred living space; older people have some additional preference for forests as well, but no one opts for the desert. In his design for English country estates the eighteenth century architect Capability Brown was playing to a deep, evolutionary conditioned sense of what is safe and congenial – we like open vistas, with clumps of trees, some water and a sense that we appear safe.

**These are differences in the way men and women perceive certain phenomena** – in what they actually see, and in how they relate to the environment and each other. These are essentially differences on a spectrum, rather than being exclusively male / female characteristics. Over the course of millennia the distinctions may be becoming less precise, but to many researchers and intuitive observers they are very real.

Men evolved a focus to their vision that more easily fixes on, and holds to, objects at a distance whereas women have comparatively poor long-distance vision but remarkable peripheral vision – the ability to see things all around them. It is still that way now, even though few men exercise such vision in the hut, and women's peripheral vision is more often employed finding those things that men have lost, rather than searching for berries or edible roots. While it is obvious

that many of our physical features (the coccyx as the last vertebra of the monkey's tail, or an appendix to creatures no longer eating a surfeit of grass) are redundant, we humans are slow to see in ourselves processes and features that evolved in different times, for different purposes. Being only slightly flippant, to remind a serious reader of this Paper of the delicious taste of a Raspberry Pavlova, or of a dark chocolate ice cream, is to activate a sense in their taste buds that will send each of us energetically searching for such foods – even though we don't need them. Only by such a compelling sense of potential “taste satisfaction” did our ancestors go that extra mile in search of rare sugars, or fats, or salt...

At some stage in the distant past the menopause began to occur earlier in human females than it does in other primates. Scientists have conjectured that this has to do with the vulnerability of very young children, and the enormous demands this places on mothers. Whereas most primate females remain fertile to within a period of time just long enough to wean a baby (in human terms that would be only three or so years) humans experience the menopause two-thirds of the way through life, effectively giving grandmothers many extra years to help their daughters raise the next generation.

In this, as in so many other instances, the more we discover about our senses and susceptibilities the more deep seated we find these to be.

\* \* \*

**And so, some sixty thousand years ago the evidence suggests, our ancestors simply started walking out of Africa.** After nearly seven million years of becoming finally adapted to life around the waterholes of the savannah our ancestors used this experience to colonize the world.

This “small-group” species, made up of extended family units of between fifteen to twenty people, loosely organized into “clans” of probably no more than one hundred and fifty people (the evidence is that, at about that scale, the competition of too many alpha males led the clans to subdivide) adapted the skill sets they had developed on the savannah to fit a vast variety of very different environments, all within about fifty thousand years.

Studying the DNA of native peoples today it is possible to plot the routes our distant ancestors followed as they spread out around the world. Their travels were largely facilitated by the lower sea levels of interglacial times, and the damper and milder climates of that period. Our ancestors appear to have reached India some fifty thousand years ago and Thailand ten thousand years later. They landed in the Andaman Islands around thirty thousand years ago, and possibly reached Australia very shortly after that. Migration into central and northern Europe was delayed by the last stages of the Ice Age until some twenty-five thousand years ago. There is some confusion as to when our ancestors reached north America by way of Siberia and the Bering Straits, with most estimates suggesting twelve and fifteen thousand years ago, eventually reaching the far extremity of Tierra del Fuego some ten thousand year ago.

These were frontier times, when none but the fittest survived. This was not a migration led by powerful and charismatic leaders. This was the energy of a species where every family, each clan, possessed amongst its tiny numbers all the multiple skills needed to investigate, respond to, and colonize new territories. To do this everyone of their members had either to possess the multiple skills to do this for themselves or, more likely, to know how to collaborate with a few others to achieve things they could not do for themselves. The diverse skills they needed would have depended on a further refinement of the multiple intelligences they brought with them out of the savannah. Inquisitiveness fired their every action; they climbed mountains to be able to

see what was on the other side; they followed rivers to the sea and, with time, constructed crude rafts to take them to off shore islands, and later to explore oceans in the hope of finding new lands.

Life was a constant struggle in landscapes never before colonized by man, and these explorers craved security in their travels. That ancient search for security is, to this day, recreated wherever people meet together for a meal, replace the electric light with candles, turn off the central heating and throw more logs on to the fire and, as the wine flows, listen again to the fisherman retell his tale of “the one that got away.” Its not simply a return to the womb – we have an inherited sense of what is safe and secure. Even the most exclusive of modern hotels seeks to blend the security of being alone with your own family by constructing internal atriums where every room looks out onto a common, but safe, enclosed area where life goes on as others sleep. Just like the ancient caravanserai of the desert.

The origin of some of the words we still use may even go back to those distant days. The Persian word for “paradise” actually describes a small walled enclosure around a spring of fresh water. Beyond the wall is nothing but sandy desert; go through a tiny door in the wall and inside all is green, cool and moist – the vegetation exotic and the bird song enchanting. This, to our ancient ancestors, was “paradise.” But we are a species of complex motives; the search for security contrasts with our love of novelty; the thrill of risk contrasts with the comfort of the predictable; the challenge of being alone contrasts with the enjoyment of collaboration. These have probably become ever stronger features of human behaviour as human genes have steadily mutated over the diaspora (the spreading of a population). Foremost amongst those risk takers – the scout out in front of everyone else – would have been the adolescents. Those adolescents that survived would have been hard tested by the experience, and become the leaders of the next

generation. (In the medieval trading practices of Venice – the *Colleganza* – that balance of energy and risk was reflected by the young entrepreneur putting up only one quarter of the capital for a speculative venture with the other three quarters coming from an older, more sedentary merchant. If the young entrepreneur returned to Venice successful he then retained half the profit). Generation after generation, perhaps as many as three thousand generations of traveling peoples, made enough successful adjustments during that diaspora to survive and colonize the world. Simpletons simply died out.

Writing his much acclaimed book “The Fifth Discipline” for business leaders in 1990 Peter Senge of MIT summarized the kinds of learning that enable people to flourish when faced with novel and problematic situations. Without his consciously realizing this Senge probably captures in the following words what our ancestors some fifty thousand years ago experienced as reality. “Real learning gets to the heart of what it means to be human. Through learning we recreate ourselves. Through learning we perceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life.” Learning makes us feel good about ourselves, said Senge, and Learners are reinvigorated by their inquisitiveness, and are “committed to continuously seeing reality ever more and more accurately. There is within each of us a deep hunger for this type of learning.” Creative learning is “as fundamental to human beings as the sex drive”, says Senge, and as with the sex drive, we humans developed that learning instinct a long, long time ago.

It seems that our ancestors had perfected their language skills long before moving out of Africa. With such linguistic skills deeply established in the human brain our ancestors developed numerous separate languages, of which currently some six thousand still exist. Cultural speciation (the formation of a new and distinctive species) proceeds far faster than physical

speciation. Over that sixty thousand year period our ancestors developed a number of relatively minor physical adaptations – blonde hair and fair skin as apposed to dark skin and dark hair, or tall tribes on the open grasslands and pygmies in the forests – but in their physical form they all remained true to the genome. When in the early seventeenth century the first French or English fur trader met a willing native American woman in the primeval wastes of northern Canada, together they had no difficulty in producing numerous “metis” offspring. Such a mating probably represented the greatest potential biological divergence that could be observed on the planet. The genes of the European fur trader meeting those of the native American had possibly moved out of Africa a full sixty thousand years before, while the native American genes had migrated to Canada through Asia and across the Bering Straits. After all that time those genes had no difficulty in recombining. No physical speciation had taken place. Three or four thousand generations were insufficient for any significant biological change; **the brains of people from all over the world seem to work in exactly the same way as do the rest of their bodies.**

Studies in the early 1990’s on what was called cognitive apprenticeship extended the study of learning beyond classroom practice to learning in non-institutional settings. “Learning is not something which requires time out from productive activity; learning is the very heart of productivity”, wrote Shoshama Zuboff of Harvard in her study of how people in the computer industry learnt to improve their skills. Mental structures for learning reflect social collaborative, problem-solving techniques, contemporary studies from the business world showed. A whole plethora of studies have followed in the last twenty years showing that learning is an intensively subjective, personal process that each individual constantly and actively modifies in the light of new experiences. The more varied a person’s experience the more perspectives that person brings to each new opportunity or problem. Writing from the Santa Fe Institute in 1995 Shank and Cleave explained that “We make sense of personal experiences by comparing these to



previous ones. Once we have found a match, we use our previous experience to decide what to do next. “What this means is that we can really only understand – and hence remember – situations we have been in before. Our memories are actually little more than the sum of stories we can recall and apply. “The thing which human beings need more than comfort, more than possessions, more than sex or a settled home, is a good supply of stories”, wrote Libby Purves in 1997. “Through stories we make sense of the world.”

At some stage those stories told by our ancient forbearers started to account for the ultimate mysteries of life – humans started to envisage God. They created stories that helped them place themselves in the universe. God was defined until only five thousand years ago as female, opening up fascinating questions as to why the subsequent gender change. Anthropologists equate the orderly burial of the dead with the development of spiritual awareness. “Mystical, symbolic and religious thinking – all those ways of thinking that rationalists would condemn as “irrational” – seem to characterize human thinking everywhere and at all times”, wrote John Barrow Professor of Astronomy at the University of Sussex in 1995, continuing, “It is as if there was some adaptive advantage to such modes of thinking that offers benefits that rationality could not provide.”

All these experiences have “imprinted (themselves) upon us in ways that constrain our sensibilities in striking and unexpected ways”, Barrow continues. **We are, literally and figuratively, the children of travelers from antique lands. In twenty first century terms our children face the same challenges, as did our ancestors’ children; our basic biology still needs to empower them to master both basic skills (those that can be readily taught) and think creatively for themselves (experiential learning).**

## **Section Five. So what is it that we now know in 2005?**

**We know that the human brain is essentially plastic, that it constantly reshapes itself in response to environmental challenges, but that it does this within the blueprint of the species inherited experience.** There are three phases during a normal life cycle when the brain goes through extraordinary periods of internal reorganization, a kind of mental housekeeping. At an involuntary, subconscious level the brain clears out those structures which its “evolutionary sense” tells it are redundant so as to enable other parts of the brain to grow. **Experience during each of these phases became critical to how the individual brain is reconfigured to deal with the next stage of life.** This process is called Synaptogenesis; a period during which many separate specific predispositions coalesce to produce a major evolutionary adaptation that becomes critical to human survival. Three phases have so far been identified – the earliest months of life, adolescence and old age. This Paper proposes that it is in the relationship of the first two phases of synaptogenesis to each other that has made the advance of the human race possible. Neither phase – be it the first three years, or adolescence – can be seen in isolation; neither phase on its own can account for the human propensity to learn. It is only through the interaction of the two that we become “the learning species.”

The highly suggestible brain of the pre pubescent child enables it to speedily and effectively learn through imitating its elders, while it is in the changes of the adolescent brain which force young people to take control of their own future by making them discontented with being told what to do. The features of adolescence – the risk taking, the exuberance and the outrageous questioning of the status quo – are there for a time, but they disappear as the young person grows older. If the adolescent does not want to follow such instincts or – as in a modern society that is

so frightened by such instincts that it does its best to get the adolescent to actually ignore them – such youngsters go into adulthood essentially nervous of risk-taking, fearful of ever becoming too enthusiastic, and unduly conforming in their behaviours. To over-school adolescents is to rob them of the once-in-a-lifetime opportunity to grow up properly. We all pay the price.

\* \* \*

Scientists have found it easier to study the development of the young brain, than to study that of the adolescent. Not only are younger children more malleable, their brains have had less time to be shaped by social and environmental inferences. The variables are fewer, and each variable is more easily quantifiable. Such research has become the stuff of much popular science. It has an immediate appeal both to politicians looking to the supposed economic advantages of getting as many young mothers back into profitable employment as possible, as well as to women themselves seeking to balance their roles as mothers with the demands of their careers. Both approaches conspire to emphasize what popularly became known as “the issue of the first three years.” Such research, it was often expected, would provide criteria by which quality childcare could be institutionalized; thus releasing more women into the work place and with calmer consciences that all would be well with their children.

That has not proved easy to achieve for such consciences are not easily to be calmed. In popular wisdom, as well as in the polished words of the intellectuals, “Education is an admirable thing, but it is well to remember from time to time that nothing that is worth knowing can be taught”, noted Oscar Wilde, echoing Albert Einstein who said “This delicate little plant, aside from stimulation, stands mainly in need of freedom; without this it goes to rack and ruin without fail.”

These tensions are not easily resolved for children needing unconditional love, not simply institutional care – however good.

\* \* \*

In the late 1990's it seemed that cognitive science and neurobiology had become entwined in a turf war when John Bruer, a leading and influential cognitive scientist, accused educationalists of "building a bridge too far" in assigning so much credibility to neuroscience to advice on desirable learning strategies. With what they saw as scientific evidence on their side, advocates of the need to provide ever more support to the youngest children successfully pushed early years education up the political agenda. Despite the well-argued case made by Bruer, in his book, "The Myth of the First Three Years", he was largely unsuccessful in persuading gullible policy makers that this was not the only important stage of brain development. What Bruer was not able to do 1997 was to show that the development of the adolescent brain was an integral part of an individual's mental development for, only half a dozen years ago, adolescent behaviour was still being explained away in terms of "raging hormones."

In their anxiety to get action on this issue advocates of early childhood education in English speaking countries (note that this is most certainly not the case in Europe) have seen fit to link the advantages of early years education to the immediate needs of a booming economy. "Given what we now know about the experiential and environmental determinants of health and human development, we must now meld this intelligence with knowledge of the determinants of economic growth..." stated the Canadian, Dr Frazer Mustard. It seems that the General Election likely to be fought in England in 2005 will focus on a play-off between Labour's determination to provide institutional provision for all children below the age of five – and from early in the

morning to late in the evening, while the Conservatives are set to offer paid maternity leave, and tax breaks for mothers to stay at home with their children.

Into this contentious issue what guide lines can a Synthesis of the research offer? At its simplest – yet most profound – level, the advice is simple. Every child is born perfectly equipped to survive under Stone Age conditions. Sue Gerhard, in her most influential book “Why Love Matters” (2004), seeks to show how affection shapes the baby’s brain by drawing on a wide range of recently published research. “Babies are like the raw material for a self. Each one comes with a genetic blueprint and a unique range of possibilities. There is a body programmed to develop in certain ways, but by no means (is it) on automatic programming. The baby is an interactive project, not a self-powered one. The baby human organism has various systems ready to go, but many more that are incomplete and will only develop in response to other human input.”

Gerhardt goes on to say “Some writers have called the baby an ‘external foetus’ and there is a sense in which the human baby is incomplete, needing to be programmed by adult humans. This makes evolutionary sense as it enables human culture to be passed on more effectively to the next generation.” In this way each baby can be customized and tailored to fit into the circumstances and surroundings in which he or she finds him or herself. A baby born to a Hadza mother would have different cultural needs to a baby born in London or Ottawa. All this the unfinished baby is able to handle, simply because of our extraordinary evolutionary history.

Within the baby’s brain there are many loosely connected neural systems, often overlapping with each other. “These systems communicate through their chemical and electrical signals to try to keep things going within a comfortable range of arousal, by adapting to constantly changing

circumstances both internally and externally. But first”, Sue Gerhard writes, “the laws have to be established.” It’s rather like a new homeowner moving from room to room programming the thermostatic controls on each radiator to come on, and go off, at the correct ambient temperature. Like the human baby the home heating system can’t initiate programmes itself but, once properly set, it will forever work within those established norms. Hence, in biological terms, is the critical significance of the synaptic changes of both the earliest years and of adolescence.

“The basic systems that manage emotions – the stress response-systems, the responsiveness of our neurotransmitters, the neuro pathways in which our implicit understanding of how intimate relationships work – none of these are in place at birth. Nor is the vital prefrontal cortex developed. All these systems will develop rapidly in the first two years of life... the path that is trodden in very early life tends to gather its own momentum, and the harder it is to retrace our footsteps.” Below the age of two or two and a half there is no real substitute for direct maternal (and some paternal) care. The situation however changes at about the age of two and a half when between ten or twelve hours of small group interaction becomes a positive advantage. That the most effective form of learning occurs through play is demonstrated, time and again, by projects such as the Reggio Emilia schools in Italy, or the vastly influential Steiner schools with those affluent-enough to afford them,

External observation of performance provides corroborative endorsement; in the Kellogg Foundation research in the state of Michigan into the predictors of success at the age of eighteen it was found that factors outside the school were four times more important in predicting subsequent success than school achievements, while the single most significant factor was the quantity and quality of dialogue in the child’s home before the age of five. A further survey in 2001 of factors that could account for variations in individuals earning capacity found that

slightly more than half the variability couldn't be accounted for by school, or academic, qualifications. Social skills such as industriousness, delayed gratification, punctuality, perseverance, leadership and adaptability were found to be more significant predictors than I.Q. tests, or years of schooling.

Commenting on Gerald Edelman's work on Neural Darwinism (for which he gained a Nobel prize) the American educational writer Robert Sylvester said (1995) "Edelman's model of our brain as a rich, layered, messy, unplanned jungle eco system is especially intriguing, however, because it suggests that a jungle-like brain might thrive best in a jungle-like classroom that includes many sensory, cultural, and problem layers that are closely related to the real world environment in which we live – the environment that best stimulates the neuronetworks that are genetically tuned to it." Most children don't experience learning like that. They live in a world carefully programmed by parents and teachers to be safe and predictable. Having to think something out for themselves becomes a rarity.

This troubles Stanley Greenspan, a highly regarded child psychiatrist in the U.S. who wrote in 1996 on the endangered nature of intelligence; "The assumption that there will be enough reflective people to maintain a free society is not to be taken for granted... if emotional experience is in fact the basis for the mind's growth, then the growing impersonality and family stress may well be threatening mental development in a significant number of individuals."

Don't simply blame the parents, argues Gerhardt, opening up the whole question of how cultural priorities shape the young brain; "Criticizing parents doesn't improve their capacity to respond positively to their children... I believe the real source of many parenting difficulties is the separation of work and home, of public and private, which has had the result of isolating mothers

in their homes without strong networks of adult support. Women therefore face the artificial choice of devoting themselves to their working lives, or to their babies, when the evidence is they want both.”

This was the issue taken up ten years earlier by one of the first widely recognized evolutionary psychologists, Robert Wright, when he wrote (Time 1995), “the suburbs have been particularly hard on women with young children. In the typical hunter / gatherer village, mothers could reconcile a home life with a work life fairly gracefully, and in a richly social context. When they gather food, their children stay either with them or with aunts, uncles, grandparents, cousins or life-long friends. When they are back at the village, childcare is a mostly public task – extensively social, even communal.” An isolated mother with bored small children is not a scene that has parallel in the hunter / gatherer existence of the Hadza.

It is not just the parents that feel this stress; children also need the experience of seeing both their parents’ working lives, and their private lives. Children need more realistic experiences of what matters to their parents than simply an hour of “quality time.” Children need – not simply want – the world that their pre-Industrial Revolution ancestors had when parents and children had common agendas. “As we attempt to progress as a society, we may unwittingly erode the building blocks that are the origins of our highest mental abilities”, warns Stanley Greenspan.

\* \* \*

It was Freud who noticed that between the ebullient learning and uninhibited play of the pre-pubescent child, and the querulous and impassioned search for independence of the adolescent, there was a period of apparent tranquility that he called the Latency Period. This was a time



when both sexes appeared to have developed almost adult bodies, but their interests were still those of the younger child untroubled by sexual tension; a time when girls enjoyed the company of other girls, and boys relished the excitement of team games, camping trips and the enthusiastic pursuit of hobbies. It was a period, Freud suggested, when youngsters consolidated the emotional behaviours that had served them well as children in preparation for the radical shakeup of adolescence. “It was a time when they gathered physical and psychological strengths to explore the world, becoming confident learners and confident socially. They were marshalling their forces to be able to go into puberty”, wrote Dr Carr-Greg, an adolescence psychologist, in Melbourne early in 2004. It was a period which, when Freud was writing in the early twentieth century, was thought to last for several years.

Not so any longer. The average age at which puberty hits is now twelve or thirteen compared with sixteen just a few decades ago. There seem to be two reasons for this, one biological, and the other cultural. There is little doubt that significantly better supplies of food (not the same, necessarily, as a better diet) has speeded up the biological maturing process. Secondly cultural change in modern societies no longer requires teenagers to engage in hard physical labour to assist in supporting their families, and has been replaced by a vast media empire encouraging children, at ever younger and younger ages to assume the behaviour and attitudes earlier associated with young adults. “Consequently”, writes Carr-Gregg, “adolescence is now an extended period of vulnerability, starting much earlier and finishing much later than ever before.”

What we are now seeing is a short-circuiting of the latency period. “Today some young people merely dip their toes into the latency period before the combination of peer pressure, an unrelenting marketing machine, and their own physiology lures them into the kaleidoscope of

adolescence.” Such youngsters behave as if they were several years older than they really are. “They haven’t completed the vital work of the latency period, and consequently don’t have the capacity to face, overcome or be strengthened by, adversity – something which was the common experience only a generation or so ago.” Adolescence, in the society we have recently created, has become more of a threat than a benefit, and adolescents are seen as a form of life most people want to avoid, rather invest in for their joint futures. It is vastly important, therefore, that all those concerned with young people rediscover what it is that this biological adaptation of adolescence is really all about, and to recognize that it is a once-and-for-all developmental opportunity.

\* \* \*

Given that, in many developed countries, there is much concern about the malfunctioning of secondary education, but a sense that primary education “generally knows what it is doing”, it must surely be significant that, in comparison to a wealth of recent research on the young brain, there is very little research indeed on the brain of the adolescent – and even less on how adolescents learn.

It was only in 1991 that Dr Jay Giedd started the first long-term, longitudinal study of the changes going on in the adolescent brain by using sequential functional MRI scans of some eighteen hundred youngsters over a number of years. This has led Giedd and others to challenge the earlier assumption by Swiss psychologist, Jean Piaget, that brain development is virtually complete by the age of twelve. Far from it, says Giedd as he studies his research, the teenage brain is far from finished, and indeed may not stabilize until the age of twenty. “Instead it remains a teeming ball of possibilities, raw material waiting to be synaptically shaped. The

teenage brain is not only still incredibly interesting but appears to be still wildly exuberant and receptive.” Giedd’s work shows conclusively that the first phase of neural proliferation and pruning to be found in the brains of the very youngest children is followed by this second wave of proliferation and pruning that occurs with the onset of adolescence. This affects some of our highest functions, and continues until the late teens.

During the early stages of adolescence, many of the neuro-connections that had been carefully crafted through interactions between the child, its parents and teachers, during the first ten or twelve years of life, and which had earlier enabled such children to behave in perfectly predictable ways, are suddenly fractured. Quite literally what had once been firmly connected parts of the neural system seem mysteriously to have been torn asunder. Functional MRI scans show many of these dendrites literally floating amidst the white matter of the brain apparently looking to make new connections – the connections the adolescent will have to rationalize for itself, and which will replace the connections suggested earlier by their parents and teachers. As this starts to happen the adolescent becomes unpredictable, unreasonable, careless and probably carefree, constantly questioning and being outlandishly disrespectful of the social order that it had earlier, apparently eagerly, accepted. A pain in the butt we think; a stage when youngsters are best tightly corralled for their own safety.

Adolescents themselves see things very differently. In the words of a sixteen-year-old Romanian girl recently “(adolescence) is the age when you have certainties, when you know exactly what you want, who you are, who everyone else is. Life hasn’t destroyed your certainties yet. Being young means feeling omniscient, very strong, beautiful, invincible, undying... prudent and indifference are words that you cannot bare... you never again have this courage, that of risking

everything in one second. It will never again seem so normal to make mistakes as it seems now when you have the excuse that you are looking for truth.”

Such over confidence, such arrogance, are hard to accept for an older generation that knows that it has long-since compromised such ideas. No wonder, from an evolutionary perspective, in times past whenever our ancestors had difficult challenges to face for which they had no personal stomach, they would happily turn to adolescents to be their soldiers, merchants, navigators, explorers and colonizers. Society, going back to the stage of the diaspora out of Africa, needs both the impatience, and the energy, of adolescents to keep it vital. As with today’s young people so it was with our ancestors who had to master the skills passed to them by their parent’s generation before they could start to make intelligent adjustments of their own to each new set of circumstances.

## **Conclusion**

Much of the research quoted in this Paper is very recent. So far little of this research relates directly to the adolescent brain nor to the possibility that this is a time-limited adaptation, critical to how the individual will reshape its brain so shaping its capacities to deal with a problematic future. This Paper is probably unique in the claim that it makes that a proper understanding of the relationship between the change in the very young brain and that of the adolescent provides the theoretical base for a complete restructuring of formal and informal systems of education. Conventional academic research lacks a methodology able to relate these “different ways of

knowing” into a coherent intellectual argument. A world of specialists is too much like the blind men of the Hindu proverb in their approach to the elephant.

The article published in Time Magazine in May 2004 “What makes Teens Tick” from which several of the above quotations were extracted, made no attempt to link any of the most recent findings from neurology to their possible evolutionary origins. Curiously the book from which that article appears to have drawn so heavily (but without any acknowledgment) was Strauch’s “The Primal Teen” published in the U.S. exactly a year earlier. Strauch does start to make such connections, but only tentatively. “Human brains are little wads of evolutionary history”, she wrote, and went on to cite Dr Francine Benes, a psychologist and neurologist from Harvard, “During childhood and early adolescence emotional experiences are not well integrated with cognitive processes. That means that you get an impulsive action that seems to bear little relation to what is otherwise happening.” As the neural networks in the adolescent brain grow better insulation (myelin sheathing) so “teenagers become more capable of mature forms of behaviour.”

In such careful language the neurologist records her research findings. But then Benes went on to make a very human, intuitive, observation. “But in a way it’s too bad to lose all that, don’t you think? Teenagers are full of exuberance, that’s what drives us. We adults tend to keep it under wraps; we wait until we get home. Sometimes I think it is too bad we can’t keep some more of that.”

Most scientists are reluctant to make such an all-embracing statement that is useful in reconfiguring popular assumptions. One man who has done so is an anthropologist from the University of Michigan, Barry Bogin; “Adolescence is fairly recent”, (in evolutionary terms) he

says, “and it developed because it was a survival mechanism for the species.” Most unhelpfully the great majority of scientists are so concerned to protect their academic reputations that they decline any responsibility to speak with authority outside their immediate disciplines. They appear to be afraid to use any form of intuition. This includes Giedd in his long-term study of adolescence; “I’m guessing here”, he said as he attempted to explain why boys and girls differed in their spatial appreciation, “but I would say that, in evolutionary terms, there was more pressure on man to develop parts of the brain that are connected to spatial skills like hunting...”

At that point the neurologist in Giedd stopped short. When Giedd said he was “guessing”, the limitations of modern scientific methodology demarcated as they are by the individual procedures of separate disciplines become frighteningly obvious. Giedd was unintentionally making the case for the synthesis which this Paper has sought to make – and which educationalists and policy makers desperately need to inform their judgments. Subject experts are overly sensitive to respecting their separate areas of expertise.

This Paper argues that it will only be when enough people can *intuitively* appreciate the kind of Synthesis set out here that they will see in adolescence that evolutionary adaptation which society continues to ignore at its peril. To do this academics need more humility, and ordinary people need more confidence in their innate ability to see how things come together. Then society will be primed for action. It is the application of ideas that matters most to people. Consequently it has to be the responsibility of those with a gift for teasing out the detail in abstract ideas, to make their findings readily available to people of action.

The separation of thinking from doing has been going on for a long time. In his classic short treatise “What is Life”, the Austrian biologist Erwin Schrodinger wrote in 1943 “a scientist is

supposed to have a complete and thorough knowledge at first hand of some subject, and therefore is usually expected not to write on any topic of which he is not a master... We have inherited from our forefathers the keen longing for unified, all-embracing knowledge... the universal aspect (was what universities was set up to establish) the spread of... multifarious branches of knowledge... confronts us with a queer dilemma... it has become next to impossible for a single mind to comprehend it all.

Schrodinger went on “I can see no other escape from this dilemma (lest our true aim be lost forever) than some of us should embark on a synthesis of fact and theories, or be it with a second-hand and incomplete knowledge of some of them – albeit at the risk of making fools of ourselves.”

\* \* \*

The implications of such an understanding about brain development are enormous. Every reader will wish to ponder for themselves the many issues that this Paper raises. They challenge many preconceived ideas about how education should be organized. Any careful reader will want to question the synthesis, and that is entirely appropriate. As it stands, as of January 2005, and with the information currently available to The Initiative, this is the conclusion that we have come to. Some of the research is obviously more robust than other parts and, in particular, The Initiative is well aware that much remains to be discovered about neurological changes in the adolescent brain. In time a methodology should evolve which will make it easier to create a synthesis from across different subjects, as well as between the physical and social sciences. This may happen when we allow ourselves to have greater faith in our powers of intuition.

Immediately, this Synthesis would suggest that by contemporary schooling continuing to emphasize the assumption of the classical curriculum (with the dominance ascribed to the role of the teacher to instruct, and of the separation of thinking from doing) and the belief that education is pre-eminently an institutional activity, it is actually schooling which is exacerbating the difficulties society experiences with its young people, rather than in any sense alleviating the problem. From the findings of cognitive apprenticeship it would seem that a model of learning is needed which gives every support possible to the youngest learners, both supporting the needs of the child, and actively supporting those adults who can provide informal support and encouragement that formal arrangements can never provide. Thus as children grow older and take ever more responsibility for its own learning, this process would seem to match exactly what is now being discovered about the progression of neurological change in both the youngest, and the adolescent, brains.

Formal education will inevitably have to question the present nature of the curriculum, and consider that much work must now be undertaken in a “Humankind Curriculum” that would help individuals to better appreciate how they can help themselves to grow up, and make appropriate contributions to the community.

In considering how best society should respond to this change of view to learning it is worth pondering the dogma of Subsidiarity. Defined in 1931 by the then pope as a doctrine to strengthen the resolve of Catholics in central Europe that it was entirely right for them hold on to their beliefs, despite all the pressure from communist governments for them to conform to the latest political ideology, Subsidiarity has more recently become the principle under which the European Community states that it operates in ensuring that decisions are always made at the



lowest appropriate level. The dogma states: **“It is wrong for a superior body to hold to itself the right to make decisions which in theory is already qualified to make for itself.”**

It would seem that the statement of 1931 was simply repeating what every self-respecting craftsman of years gone by knew had to be the evolving relationship between himself and each of his apprentices. People learn through constantly facing challenges somewhat beyond what they think are within their reach. The strategies humans apply to do this have been shaped, quite literally, through millions of years of fine adaptations to learning collaboratively, on-the-job, to the solution of real problems. Secondary schools have existed for only about two hundred years, and reflect a Behaviorist’s philosophy of learning which is now seen as being inaccurate, inappropriate and incomplete. If today’s secondary schools are then the wrong places for the descendants of brilliant stone age thinkers to thrive in, then society as a whole (and certainly not simply schools on their own) has to rethink how to use the creative energy of adolescence to the overall good of the community. **Youngsters who are empowered as adolescents to take charge of their own futures will make better citizens in the future than did so many of their parents and their grandparents who suffered from being over-schooled, but under-educated in their own generations.**

The 21<sup>st</sup> Century Learning Initiative’s essential purpose is to facilitate the emergence of new approaches to learning that draw upon a range of insights into the human brain, the functioning of human societies, and learning as a self-organizing activity. We believe this will release human potential in ways that nurture and form local democratic communities worldwide, and will help reclaim and sustain a world supportive of human endeavor.

The 21<sup>st</sup> Century Learning Initiative  
Bridge House, 15 Argyle Street  
BATH, BA2 4BQ, U.K.  
Tel/Fax: +44 (0) 1225 333 376  
Email: [jabbott@rmpc.co.uk](mailto:jabbott@rmpc.co.uk) or [info@21learn.org](mailto:info@21learn.org)  
Website: [www.21learn.org](http://www.21learn.org)