CHAPTER 3 EMERGENCE AND EVOLUTION OF COMPLEX SOCIETIES

THE IDEA OF A UNIVERSAL EVOLUTIONARY PROCESS

Is there a sense in which the evolutionary process which has produced everything from elementary particles to the industrial age has always been the same process? And, if it is not just one process, how many processes is it?

At a very general level, all evolutionary changes are certainly expressions of a single universal process, namely one in which an existing dissipative system spontaneously reorganises all or part of its static and kinetic structures in a way which converts higher-quality energy (exergy) from one form to other forms at an increased rate and, in so doing, increases the overall rate at which low-quality energy (entropy) is being produced and dissipated into the parent environment. In this sense the evolutionary process is a spontaneous equilibrating process, satisfying a 'thermodynamic imperative' to reduce thermodynamic potential (flatten energy gradients) in the most effective available way. Inverting this, the principle, the law perhaps, to which the evolutionary process is conforming is that entropy spontaneously increases at the maximum available rate.

Newly-organised dissipative systems, singly or in combination, can behave in extraordinarily diverse ways and have diverse impacts on their surroundings. Much effort has gone into recognising recurring 'context free' patterns in such behaviours and impacts. For example, the theory of non-linear dynamic systems (see chapter 3) suggests various templates for the behavioural trajectory (eg cyclic, chaotic, point) of a system entering a new basin of attraction and clarifies concepts like thresholds and resilient behaviour (bouncebackability!). Some systems swing rapidly through a sequence of basins, others persist stably in one basin. Other well-recognised behaviours include the formation of hierarchies of systems (systems contained in or made out of other systems) and various symbiotic interactions between systems. We might also note, as pointed out by Salthe (1995), that, from a self-organisation perspective, the distinction between evolution (moving between basins?) and development (moving within a basin?) becomes blurred. They are overlapping historical processes.

Here, it is not our intention to attempt to abstractly and comprehensively classify what is a superabundance of dynamic behavioural possibilities for mixtures of evolving systems. Perhaps it is just semantics, but I find it more useful to think of these diverse behavioural possibilities as variations on one basic evolutionary process rather than as separate evolutionary processes.

[[[[probably of no use .. Systems emerge aand go through a developmental or life cycle process to The history of evolution not being used to mean history of the evolutionary process …..not if has always been the one process anyway history off what things evolved vs history of how things evolved ..has the evolutionary process changed ? diversified?..what has evolved vs how it has evolved

Evolution as History

The history of evolution can be written in terms of the changing mix of products (types of dissipative systems) which the *evolutionary process* has created, maintained, destroyed. A broad–brush anthropocentric history of how the universe has evolved over time to produce contemporary humans and the world they live in falls readily into three overlapping 'eons', for want of a recognised word. These are the *Physico-chemical Eon*, the *Biological Eon* and the *Cultural Eon*---names chosen to suggest the advent and proliferation (and eventual decline in numbers) of what are, from the perspective of their human significance, three radically different types of dissipative systems. That is, they are radically different in terms of the types of energy and materials they take in and pass out and in the types of kinetic and static structures they use those inputs to create and maintain.

Central to understanding this temporal sequence is the 'piggybacking' idea of *path dependence*, eg that biological systems of the Biological Eon could not have evolved without the prior evolution of physico-chemical systems and cultural systems of the Cultural Eon could not have evolved without the prior evolution of biological systems. Nor could the systems of any eon persist without the survival of systems from previous eons, inasmuch as it is these which nourish that eon's systems with flows of materials and energy.

Just as the history of evolution can be subdivided into eons, the history of each eon can be subdivided into overlapping 'ages' identifying periods of emergence and proliferation of markedly dissimilar types of dissipative systems. Thus, in the Physico-chemical Eon, physical systems first emerged during the *radiation age* that followed the big bang and subsequently diversified over billions of years. Following the condensation of material particles in a cooling universe (the *particulate age*), this eon produced successive overlapping waves of galaxy formation (*galactic age*), star formation (*stellar age*) and planet formation (*planetary age*). Particles, galaxies, stars and planets are dissipative systems which come into existence and which, in time, 'die' in some sense. Each age signifies a major transition in the evolutionary process's reigning product mix.

It was only with the formation of planet Earth and its chemically-rich water bodies that the *chemical age*, a link between the Physico-chemical Eon and the Biological Eon, became possible. It was in the chemical age that life's precursors---sets of linked autocatalytic chemical reactions feeding (metaphorically) off each other---first emerged from an environment capable of sustaining supplies of suitably energetic raw materials to these dissipative cycles.

The Biological Eon

The Biological Eon is conventionally, and adequately enough for present purposes, divided into a sequence of ages that encompasses the following: an *age of ecosystems supporting unicells*, an *age of ecosystems supporting multicells*, an *age of ecosystems supporting fishes*, an *age of ecosystems supporting reptiles[[land animals??]]*, an *age of ecosystems supporting mammals[and flowering plants??]]*, and an *age of ecosystems supporting humans*.

Living systems provide an early and important example of dissipation through the conversion of chemical energy to kinetic and thermal energy. Such systems depend for their survival on a process which is conceptually and operationally different from the process determining the survival of the physical and chemical systems which preceded them. At the heart of that novel process is the capacity of early life forms, namely single-celled prokaryotes, to grow (ie process energy at an increasingly higher rate) to a physically-determined 'maximum' size and then (approximately) self-replicate by dividing into two smaller, but otherwise still similar, physically-separate parts, each of which can disperse (eg drift away) and regrow to 'maximum' size, provided energy and material resources are not limiting. The fact that its parts are dispersed need not stop us regarding a population of single-cell sub-systems, formed by a cascade of divisions, as just one dissipative system.

Just as all dissipative systems take in energy and materials, they all produce outputs or products which can be described in terms of energy and material fluxes. The terms *autopoietic* (literally, self-creating) and *allopoietic* (see chapter 3) are a recognition that the outputs of living and non-living systems are fundamentally different. Non-living systems are allopoietic, meaning that they produce things different from themselves, eg volcanoes do not produce more volcanoes. Living systems, being autopoietic, produce outputs which, following growth, will be very similar to themselves; a population of unicellular organisms outputs small unicellular organisms, each of which stands to produce a population of unicellular organisms!

Non-living systems rely for their survival on the energy-materials fluxes that drive them staying within certain 'fixed' tolerance limits, limits which can be thought of as defining that system's *niche* in environmental space. If the system's environment keeps changing in any particular direction it will eventually move beyond the environmental limits defining the system's niche and the system will necessarily reorganise. Thus, if energy gradients are flattening, the system will tend to collapse, disaggregate, simplify or shrink and, if energy fluxes are rising, the system will tend to grow or complexify. [[activation energy??]]

Early living systems, eg dispersed populations of similar unicellular organisms, were somewhat different. They relied (a metaphor) for their survival in a changing and spatially-variable chemical 'soup' on two attributes which followed from their tendency to bud off imperfect copies of themselves (imperfect in terms of the molecular 'species' feeding and participating in the cell's autocatalytic cycles). One attribute was a tendency to occupy (drift into) all accessible parts of the niche. The other was a tendency to extend the niche to include environments where occasional imperfect copies proved able to survive and replicate more reliably than their parents. Both tendencies improved the population's survival prospects. For example, a small catastrophe which wipes out part of the occupied environment will still leave part of the population to survive and perhaps multiply. Or, if the environment changed so that more of it was favourable to some particular sort of 'imperfect copy', then that particular component of the population would expand in numbers to fill the 'new' environment.

For this two-pronged survival strategy (another metaphor) to work, each part of a dividing organism has to reliably 'inherit' a spread, a starter kit so to speak, of all of the chemical resources needed for autocatalytic growth to proceed. But not too reliably; a *population* of cells which all have exactly the same capacity as their

parents to process environmental materials through an autocatalytic growth process may be less able to survive a change in the availability of environmental materials than a *population* in which individuals vary to some extent. Conversely, if the inheritance process is too unreliable then most offspring cells will be unable to continue growing and dividing and the population will remain small and at risk from local catastrophes. The optimum degree of reliability in this 'divide and bequeath' strategy will depend in some complex way on the variability of the environment.

Even though there are, at this early stage in life's history, no genes being transmitted between generations, a form of natural selection is nonetheless operating. When individuals vary in terms of their autocatalytic chemistry, some will grow faster and divide more frequently than others, ie they will be selected. Genes and chromosomes evolved subsequently, functioning as a mechanism which reliably transmitted, not so much the molecules required for autocatalytic growth, but encoded information which triggered the construction of all necessary molecules from the raw materials diffusing into the cell. In time it would be the occasional imperfect replication of genes (not of the molecules participating in the cell's autocatalytic cycles) that would generate unicellular organisms of differential fitness and hence create the possibility of natural selection. Gene-based natural selection would, in more time, lead to adaptations such as a capacity for directed mobility or for photosynthesis.

While gene-based natural selection is most commonly thought of as a process which leads to speciation, it is, more fundamentally, a process which increases the survival prospects of multi-organism dissipative systems located in a heterogeneous and changing environment. Just as gene-based natural selection led to populations of organisms of various species being more likely to survive for a time, so did the emergence of *cultural inheritance* and *cultural selection* in populations with a capacity for individual learning and imitation.

The Cultural Eon

When it comes to the Cultural Eon, there is, again, a well-recognised sub-division of history's passing parade of human societies. While culture, in the sense of transmitting learned behaviour to others, could well pre-date the age of mammals, it suffices here to divide the Cultural Eon into a *hunting-gathering (or foraging) age*, a *farming-herding age,* an *urban age* and an *industrial age*. And while the seeds of a *post-industrial age* have no doubt germinated, the paramount feature of the dissipative systems that will characterise that next age is not yet clear enough to give it a specific name.

Of these several ages nominated as comprising the Cultural Eon, this book has so far looked only at hunting-gathering. We have particularly explored how cultural innovations in the hunting-gathering age, including material, social, cognitive and communicative technologies, co-evolved with such notable biological transitions in the age of humans as those in brain size and organisation, the vocal apparatus, body size and maturation rate. After the end of the last glacial, as energy flows through the biosphere increased [[??probably Q10]] and climates changed, the stage was set for the next major re-organisation of the Cultural Eon, namely a shift to a farming-herding age. It is to the evolution of farming-herding and later societies that we now turn.

THE NEOLITHIC AND URBAN REVOLUTIONS

The last ice age ended with Eurasia experiencing a period of severe 'glacial aridity'. From 20-18 kya temperatures were lower and glaciers more extensive than at any time during the previous 100 kyrs. Sea levels were about 130 m below present levels with, for example, Tasmania and New Guinea being linked to Australia by land bridges. As rainfall diminished, half the land between the tropics turned to desert. In Australia the population was reduced by, perhaps, 80 per cent with plant growth being slowed by low temperatures, low rainfall and low levels of atmospheric carbon dioxide. Humans survived in a few refugia across the continent.

Thereafter, temperatures began to rise, but not reliably; there were sharp cooling periods around 14 kya (called the Older Dryas event) and 13 kya---the Younger Dryas event. Nonetheless, the onset of a warmer wetter climate created opportunities for a variety of more sedentary lifestyles (still based on hunting, fishing and gathering though) in places where food supplies could be obtained year-round. Populations grew under these more settled conditions.

12 000 BP-6000 BP The Neolithic Revolution

Along with the final retreat of the glaciers, about 12 kya, came a dramatic reduction in climate variability. The benign Holocene had begun. Much of Europe became covered with dense forests and most of the large animals of the Ice Age either moved north or went extinct. In the Middle East's 'fertile crescent', wild barley and wheat could be relied on to produce harvestable quantities of seeds in most years while wild sheep, cattle[??]goats and pigs flourished on the expanding grasslands. Photosynthesis rates rose by, perhaps, 50 percent in response to atmospheric carbon dioxide levels rising from 190 ppm to 250 ppm.[1] Here, the stage was being set for the emergence between 11000 and 8000 BP (Before Present) of a village-based Neolithic (new stone age) society based on the deliberate planting of cereal crops, some primitive irrigation and on domesticating and hand-feeding indigenous social animals. Some, as their flocks of animals grew, became nomadic tribespeople searching for larger and larger areas of grasslands.

There were setbacks. Some 8200 years ago, sea levels, which had been rising since the last glacial maximum were still some 15 m [[??]] below present levels. Then, for the third time since the glacial maximum, came the collapse of glacial barriers which had been holding back huge quantities of lake water in North America. Enormous floods spilled into the north Atlantic causing rapidly rising global sea levels, short-term flooding, and permanent inundation of coastal areas around the world. These areas included much of south-east Asia (Sundaland) where established Neolithic societies would have been destroyed or displaced. The flooding of the river valleys of the Persian Gulf at that time suggests an origin for the story of Noah's flood. Alternatively, the Black Sea is estimated to have filled rapidly from the Mediterranean at this time.

Just as their pre-hominid African ancestors had adapted to the first stirrings of the Pleistocene ice ages by moving from a declining gallery-forest habitat to an open

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[1] The Origins of Agriculture as a Natural Experiment in Cultural Evolution Peter J. Richerson, Robert Boyd, and Robert L. Bettinger (paper in e-library)

forest (savanna) habitat, Neolithic hunter-gatherers adapted to the suite of ecosystem changes that marked the end of the Pleistocene by becoming farmers and herders. While the first Neolithic peoples flourished in northern Iraq and Turkey, their technology 'revolution' spread to the Balkans by 7000 BP, to Egypt and central Europe by 6000 BP and to Britain and parts of India by 5000 BP. The warm productive period---7000 BP to 5000 BP---which encouraged this spread is known as the *Holocene thermal maximum*.

Apart from agriculture and herding *per se*, Neolithic peoples developed a large suite of supporting material technologies which would remain useful even as village agriculture began to give way, in the Middle East, to large-scale irrigated agriculture. These included artificial irrigation using canals and ditches; the plough; animal motive-power; the sailboat; wheeled vehicles; orchard (hoe and dibble) husbandry; fermentation; production and use of copper; bricks; the arch; glazing; animal hobbles.

Life for Neolithic villagers was mostly peaceful (although not necessarily longer and more leisurely) because food was produced only in subsistence quantities and this left little opportunity for non-producers such as priests and soldiers to be supported by farmers and little temptation to attack other villages in search of food. Population grew by the spatial spread, rather than the intensification, of settlement. More reliable food supplies led to women being fertile for longer. Also, cereals were useful foods for improving post-weaning survival rates.

Neolithic villages could contain hundreds of people, ie they were much larger than most hunter-gatherer groups. Social cohesion was underpinned by kinship systems which imposed elaborate obligations to assist one's 'relations'. While language and chiefdoms had emerged as important tools for organising and co-ordinating individual behaviour in hunter-gatherer groups, their effectiveness was based on face-to-face contact, too unwieldy a method for managing larger groups where people might not even know all members of their group. It was in this context that social control through obedience to the 'voices of the gods' or their earthly messengers emerged. Whether the 'voices of the gods' were the hallucinated voices of dead chiefs who, over time, became godlike is the hypothesis so marvellously explored by Julian Jaynes (1976). Perhaps the real significance of this hypothesis is that it suggests a first mechanism for achieving social co-ordination *out of earshot* (just as writing would at a later date). What can be said with confidence is that religion and magic became increasingly important tools for managing society as the size of social units continued to expand.

6000 BP-3000 BP The Urban Revolution

[[[[[[richerson e-library Near Eastern trajectory of agricultural innovation was also comparatively rapid, but the whole sequence of increasing dependence upon plants and then upon domesticated plants and animals leading to nearly complete dependence on domesticates occupied roughly 4,000 years.]]]]]]]]]][[[[TAKEOFF: in economics, the point in the history of a society at which its economic surplus is sufficient to permit continu al reinvestment in economic growth, so that growth becomes self-sustaining.]]

Large-scale irrigated agriculture began about 6000 years ago and, with the invention of writing, marked the beginning of history proper. Sumeria, the first real

civilization---meaning a society supporting cities and specialist occupations---appeared about 5500 years ago in southern Mesopotamia in the swampy flat lands around the lower reaches of the Tigris and Euphrates rivers. It was a time of drying climates, making rain-fed agriculture difficult, and people gravitated to large river valleys and their floodplains. Soon after, c. 5000 years ago, a Nile valley civilisation appeared. In addition to writing, this revolution in social organisation quickly spawned three particularly consequential inventions---a solar calendar as still used, numerical notation and bronze (a tin-copper alloy) for making tools and weapons.

Reclamations of the lower Nile and the Euphrates from their swamps were massive tasks which could only be undertaken by large organised communities. The complexities of setting-up and managing big irrigation systems devolved to a specialised priestly class who were fed from large grain surpluses (partly explainable by the invention of the plough as well as by high yields under irrigation), as was the warrior class which emerged to protect those same surpluses from marauders. These same warriors were responsible for the internal coercion which was beginning to emerge, alongside religion, as an instrument of social control. The need to serve 'the gods' provided priestly oligarchies with a rationale for organising the concentrated use of labour on public projects.

As marauding [[??by horse-riding steppe peoples]]]] increased, command (military) management replaced priestly management in the Mesopotamian and other irrigation civilizations. As urban populations grew in the irrigation civilizations, additional specialist occupations emerged and the technologies associated with these new occupations advanced in step with the numbers who practised them. For example, the construction of bronze weapons and tools needed, apart from metal workers, many people, carts and animals to transport ores from far places and large quantities of timber to make charcoal for smelting. It was the dominant military and priestly classes who now took responsibility for the distribution of food in societies organised more-and-more around occupational classes rather than fragmenting kinship groups; a new form of economic system had emerged[2].

In time, it was competition among the emerging city-states of southern Mesopotamia (Lagash, Kish, Ur, Erech, Surupack, Larsa and Umma) for, *inter alia*, access to scarce ores and timber which initiated an era of 'survival through conquest' that persisted across Eurasia till, perhaps, the collapse of the Western Roman empire in 476 CE (Common Era). Sargon of Kish defeated the other city states to create the world's first empire, the Akkadian empire, which lasted from 4330 BP till destroyed by drought in 4230 BP. As a way of increasing a nation's food supplies, empire-building proved to be a more effective social technology than marauding once annual food surpluses in surrounding regions had stabilised. In this way, through taxes and tributes, a conquered state makes its maximum contribution to the conquering state in all years.

[[[[[4300 +- 200 BP (Peiser MPA) saw the collapse of a large number of major civilisations ; The Old Kingdom in Egypt, the Akkadian empire in Mesopotamia , the early bronze age societies in Anatolia Greece and Israel, as well as the Indus Valley

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[2] In several medium energy societies, the Aztecs in Mexico for example, a market-based system of distribution emerged rather than a socialist or state-controlled system. (White p 295).

civilisation in India and the Hongshan culture in China , the hilmand civilisation in afghanistan]]] [[Peiser B 1998 Comparative analysis of late Holocene environmental and social upheavals pp117-139 in Peiser BJ, Palmer Tand Bailey ME 9eds) Natural Catastrophes during Bronze Age civilisations: Archaeological, Geological, astronomical and cultural perspectives BAR International Series 728]]]]

It was the availability of food surpluses which induced a second (ie post-Neolithic) surge in human numbers, this time in urban rather than rural areas. But waterborne diseases (boosted by closer human contact) and the need to maintain and replace armies acted as major checks on population growth. Only rich urban civilizations could sustain viruses and armies which ate but did not produce. And, of course, once population rises to match increased food supplies, a Malthusian trap closes, meaning that there is great pressure to maintain or further increase food production. While urban populations acquired some immunity to the new diseases of crowded civilisation, rural peasant populations did not---an important part of the success of urban elites in controlling outlying areas. More generally, skeletal evidence indicates that as soon as humans began to farm, health levels declined due, perhaps, to population crowding, altered workloads, and increased nutritional deficiencies

[[check dates??]] By about 3500 BP the Middle Eastern agricultural civilizations had been joined by an Indian civilization in the upper Punjab area and a Chinese civilization on the middle Hwang-Ho. The Mesoamerican and Andean civilizations began around 3500 BP. The classical Greek civilization on the Aegean Sea emerged about 3100 BP.

Across Eurasia, societies were now coming to be organised into spatially-extensive politically-independent imperial command structures. Government-at-a-distance was achieved through the bureaucratic principle of delegation. Taxes, collected on commission for the central authority by feudal warlords, were the price of military protection. Difficulties with transport and communications were persistent challenges to the management of empires, as were fluctuations in crop yields. For instance, in 3628 BP the Santorini volcano exploded, destroying, by tidal waves, the Minoan civilization in Crete and initiating a period of volcanic winter, and political instability, worldwide. In the words of McNeill (1979), most of Eurasian political history can be viewed as unending fluctuation between imperial consolidation and peripheral feudal unrest, punctuated at times by epidemics of invasion by mobile horse-riding nomads from the animal-producing steppes which lay beyond areas suitable for cropping. Mass migrations caused by floods, droughts and famines were common and led to invasions and, for some peoples, servitude, eg the Jews.

The rate of technical and social innovation was now very low, possibly because most communities were still living precariously, meaning that a close adherence to traditional proven methods was a better strategy for survival than experimentation. Perhaps also, in the interests of maintaining social control, imperial rulers would have actively discouraged potentially-disruptive innovations. Indeed, the ruling classes had little respect for or interest in farming and farm workers. Childe (??) notes only four major innovations in the 2000 years after the urban revolution, say from 4600 BP---decimal notation in Babylonia, iron smelting, a true alphabetical script ((3300 BP) and aqueducts for supplying city water (2700 BP). Massively important here was the advent, c.3400 BP, of economical methods of producing iron, for tools and weapons, on a large scale.

The Bronze age ended with the somewhat mysterious collapse between 3225 BP and 3175 BP of at least 50 great Mediterranean cultural centres, including Troy, Mycenae and Knossos. The geophysicist Amos Nur[3] has suggested that a [[an intermittent]] chain of earthquakes along a major fault line could have rocked city after city, degrading their economic, social and political structures and leaving them vulnerable to marauders and waves of hungry refugees. Certainly it was around this time that chariot armies of various cities in the eastern Mediterranean succumbed to the iron swords of barbarian foot soldiers. Drought too may have played a part.

THE COGNITION-CONSCIOUSNESS REVOLUTION

The first millennium BCE was an era in the development of human societies when, across Eurasia, human knowledge, beliefs and ways of thinking changed markedly. Before reviewing a little of those changes and times, we will pause to abstract some working perceptions from the tangle of ideas around the phenomenon of consciousness and its relation to cognition.[4]

The Problem of Consciousness

The enormous yet inconclusive scientific (and other) literature on consciousness attests to the difficulty we have in understanding its function, its evolution and its processual nature. Defining it and its various forms, locating it within and between individuals and species, and in time (when did it appear?) are likewise problematic.

That same large literature indicates that many think it important to understand consciousness. Why? Plain curiosity is part of the answer. Another answer, for some, is that consciousness is a cognitive technology which appears to have played a major role in shaping human history and if we want to understand history we need to understand consciousness. The specific perception here is that the process which produces consciousness---call it the consciousness-generating process---is a general-purpose technology which has helped humans to dramatically increase the rate at which they have produced technologies intended to improve survival and life-quality prospects; and to produce one-off plans for solving novel problems. Perhaps a clear understanding of this technology can lead to its further improvement and hence to its making an increased contribution to future human welfare.

Here, I propose to take a selective approach to the concept of consciousness. I will restrict the term to an experience which, I believe, takes place only in humans (not little children), namely the implementing of an ability to observe (watch), and to know that one is observing, some of the operations of one's own (autonomous) mind. Note that, in this rendition, consciousness (being conscious) is a process of introspective observing and is quite distinct from what is being observed via this process, ie what I am conscious of does not constitute consciousness. The telescope is not the landscape. Equally, consciousness is not the cognitive processes which generate that which is being observed.

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[3] Nur, Amos and Cline, Eric; (2000) "Poseidon's Horses: Plate Tectonics and Earthquake Storms in the Late Bronze Age Aegean and Eastern Mediterranean", Journ. of Archael. Sc. No 27 pps.43-63 - http://srb.stanford.edu/nur/EndBronzeage.pdf

[4] Mental activities involved in acquiring, processing, organising and using knowledge

Failure to make these distinctions is a pervasive source of confusion. Others have avoided this potential muddle by using another term for consciousness as it is being used here, eg Edelman's (1989) term is *self-conscious awareness* and Torey's is *reflective awareness.*[5]

How does consciousness manifest itself? As a simple example, when you look at your familiar finger, your brain recalls, from memory, a referent couplet made up of (a) a stable and selective visual image, called a percept, of 'my finger' and (b) a verbal label (finger) for that image. You are conscious of your finger if you are both aware of this referent couplet and, reflectively, aware that you are aware of it; aware that you are paying attention to it. The portion of experience being irradiated by consciousness appears as clear and distinct against a background reality which is dim.[6] While you might be more aware of your finger if you have just hit it with a hammer, you are not more conscious of that awareness. Differently, you might be subconsciously aware of your finger in the sense that you move it in response to a stimulus, an itchy nose say, without realising consciously that you are aware of your reaction. To be clear here, subconscious awareness is not consciousness, is not self-conscious awareness.

Clarifying the Consciousness Experience

Before further discussing the mechanism and function of the consciousness process, there are several aspects of the consciousness experience which, in the interests of later discussion, need to be clarified:

[[reinstate bullets below]]

Who is the observer, or, alternatively, since they are felt to be one and the same, whose thoughts are being observed? Does it help to say that 'I' or 'I, myself,' am the observer; or, to say that the thoughts of which there is awareness are felt to be the experience of a *self* or an *ego* or a *me*?[7] The verbal labels 'I', 'me', 'my self' and 'my ego' have all come to be applied to that [[(the experient)]]??]] which experiences consciousness---I have thoughts and, when I am conscious, I observe (am aware of) my thoughts, and I am aware of myself and I am aware of myself being aware of my

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[5] Torey Kant's apperception??

[6] Whitehead Adventures of Ideas p 270)]]]

[7] torey paperin J Consciousness Studies The Immaculate Misconception 13(12) 2006 105-110. Zoltan Torey reminds us that " …the 'self' is something we experience, not some entity in us that experiences" ..we have a'sense of self' that builds up with life experience.?? [[[[[[[[[[The self as a complex process For process philosophy conceptualises the core 'self' of a person as a unified manifold of ongoing and potential processes –of action andcapys , tendencies , dispositionsto action 9both physical an psychical0 –then we therebysecure a concept of personhood that renders the self experientially accessible, seeig that experiencing itself simply consists of such processes … the unity of a person is aunity of experience –thecoalescence of all one's diverse mictro-experiences as part of one unified macro-process ..tt self is the complex process composed of those various activities]]]]]]]]]] NB Jaynes THE SELF IS AN OBJECT OF CONSCIOUSNESS ..below?]]][[[the self is a unification of past experience]]]

thoughts.[8] Whenever you think 'I am observing such-and-such a thought,' it is a sure sign of consciousness. When you answer the question 'What are you thinking about'? you are stating what you are conscious of at that moment. But being an abstraction which cannot be pointed at, we can only know this observed and observing ego metaphorically, viz. the ego is like an observer, like, say, an animal observing its prey. Like other abstract concepts (eg energy, gravity) we can only say what consciousness does and how it behaves operationally, not what it is.

One difficulty in referring to one's 'awareness of awareness' metaphorically is that it is just not like anything else we experience. I am attracted to Julian Jaynes' insight that all experiences of consciousness appear to be glimpses into an imagined mind-space which is a metaphor or model of real space (the real world) and in which an imagined ego, what he calls an analogue 'I' or a metaphorical 'me', can observe and, metaphorically, move around.[9] Each referent we become conscious of appears to have its own definite boundary surface and to be separate from other referents, ie can be thought about separately. Referents can be ordered in mind-space in ways analogous to the various ways in which objects can be spatially related in reality. Mental acts are analogues of bodily acts. So, when I am conscious of my finger, I am (metaphorically) looking into my mind-space and seeing 'me' looking at my finger, ie I am aware of three things: my finger, 'me' and 'me' looking at my finger.

For abstract entities too, we use the metaphor of seeing, of observing, to understand (give meaning to) how they are related, eg (the word) justice seems to be close to (the word) fairness in mind-space. George Lakoff points out that, metaphorically, consciousness is 'up'(eg, wake *up),* and unconsciousness is 'down' (eg, she *dropped off* to sleep).[10]

As for entities which are related in (abstract) time, we think of them, metaphorically, as being located 'before' and 'after' along a 'time line.' In particular, words in sentences and thoughts emerge sequentially through time and that might explain the pervasiveness of the spatial metaphor for understanding thought processes. It will be suggested presently that the ability to manipulate words in ways which are directly analogous to the ways objects can be manipulated in the real world is the basis of advanced cognitive skills.

What categories of thoughts might be accessed and what cannot be accessed through a consciousness experience?

When you are conscious, you are always conscious of something, a *referent* or so-called *intentional object,* usually a thing or a relationship, perhaps in memory,

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[8] In Jungian psychology the self includes the mind's unconscious processes as well as that which experiences consciousness, namely, the ego. I am using the terms 'self' and 'ego' interchangeably here.

[9] ???????? Understanding something is commonly a matter of finding a suitable metaphor (A is B) or simile (A is like B) or analogue (A is like B in part) for the entity we wish to understand.We will use *metaphor* as a catch-all term (see Richards IA (1936) The Philosophy of Rhetoric Clarendon Press Oxford

[10] (p15 Metaphors…)

perhaps in the internal (intra-body) environment, perhaps in the external environment. Thus, the contents of the three main types of memory---short-term, long-term and sensory---are, in principle, accessible by the ego, ie can be experienced consciously. Long-term memory includes an organised body of knowledge, a narrative, about one's personal history. According to Freud, the ego is like an agent of the mind (a metaphor), by means of which the subject acquires a sense of unity and identity, 'a coherent organization of mental processes.' For the moment though, we are more concerned with ego as that which experiences consciousness rather than as that which builds identity.

By definition, thoughts in the unconscious mind are inaccessible through the consciousness experience. For example, you cannot observe your thoughts at the moment of making a decision, only, at best, the thoughts that go into the decision and the thoughts that come out of the decision-making process. It is this apparent spontaneity of our decisions which invites speculation that we might have 'free will.' Similarly when retrieving memories: to the extent that you cannot perceive, at the moment of selection, what memory frame will be retrieved next (it just arrives), there is an inclination to impose meaning on this mystery by attributing the selection made to an act of will on the part of the ego.

Another basic aspect of the consciousness experience, sometimes called a sense of doership, perhaps better called a *proprioceptive sense*, is the feeling that you are the entity *creating* (cf. experiencing) the sense of awareness of your thoughts. As will be discussed below, the consciousness process has a motor component (sub-vocalisation). The importance of this is that all motor activities are proprioceptive, meaning that when they are (consciously) executed they generate a feeling that you, the executor, the analogue 'I', are carrying out the activity.[11] The consciousness process seems to involve an understandable extension of the proprioceptive feeling from body awareness to thoughts awareness. [[not sure about this interpretation of propceptn][[[looksok i think]]] [[if you do become aware of your thoughts, you will recognise them as your thoughts because they are a motor activity and all motor activities that come to awareness evoke this feeling of body awareness ..hang on basic proprioception is the tagging of body movement information with an awareness that it is information coming from the body—not necessarily conscious]][[[have just said enough here to allow better formulation next time I look at this para]] [[torey says proprioception is … [[[proprioception normally (not in anarchic hand case) associated with sense of ownership joel smith review]]]]

Being conscious of certain thoughts need not imply any knowledge of the source or origin of those thoughts. Normally though, irrespective of their specific content and origin, one's 'visible' thoughts are felt to be self-authored. That is, the thinking process which produces 'my' conscious thoughts is felt to be autonomous. The thoughts I am conscious of are not the products of another's thinking which are being channelled through me. [[[isn't this the same as proprioception??]]]

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[11] Note that awareness of what your body is doing (ie proprioception) may or may not come to consciousness.

While most people, through socialisation, do come to believe in the autonomy of their own thinking (it can't be proved), there are those, notably schizophrenics, who believe that at least some of their 'thoughts' are freshly planted in them by outside entities. Many schizophrenics experience auditory hallucinations in which authority figures, even gods, tell them what to think and do. And, as will be further discussed below, it is Julian Jaynes' hypothesis that it is only since 2nd millennium BCE that most people have felt themselves to be the authors of their own thoughts and actions.

Consciousness is a thin, intermittent and discrete (ie, either 'on' or 'off') experience. Few of the brain's hundred billion neurons are involved in an experience of being reflectively aware of one's thoughts and, we suspect, if memory serves aright, that one is conscious for but a tiny fraction of each day. Consciousness is rooted in the 'here and now' reality of everyday life and it is to this reality that consciousness returns after each excursion into the consideration of a what-to-do problem outside everyday experience.

The set of referents that an individual, and his/her society as a whole, are potentially conscious of is continually expanding. In Jaynes' phrase we are constantly renewing and enlarging our mind-space with each new thing or relation 'consciousised.' Every new suite of words coming into a language mirrors the creation of new percepts and concepts, expanding the spread of what one can be conscious of but not changing the essential nature of the consciousness experience. The exception to that may be consciousness itself. It is at least plausible that you cannot be reflectively conscious if you do not have a vocabulary which allows you to describe (or agree) what it is to be conscious, eg non-human animals, little children.

The Consciousness-generating Process

[[[[[[[[[[Gerrans] It is not just the size of the prefrontal cortex but its dense interconnectivity

with posterior, limbic and brainstem areas which enables offline cognition.

These connections are both afferent and efferent which enables bi-directional

signalling between the prefrontal cortex and posterior areas. Furthermore

while most connections from posterior networks to the prefrontal cortex are

excitatory the prefrontal cortex has extensive inhibitory connections (via GABA

interneurons) to posterior areas. This interconnectivity enables construction of

transient recurrent circuits distributed across the prefrontal cortex and posterior

assemblies (Friston 2002). The prefrontal cortex maintains salient representations

by enhancing the level of activation in their implementation

circuitry and inhibiting activation levels in other circuits competing for prefrontal

resources (Fuster 1997).]]]]]]]]]]]]

We have already noted that neither the experience of consciousness *per se* nor the entities one is conscious of should be confounded with the mental processes which generate the experience of consciousness; there is more to the consciousness process than the consciousness experience. Here, I will draw on ideas in Zoltan Torey's path-breaking book, *The Crucible of Consciousness*[12] to identify what the consciousness-generating process generates in addition to the consciousness experience itself, and how it does so[13].

Torey's model of the self-aware brain concentrates on three interconnected regions of the physical brain each of which can be regarded as a self-organising (sub) system of neurons---storing and re-organising information as well as continuously receiving and transmitting information in the form of neural messages, electrical impulses, along neuronal pathways. The three are the right hemisphere's *awareness system,* the left hemisphere's *speech system* and the brainstem's *arousal system*.

The awareness system

The *awareness system* is located in the frontal lobes of the brain's right hemisphere. Metaphorically, it ceaselessly generates an ever-evolving situation report (What's happening?) on the body and its environment based on the receipt of diverse inputs from both outside (via the sense organs) and inside the body (from muscles, from other parts of the brain, from the nervous system and from the endocrine glands). The awareness system integrates (totalises) or translates all these inputs into an ever-updating internally consistent set of 'off the shelf' percepts called an *endogram.* An endogram is something like a frame from a movie, a manageable summary of what the brain is aware of at the time, a model of the world outside the awareness system. Being 'internally consistent' simply means that the endogram's constituent percepts are recognised as being related in some fashion. Remember that a *percept* is anything that can be separately identified and named, ie be labelled with a word or sentence.

All sensory inputs reaching the awareness system [[[[what about saying 'all sensory inputs that signal change in the environment??]] are immediately cycled through an *arousal system* located in the limbic area and reticular formation of the upper brainstem.[14] Here an emotional 'flag', positive or negative, is grafted onto the percept

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[12] Torey, Z 200?

[13] Calling the consciousness process the consciousness-generating process risks giving the impression that the only thing the consciousness process does is to generate consciousness. What I am calling the consciousness –generating processis similar, I think, to what Torey calls the *mind system.*

[14] The reticular activation system is a network of fibres and nuclei in the brainstem whose function is to activate portions of the cortex. The limbic area is an evolutionarily ancient part of the brain, concerned with emotions and instinctive behaviour.

before it is returned to the awareness system. Depending on the emotional significances assigned to different percepts, different parts of the endogram will thus express different degrees of arousal and , hence, will elicit different degrees of attention from the ego. Any 'insignificant' percepts will not even reach the endogram. Functionally, a 'cognitive technology' of selectively attending to those referents in the endogram with significant emotional overtones protects against sensory overload in the awareness system and, hence, against undirected behaviour. Also, percepts for which the added emotional overtones exceed a threshold intensity are embedded in long-term (permanent) memory storage from where they will be retrievable in the future (along with the added feelings).

[[[[[A metaphor for awareness is shining a torch on something that seems to be out of place or disturbed, not as you expected it to be, not matching your memory or your model of what it should be like …. Awareness of awareness is like seeing yourself on a surveillance camera as you are shining your torch on the item which has attracted your attention ..when something comes to awareness it is like it suddenly stands out against a much vaguer background]]]]][[awareness is an EXPERIENCE??]]

The awareness system does more than assemble percepts. The awareness system also has a *word response mechanism* which first classifies and then attaches a word-label to each percept entering the the focal or high attention part of the endogram. Thus, all input experiences which make it to the focal area have are first converted into stable referent couplets (ie, percept plus name) drawn from a largely pre-existing 'library' of long-term memories of such couplets.[15]

The main task of the awareness system is to manipulate emotionally significant percepts and, with the help of feedback from the *speech system* about the meaning of those significant percepts, devise a 'rolling' what-to-do plan, an action schema, a narratised sequence of motor behaviours. Such schemata are automatically read and initiated (imitated) once attention fades, ie as the endogram moves on, updates, in response to new sensory and reflected inputs. It is only if and while attention is sustained in some way that motor action is suppressed.

<u>The speech system</u>

The *speech system*, located in the temporal and frontal lobes of the left hemisphere, receives, as its predominant input, words and sentences corresponding to a selection of the percepts in the endogram of the awareness system. That is, it receives, via the cross-cortical link, the word parts (not the percept parts) of those endogram couplets currently being brought to high attention by the *arousal* component of Torey's self-aware brain. In functional terms, this inter-hemisphere information flow facilitates co-ordination of the activities of the two hemispheres; it ensures that corresponding words in the left hemisphere and word-percept pairs in the right hemisphere are processed, if not simultaneously, then in rapid oscillatory sequence. This means that the two hemispheres will never be processing unrelated data sets.

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[15] Obviously this 'library' is evolving, as when vocabulary increases. Also, the identification of percepts includes a 'constancy mechanism' which allows a changing input eg a moving person, to continue to be associated with the same percept.

The speech system manipulates this verbal input, putting it, along with other *associated* words, through a rule-based word-ordering or *thinking* process and outputting the resulting narrative[16] back to the focal region of the awareness system. Thus, there is a 'speech loop', and nothing more, connecting the awareness system and the speech system. As well as transmitting 'covert' speech back to the awareness system, it is this same speech system which activates the vocal apparatus, as needed, to produce 'overt' speech---much as the right hemisphere's awareness system is responsible for generating peripheral motor activity such as moving a finger.

It is the back link from the speech system to the awareness system (call it the S-A link perhaps?) which is at the heart of the consciousness-generating process. Why and how? Basically, it is because the awareness system treats the neural excitations, the stream of covert speech, the thoughts, coming to it from the speech system in much the same way as it treats 'real' speech coming from another person, ie as sensory input.[17] This has various consequences:

One is that the verbal thoughts feeding back into the awareness system generate a stream of visual, auditory etc percepts, just like referents coming to the brain through the sense organs.[18] We can note in passing that research shows incoming words to be highly effective in evoking their matching percepts when they reach the awareness system.[19] This is because, mostly, incoming thoughts have attentional priority over other sensory inputs.

[[[[[[combinations of words guided by rules of syntax give meaningful information about relations between the words and hence about understood relationships between the objects or ideas symbolised by those wrds]]]]]]] price jjs site]]]]] [[[The theory is supported by arguments regarding the two-hemispheres of the brain. The language center, based in the left hemisphere, communicated across the corpus collosum to the right hemisphere, and this interior exchange of linguistically coded information was subjectively experienced in ways that gave rise to the long lineage of literary and religious cultural traditions that includes Muses, guardian angels, prophetic visitations by Greek and Hebrew and Christian gods and saints. The rare Joan of Arcs and Saint Pauls of the current two millennial era were preceded in the prior two or three millennia by whole societies steeped in the oracular mode of consciousness, as opposed to the more common ego consciousness of modern times, according to Jaynes. And in that era, the authoritarian command and the rule of social hierarchy were the *apex* of human social and moral and psychological development. Today, through the discouragement of our 'betters' toward more conscious pursuits, we are in the habit of harking back to those days and that era as if nostalgically longing for a

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[16] Narrative: An account of a series of events, facts, etc., given in order and with the establishing of connections between them; a narration, a story, an account.
[17] [[[It helps to understand this to recognise that the speech area of the left hemisphere developed, evolutionarily, from an area of the brain formerly used to control muscular activity.]]]]] Indeed R Allott argues that each type of sound made during speech is still accompanied by a specific residual muscular activity in the arms, face etc.
[18] Jaynes, J (1986) Canadian Psychology 27(2) Consciousness and the voices of the mind. Jaynes makes the further point that before the emergence of modern self-awareness, people treated imagined words as though they were spoken words.
[19] Torey p 53

better time, an Edenic existence in which certainty about important things still existed.]]]]]]]]]

Now, because a large part of what the speech system transmits to the awareness system is simply a *reflection* of what the awareness system transmitted to the speech system some fraction of a second earlier, the speech system is effectively telling the awareness system what it has just been thinking, perhaps 'loudly' enough for those thoughts to 'break through' to consciousness, to reflective awareness ('Hey, I have been thinking about X') and to be perceived, proprioceptively, as self-authored. For this to happen, and it only happens intermittently, the words which the awareness system 'hears' from the speech system must have evoked a threshold degree of arousal from the attention-arousal system. In principle, what is happening here is no different from a finger on a hot stove evoking a threshold degree of arousal. Note that consciousness is not being 'explained' here beyond saying that, because transmitting sub-vocalised words is a motor act, one is aware of that act no more and no less than one is aware of any motor act the body executes.

Feedback from the speech system to the awareness system has other effects too. One is that the endogram will keep getting updated, not just by 'real' sensory inputs, but by the speech system's verbal understanding of the meaning of the endogram selection it has just processed. We will talk presently about the various cognitive techniques the speech system uses to process input from the awareness system. A related consequence here is that feedback from the speech system amplifies or reinforces the arousal levels already associated with the focal percepts of the endogram and hence reinforces the tendency for these focal percepts to be embedded in long-term memory. Feedback which has sufficient emotional significance to enter consciousness is also particularly likely to enter long-term memory. Note though that while we tend to remember what we become conscious of, it is not because we have become conscious of it. Note also that it is only while 'reverberation' around the feedback loop between speech and awareness systems continues that thoughts can remain in short-term memory, and in consciousness, and that motor responses will be delayed.

<u>The arousal (limbic) system</u>

[[[[[[….?? .it is largely through parental approval-disapproval of the child's learning attempts that the limbic system acquires the library of thought-feeling couplets against which a proposed behaviour will be evaluated]]]]] [[[[Note the Parallel between Freud's unconscious and the limbic system Damasio etc are ever more interested in the unconscious, emotional steering of cerebral processes.elbry]]] Note also Watson's experiments with Little Albert and making him fearful of the white rat]]

The human brain is unique in its asymmetry. Unlike any infrahuman brain, the left and right hemispheres have different functions. The left hemisphere is largely responsible for managing speech-thought and the right hemisphere is largely responsible for managing other behaviours, notably peripheral motor actions. A feedback loop between the two hemispheres carries information which ensures that

both speech-thought and other behaviours are co-ordinated, ie are working together on what-to-do plans/options for meeting the person's needs.

The aforementioned *arousal system* in the upper brainstem is strongly connected to the right hemisphere and weakly connected to the left hemisphere. It has several functions:

One, as noted, is to help shape which of the many inputs to the sensory cortices of the right hemisphere will be represented in and focussed on as percepts in the current endogram---and hence which will be sent to the left hemisphere as inputs to the speech system.

But as well as shaping input to the speech system, the arousal system is fundamental to the processing of the re-organised and upgraded words being returned from the speech system to the awareness system. The speech system processes inputs from the awareness system, linking them with related word-percept pairs and generating a sequence of behavioural options which are routed, one at a time, through the awareness system and on to the arousal system. There, each is evaluated by the arousal system until one which does not generate a 'rejection' response arrives. In the absence of such an inhibitory response from the arousal system, the behavioural option currently in the awareness system now initiates a corresponding motor response. That is, when attention is released, the endogram moves on and a motor response follows. Each behavioural option which 'fails' to trigger a motor response from the awareness system is re-sent via the corpus callosum back to the speech system for further processing and thereby sustains the brain's attention to the current what-to-do situation a little longer.

The infrahuman brain does not have such a capacity to delay responding (initiating a motor response) to a stimulus (input) and so has no capacity to make decisions in the sense of selecting a motor response from multiple options generated by interaction between the speech and awareness systems. But neither, for most of the time, is the human brain choosing amongst multiple behavioural options. In practice, learned customary and habitual responses to the standard situations of everyday life provide immediate answers to most what-to-do questions. But, when these break down, ie do not match some novel situation, a behaviour generating and choosing process generates successive behavioural options till one is judged 'good enough' and implemented. If the implemented behaviour is associated with a threshold level of emotional significance its image (a) rises into consciousness and (b) is stored, along with its context, in long-term memory.

Imagine walking from A to B. Most of the time the selection of where to place your feet is handled by habituated rules that initiate peripheral motor responses. If an obstacle appears, you stop and, probably unconsciously, try to pick an acceptable way around it, one that meets certain evolving criteria. What you have done, given the 'warning' endogram, is switch from one kind of motor response---peripheral---to another kind of motor response---intra-cortical. And if the obstacle is a snake the situation will rise into consciousness! All endograms produce a motor response of some sort but, if you are a dog and not a human, you can only respond with the best available peripheral motor response in your 'stimulus-reponse' library. You have no

'off-line' motor response capability. In either case, dog or human, the stimulus mix changes and the endogram is updated once more.

Is consciousness an epiphenomenon?

It is not at all obvious that the effectiveness of the brain's what-to-do decision making would decline if consciousness did not keep popping up. Torey says (p 155) that without reflective awareness we could not upgrade and enrich our range of choice, insight and behavioural options. I am doubtful. These are 'rewards' from the consciousness-generating process, not from consciousness per se. While that name is not wrong (it does generate consciousness), it might more accurately reflect the significance of this process to call it the behaviour–choosing process. It is, after all, the process which allows the brain to generate and evaluate alternative responses to what-to-do situations---rather than just accepting and initiating the first behavioural impulse evoked [evoked in the limbic system] by the situation.

So, unless it can be suggested how awareness of one's current thoughts might change one's next thoughts, the simplest conclusion to draw (the null hypothesis) is that it does not. Unfortunately, as with the question of freedom of the will, there does not appear to be a way of testing this hypothesis. The suggestion lurking here is that *realising* what you are thinking does not change what you are about to think. However, this is in no way incompatible with the idea that what you are currently thinking will always influence what you think next. Remember that awareness of an action tends to follow, not precede, the action. Before one utters a sentence, one is not conscious of being about to utter those specific words.

Before writing the consciousness experience off as an epiphenomenon, a byproduct of the behaviour-choosing process, consider the speculation that without consciousness' particular contribution to long-term memory one would have little understanding of what others are thinking and, hence, what they might do. The particular contribution being referred to is that each thought coming from the left brain and passing into both consciousness and long-term memory carries with it the knowledge that is an internally-generated thought. One consequence of this is a selective memory trace of one's (conscious) thoughts over time, something that ancient people would not have had. Not only are these memories (eg of past interactions with the environment) a large part of one's self-knowledge, and hence a large part of the self, they allow one to infer that others, so like oneself physically, may well be like oneself mentally. As psychologist Nicholas Humphrey says, consciousness gives every human a privileged picture of her own self as a model for what it is like to be another human.[20] In turn, at least after the invention of 'questions', this recognition opens the way to asking the other what, specifically, they are thinking of and, by comparing percepts, take part in building a 'collective mind' of shared stable percepts---a basis for efficient communication and co-operation.

Similarly, having access to a history of one's thoughts and their consequences, plus some understanding of causation, allows one to improve one's thinking by asking questions of oneself about relationships amongst one's memories, eg constructing narratives. Memory is at the heart of cognition. Consciousness is rescued from

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[20] Humphrey

being an epiphenomenon by its role in tagging long-term memories with the useful realisation that they are past thoughts. I am reminded of the technique of filming an athlete, not to improve the performance being filmed but, after analysis, to improve future performances.

Consciousness is not Cognition

Before looking to understand the immense significance of the cognition-consciousness revolution of the first millennium BCE, and remembering how consciousness, its content and the processes within which it is generated get confused, it will help emphasise these distinctions to recall a few aspects of the cognitive instruments, the thinking tools, which modern humans use in responding to, and, indeed, constructing what-to-do challenges.[21]

Arguably, *Homo sapiens*' core cognitive skill is *conceptual thinking*, the ability to perceive similarities and differences, to develop abstract concepts by inductive generalisation, memorise and name them, and use those names (words) to construct grammatical sentences expressing relations between concepts, eg snow is white. To a large extent, we think about concepts and percepts and we think with words; concepts are bearers of meaning, as opposed to words being agents of meaning.

We will not attempt to classify the many ways in which concepts can be related/ manipulated, verbally or mentally, in sentences and strings of sentences, just mention several which have proved particularly useful in support of what-to-do plan-making:

Factual propositions are statements about concepts, statements which are either true or false depending on the meanings of the concepts. A question is an inquiry into a proposition's truth value.

If this…then that statements reflect (i) causal understanding of relationships, in time, between concepts or (ii) structural understanding of spatial relationships between concepts. If war is declared, then truth will be the first casualty.

Metaphors of the form Xs are like Ys are the starting point for developing and naming new concepts; and for 'understanding' existing abstract concepts. My love is like a red, red rose. Language itself grows by metaphor, helping us to understand the unfamiliar (Jaynes 1976).

Narratives (stories) are accounts comprising events, propositions, etc given in an order which reflects their relationships in space-time. Narratives are the cognitive technology which enables the consequences of alternative behaviours to be simulated mentally. In societies, narratives transfer information between people. *Abduction* is an important form of narratisation in which an explanatory hypothesis that is consistent with the known facts is generated.

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[21] In John Dewey's terms, this is an instrumentalist perspective--- thought exists as an instrument of adjustment to the environment. Specifically, terms of thought and meaning are relative to the function they perform and that their validity or truth is determined by their efficacy.

Inductive generalisation[22] not only allows concepts to be drawn out of experience but allows the construction of 'super-concepts' which embed concepts within concepts and identify relationships between concepts. This 'chunking' process allows more complex thinking within the constraints of short-term memory, eg an ethical principle can guide thinking about the ethics of a particular case.

Bisociation is Arthur Koestler's term for the process behind creativity, namely, intuitively seeing a connection between concepts not hitherto recognised as being connected.[23] Aaahh, lemon juice cures scurvy.

Associative memory is the capacity to recall, from a suite of stored concepts, the concept most closely associated with some 'sensory clue,' eg, as in indexed memory, recognising a whole pattern when presented with a fragment of that pattern.

Rationality is that orientation towards reality which attempts to weigh up the costs and benefits of means and ends of an action before adopting it..

Deductive reasoning is a procedure for drawing conclusions (in the form of propositions) from premises (statements, assumed to be true, about concepts) by applying a set of rules. Deductive systems comprising a set of axioms and a set of rules for operating on those axioms provide an extremely compact way of storing a large number of propositions.

This list of cognitive technologies and the ways in which they can support behaviour-choosing processes could be much extended (eg means-ends analysis, hypothesis testing, binary discrimination) but our purpose is no more than to exemplify that modern individuals have a range of thinking tools which apparently do not need consciousness. We can turn now to a time when these skills were less developed.

3000 BP-2000 BP New Religions, New Thinking, New Societies

Much of the millennium preceding the Common Era (ie, the first millennium BCE) was a chaotic interregnum between the passing of the Bronze Age and its great empires and the translation of the centre of civilisation westwards to Greece and Rome. Not that all was destruction in the latter part of the second millennium; new cultures arose in in the Indian Punjab (c. 3500 BP), the Chinese Hwang-Ho region (c. 3400 BP) and in the Aegean (c. 3100 BP).

In the early part of the first millennium BCE, disruptions to food production and trade routes reduced energy supplies in many societies below levels needed to support unproductive specialists as well as agricultural workers. Social structures were necessarily simplified with many turning to marauding and migration to survive; others returned to self-sufficient village life. Under stress, the theocracies which had guarded, guided collective decision-making, and imposed social order on increasingly complex societies for some thousands of years broke down, some slowly, some rapidly. Notwithstanding, over the millennium agricultural production expanded

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[22] In logic, induction is the process of generalising over multiple examples, commonly by emphasising similarities and ignoring differences between them

[23] Koestler Act of Creation

rapidly (due not a little to the use of the iron plough) and world population increased from c. 50 m to c. 170 m.

It was a time which saw major shifts from oral to literate cultures, from magic-based polytheistic religions to monotheistic religions and in the nature of human consciousness and human cognitive-linguistic abilities. Where the Neolithic period is characterised by the emergence of material technologies and the Urban period by new social technologies, the first millennium BCE was to be a time of great change in cognitive and communicative technologies.

In what Karl Jaspers (1953) calls the 'axial age' of new religions, the period c. 2800 BP to 2200 BP saw the emergence of Taoism and Confucianism in China, Buddhism and Hinduism in India, monotheism in Iran and the Middle East (Zoroastriansm) and Greek rationalism in Europe. Beneath their obvious differences all reflected an emerging ability to think with the idea that each human is an independent entity with a faculty of choice in line with their individual character, ie each possesses an ego. All shared a concern for how to cope with the misery of life (oppression and disease), how to transcend personal weaknesses and how to live in peace in a flawed world.[24] Personal morality and responsibility were becoming more central to religion in a world where behaviour was no longer so tightly dictated by theocratic rulers; the ways in which the gods might react to one's actions became less troubling.

What was crystallising here was a trend which can be traced back to an *animism* in which everything had its motivating self-interested spirit, a spirit which was often manipulable by magical procedures. Next, with the early Neolithic perhaps, came a *manifest polytheism* in which numerous gods (idols), including personal gods, were always near at hand, needing to be placated and directly consulted in what-to-do situations. In time, all manifest polytheisms gave way to *remote polytheisms* (eg early Hebrews, Greeks, Romans) in which gods were distant, less talkative and generally less interested in human affairs.[25] It can be suggested that the next shift, to *monotheism* (one god), was an adaptation which, thinking of religion as an instrument of social control, had the virtue of creating a single authority to be obeyed rather than many; especially where a single priesthood had a monopoly on interpreting a single God's will. Going further again, both Buddhism and Greek rationalism began substituting the moral autonomy of the individual for supernatural external authority as society's way of imprinting behaviour supportive of the existing social order.

The emergence of the modern mind can be seen most clearly in the flowering [[??fluorescence?/]] of Greek thought, culminating by the sixth century BCE in a society where people had acquired sufficient cognitive skills, sufficient vocabulary

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[24] (Armstrong 2001)

[25] Jaynes & Comprehensive Paradigm Shifts &
My Evolving Plausibility Attitudes Towards Jaynes' Theory On The Origins of Consciousness jjs website accessed 25/03/07
Richard Singer, Ph.D., Professor Emeritus at Webster University in St. Louis, MO

(including the vocabulary of subjective consciousness) and sufficient memory (boosted by phonetic writing) to debate individually and collectively, the nature of the world and society and how these might be better managed For example, democracy was a social technology made possible, at least in part, by the Greek recognition that people are individuals as well as class members. Speculation was explicitly recognised and ardently pursued. More generally, the classical and Alexandrian periods of Greek civilization, through their contributions to language, politics, pedagogy, arts, science, and philosophy, laid the foundations on which, eventually, the European Renaissance would be built. There is bite in the aphorism that the history of Western philosophy is a series of footnotes to Plato.

The Greek capacity for systematic thought equalled ours. They knew how to trial candidate behaviours in the mind at low cost and how to bring disparate ideas into a consistent harmony. They knew how to use premises to underpin an argument. They were able to challenge the truth of comforting beliefs. Indeed, it was c.2430 BP that Solon and others recognised that truth was something to be discovered, not revealed.[26] [[wait on Solon =600BCE]]]

But societies are learning systems in which knowledge acquisition has to build on what has gone before and the process is necessarily slow for a long time. In any case, the knowledge and understanding the Greeks achieved was lost for hundreds of years following their conquest by the Romans in 146 BCE.

Contribution of Writing to the Cognition-consciousness Revolution

Walter Ong, an early student of the differences between oral and literate cultures, described writing as the most momentous of all human technological inventions, the technology which has shaped and powered the intellectual activity of modern man.[27]

Writing systems developed and spread in two waves. The first, based on pictographic forms, began in Sumer some 5500 BP and dispersed from there through Mesopotamia to Egypt, Europe, India and China. Writing systems in the second wave, beginning in the late Bronze Age, were alphabetic, meaning that they used one sign to represent one sound. A good example is the Phoenician alphabetic system which gave rise to Hebrew, Aramaic and early Greek; and then, via Greek, to Latin and Cyrillic. Around 2800 BP the Greeks invented signs for vowel sounds, making theirs the first complete alphabet with both consonants and vowels.

Writing systems are more than memory aids and more than pictorial depictions of things. They accurately represent someone's uttered or imagined words. Without the distortions which plague memory, they allow the storing of information over long periods. But writing is much more than a substitute for spoken language. Extending language transmission from an oral-aural medium into a visual medium has had enormous impacts, over time, on diverse aspects of cultural evolution, notably, cognitive capabilities, belief systems, knowledge acquisition, inventiveness and social organisation:

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[26] Saul in the unconscious civilisation
[27] Ong, W (19) Orality and Literacy

As the Bronze Age progressed, and societies became more complex, writing was increasingly used for practical purposes such as keeping records of transactions and contracts; transmitting instructions from supervisors to workers; and providing permanent, accessible public statements of proclaimed laws. In this context writing was a technology which provided certainty as to what had been communicated and which allowed communication across time and space.

It was towards the end of the Bronze Age that culturally-important stories and narratives which, till then, could only be transmitted orally began to be written down, the first perhaps being the Zoroastrian Vesta (c.1500 BCE). The oldest of the Indian Upanishads has been dated to around the eighth century BCE---it is the philosophy of the Upanishads which underpins Hinduism, Jainism and Buddhism. In China Confucian writings date from c.500 BCE. The first-written book of the Hebrew bible, Amos, is now dated at 750 BCE.[28]

It is hard to see how the great religions could have spread and matured without such sacred authoritative texts, unchallengeable as they were by the mindset of the time. Because they record what was said by God or prophet or enlightened one, they have the authority of the spoken voice, especially when read aloud. Think also of the importance of the New Testament and the Koran in the following millennium. Certainly the Greeks and Romans had no sacred or revealed texts of any stature and their religions withered. Rather, texts, particularly for the Greeks, became vehicles for the elaboration of philosophical and scientific inquiries and for the 'fixing' of foundation myths such as 'Homer's' two epic poems, the Iliad and the Odyssey (transcribed c. 2700-2650 BP).

While writing a narrative down freezes the words spoken and renders it available in canonical form on demand, it does not wholly capture the experience of listening as the owner of the narrative delivers it. Written words are always an abstraction from a total situation which is more than verbal. Inflections, emotions, emphases etc are lost. Particularly if a text is sacred, it cannot be adjusted to reflect a changing world and becomes a source of debate over interpretation. Scientific, philosophical and instructional texts are more open to correction.

It is interesting to speculate that it was only with the transcription of foundation myths and the later realisation that the world was no longer as it was that the concept of historical time entered the consciousness.of newly-literate societies. Mecea Eliade in *Cosmos and History* suggested that the Hebrews, the first truly alphabetic people, developed a sense of 'one-way' time---an accreting, non-repeating sequence of events against a backdrop of cosmic cycles. Eliade's bold hypothesis, known as *the myth of the eternal return*, is that preliterate people inhabit a cyclical time wherein, they believe, their periodic ritual reconstructions of mythic events actually recreate (reactualise) those events and return the world to its beginnings.

What of the contribution of writing to the evolution of cognitive capabilities and the buildup of collective knowledge? First, multiple individuals can learn from the writers of texts (ie, extended discussions) even if such are distant or dead. In

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[28] James Cohn (2007), The minds of the Bible: Speculations on the Evolution of Human consciousness, http://www.julianjaynes.org/ (accessed Nov 1, 2007)

principle that can also happen in an oral culture (via teachers) but the scale is likely to be different. Given multiple copies of texts and a core of people able to read (libraries were invented in the late first millennium), more people will be holding more knowledge in common in a literate society than in an oral society of the same size. This in turn will mean more people primed to contribute, through learning, to the creation of further knowledge.

Texts themselves provide a stable starting point for ongoing verbal dialogue about their truth or about how the thinking they embody might be extended. [[[The critical innovation was the simple habit of recording speculative ideas—that is, of externalizing the process of oral commentary on events.]]]] But a written text has several advantages over verbal discourse as a means of evaluating and upgrading an argument or exposition. Improving a written text can be treated as an iterative task, reviewing and revising one's previous thoughts. Selectively rereading what you have written reloads your working memory, sometimes in novel ways. Rewriting involves a dialectical process in which product and process, content and the tacit rules for writing persuasively and logically, have to be constantly harmonised. Reasons have to be crafted and conclusions synthesised.

Against this, the tacit rules of *spoken discourse* are much looser, a game of verbal ping-pong which can easily wander. It is much easier to get away with sloppy thinking in discussion than on paper. On balance, you are more likely to 'know what you think' when you see what you have written than when you listen to what you say!

Writing, being slower than talking, offers more opportunities to be creative, to reflect, to generalise , to abstract, to integrate ideas. It encourages introspection, including the push to find words to capture the emotions which are expressed otherwise through gesture, mien etc when speaking. Metaphor is particularly important as a technique for understanding, exploring, capturing and, eventually, naming fuzzy feelings and values.[29] And insofar as writing gradually evolved syntactical structures capable of expressing metaphors, it may have played a pivotal role in the invention and experiencing of consciousness and selfhood.

Against these positives, the difficulties of using and learning from early texts need to be kept in mind. In Plato's time a library's documents were stored in unlabelled jars; there were no spaces between words, sentences or paragraphs and no punctuation marks; texts usually had no contents listing and no pages.

[[idea that writing helped kill off the bicameral mind because introduced the idea that here might be more than one reason for doing something Ka vs stele]]]]] writing allowed government by law, not by by individual judgement each time

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[29] AN Whitehead notes the difficulties Plato, a metaphysician of genius, had in making language express anything beyond the familiarities of everyday life and goes on to say that it is misleading to study the history of ideas without constant remembranceof the struggle of novel thought with the obtuseness of language. (Adventures of Ideas p120)

Stages in the Evolution of Consciousness-cognition

Any attempt to overview the evolutionary development of consciousness-cognition cannot be other than highly speculative, even into the period when written records begin. The value of attempting such though is that it might suggest [[features and]] trends in that process which are still operative and hence part of understanding social and cultural evolution today. [[[Here we will briefly recapitulate three plausible earlier stages in the evolution of consciousness-cognition before coming to the revolution that we are claiming for the first millennium BCE. These are a pre-verbal stage, a syntactic language stage and a ??bicameral ??stage

In fact there is one cognitive operation, an inductive learning operation, which, at least since the first hominids, underlies all expansions in the range of entities of which the brain can become aware. From the early Pleistocene, the hominid brain has been learning to abstract recurring similarities and patterns---called percepts and concepts---from a kaleidoscopic flux of input stimuli and store representations of these in memory.[30] From there these internalised representations have been available as templates (together with links to action schemata and emotional tags) against which new experiences can be tested for conformity. Francis Heylighen (1991 p5) suggests that the emergence of just one further cognitive operation, the capacity to recombine concepts, free of their original context, in a more-or-less controlled way, allows all the typical characteristics of human intelligence to be explained.[31]

What we have here is an evolutionary development under which the brain comes to learn to subdivide, and further subdivide, stimulatory experiences into categories and react differently (ie initiate a different motor response) according to which category is being experienced. One way of interpreting this is to view the brain as extracting more and more information from the environment over evolutionary time. A complementary perspective is to see the brain as an adaptation which protects the individual from being overwhelmed by comprehensive awareness of everything she/he has known in the past and could be aware of now in the present, ie the brain acts as a *reducing valve* which, in principle, leaves the individual with the information relevant to hir purpose of the moment.[32] [[[[[[[[insight : oral cultures can only accumulate so much knowledge, non-verbal cultures even less ..our problem nowadays is that we can accumulate lots of knowledge but are limited in our ability to bring that knowledge to bear on solving our what-to-do problems]]]]

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[30] What is stored in long-term memory may well be procedures or algorithms rather than direct mappings between the flux of stimuli and what is stored. For example, an object is recognised as an X if the sensory input it generates produces the result X when passed through a set of sieving rules (see goertzel chapter 6 The Ecosystem of Ideas)

[31] Heylighen F (1991) Cognitive levels of evolution: from pre-rational to meta rational, in The Cybernetics of Complex systems-Self-organisation, evolution and social change F.Geyer (ed) Intersystems, Salinas, Ca 75-9. Heylighen points out that 'legitimate' associations conform to (are controlled by) learned rules based on experience, eg syntactic rules, cultural rules, selection rules, historical rules.

[32] CD Broad quoted by Huxley Cecy thesis p24??

The pre-verbal mind

Under several descriptive names, including participatory consciousness, a typhonic state, an archaic state, mind-at-large, a mystic state, and a phantasmic state, empathetic writers have tried to evoke the mental experiences of early humans still equipped with only a small number of percepts.[33] One interesting metaphor is that such a person's experiences might have been like those of someone who has taken mescalin or a comparable hallucinogen which suppresses the higher control areas of the brain, ie being a habiline would have been like being in a world of vivid experience where nothing is easily recognisable. [[The whole of the world is seen as unity, as a single rich live entity" (Maslow, 1968, p. 88).]] Akin to the reports of modern mystics, there might have been a sense of a floating *self*, immersed in a kaleidoscopic world. This *self* would not have had a sense of agency, of consciousness such as we experience, but would have been a 'body self', an image of oneself in terms of joint, muscle and visceral awareness. The implicit suggestion here is that a loose percept of a body self is one of the first 'cleavages' the brain learned to make through the world outside itself, an early step in a still-ongoing internalisation (inner modelling) of the external world.

As discussed in Chapter 6, behaviour at this time would largely have been governed by instinctive and affective responses, not cognitive ones. Behaviours which produced positive emotions or ameliorated negative ones would have quickly become habitual, and, through mimesis, spread throughout the social group, ie have become customs.

Custom not only makes individual behaviour predictable, it results in all individuals having a similar behavioural repertoire---like 'cells' in a 'superorganism.' And, for most of the Pleistocene, it would have been through averbal custom that societies co-ordinated themselves. Societies with a sufficiently diverse repertoire of customary responses to particular environmental contingencies would have enhanced survival prospects. In the longer term, the repertoire of customary responses in those societies that survived must have evolved in parallel with environmental trends such as declining temperatures.

In parallel with the evolution of custom, the Pleistocene would have seen slow growth in simple non-verbal language (see Chapter 6). We can suppose an expansion in each group's common stock of concrete (not abstract) percepts, each sculpted from re-occurring emotionally-charged episodic experiences. And we can further suppose the emergence of *associative learning*, ie a capacity to associate, in memory and in recall, percepts previously encountered together in recurring episodic experiences,[34] for example, dead bodies and dry waterholes (or would such constructs be outside the scope of non-verbal language?). In terms of cognitive skills such associative learning is a precursor to causal thinking.

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[33] Scaruffi Lazlo and Wilber and Berman Levy-Bruhl (L-B =mysticism)

[34] The physiological basis for associative learning is that a synaptic connection which is used often will increase its strength such that the probability that it will be used again increases. Ultimately, associative learning is the only sort of learning there is.

In time some percepts would have separated from their original contexts and associations and come to be associated with 'context-free' non-verbal signs, earlier called *mimes*. This would set the stage for the development of syntactic language---strings of mimes assembled according to rules---capable of communicating simple stories. Every language, verbal or non-verbal, is a collective *functional* model of reality, one that stores the experience of preceding generations and one on whose refinement all members of society are working. Imagine the value of an elder's story which told of the existence of a place of refuge from drought. Or is that asking too much of non-verbal language?

Probably yes, but even as it was reaching its modest developmental limits, towards the end of the Pleistocene, non-verbal communication was creating a template on which oral language could be built. That is, in crude form, percepts, signs (symbols) for percepts and syntax were now in place.

The syntactic mind

Wide limits, from 200 kya to 70 kya, bound the various suggestions for the time of emergence of oral protolanguages.[35] Here we will bypass the various origin hypotheses and take up the story of cognition-consciousness at the time of the Upper Paleolithic cultural revolution, some 40 kya, when we can be fairly confident that syntactic language (sentences) had become a well-established communicative technology, at least in 'here and now' situations.

Chapter 6 noted the various ways in which the advent of structured speech might have led to improvements in thinking, faster accumulation of collectively-held information and a reinforcing of the tribal mode of social organisation. As language developed, each new group of words created, literally, new perceptions and attentions, ie language was not just a tool for communication but another 'organ' of perception, [[as valid as the senses and]]] able to direct and hold attention on a particular task. Perhaps the the Upper Paleolithic revolution, with its explosion of advanced stone artefacts, reflects the coevolution of material and cognitive-communicative technologies.

The period between the Upper Paleolithic revolution and the Neolithic revolution (15kya), while climatically difficult, saw the persistence of the hunter-gatherer group or tribe as the ubiquitous form of social organisation. Terms such as the magic mind, the mythic mind, the membership mind, the group mind and the tribal mind have been used when speculating on aspects of the mentality and social psychology of these late hunter-gatherers.[36] These various terms are drawing attention, first, to the sameness

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[35] Relative to syntactic language, protolanguage is characterised by a form of expression in which words are merely grouped in short utterances, with no grammatical support. Its characteristics

are: no grammatical words, no long-range dependency within the sentence, no inflection, no consistent order. Search engines use protolanguage.

[36] Wilber….?? Mind is synonymous with 'the brain's mental operations.'

of individual minds within Upper Paleolithic tribal cultures and, second, to these people's changing models of the world and their place in it.

As is still true today, language could now be used to describe the world to children until they were capable of perceiving the world as described. Under this view, reality is only a description which is shared, largely unconsciously, with those who use the same language. Furthermore, from the perspective of social psychology, a shared language is a form of social control, again largely unconscious. That is, once an individual responds to a description of reality, hir behaviour is already circumscribed by that description.[37] Linguistic formulae for norms, customs, taboos etc would have been similarly transmitted and internalised. For example, a child's memory of being verbally instructed by its parents would have functioned as a primitive conscience or superego, recalling past instructions, by association, in similar situations. Socialisation through language thus became the main instrument for keeping individual behaviour within functional limits. As a group's culture, its learned behaviours and shared ideas, became richer and more complex than in pre-verbal days, spoken language woud have been essential to reproducing/ maintaining that culture.

But, apart from episodic memories, there would have been little qualifying as personal in the minds of tribal members. The vocabulary which would allow the modelling and awareness of one's inner feelings and motivations or the minds of others had not yet been invented. Tribal societies were not made up of people who, having recognised themselves as individuals, then identified with the group. Rather, over the Upper Paleolithic, concepts and words (eg one's name?) appeared which allowed the individual to begin to split out from the concept of the group, a dim conception of a 'mental' self, ie something additional to a 'body' self.

As was discussed in Chapter 6, there is a variety of evidence that the Upper Paleolithic was the period when animistic, magical and mythical thinking emerged and flourished. Cognitive tools for questioning the reality of this primitive thinking, based as it was on inappropriate metaphor, did not yet exist. The capacity for causal thinking which was proving useful enough in everyday tasks, just did not have access to sufficient abstract concepts to provide naturalistic explanations for natural processes.

Nevertheless, as noted earlier, primitive thinking did serve various functions such as providing all the tribe's members with a common set of meanings, explanations and beliefs about the world. And it provided some sense of psychic security and meaning in a capricious and mysterious world for what we would see as the child-like egos of the time. For example, misfortunes and calamities could be explained as part of an intelligible order and, by following customary rules, be warded off to some extent (Habermas, 1976:98). Even in the absence of abstract principles, myths and stories were 'case studies' which provided role models and examples for guiding behaviour. Of course, it would only be with difficulty that such guidelines could be updated to reflect changed conditions.

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[37] Wilber p423

These then were the oral cultures which allowed hunter-gatherers to survive the rigours of the last ice age. We have every reason to believe that spoken language, the master technology, played a central role in driving the evolution of the material, social, cognitive and communicative technologies which collectively define cultural evolution

The [early] post-glacial [[[but still bicameral]]??]]mind

As described above, the period from the end of the last ice age (say 15 kya) till the end of the Bronze Age (say 1000 BCE) was a period of dramatic socio-cultural response to dramatic climatic and ecological change. While the period saw numerous interdependent innovations within and between the categories of material, social, communicative and cognitive technologies, it is changes in food production technologies and parallel facilitating changes in social organisation-social control technologies which stand out. In a sentence, these core changes were from hunter-gatherer societies to, first, Neolithic farming villages and then to empires based on broad-scale irrigated agriculture.

Looking back, we can see how creating, refining and combining technologies allowed post-glacial societies and groups within societies to make adaptations which, at least for a time, improved the survival and wellbeing prospects of the innovators. In line with mounting archaeological evidence, one can imagine plausible sequences of small steps by which individual technologies might have entered, left or matured within the technology pool-technology mix. And as the technology-mix being used ebbed and flowed, various emergent and collective properties of the society would have responded, entities such as energy throughput, social character, class structure, food security, demographic structure, accumulated knowledge etc. Thus, a process of cultural evolution similar (albeit faster) to that described for tribal societies in chapter 6, one based on the selective retention of exploratory behaviours in what-to-do situations, can be presumed to have continued through the Neolithic and urban revolutions.

While the post-glacial mind was confronted with managing ever-bigger groups of people in a growing range of interdependent roles, there is little to suggest a system-shift in people's basic mental skills such as their ability to model reality, their learning skills, their memory skills and their capacity to remain focused on a task. Rather, it was the enhanced *contents* of the post-glacial mind, not its raw capabilities, which differentiated it from the tribal mind of the hunter-gatherer. Under 'contents' we can include knowledge of norms, taboos, beliefs, customs, facts, vocabulary, causation, myths, recipes, rituals, values and traditions. That said, these were oral cultures which depended critically, and in diverse ways, on language to make a system of new and more complex farming and social management technologies work and keep working.

Consider the place of language in ensuring that individuals learned and reliably filled the roles assigned to them by tradition. We can assume that post-glacial people were still signal-bound or reflexive, ie they responded minute-by-minute to cues from their environment, including a verbal environment characterised by commands and assertions (plus, possibly, questions) uttered by other group members.

An important factor in the primary socialisation of children would have been learning to obey routine parental commands as they absorbed and internalised the group's stock of shared knowledge. As discussed by Castro and Toro (2004), humans, at some point, must have learned to express disinterested approval and disapproval of childish attempts to imitate adult behaviours and hence to guide successive improvements. In play, the child could verbalise and practise responding to commands. Once parents had acquired the capacity to express approval or disapproval of children's behaviour, it would lead to the children associating positive or negative feelings with memories of performing those behaviours, and with the words by which approval/disapproval was conveyed. This, in turn, would lead people to behave, depending on context, in ways which they knew, from memory, would generate positive feelings or avoid negative feelings. In contrast to other primates, episodic memories could be triggered in human children.by learned words, nothing more. As well as this, emotionally charged words of approval/disapproval would, in time, become decoupled from the particular learning situation while still retaining their ability to guide future responses to those words, be they overt or covert. Here could be the mechanism by which a modern human's limbic system learns to accept or reject verbally proposed behaviours. [[[..acquires the thought-feeling couplets against which a proposed behaviour will be evaluated

Conrad Waddington interpreted human docility, our tendency to accept authority, as an adaptive response by a neotenous species to the need for its young to be teachable. [38] But insofar as the habit of obedience to an authoritative voice carries over to adulthood, it becomes a pre-adaptation for the social technology of leadership (eg chiefs, big men, elders), a technology based on giving verbal commands to people within earshot. Leadership is a social technology which co-ordinates the group's behaviour by considering only the options perceived by the leader in what-to-do situations. Presumably, it evolved as a successful balance between the need for timeliness in decision-making and the need to consider a sufficient variety of candidate responses to novel situations.

Nevertheless, as the food production system was transformed and complexified, and as communities grew larger, face-to-face leadership in non-routine, and hence stressful, situations would have become more difficult. Even for routine tasks, in the absence of the leader signal-bound workers would need frequent cueing. For example, custom, ritual and habit would have each played a part in maintaining a work party's attention to a task. Remembering and obeying a leader's commands in his (?) absence would have been difficult in the face of poor impulse control and a limited ability to self-trigger the recall of instructions from memory in the form of either mimetic imagination or verbal symbols. People would have been willing to obey but not very good at it! Leaders themselves would have had no special capacity for formulating behavioural plans and remaining focused on their implementation.

Despite these problems, as people's vocabularies grew and their verbal models of practical realities improved, we can postulate that their self-cueing abilities also improved. The self-cueing process in post-glacial people would necessarily have been similar in some ways to the consciousness-generating process outlined earlier for

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[38] Waddington, C. H (1960). *The ethical animal*. London : George Allen & Unwin

contemporary humans. In particular, in what-to-do situations the off-line speech-thought system generates a sequence of schematic behavioural options until one appears which, after being returned to the awareness system, is 'passed' by the limbic system and then implemented. We can imagine though, in contrast to modern self-aware minds, only a small range of customary, formulaic responses would ever be available for such evaluation.

However, if Julian Jaynes, Bruno Snell, Mary Clark, Wilber Whyte [39] and others are right, post-glacial peoples, at least until the first millennium BCE, did not have a strong enough sense of self, or sufficient vocabulary, to recognise that thoughts they were becoming aware of were self-authored. Rather, they experienced those thoughts, Jaynes argues, as words spoken aloud by an authority figure, ie as what we would call an auditory hallucination.[40] And they obeyed (or believed, as the case may be).

To appreciate the next part of this plausible scenario (and that is all it is), recall that early post-glacial peoples were animists who believed that every material entity was alive and able to act with purpose. So, while an authoritative voice might, in the first instance, be (mis)attributed to a living leader, it could equally be (mis)attributed to the corpse or remains of a dead leader. Indeed, given that living leaders grew up to have the same dependence on authority as their followers, we can readily imagine that such might attribute their cueing voices to dead predecessors. From there, it is a small step to visiting the remains of one's dead predecessor to hear his advice and commands concerning what-to-do situations. These pronouncements could then be relayed, with attribution, to one's followers. The elasticity of magical thinking would have further allowed statues or other symbols of the dead leader to become cues for hearing the dead leader's voice. Indeed, each individual could have their own personal cueing symbol; not that it was a symbol to them---it was the real thing!

And so begins eight thousand years of unquestioned belief in the direct participation of 'dead' authority figures in the management of post-glacial societies. As 'dead' leaders receded into the past, one can imagine their being transformed into, first, legendary heroes, and then into what we would think of as *gods*. Depending on the particular society, the living leader might be seen as the mouthpiece of the gods or, using magical reasoning, a god himself. Jaynes (p143) suggests that an eleven thousand year old propped-up skeleton found in a tomb in the Levantine village of Eynan might have been an early god-king.

As a social technology for accurately guiding the individual's contribution to society, gods have several advantages over living leaders. Their repertoire of injunctions, their leadership styles are free to settle down over time, be objectified, and provide a baseline of stable guidance during the uncertainties of transition between living leaders. Their authority can be cumulatively strengthened over generations through the development of worship rituals, rites and ceremonies. Of course, for most of the

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[39] Snell B Origins of the Greek Mind

[40] Jaynes likens this experience to that of contemporary schizophrenics while Luria's (1961,1979) research on contemporary children posits that a child is at first instructed to do various tasks by an adult, then learns to give him/herself linguistic commands. These self-instructions are at first uttered aloud and then gradually take the form of internal covert instructions.

reign (metaphor) of the post-glacial mind, at least in closed self-sufficient societies, there would have been little questioning of divine authority. People were docile, we have suggested. Despite having language, they, like every other animal, had no concepts of introspection, deception, evil, justice, guilt, objective space-time. They had no sense of the future and no memories as we know them. These are all abstract concepts which we understand through metaphor; and the technology of expanding language through the use of metaphor had not as yet been invented.

As the climatically-favourable Holocene continued and farming technologies continued to evolve to exploit the opportunities entailed therein, agricultural systems delivered food surpluses sufficient to support a priestly class, particularly after Eurasia's great irrigation civilisations grew out of village agriculture. While the respected historian, William McNeill, dubs these first priests 'macro-parasites,' it is surely more complex than that. Priests were no more reflectively aware than the workers they organised on behalf of a leader (a king say) and one or more gods. The priesthood can be seen as a managerial class which, plausibly, co-evolved with the increasingly complex management tasks associated with population growth, urbanisation and expanding irrigation systems. Over millennia gods too proliferated and specialised in cueing different types of decision-making, eg personal gods. It would seem that cultural evolution had produced a set of technological themes which, for a long time and in many places, would prove able to adapt to or cope with both slow complexification and modest environmental variation. Communication by writing was the most promising technological response to complexification, albeit slow to spread. And the best available social technology, in times of drought or other environmental challenges, was placating or pleading with one's anthropomorphised gods.

That is, it was the best until someone invented the more practical idea of stealing grain from another village's granaries. Such marauding inevitably spread and spawned the widespread adoption of defensive technologies, including fortified villages and cities and specialist warriors. The seeds of the 20th century's wars were being sown. When the idea of stealing grain was extended to stealing people to be slave labourers, the technologies of coercion began to assume an increasingly important role within societies. Slaves knew nothing of local language and customary behaviours, and could not really be re-socialised into a compliant workforce. It was easier to extract their labour using physical coercion.

Increasingly throughout the transition from villages to city states, militaristic management based on maintaining standing armies was now complementing theocratic management. Military conquest (stealing the neighbours' land) and empire–building (setting up tribute states) became recognised social technologies for improving and maintaining a society's survival prospects. For example, Hammurabi, steward-king to the Babylonian god Marduk from 1792 BCE to 1750 BCE, formed the city states of Mesopotamia into an empire and held them together, in considerable part through his use of written proclamations and letters of instruction.

And now the trap began to close. It transpired that the militaristic-theocratic states and empires that had spread across Eurasia by the middle Bronze Age were in ever-present danger of collapsing, both individually and, domino-style, collectively. Jaynes (p 195) talks about the built-in periodicity of such societies, ie their propensity to

collapse at intervals back to less energetic tribal forms. And, indeed, around 2300 BCE [[[??? Peiser??]] a number of major civilisations did collapse. [[It would not be the last time.]]

The source problem here was that the mix of material, social, communicative and cognitive technologies was changing only slowly and agricultural output was no longer growing strongly. Trade was increasing but was still a minor activity. Population growth continued, providing the state/ empire with more warriors and serfs but lowering surpluses per head. This left increasingly complex societies increasingly vulnerable to climatic variability, natural disasters and the disruptive effects of military campaigns and invasions.

[[paragraph is a repetition of introduction---rewrite] Joseph Tainter (2000), one of the few archaeologists to have made a comparative study of collapsed societies, concludes that adding new management operations is a sound way of addressing newly perceived problems. At first the strategy works. For example, agricultural production increases through more intensive farming methods, an emerging bureaucracy co-ordinates production and distribution competently, expanding trade brings wealth. However, as the less costly solutions to society's problems are exhausted, it becomes imperative that new organisational and economic answers be found, even though these may well be decreasingly cost-effective. One reason for that is that as new components are added to a system, the number of inter-component linkages that have to be managed tends to increase geometrically rather than linearly. Finally, at some point the costs of additional reorganisation exceed the benefits. Tainter's insight is that, as a strategy for solving a society's problems, complexification is often successful in the short term but, in the long term, may well increase that society's vulnerability to collapse.[41]

Much of the increasing complexity which bronze age societies had to manage was the result of interactions between societies, particularly war, trade and forced migration. To quote Ernest Gellner (p160), violence which in tribal and village times had been 'contingent and optional,' had now become 'pervasive, mandatory and normative.' Individual societies were being selected to survive on the basis of their military 'fitness' but, for bronze age society as a whole, war was a 'social trap,' an extraordinarily costly and unproductive way of allocating resources. And it could not be avoided. In the absence of any overarching institution for internalising the external costs of war, every state had to join its local arms race to have any prospect of survival. Given that bigger societies tend to be 'fitter' militarily, the bronze age world was already on a growth treadmill. How familiar all this sounds.

Religion was a second major source of increasing complexification. Religious observances and practices (including the building of temples and monuments), consumed ever-more resources in most Bronze Age societies. The adaptive value of

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[41] Western civilization has avoided this fate so far, he says and we will discuss presently, through a combination of luck and ingenuity which has allowed complexification to continue.

this development is not immediately clear to modern eyes. It seems unlikely that the gods needed more authority over what were docile people who believed and did what they were told. Perhaps the cultural evolution of the priesthood had become decoupled from the cultural evolution of the mass of people? But there is nothing to suggest that these changes were primarily for the benefit of the priesthood. There was as yet no recognition of the idea of disparate class interests, even though, in practice, the military and the priesthood constituted a dominant minority. More plausible is the idea that because religious guidance of these societies was apparently no longer solving their problems adequately, they turned to making greater efforts to communicate with their gods.

But things got worse rather than better. Around the end of the 2nd millennium BCE, as Jaynes interprets the historical record, the various hallucinated voices (ie, misattributed thoughts) became confused, contradictory, and ultimately counterproductive. They no longer provided relevant directions in what-to-do situations. This should not surprise us. The vocabulary available for expressing instructions was limited and descriptive-only. So, faced with novel, complex situations, only simple, and likely irrelevant, stock responses could be generated. A related idea here is that the increasing use of written instructions which had to be read out loud before being acted on might have moved the post-glacial mind closer to recognising that verbal instructions can be self-authored and not necessarily divine.

While Jaynes argues convincingly from the historical record that the 'voices of the gods' did indeed fade in light of these failures, it is not clear how thoughts were processed thereafter, at least not till the appearance of the self-aware mind some 500 years later. In the interim, there were several types of technological responses to the loss of direct divine guidance. One was to seek out oracles and prophets, people who retained a capacity to hear divine instructions and to answer questions on behalf of the gods. Thus, oracles (eg Delphi) remained important in Greece for another thousand years. Another approach to improving communications was to pray to one's departed gods through new intermediaries such as angels. Then there were techniques based on inferring divine intentions from indirect evidence. These included choosing between alternative scenarios by casting lots, by divination and by reading auguries and omens. While misguided, such inferential methods reflected an expanding awareness of the concepts of both choice and causation.

[[[[[[[[[[[[[[[[[[[[???Both left and right hemispheres of the human brain

are able to understand language, while normally only

the left can produce speech. However, there is some

vestigial functioning of the right-hemisphere Wernicke's

area which could explain the 'voices of the gods'. If the

two hemispheres under certain conditions are able to

act almost as independent persons, their relationship

would correspond to that of the man-god relationships of bicameral times.?? Jaynes newsletter]]…..next newsletter 2 Jaynes hypothesised a bicameral process of brain functioning. He asserts that about 3000 years ago there was a left brain/right brain split that had until that time, made the right brain act as 'god' to the left brain, which would hear and obey. The emanations from the right hemisphere would produce visual and auditory hallucinations that were powerful enough for the left hemisphere (and the human being as well) to follow.]].. furthermore, he regarded this mentality of the era of the Iliad as the bicameral mind. By this term he is referring to a two-chambered mental process by which there was 'a decision-making part and a follower part'. Specifically, hearing the inner voice involves a region of the right hemisphere that corresponds with Wernicke's area in the left hemisphere , which is implicated in receptive communicaton]]]]

The self-aware mind

Having now made an effort to understand cognition-consciousness in contemporary humans and to recapitulate several stages in the evolution of the human mind, we have a framework within which to better understand the revolution in cognition-consciousness that occurred in various parts of Eurasia, most spectacularly in Greece in the first millennium BCE.

Under the interpretation offered here, this is the millennium in which humans started to deliberately think metaphorically. The adoption of that one cognitive technology was the 'big bang' which projected the human mind into a whole new universe, metaphorically speaking. More explicitly, thinking metaphorically is a tool which can rapidly extend the range of behavioural options a person might consider in what-to-do situations, and, equally importantly, it is a tool which can extend, enrich and selectively focus meaning (perceptions of relationships between entities). Consider a simple example. "We will attack the Trojans," is a concrete expression of intention, but "We will attack the Trojans like a crab catches fish." is a metaphor which makes the idea of a pincer movement readily and immediately understandable; or, "We will attack the Trojans like a scorpion out of its nest." But being like a scorpion entails much more than launching a stinging attack from a hiding place (wooden horse!). It means being willing to feint, to hold your weapons high, to fight to the death and so on. As George Lakoff says, metaphors make sense of our experience; they provide coherent structure, highlighting some things and hiding others.[42] If a metaphor 'passes' emotionally, it has the potential to provide a variety of options for understanding and acting, even as it constrains that variety to a manageable level.

Even more powerfully, the act of changing from one metaphor to another changes one's working mental model of a what-to-do situation, eg from thinking 'crab' to thinking 'scorpion.' Metaphors make connections between different domains of discourse and what is being suggested here is that during the first millennium BCE people learned to generate metaphorical thoughts in a richer and more controlled way than hitherto. In part this may have been a reflection of an enlarging vocabulary and a densifying network of neural associations between concepts-percepts. On that particular point, the theory of graphs suggests that as more and more contingent links

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[42] Lakoff, G and Johnson, M Metaphors We Live By p??

(associations) appear between the words in a lexicon, there will come a point where a few more links dramatically increase the probability of there being a chain of links between any two words.[43]

Believing that a metaphor is valid as a basis for understanding or action is an act of faith, something which can't be proven; but then so is any belief in any causal relationship. We can imagine that trial and error experience in using metaphors would have led to various pragmatic rules for narrowing the range of metaphorical associations thought to be worth exploring in various situations: For example, when A is likened to B, both A and B are normally the same part of speech, eg both nouns. Metaphors with negative emotional loadings stand to be rejected. As in the 'attack' metaphor above, candidate metaphors need to be consonant with goals and values. And then there will be various culture-specific guidelines based on taboos, memes, traditions etc which favour rejection or favour further consideration of metaphors with particular attributes.[44] Within the options remaining after such pruning and pre-judging, metaphors which emerge for further consideration are thereafter, for practical purposes, randomly selected---a process reminiscent of gene mutation. And the genetic metaphor leads to the idea that if the rate of cultural evolution is lagging the rate of environmental change, cultural evolution can be speeded up by generating more metaphors around the problem issues. Conversely, some metaphors get cemented into belief systems as truths which can only be changed with great difficulty over a long period.

Where did metaphorical thinking come from? Not out of nowhere. It can be viewed as a refinement of Frazer's two laws of magic, introduced in chapter 6 as the law of similarity and the law of contagion. Indeed Robin Fox suggests that, in contemporary language, the law of contagion could be rewritten as the law of metonymy and the law of similarity as the law of metaphor.[45]

Not quite perhaps. A metaphor is a type of assertion: If A resembles B in some way, structurally or functionally, then it might resemble B in other ways. However, metaphors do not go as far as the law of similarity which postulates parallel and remote causation That is metaphors do not claim, as sympathetic magic does, that operations on A alone have effects on both A and B and those effects are similar; the effects on B *resemble* the effects on A. For example, breaking the arm of a voodoo doll, A, one representing and resembling person B, magically causes the breaking of B's arm. The corresponding metaphorical thought might be that if person B is like a straw doll, then their arm might be easily broken.

Metaphorical understanding of mental experiences

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[43] reference
[44] Heylighen 1991 cognitive levels of evolution paper
[45] Robin Fox: The challenge of anthropology, Transaction Publishers, New Brunswisk, N.J., USA, and London, UK, p173 metonymy (treating parts as wholes; eg counting 'heads', not people)

Learning to use metaphorical thinking culminated in its extension to understanding *mental* experiences.[46] Thus, as noted earlier, Julian Jaynes suggested that a human organism's mental experiences can be understood and talked about by thinking of them as being like the natural experiences of a bodily organism in the real world. Natural experiences include direct body experiences and interactions with both the physical environment and with other people.[47] And that is what humans learned to do. People moved from treating imagined events as real events to treating imagined events as being *like* real events. They learned to verbalise and share their thoughts by (partly) expressing those thoughts with the help of this 'natural experiences' metaphor. Nowadays we talk so readily about our mental experiences that it is difficult for us to see how the narratives we produce are based on understanding mental experiences as being like physical experiences such as looking, listening etc.; and that people had to learn to describe their mental acts and experiences. [[Language had begun to split into one frame of reference pertaining to publicly observable physical things and one pertaining to privately knowable mental things.]]

Jaynes called the metaphorical entity which participates in the bodily organism's stream of imaginings *Analogue I*. We might equally, and more briefly, call it *Ego-I* although ego is a more contentious term. In the real world, the word 'I' is most simply thought of as the name which a bodily organism gives to that same bodily organism when conversing. Just as a physical person does things in the real world (moving around, arranging objects, looking, listening, etc), the metaphorical I does analogous things, has analogous experiences, in an analogue of the real world which Jaynes calls *mind-space*. As well as actively doing things in mind space, Ego-I participates passively in the body's mental experiences, eg being spoken to as well as speaking. Thus Ego-I plays more than one sort of role.

So, if I have a mental experience in which I imagine I am patting my dog, that experience is very like, is analogous to, a real world experience in which I am watching someone who looks like me patting a dog that looks like my dog. I report that Ego-I looked into mind-space (introspected) and saw a visual image of a 'metaphorical me' patting a dog like mine. Or, more shortly, I report that I imagined patting my dog. Thus, 'seeing in the real world' is a metaphorical explanation of 'seeing in mind-space.'

What about the mental experience of imagining syntactic speech without, say, any accompanying visual images or auditory hallucinations? You could interpret that experience as being like a real world experience in which someone talks to you or, alternatively, you are talking to someone. Perhaps the best metaphor for understanding the experiencing of inner speech is the real world experience of talking aloud to oneself ? If so, the experiencing of inner speech is like observing an

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[46] The property of being intentional, of having an intentional object, is the feature which distinguishes mental/psychical phenomena from physical phenomena (objects). Every mental act is directed at or contains an object — the so-called *intentional object*. Every belief, desire, etc. has an object to which it refers. Physical phenomena lack intentionality altogether (Wikipedia, Accessed 10 June2007).

[47] Lakoff (p117)

intrapersonal dialogue in mind-space. Call it Ego-I One talking to Ego-I Two. Now you can explain to someone that you had imagined you were talking to yourself and you said "X." Or, more shortly, as the shared metaphor shrunk with familiarity, "I was thinking 'X.' " Other words for directed mental experiences and mental acts---knowing, believing, planning, speculating etc---began to appear in texts of the 1st millennium BCE. In the same period, words for feelings and emotions, based on the bodily changes associated with these mental states, come into use. We can conclude that the scope of the consciousness experience was being expanded.

Metaphorical understanding of consciousness and selfhood

We can draw on these ideas to suggest how a growing metaphorical understanding of mental experiences opened the way for the emergence of consciousness and selfhood. As noted, consciousness is here understood to mean the implementing of an ability to observe, and to know that one is observing, some of the operations of one's own (autonomous) mind. It is a process of listening to (a metaphor) oneself thinking, and being aware that one is doing so, and that the thoughts being listened to are one's own, ie are self-authored.

If you accept this somewhat-constrained (but unmuddled) definition of what consciousness is, then you cannot be conscious unless you can say, or imagine saying, "I was thinking 'X.' " Hence, consciousness could not exist before people had the vocabulary to say "I was thinking 'X.' " As Wittgenstein said 'The limits of my language mean the limits of my world'[48] What happened at the emergence of consciousness was not that inner speech was new but that the stream of inner speech generated by the left hemisphere's offline speech system was now being interpreted as self-authored, as being like talking to oneself, and not as being like the voice of another person or a god (with or without auditory hallucination) talking to you.

Let us return to the word 'I' in the statement "I was thinking 'X.' " In the present discussion of mental experiences 'I' is short for 'Ego-I One.' Ego-I One is a metaphorical entity which, in contemporary terms, is like a person in the left brain who is thinking-saying X and, because this is a motor activity, such thinking-saying is proprioceptive or experiential. Recall that proprioception accompanies all motor activity and is the feeling that the body knows it is doing something---if that something comes to consciousness. In the case of thinking-saying, it is thoughts which are sufficiently charged with emotion that come to consciousness and which thereby tend to be remembered in the longer term. Note that the thought that is remembered is not 'X' but "I was thinking 'X.'" The particular proprioceptive feeling in the case of thinking-saying is the feeling that the thoughts X which are being conveyed to the metaphorical person in the awareness system in the right hemisphere (Ego-I Two) are assembled and 'spoken' by Ego-I One. If X happens to be a command, we can interpret it as the metaphorical Ego-I One saying "Ego-I One told Ego-I Two to do 'X.'"

The concept of 'self' is entering this story in several ways. In real world conversations words like 'oneself,' 'yourself'and 'myself' are grammatically useful extensions of the word 'I.' But what about 'the self' as appears in discussions of

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[48] Wittgenstein (1921/ 19745.6 5.61 tractatus)

mental experience? The understanding favoured here is that the self is, *structually*, a family or library (more metaphors) of narratives constructed from the sequence of autobiographical memories which is a record of the thoughts and images of which the individual has previously become conscious. Examples might be the story of where and why you lived in particular places at different times, or 'my first day as an apprentice,' or 'what I have learned about women.' In very general terms, such narratives identify and report, syntactically, similarities and differences amongst one's episodic memories. This is what gives them meaning.

Viewing the self *functionally*, narrative chains abstracted by a process of association from the brain's library of memories are available to the speech-thought system as imputs which, along with inputs from the awareness system, can be used for constructing behavioural options (schemata) in what-to-do situations. Depending on the emotional acceptability (to the limbic arousal system) of a narrative which is being suggested as a behavioural option, it may be reflected, more than once perhaps, between the awareness and speech-thought systems; and it may be modified in the process. When a narratised behavioural option is accepted and physically implemented it is as if, metaphorically, the body has acted as the *agent* of the mind, of Ego-I.

Thus, the link between consciousness and the self is that consciousness is the process which gets thoughts that the (unconscious) mind evaluates as emotionally significant into long-term memory, tagging them as mental experiences; once stored, these memories are the stuff of which the self's narratives are made. It follows that it is misleading to regard the self as a metaphorical person and that the thoughts one becomes conscious of are not so much self-authored as authored, metaphorically, by Ego-I One *with the aid of the self*.

More than this, the self, still understanding it as an ever-changing library of memory-based narratives, is available to become an integrated object of consciousness, a gestalt, which, as it develops over a lifetime, becomes the basis of the individual's unique identity. It is worth emphasising here that part of any individual's self-awareness (conscious awareness of hir self) is the realisation that it is but one entity which is accumulating memories. That is, the concept of the self includes a recognition that something which all its memories have in common is the fact that they record the experiences of a single unique bodily organism. It is an idea which is so blindingly obvious to us, at least till we encounter the 'pathological' idea of multiple selves, that we find it hard to comprehend that it had to be learned. Somewhat similarly, Snell describes how archaic Greeks had words for the limbs but no word for the living body. By classical times they had learned to recognise that collectively the joints, limbs and torso formed a single entity.[49] It is to one's self-based narratives that Solon, the great Athenian law giver and founder of Greek democracy, is referring when, in 600 BCE, he coins the injunction: Know thyself. Jaynes (1986) suggests that Solon might be the first person to seem like us, talking about the mind in the way we do.

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[49] Snell chapter 1

Identity and accountability

In contemporary everyday life, knowing yourself, having a sense of self, means, to make a useful distinction, having a sense of both a social and a personal identity. Your *social identity* is derived from playing roles in the various social groupings you feel part of and are identified as belonging to (eg, teacher, mother). You learn to play the role of being a member of a social group by building up memories of past participation in group activities and drawing on these to visualise and narratise normative behaviours for yourself which accord with the group's precepts and institutions. Institutions are defined by Douglass North as the humanly devised constraints, formal and informal, that structure political, economic and social interaction.[50] As in a tribal society, generalising and imitating the behaviour of others still remains important to the acquisition of a social identity. Your identity within a social group is confirmed when you are able to say: I am an X which means I do Y. As discussed somewhat chillingly by Arthur Koestler,[51] a sense of belonging to a group can be very rewarding emotionally and the 'need to belong,' the need to be approved, is dangerously strong in most people.

Your *personal identity*, on the other hand, is based on an awareness, an identification, of how your habits, appetencies, beliefs, experiences etc differ from those of others and, indeed, how your preferred behaviours might not be as satisfying to others as they are to you---and therefore, you predict, they might not behave as you would. Being able to articulate one's sense of personal identity means being able to say: I am John Smith and I am the sort of person who behaves in such-and-such ways when… And you do. You act out what you believe yourself to be like, and, in doing so, test your understanding of your relationship with the world, eg your powers, skills etc.[52] Under this perspective, your *personality* is your consistent behaviours, your *character* is the values to which your behaviour conforms.

While one's personal and social identities evolve throughout life, they nonetheless provide reasonably stable day-to-day guidance, 'suggesting' behavioural options which previous experience has found to produce emotionally acceptable outcomes (as well as rejecting emotionally unacceptable options). *Habits* are formed and, much of the time, habitual behaviour does not even reach consciousness. Notwithstanding, there is commonly a tension between the behavioural suggestions offered by, respectively, one's social and personal identities. One's social identity suggests behaving in ways which reinforce the group's continuation and your membership therein and one's personal identity suggests behaving in ways which, foremostly, will produce satisfactory emotions in oneself, even at the cost of undermining the

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[50] D.C. North, Institutions, The Journal of Economic Perspectives 5 (Winter (1)) (1991) 97–112

[51] Ghost in machine

[52] Taylor, Charles (1971). "Interpretation and the Sciences of Man," reprinted in /Philosophy and the Human Sciences: Philosophical Papers, /Vol. II., Cambridge University Press.

functionality of the group. And that tension, in one form or another, is of course one of the great recurring themes of literature, the humanities and the human sciences. Perhaps the pervasive idea that humans (have a capacity to) make *choices* had its origins in the overt recognition of this perennial tension and its somewhat unpredictable consequences.

Over the first millennium BCE, the directions in which vocabularies were expanding suggest that people's personal identities were evolving and developing far more than their social identities. Homer's Achilles could never have said, "When I was a little boy back in Greece…" but, written some centuries later, his Odysseus could. More generally, the idea began to spread that, as well as gods and authority figures telling people what to do, people could, metaphorically, tell themselves what to do, ie authorise their own behaviour; just as leaders tell followers what to do in the real world.

And then, early in the first millennium another new insight appears to have been grafted onto people's understanding of their mental experiences, one which helps explain the rise of that age's new religions. This further idea was that when people make choices between behavioural options, it is as though, metaphorically, they are agreeing with themselves about what to do---just as, in the real world, hunters might debate and agree on a hunting strategy.

Once the idea is perceived, rightly or wrongly, that people 'agree to and authorise' their own behaviour, it can be re-expressed as the idea that people are *responsible* for or *accountable to themselves* for their own behaviour. The opposed idea of being accountable to an external authority figure for one's behaviour first appears in the written record in the legal code of Hammurabi (3760 BP). For example:

> "If a man uses violence on another man's wife to sleep with her, the man shall be killed, but the wife shall be blameless."

The suggestion here is that in the 'axial age' of the first millennium BCE, the idea of *accountability* was internalised. Just as external authorities can hold you responsible for your behaviour and punish you for breaking society's rules, you can be accountable to yourself and punish yourself for breaking your own or another's proposed rules, eg by doing penance or by feeling guilty. It is at this time, independently in China, India and the Mediterranean world, that there emerged spiritual leaders and philosophers who, supported in some cases by sacred texts and claims of divine revelation, provided people with moral codes and psychological insights to guide their behaviour, both social and personal.

Even though the great empires of the Bronze Age had given way to a raft of smaller states, the power of state apparatuses to control individual behaviour through a legal system backed by coercion remained. For instance, in the middle of the sixth century BCE, a penal code of law formed the system of political control in China.[53] The elites there believed it more important to keep the people, through strict laws, from doing 'evil' than to encourage them, through moral persuasion, to do good.

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[53] Ames RT (1983) The Art of Rulership: A Study in Ancient Chinese Political Thought

Despite such attitudes, a massive change was occurring in the psychological control of behaviour. Unlike being told what to do on a case-by-case basis by the gods or their messengers or their signs, individual behaviour was now beginning to be controlled through a process of obeying, *in absentia*, authority figures who were seen to have no direct coercive power over one. The origins of *morality* lie in interpreting and obeying the behavioural rules proclaimed by a spiritual leader or secular (non-theistic) philosopher while the origins of *individualism* lie in obeying 'rules' derived from one's own experience.

Institutions, including legal systems and traditions, customs, and widely shared moral codes are all powerful technologies for stabilising and integrating societies, protecting them from disruptive individual behaviour and fostering predictable behaviour. But societies also need to be able to adapt to internal and external changes, must learn to do things differently, if they are to have any prospect of surviving. The advent of morality and individualism both created possibilities for novel behaviours to be suggested and tried at a rate in line with the rate of social change.

How was this so? In the case of received moral codes, it was because disciples and priests had to adapt general injunctions about 'right' and 'wrong' behaviour from a sage or prophet to particular situations. For example, this might require the meanings of words to drift, amounting over time to a major reinterpretation of the orignal teachings. Particularly for 'divinely inspired' teachings, most people, eschewing individualistic interpretations (few could read), chose to accept priestly interpretations of the authority's words. Provided that their priests were flexible enough, this would suffice for a society to learn new ways of behaving while not exceeding the society's capacity to change without breaking down.

However, it was individualism and secular philosophy rather than flexible morality at group level which led to the major changes in social and cognitive technologies that characterise the Greek enlightenment. For example, it was the broad acceptance in Athenian society of the idea that individuals are responsible for their own behaviour and free to think and worship as they please, plus the additional idea that all male citizens have an equal claim to positions of authority (eg public office), that produced the group governance technology we know as *democracy*. Metaphorically, democracy can be thought of as an externalisation to the group of the individual's capacity to internally generate and evaluate alternative behavioural options. Politically, rule by democratically-agreed law had now emerged as a technology which challenged the arbitrary powers of kings. Thus, for some, democracy was more a threat to order than a wellspring of responsive decision-making: Plato condemned the city-state of Athens for giving power over their own lives to people who had neither the inclination nor training to accept it.

<u>Reflecting on the First Millennium BCE</u>

Three thousand years ago the world was coming to the end of its Bronze Age. Cities, states and empires were being destabilised or even destroyed by various sorts of internal and external shocks. Some of these were widespread like drought and earthquake and others were transmitted from place to place as people were displaced by marauding and famine and as trade routes closed down. Military technologies were increasingly destructive, armies increasingly mobile. Far-flung and growing populations had to be managed. Bronze Age society had become a dissipative system

which was reorganising to something simpler as its material and energy supplies failed.

This was the world in which the post-glacial "tribal" mind, or what Jaynes calls the bicameral mind, proved inadequate for making decisions which could protect Eurasia's complex theocratic-militaristic societies from disruption or breakdown. Whether or not what-to-do plans were being interpreted as divinely ordered, the fact remains that such were relying heavily on an accumulated reservoir of custom and tradition and myth. It was a reservoir which, till then, and not withstanding some earlier collapses, had evolved fast enough to routinely supply plausible responses to the slowly complexifying suite of problems thrown up during the essentially-benign Holocene. However, now that, in many societies, multiple shocks had to be managed simultaneously, multi-faceted decisions were needed. As Ashby's law of requisite variety says, the larger the variety of actions available to a control system, the larger the variety of perturbations the control system is able to compensate for.[54] Custom, tradition and myth were not providing enough control.

As it transpired, a powerful new way of thinking did emerge; metaphorical thinking grew out of magical thinking. Over time, the fruits of this cultural adaptation, this cognitive technology, were astounding---consciousness, the self, personal and social identity, morality and individualism. For the first time people were thinking about and learning to talk about their mental experiences. More generally, drawing on a vocabulary of concepts which, with the aid of metaphorical thinking, continued to expand steadily, people began asking and postulating answers to an ever-wider range of questions about society, the individual, religion and the natural world. This was the environment within which the axial age's great religious and secular thinkers emerged.

For Eurasians, the world became an intellectually richer, better understood and more predictable place. But, while science, art, literature and philosophy flourished in various urban centres, did decision-making and plan-making improve? In what-to-do situations, were more, and more creative, options being considered and evaluated more realistically in terms of their consequences? Were societies in the second half of the first millennium BCE more able to cope with or prevent internal and external shocks? Or did the fierceness of the disruptive forces, natural and social, swamp the new cognitive technologies? Given many confounding factors it is difficult to say, but the evidence suggests the latter. Certainly the Greeks, despite being in the vanguard of the consciousness-cognition revolution, and despite building a mighty empire under Alexander the Great (336-323 BCE), were finally conquered by the Romans in 31 BCE.

Notwithstanding the spread of Greek culture in the wake of Alexander's conquests and the eruption of cognition-consciousness revolutions in various centres across Eurasia, the world, in many respects, did not change. After the chaos of the late Bronze Age, nation states slowly recovered and re-formed, but were soon turning frequently, as before, to war, empire-building (Assyria, Persia, Babylon…) and the enslavement of conquered peoples as technologies for boosting energy surpluses

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[54] Ashby's law of requisite variety

available to their military and priestly ruling classes who continued to dominate their own societies through coercion, religious obligation and patronage. For a variety of reasons, the internal management of urban populations was becoming more difficult. These included population growth *per se*, an increasing diversity of occupations due to changing technologies, and an increasing diversity of tribal and religious affiliations aamongst the residents. Other reasons included the need to replenish armies and, under the influence of the new individualism, the greater willingness of a few to question authority. Still, not to put too fine a point on it, as a technology for improving Holocene society's survival prospects, consciousness-cognition was a failure, at least in the short term. [[[greek enlightenment was an adaptation which had limited impact on politics (class conflict) (morality won) and international relations at the time but re-emerged during the Renaissance]]]]]

Nonetheless, with the conquest of Greece by Rome, the world did enter a period of increased geopolitical stability. By the end of the first millennium BCE, most of the world's people were to be found in four major agricultural civilizations stretching from the Atlantic to the Pacific ocean, north and south of the Mediterranean and across southern and eastern Asia. To the east of the Roman empire was the neo-Persian or Parthian empire (covering Iraq, Afghanistan, Iran). To the west of the Chinese Han empire was the Kushan empire covering parts of northern India, Afghanistan and central Asia.

COEVOLUTION OF FOOD PRODUCTION, SOCIETY, AND ECOSPHERE 12000 BP-2000 BP

Standing back from just the first millennium BCE, what did the entire post-glacial period up to the beginning of the Common Era demonstrate about the ability of humans to survive and thrive? Accepting that there is no way of making reliable estimates, we can suggest that human population grew over this period from, perhaps, 5-10 m to, perhaps, 150-200 m. As for thriving, average life expectancy before the health transition of the modern era is thought to have varied between about 20 years and 35 years. But, as noted earlier, it seems that life expectancy might have fallen after the Neolithic revolution (a) because of higher infection rates associated with larger, denser settlements and (b) poorer nutrition, the result of a low-variety diet deficient in certain amino acids. For comparison, life expectancy at birth in the United States in 1900 was still only 47 years. One can further imagine that life, at least for the lower classes, would have been unremittingly physically demanding and psychologically unhealthy. By our standards, coercion and superstition dominated people's lives---perhaps they acculturated and were not too miserable.

One illuminating way to view the human story over this ten thousand year period, putting it into the context of a much larger story, is to see it in terms of energy flows through various dissipative systems. The starting point for taking this perspective is to see the globe as a single, but multi-layered (hierarchical), dissipative system which began processing, dissipating and storing increased quantities of energy from the sun as the last glacial period was coming to an end. These increased energy flows went, first of all, into speeding up the rate at which materials (primarily water and gases, but also minerals) were being cycled through the atmosphere, hydrosphere and lithosphere. More than this, flows through these cycles spontaneously reorganised themselves into somewhat different kinetic structures (persistent flow paths). In other words, circulation patterns changed.

The world's ecosystems are dissipative systems that are embedded in, that redirect materials and energy from these global cycles, as well as taking in direct solar energy. They are organised into persisting *trophic structures* (food webs) where energy and nutrients captured by primary producers (plants) are consumed, degraded and recycled by herbivores and then by carnivores and finally by soil organisms. The functional reason why such structures persist is that each trophic level contributes, by way of stabilising energy or nutrient sources, to making the environment more equable or less demanding for organisms at other trophic levels. The population of any species in an established ecosystem is likely to be more stable in face of perturbations in global cycles than it would be outside that system. In their turn, in response to post-glacial changes in global cycles, the world's ecosystems self-reorganised, migrating, expanding and contracting.

As hunter-gatherers, humans were adapted to a variety of ecosystems during the last ice age. They occupied *niches* where they survived by harvesting and eating local components of the food-web flows (plants and animals). At this stage in their history, humans, in many ways, were just another large predatory mammal, one who successfully displaced other large predators from their niches. Subsequently they survived the further suite of climatic and ecospheric changes associated with post-glacial changes in the global energy budget. At first they adapted to this new environment by simply changing their harvesting behaviours. For example, seed-gathering became a way of life as grasses proliferated across the Fertile Crescent and the Asian steppes. And then, momentously, perhaps triggered by the temporary return of harsher times, they began to actively adapt the environment itself to more reliably provide for their energy needs. They learned to use their own human energy to trigger and guide increasing energy-material flows through selected edible plant and animal species (crop plants and grazing animals), and then through animal species which could provide draft power and transport. The significance of grazing animals is that they can assimilate, and convert to usable energy, parts of plants which humans can't eat directly. Because they store sunlight which would otherwise be dissipated as heat, plants retard the dissipation of energy while plant-eating animals accelerate it. *Agro-ecosystems* is a useful term for ecosystems whose material-energy flows have been substantially modified in order to increase human-food production. New adjunct technologies, ie other than cropping and herding *per se* (eg better ploughs, milking sheep and cattle), can be viewed as ways of further increasing the yield and reliability of supply of useable plant and animal energy per unit of human energy expended.

These adaptations or, equally, technologies for harvesting domesticated species increased usable energy supplies to the point where populations within Neolithic villages expanded. For a long time, land was not a limiting factor in the food production system and when a village passed optimum size in terms of organisation, walking distance to cropping areas etc, a new village was established nearby and populated from the old village. Such fissioning, so commonplace in biological and physical dissipative systems when a system's size or its energy supplies increase, can also be seen as the tribe's way of reducing the world to size, to terms with which they could deal (Adams p.281).

Several factors combined to bring Eurasia's Neolithic Revolution to an end and trigger an Urban Revolution based on the social technologies of urban consolidation and task specialisation and on the material technologies associated with extensive

irrigated agriculture. A drying climate was certainly one factor. Another was that, under ongoing population growth and fissioning, land for dryland cropping did start to become limiting, both in quality and quantity. Another was that, while small by modern standards, the surplus energy made available by domesticating plants and animals was sufficient to encourage marauding and, conversely, to encourage the aggregation of villages for defence reasons.

So, once populations began to grow and aggregate on the fertile flood plains of great rivers, the pre-conditions were in place to establish extensive irrigation schemes in which crop production per field worker was much higher and more reliable than in village agriculture. Laying down the infrastructure for such schemes required the organisation of massive amounts of labour, as did the ongoing maintenance of channels, headworks etc. It was for the sustenance of the builders, managers and defenders of these undertakings that the new surpluses were destined.

Not that urban civilisations developed from village agriculture overnight. Just as the mammalian eye did not evolve as the result of a single mutation, urban culture did not flow from a single visionary purposive action. Neolithic culture was reshaped into urban culture by extended sequences of innovative activities such that each step in each sequence became a pre-adaptation which (unintentionally) established (some of) the conditions under which the next step could emerge.[55] If it were not to be resisted as a perceived threat to the established order, each step would necessarily have been small in terms of the amount of energy redirection it involved. We will take it on trust here that such sequences might be plausibly reconstructed.

The term *coevolution* can be usefully introduced here to capture the fact that adaptations in one type of technology will sometimes serve as pre-adaptations for another type of technology, the obvious example being that the adaptations in the material technologies of food production, technologies which produced surpluses, were a necessary pre-condition for the emergence of social stratification, a social technology. In another clear example of coevolution, developments in agricultural and social technologies transformed natural ecosystems into agro-ecosystems; and when reigning technologies degraded the resource base (erosion, salinisation), niches appeared for ameliorative technologies. But whether this led to *directed* coevolution in the form of an active search for ameliorants we do not have the evidence to judge. More broadly, d*iffusion* of technologies from one society to another (eg via trade, war) suggests as a plausible form of coevolution between Holocene societies.

Cultural evolution is here being likened to biological evolution wherein a sequence of 'short-sighted' adaptations, each selected for their immediate survival benefits, can lead to new species or, conversely, to the channelling of a species into an evolutionary cul-de-sac. In much cultural evolution, including the transition to urban culture, it is exploratory and playful behaviour by individuals which throws up *variations* on existing customary behaviour patterns, variations which, for our purposes, are technological innovations. An occasional such variation will be recognised as

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[55] Purpose End state that one plans to assist to eventuate (a) because it seems causally feasible and (b) which, for sufficient reasons, one wishes to see eventuate.

perhaps improving an existing technology and *selected* for further trial. If this perception of improvement persists under a range of conditions, the selected variant may be 'permanently' incorporated into the technology recipe and become widely used.

The degree to which such adaptations were conscious and purposive cannot be known, although that interpretation does seem doubtful for much of the Holocene prior to the Common Era, ie, it is doubtful that people at that time could have said 'We are trying to improve this technology.' That sort of thinking would have been more characteristic of the first millennium BCE. It is probably more realistic to think of cultural evolution prior to, say, the axial age beginning about 800 BCE as a matter of people imitating their own and others' accidental successes; verbal instruction would have played a part too.

Sociologist AnthonyGiddens' theory of *structuration*, while focused on change in modern societies, is equally suggestive of how social structures and human agency might have interacted in the Holocene to produce cultural evolution: Repetition of their role-defined tasks by individuals reproduces the social structure---traditions, institutions, moral codes, and established ways of doing things---but these can be changed when people start to ignore them, replace them, or reproduce them differently[56] (ref). This model recognises two-way causation, with humans having structuring power and structures having enabling and constraining power. (Lloyd, 1993:42-43)

Holocene Survival Strategies

One can think, metaphorically, of Holocene society as having been a single entity (call her Humanity) who was intentionally trying to develop 'what-to-do' survival strategies in the face of, first, large exogenous changes in her bio-physical environment and, second, (endogenous) survival threats caused, in part, by her own prior survival strategies. Coming into the Holocene, Humanity retained the hunter-gatherer strategy (social technology) of dividing into widespread geographically-separated groups each capable of multiplying in the presence of a food surplus. This is a strategy which 'recognises' that environmental conditions vary from place to place and ensures that locally-harsh conditions will only threaten a portion of the species. Comparably, the strategy of developing two very different food production systems---cropping and herding---might also be seen as a form of risk management insofar as global changes might impact differently on the two systems. Against that idea, different production systems, as well-argued by Diamond, simply reflect adaptation to different local resource complements.[57]

Early in the Neolithic the social technology of marauding---plundering the grain stores of neighbouring villages---was invented and while it may have provided a spike of cheap energy supplies to the raiders, marauding, on almost any reading, would have to be judged one of the great maladaptations of all time. First, it reduced total food supplies insofar as the marauders were temporarily unproductive. Second, it threatened, particularly during drought, the survival of the portion of the population

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[56] Lloyd, Christopher (1993) *The structures of history*. Oxford: Blackwell Publishers.42-3
[57] ReferenceDiamond

being deprived of food reserves (although this does raise the suggestion that marauding functioned as a (very inefficient) method of population control in situations where carrying capacity limits were being approached). Third, it forced those being plundered to invest their energies in defending their reserves, by forming both armed forces and inefficiently-large but more defendable villages-towns. Fourth, it killed off the able-bodied and, with the soon-to-be-invented technology of taking the defeated into slavery, further depleted the survival prospects of the 'losers' in such encounters; in a perverse way taking prisoners probably improved communication between village societies and hence opportunities to exchange technologies. Fifth, it led to a tit-for-tat mentality which would only be checked with the establishment of empires having the "head-banging" coercive powers to stop marauding within their borders. [[We might also note that there is no reason to believe that cycles of plundering and being plundered imposed selective pressures which, genetically or culturally---even if they had persisted long enough---improved Humanity's longer-term survival prospects]]

Overall, marauding, exacerbated by a drying climate after 5500 BP, led Neolithic society into a social trap where the species' survival prospects could not be further enhanced and where, despite its high external costs, there was no escape. That is, not until Holocene society self-reorganised around a new set of material, social and communicative technologies, notably extensive irrigated cropping and cities with populations stratified by socio-economic role. By diverting the energy of river flows into reliably delivering water and alluvium to grain crops, the new urban civilisations increased net energy yield per field worker markedly. One can only speculate as to what would have happened if Eurasia had had no great river valleys capable of supporting cities and large-scale irrigated agriculture. We are provided here with a good example of the contingent nature of cultural evolution.

Conversely, the relative decline of village agriculture illustrates how a successful survival strategy can exhaust the resources it draws from the dissipative system in which it is embedded (eg vacant habitable land); and also how a successful strategy can be threatened by parasitic behaviour from within (as well as by climatic etc shocks from without). Indeed, in the distinction between raiders and raided one can see the beginnings of the human equivalent of what biologists call *pseudospecies,* ie sub-populations of a species which, at times, behave as separate species (eg work together, breed together) including, perhaps, behaving in ways inimical to the interests of other pseudospecies. For example, Steven LeBlanc (2003) argues that humans have long been the main predators on the human species.[58] Alternatively, a pseudospecies is a group with a shared culture.[59] It is an idea to which we will return, along with the further idea that pseudospecies, as well as parasitising each other, can associate symbiotically, ie in mutually beneficial ways. Catton's (p100) [sp?] less emotive term for parasitism is *antibiosisis* and Richard Adams' less biological term for pseudospecies is *operating units.*[60]

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[58] LeBlanc(2003)

[59] Lorenz On Aggression p80

[60] Catton P101 among higher forms of life there are increasingly elaborate symbiotic relations within species ..by behaving differently and making somewhat different demands on the environment ..with man is as if we are divided into many species ..a

In moving from a survival strategy based on village agriculture and herding to one predominantly based on extensive irrigated cropping and urbanism (plus urbanism's associated social technologies), Humanity was learning to convert accessible energy to more useful forms at a higher rate per field worker per annum. The size of the overall surplus was further increased by using poorly fed slaves and 'serfs' as field workers. However, apart from the use of river energy to transport water and materials, most of the energy being captured for human purposes still came from plants and animals. From a contemporary perspective, these were still low-energy societies.

Most of the modest surplus was used to energise the increasingly complex and diverse set of overhead activities---religious, military, engineering, trading---needed to maintain, protect and sometimes-expand an increasingly complex production system. Recall Ashby's idea that an effective control system needs to be as complex as that which is being controlled. Central to the strategy was the emergence of political *states* as the dominant form of social organisation; each state had a *ruling class* with the capacity (technologies) to organise a *working class* into reliably providing the large amounts of labour, both manual and craft, needed to keep things going (reproduce the society) from season to season and year to year. Having control over food distribution, coercive powers and religious authority all played a part here. Whether it was seen as such we cannot know, but appropriating food surpluses also functions as a population control mechanism (White P205). Effectively, a ruling pseudospecies had developed technologies which allowed it to 'domesticate' a labouring pseudospecies. It was an association which was mutually beneficial to the extent that each pseudospecies needed the other to survive but which also relied on 'exploiting' the working class to extract co-ordinated flows of human energy large enough to undertake collective works such as constructing religious monuments, protecting supplies of raw materials (eg wood, stone, minerals) and conquering neighbouring states/ settlements to create empires.

While the practice of marauding at inter-village level was increasingly suppressed within individual empires and large states, it re-emerged, as the Bronze age blossomed, in the form of frequent organised warfare between states and/or empires. In the mid-Holocene world, empires were as much pseudospecies as were classes within an empire, the difference being, perhaps, that the mainly conflictual relations between empires produced minimal mutual benefits. Trade was a limited exception possibly. [[[[[White (p227) reflects that because of tendency to romanticise the past, there is little awareness of the frequency of internal and external conflict in the great agrarian empires.]]]

Notwithstanding ambition, Bronze age empires were restricted in size by not having technologies which allowed rapid communications (of commands, information etc) and transport (of people, materials etc) over long distances. Cottrell (p34) points out that none of the fertile crescent civilisations could expand beyond limits imposed by

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distinct confign of competitive (antibiotic) and symbiotic relations
Adams, RN (1975) Energy and Structure: A Theory of Social Power, University of Texas Press, Austin and London, p 54.

the *relatively* high energy cost of transporting surplus energy to be used at distant frontiers. The Egypt of the Pharaohs is a good example. Over time, these limits relaxed somewhat with the rise of a technology set which included horses large enough to ride, wheeled wagons, chariots and, most importantly, communication by writing. Hence, as the Common Era approached, most people in Eurasia lived in one of four great empires.

The millennium before the Common Era also saw a succession of maritime trading cultures or sea powers, based on networks of coastal cities; most notably Phoenicia, Greece and Rome. Using sailed and oared vessels significantly reduced the energy costs of transporting goods and soldiers between coastal cities around and near the Mediterranean Sea. Putting this another way, societies which mastered maritime technologies were in an enhanced position to rule the seas, acquire colonies and slaves and monopolise the expanding gains from trade. For example, it can be argued that the boundaries of the Roman empire were set at the point where the extra costs of enforcing Roman rule at a distance balanced the extra gains from tribute and trade; and that it was maritime technologies that particularly allowed those boundaries to be extended. While oared war galleys remained in use till the 18th century CE, it was the efficient use of sailing technologies, with their ability to capture "free" wind energy, which came to increasingly determine the wealth and strength of nations on the geopolitical satage.

Ready to Survive the Common Era?

Any notion that urbanised medium-energy societies of the post-Neolithic Holocene were in some way 'better' than low-energy village societies of the earlier Holocene must be rejected. Each developed and employed its own technology-mix in its own environmental context. The fact that medium-energy societies processed energy at a higher rate per capita through a more complex social structure does not imply that they had a greater intrinsic capacity to survive (self-reproduce), or that they offered the individual a higher quality of life. In principle, the advantage of having more decisions made by a ruling class is that this offers the possibility of adjusting a society's behaviour more rapidly than waiting for tradition and custom to respond to changed circumstances. In the event, both low and medium energy societies co-evolved with their total environments to the point where they were no longer recognisable as the societies described above. Having said that, to the modern eye, and given the choice, one might prefer to be a member of a low-energy village society offering something like liberty, equality and fraternity rather than being a member of a medium-energy society characterised by state power over the individual, a strongly stratified society and loss of the mutual aid provided in low-energy societies by strong kinship systems.

By the beginning of the Common Era, many of the broad elements of the survival strategy which Humanity would use for the next 2000 years were well in place. To recapitulate, these included:

- Growing the size of the human population and (a) spreading parts of that population into unoccupied or lightly populated niches as these become available and (b) concentrating parts of that population into cities

- Using food-energy surpluses to support the political organisation of populations into geographically bounded and occupationally-structured (social pyramids[[??]]) states and empires.
- Using conquest and war between states/empires to expand the scale of and reap the benefits of activity-co-ordination at a broader scale, eg ameliorating localised disasters, suppressing inter-state conflicts. [[[Wesson And, conversely, to shake up ossified societies and allow them to be reorganised…..war creates new suites of NICHES (yeah, yeah) .]]]]
- Using trade within and between states and empires to acquire resources for improving the efficiency with which production systems and production-support systems operate. Trade can lubricate a society by making a limiting resource more available.
- Developing and adopting technologies (material, social, cognitive and communicative) which reduce the human effort needed to carry out the tasks through which society reproduces and protects itself from environmental and other variability.

The fact that humans have not died out means that this survival strategy (including its various elaborations) has not failed, either before or after the common era began. Perhaps this has just been luck in that if (eg) a slightly longer drought or more virulent pandemic had occurred the species would have disappeared. Think how close to extinction the Mt Toba eruption brought humanity 70 kya. Alternatively, if they had occurred, Humanity may have survived disturbances much more threatening than those to which she was actually exposed. We cannot know.

Taking another tack, what if we imagine metaphorical Humanity to have been seeking to develop a *quality survival* strategy rather than one directed exclusively towards survival? Here, I mean a quality survival strategy to be one seeking to offer high quality of life to most members of the species. Many measures suggest themselves. One is how much exhausting and unrewarding physical work people have to do to survive. Another is how frequently and severely local and regional populations crash under the strategy. On both these measures Humanity's quality survival strategy seems to have performed badly, both before and during the Common Era. While war, famine and pestilence have not halted the upward climb in human numbers since the last glacial, countless regional and local populations have been depleted and disorganised by these and other associated scourges such as mass migrations and other flow-on effects of natural disasters. In between such disturbances, most people in most societies since the urban revolution, have had their lives shortened by debilitating work. [[more stability in local and regional populations]]]]

While a survival strategy with the same broad foci (population, pyramidal societies, conquest, trade, technology) persisted through the Common Era, the particular technologies (including material, social, communicative and cognitive technologies) through which these focal concerns were recognised changed enormously. As consequential examples, the Common Era saw the emergence, although not necessarily the full flowering, of:

- Markets for all factors of production, including land, labour and capital

- Extraction and use of non-renewable energy
- Technologies for systematically and deliberately creating new technologies, eg scientific research and development
- Human rights
- Global governance
- Population control technologies
- A global economy

In the next chapter we will consider a little of the Common Era's history, looking for trends, patterns and generalisations that provide context for understanding, and perhaps better managing the contemporary world. Here, we pause to bring together our accumulating understanding of the mechanisms underlying cultural evolution

UNDERSTANDING CHANGE IN HUMAN ECOSYSTEMS

There are many perspectives from which one can view and begin to understand how human ecosystems change with time. In my book *Deep Futures* I find value in viewpoints from all of history, geography, sociology-anthropology, social psychology, systems theory, ecology and evolutionary biology.[61]

The biological disciplines are rather more concerned with changes amongst species in general---their interactions and their phylogenetic-ontogenetic paths---than with the human species in particular. Nonetheless, despite fierce debate over the specifics of biological change (at *all* space-time scales), and despite its many gaps, the biologist's story of how the human lineage became hunter-gatherers is plausible (no miracles) and wonder-full (Fancy that!). By the end of the last ice age, the species' capacity to adapt had equipped it with a phenotype (set of observable characteristics) and a suite of cognitive, social, material and communicative technologies which, with or without any further evolution, was going to allow the species to survive and multiply under the markedly different conditions of the Holocene. In many ways, humans turned out to be pre-adapted to their new environment.

While the creation of biological adaptations by natural selection, symbiosis, self-organisation etc has never stopped, the additional contribution of such to the persistence of the human ecosystem declined relatively and (probably) absolutely after the emergence of modern humans (c. 200 kya). Thereafter it was cultural evolution---treated here as much the same as technological evolution when the latter is broadly defined---which, *prima facie*, produced the adaptive behaviours that appear to have allowed humans to continue surviving. Thus, come the Holocene, it was cultural-technological evolution which was largely responsible for the Neolithic, urban and consciousness-cognition revolutions.

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[61] Deep Futures

And, as argued earlier, cultural evolution is strongly analogous to the basic Darwinian process of natural selection through variation and selective retention---but with two exceptions. One exception is that variations in the pool of available technologies are not only generated by random exploratory behaviour but purposively in response to a perceived opportunity or challenge. More of that below. The other difference is that the process of selecting which new technologies will be adopted widely is more accurately thought of as a diffusion process based on imitation and learning, rather than as one based on relative reproductive success. Together, these differences convince some to describe cultural evolution as more Lamarckian than Darwinian.[62] Perhaps so, but what is more important is to recognise that both speciation and changes in human ecosystems exemplify the same process of universal evolution. It is the 'details' that are different.

With the arrival of the Holocene, the perspectives of the human-centred disciplines become increasingly relevant to the modelling of change in human ecosystems. This is particularly so as equilibrium-centred theorising about human societies has given way to change-centred theorising; that is, there has been a shift from seeing societies as basically unchanging to seeing them as always changing, sometimes rapidly, sometimes (very) slowly. Basic to the theorising of the human-centred disciplines is the idea of *agency*, i.e. of individuals and groups (pseudospecies, classes, states, interest groups etc) responding to changes in their circumstances by making *behavioural choices* according to various more-or-less-rational criteria, including their beliefs and preferences. British philosopher, R. G. Collingwood was especially appreciative of the role played by thinking in determining historical phenomena: "All history," he once affirmed, "is the history of thought."[63] Given this starting point, social change can be studied in terms of the cascading mutually-causal interactions that are triggered by the behavioural choices of groups and individuals. But of course it was not until the Holocene that societies produced the social groupings and autonomous individuals which make such a conceptualisation possible. The view that people, individually and collectively, can act as change-agents in society is recognised explicitly in schemata such as Anthony Giddens' *structuration* and Christopher Lloyd's *structurism.* What is being further suggested here is that behavioural choices can often be interpreted as decisions to apply some existing or, occasionally, newly-created technology to what-to-do situations.

The idea that the evolution of human ecosystems---eco-cultural evolution---can be understood as a pageant of changing interdependent technologies is not at all new. The very naming of Holocene time-blocks after material technologies (Bronze Age, Iron Age…) tells us that. Gordon Childe and Lesley White are two well-regarded pioneering students of Holocene societies who give technological change a central role in their histories, although both are working with a narrower, primarily material, understanding of the nature of technology than I am.[64] Sociologist Gerhard Lenski is another who sees sociocultural evolution as a process of technological advance with downstream consequences.[65] Lewis Mumord, a great historian, gets closer to the

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[62] Hodgshon

[63] (Idea of History, pp. 214-15)]]]

[64] Carneiro RL 1973 A Reappraisal of the Roles of Technology and Organisation in the Origin of Civilization *American Antiquity* 39 (2) 178-86.

[65] Lenski p79 Childe White refs

perspective being taken here when he suggests that large groups acting coherently, eg to build pyramids, have all the characteristics of large machines, what he called *mega-machines*[66]. My perspective is that the 'recipe' for, say, building pyramids is a *social technology*. Another example: Graeme Snooks is the economic historian who sees war, population growth, trade and (material) technology as the main tactics encompassed in humanity's long-term survival strategy. Without judging Snooks' insight *per se*, I group war, population growth and trade as social technologies. Even Marshall McLuhan's famous aphorism, "the medium is the message," is saying that technology, directly or indirectly, drives change---once it is realised that for McLuhan *medium* means any extension of our bodies, minds or beings and that the *message* of any medium is the changes in scale, pace or pattern that it causes in a culture (pp 43-44 Gutenberg).

Perhaps it needs to be pointed out before proceeding that what is being advocated here is not *technolgical determinism*, at least not in the simple reductionist ('nothing but…') sense of that phrase, ie the view that technology (alone?) determines history, or that spontaneous developments in technology are the (only?) triggers of social and cultural change. Or, more narrowly, that developments in a particular functional group of technologies (eg energy technologies) suffice to explain history. Such a view is unsatisfactory because it fails to capture the idea of *eco-cultural evolution*, ie that (material) technologies and institutions (which I am calling social technologies) co-evolve both with each other and with the ecosystem-resource base.[67] Every widely-adopted innovation creates niches (externalities) which may or may not evoke further innovations. For example, urbanisation created a niche for disease-control technology which was not filled till the arrival of public health reforms in Victorian times. Simple determinism does not capture the element of niche-identification and purposive experimentation which underlies much technological innovation.

Patterns of Eco-cultural Evolution

Unfortunately, modelling and understanding eco-cultural evolution in terms of coevolving technologies confers little capacity to predict future eco-cultural evolution. This less-than-encouraging conclusion is consistent with the view that social systems are true dissipative systems which self-re-organise spontaneously (although not necessarily rapidly) when energy flows through the system change sufficiently. A decision to adopt a technological change is a bifurcation (meaning, in physical terms, a small, critical energy fluctuation), under the influence of which the social system moves into a new behavioural domain (basin of attraction). In this new domain the society still reproduces itself (cycles) in much the same way but, reflecting the use of new recipes, with some modifications to the ways energy is allocated to different functions. Accepting societies to be true dissipative systems does not preclude seeing

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[66] Mumford mega-machines

[67] By viewing cultural evolution in terms of the coevolution of material and social technologies one avoids bruising arguments as to which of these leads and which follows in the development of culture. See Carneiro RL A Reappraisal of the Roles of Technology and Organization in the Origin of Civilization American Antiquity, Vol. 39, No. 2 (Apr., 1974), pp. 179-186

them as systems of coevolving technologies. In appropriate context each perspective is valid and useful.[68]

While making specific predictions about future change in specific human ecosystems will always be fraught with uncertainties, there are, nonetheless, all sorts of patterns in the history of eco-cultural evolution and, if a specific situation matches any of these, a plausible scenario or two for that situation might thereby suggest itself. The modest value of this is that if any such unsurprising scenario implies a significant threat or opportunity, then it would seem sensible to act as though it were highly likely to occur.

Here we have space to mention but a few (overlapping) generalisations and patterns which illuminate how technologies, singly and together, rose, persisted and fell as threads in the tapestry of eco-cultural (co)evolution prior to the Common Era (and, when we get there, in the Common Era too).

All Technologies are Energy Technologies

While many threads can be extracted from the rich tapestry of cultural change in post-glacial societies, two stand out. One is the increase over time in energy use per capita per annum, and the other is the increasing complexity and size of social structures (more people in more groups, more interactions between groups). And, as suggested, the streams of technologies underlying these two trends can be seen to have co-evolved. Cottrell (1955) suggests that the amounts and types of energy a society employs not only condition its way of life materially, but set somewhat predictable limits on how that society can and will be organised.

More specifically, technologies which increase a society's rate of energy conversion (ie, from one form of energy into entropy and other (useful) forms of energy), necessarily require additional social structures and relations to acquire and guide the flow of that additional energy through the society's technological processes, determining just where and when it is converted and what further energy conversions it might trigger. Complexification then is a natural correlate of increased energy use. Population growth is commonly a part of complexification too and particularly tends to occur when there is a sustained increase in the food energy available to a society. Increased pollution and resource degradation are other tendencies associated with increased energy use, particularly when a system's additional energy supplies come packaged with materials, eg food, wood. In this case, pollution is simply the material residues remaining after the potential energy has been stripped out. In other cases, resource "degradation" is simply a rebadging of the fact of resources being diverted from a shrinking system (eg forest) to an expanding system (eg farming).

All technologies are energy technologies in the sense that they convert energy in one form to energy in another putatively more useful, form. Jewellery making, to take an

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[68] Abel, T. 1998. Complex adaptive systems, evolutionism, and ecology within anthropology: Interdisciplinary research for understanding cultural and ecological dynamics. *Georgia Journal of Ecological Anthropology* **2**: 6—29. Retain this ref ??

unlikely example, uses human kinetic energy to redistribute energy stored in the bonds of gemstones from one set of configurations to another. Spear-making produces a tool which allows human kinetic (movement) energy to be concentrated onto a small surface area. But technologies which, like these examples, use small amounts of energy *per se* are not for that reason unimportant. Many such are *trigger technologies* which are not directly useful but which inject sufficient activation energy into another more useful energy conversion process to allow it to proceed spontaneously. Verbal commands and signals which use small amounts of energy to convey, potentially, large quantities of information on which people then act, are good examples. Indeed, all conscious activity is triggered by the cognitive technology of decision-making. In some situations, a sequence of triggers may be required before the target technology is activated as when sparks are struck to initiate the energy-extracting technology of burning wood in a hearth.

In general, a trigger is an energy-dissipating perturbation that releases or inhibits the further dissipation of its own energy or that of other energy forms. Richard Adams (p 49) nominates triggers as the key mechanisms that relate one dissipative event to another. A trigger always has an energy cost and an energy yield and, to achieve efficiency in energy use, it is important that the ratio of yield to cost be as large as possible. For example, if human labour is the trigger which converts solar energy to grain, there must be a surplus of grain-energy output over human-energy input if this technology is to persist.

And, as discussed above, it is when that surplus is large that job specialisation and urbanisation become possible; the use of human energy to organise and increase control over human energy is a defining characteristic of civilisation. Even when it is not efficient in energy cost-yield terms, stratified societies may choose to co-ordinate and concentrate human energy to undertake tasks which would otherwise be impossible, eg manning galleys, building pyramids. The use of draft animals for ploughing is another example where the capacity to do work at a high rate during a critical few weeks of the year may be more important than being energy-efficient.

A society can only use more energy if it first extracts more energy from primary sources in the environment. Thus undomesticated plants and animals were almost the only primary energy source for hunter-gatherers; cultural evolution for them was largely expressed in the form of better tools. At some stage, fire, a technology for releasing the energy stored in wood, appeared. Fire was a *fundamental technology* which opened the door to an intensification and geographic expansion of human society. In Neolithic and post-Neolithic times, undomesticated plants and animals were largely replaced by domesticated species as the primary energy source, along with a range of production technologies which increased the efficiency with which energy could be extracted from these sources, ie which saved human energy. Harvesting with sickles and ploughing are examples of energy-saving technologies. Sailing vessels were almost the only radically new energy-extraction technology to appear, and that in a minor way, in the Bronze and Iron Ages. Their time would come.

And, to complete a first simple functional classification of energy technologies, *energy-storage technologies* became possible once the technology-mix was able to

reliably produce an energy surplus; granaries and domestic animals themselves are good examples.

So, it is being suggested, any individual technology in a society's changing mix of technologies can be interpreted as contributing to that society's energy security (stability of energy flows) in one, or more, ways as follows:

- Energy extraction, eg fire-making, food gathering, animal domestication, sails, marauding, enslaving
- Energy release (triggering), eg verbal commands, signals
- Energy saving, eg hand tools, water wheels
- Energy conversion, eg cropping, food-sharing
- Energy concentration, eg labour gangs, galleys, draft animals, hand tools and other prostheses
- Energy storage, eg granaries, domestic animals

Now we have a vocabulary for understanding, with hindsight, the energetics of cultural change, ie a society's changing patterns of energy flows and its behaviour as a dissipative system. Any historically changing mix of technologies can be described in terms of changes in energy extraction, concentration, storage etc. And, qualitatively at least, such changes can be evaluated in terms of their capacity to deliver stable or smoothly changing energy flows. For example, food-storage and food-sharing technologies allow a society to survive natural fluctuations in food production.

[[? Hierarchy of technologies in wh big energy flows are dissipated via smaller energy flows and so on ???]]]]][[does this idea have legs .is it in any way a tree or just a confusing bush ..suspect not ..triggers would be one confusing element ouldn't they?//]]]]]] perhaps the clue is to use storages, not flows ..egy stored in food is transferred to energy stored in humans who then store energy in stone axes

Many Technologies are Combinatorial

Not all new technologies involve an upgrading of components in existing systems. Many are *combinatorial*. That is, components of established technologies are linked together to form a new composite technology. Bronze production is a good example of a 'long chain' technology, requiring as it does the linking of mining technologies, transport technologies and smelting technologies. And while bronze production is a material technology, it would not be possible without adequate social technologies for co-ordinating the links in the production chain. We might also note, in terms of coevolution, that improving one link in such a production chain can highlight a need to improve other links. More generally, as the stock of available technologies increases, the number of possibilities for combining existing technologies into new technologies increases even faster. In principle then (there are many barriers) it should not be surprising to see (fitful) *compound growth* in the pool of available technologies; what we might call the stock of *cultural capital*. Indeed, some writers,

Hornell Hart being one, suggest that cultural capital accumulates at a compound growth rate which itself increases over time.[69]

Initial Conditions Preclude-Shape Technology Opportunities

Another principle for understanding (but not predicting) technological change is that opportunities for introducing new technologies into "unoccupied niches" are highly dependent on the configuration of the pre-existing environment, both natural and as socially constructed. The phrase *path dependency* captures the idea that a society's past choices of technologies constrain the choices available to it ("structure the alternatives") in the present and the future. Historical geographer Robert Dodgshon (1998) lists the types of constraints, what he calls *historical bindings*, which any new or replacement technology will have to satisfy. His list includes natural laws, physical limits and logical, technological, economic, ethical, psychological, cultural and political constraints.[70]

The importance of such *initial conditions* is well-evidenced by Jared Diamond's explanation of how cultures evolved differently in different regions according to the possibilities in each for domesticating local plants and animals. Thus, early Eurasians had access to plants and animals that were intrinsically susceptible to domestication, but this was less so in the Americas and even less so again in Australia. While Australian Aboriginals had little in the way of domesticable species available to them, Andean farmers could build a food production system around five local species: llama, alpaca, guinea pig, potatoes, and a grain crop, quinoa.[71]

While the specifics of new technologies are unpredictable, can anything be said about what sorts of initial conditions are particularly likely to evoke new technologies? Certainly there is little to suggest, prior to the Common Era at least, that the idea of pro-actively seeking to improve existing technologies was part of people's thinking. The first exceptions to such thinking may have come in areas which had already accumulated a long visible history of technological change; the family of warfare technologies which had been evolving since Neolithic times, is a good example.

More reactively, "Necessity is the mother of invention," as the saying goes. Initial conditions which include threats to the ongoing smooth operation of an established society seem particularly likely to trigger innovative responses in material, social, communicative or cognitive technologies. The improvement in cognitive technologies in the chaotic times at the end of the Bronze Age is one dramatic example. So indeed are the Neolithic and Urban revolutions themselves.

Exhaustion of a widely-used resource has ever been a common challenge to existing technologies. Running out of timber or building stone or, because of population growth, out of habitable land are examples which get cited. As one particular pattern of human exploitation of the environment began to encounter difficulties, thanks to exhaustion of one or another key resource, human ingenuity had to find new ways to

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[69] Hart, H (1959) Social Theory and Social Change, in Gross, L., editor (1959). Symposium on Sociological Theory Harper and Row Publishers, New York
[70] Dodgshon 1998
[71] Diamond

live, acquiring new supplies by trade or war or by finding replacement technologies. From a dissipative systems perspective, this is self-reorganisation.

Note that if a society has reached its capacity to acquire and use a particular form of energy, a new technology which uses that form of energy can only be taken up if the use of an existing technology processing that energy form is discontinued. The need to re-allocate a fixed labour force if a new form of social organisation is to be implemented is a good example. In more recent times, of course, many such re-allocations are made through markets. A corollary to this *re-allocation principle* is that technology development does tend to follow an *economising principle*, namely, to use as few resources as possible to satisfy society's needs, particularly those in limited supply.[72]

Technologies Come and Go

Why do technologies disappear? One reason has just been given but basically it has to be because the niches (needs) they are filling disappear or their niches can be better filled by other means. Weapons provide good examples of both processes. Sometimes one can track a technology as it is being adapted to a changing niche till, at some arbitrary point, it 'disappears' by morphing into a new technology. Sometimes there is genuine coevolution between the niche and the technology; pot-making is one example, writing is another.

And, between birth and death, why do technologies persist? A promising new technology is not taken up rapidly unless it is imposed from above as may happen in a stratified society. Otherwise, it diffuses through and eventually saturates its niche as more people learn of, become aware of, its utility. And when it does disappear, it is more likely to fade away than vanish overnight; unless of course the society in which it is embedded suffers a collapse. Like many diffusion processes, the rates at which technologies spread tend to follow logistic or S-shaped curves, ie slowly at first, then rapidly, then slowly again. Truly fundamental technologies like language and writing seem destined to persist as long as their parent societies persist. More generally, new communication technologies have a special potential to increase the diffusion rates of other types of technologies.

In a general way it is *inertia*, society's tendency to resist change, which slows both the rise and fall of an emerging technology. Robert Dodgshon gives several examples.[73] The physical use of space in the past (eg structures erected, forests cleared) raises barriers against and reshapes opportunities for future change. His second example is institutional inertia. The standard analysis of institutional change sees ageing institutions becoming trapped in a performance crisis until a political crisis shifts the balance of power in a way which allows a radical overhaul of the 'rules of the game.'[74] Dodgshon's third example is 'knowledge inertia'. Societies transmit information in the form of cultural norms (how to behave, what recipes to use) from generation to generation and while there is a degree of selection and novelty in what is passed on, most is handed down unchanged.

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[72] Lenski p 33
[73] Dodgshon 1998
[74] (Visser and Hemerijck 1997: 53).

Inertia is not necessarily irrational. For example, 'lock in' is the name given to the situation where an institution or organisation recognises that a new goal-seeking strategy would be more cost-effective than current strategy (equals initial conditions) if it were not for the investment cost involved in switching to the alternative. And, as suggested earlier (Chapter 6??) risk of failure is another reason for inertia. For example, in hunter-gatherer societies operating near survival thresholds (eg the end of the last ice age), *technostasis* is the norm, ie the technology suite neither expands nor contracts. Why? The penalty for committing to a new technology which might subsequently fail is too high.

The obverse of inertia is stability. When technologies persist for a long time, they provide conditions, a nurturing environment, under which less stable technologies can evolve and adapt to the enduring technology. Adherents to a *cultural materialist* view of society are 'infrastructure determinists' who suggest that the entire structure (organisation) of any socio-cultural system rests on the way the society exploits its environment to meet the biological and psychological needs of the population.[75] That is, the (slow-changing) mode of production determines the forms of families, collectives and other group structures which in turn determine the behavioural and cognitive superstructure (social and cognitive technologies) of society. Infrastructure is given this leading role because it reflects the way a society adapts to its environment to meet basic needs---society's primary task. Group structure and mental and cultural superstructure must necessarily adapt to be compatible with the 'given' infrastructure (our values depend on the age in which we live). There is a clear debt in this thinking to Marx's basic idea that social life is shaped by the way people engage nature through production and that the mode of material production nurtures the forces which will guide social alignments such as class.

Cultural materialists nonetheless view societies as very stable systems with most changes in structural, infrastructural or superstructual technologies being resisted and dampened elsewhere in the system. Most successful social changes start with a mutual change in both the production system and its environment. Elwell (1991: 11) claims that many of these reconfigurations have been changes that extract more energy from the environment, particularly where this favours the wellbeing of elite groups. Intensification of the production system in this way leads eventually to some form of environmental depletion and then to either a sudden collapse of the cultural system or a shift to a new mode of production. If the culture shifts successfully, intensification starts all over again.

Fernand Braudel, the great French historian, had a comparable hierarchical view of social change. He saw geography as the enduring environment within which layers of institutional and psychological structures emerged and remained stable, often for generations, before crumbling away.[76] It is a view which equates with Eric Fromm's

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[75] (Elwell 1991, Harris 1979)

[76] Braudel, Fernand (1972) *The Mediterranean and the Mediterranean World in the Age of Philip II*, (2 volumes) vol. 1. trans. S. Reynolds, London, Collins. p16f

aforementioned [[??]] observation, that a society's social character will change readily to be compatible with its production system.[77]

Confliction and Co-operation have Long Shaped the Technology-mix

Confliction and co-operation are pervasive behaviours in primate society (societies). Both can be regarded as 'umbrella' strategies (macro-technologies?) under which numerous social technologies for stabilising and/or expanding energy flows have evolved. Co-operation entails people working together to one end (eg, a hunting party) and conflict entails people trying to thwart an other's behaviour (eg, war). Both can be traced back to the primate trait of living in groups, each occupying a more-or-less fixed territory. This is, in several ways, an energy-efficient form of social organisation: being familiar with a territory means more efficient food-gathering and confers a knowledge of its danger spots. Living in groups, among other advantages, allows food-sharing, an early form of co-operation. Conversely, as an evolved 'technology' which differently helps to maintain this form of social organisation, primate groups attempt to aggressively expel trespassers, particularly of their own species---an early form of conflict. Aggression is behaviour intended to threaten or inflict physical injury on another. In tribal societies aggression is channeled and limited by customs rules, taboos etc. It is further limited by the weapons available. Wesson [[??]] makes the observation that, in tribal society, most aggression is initiated at the group level and most individuals simply conform, ie individuals are not particularly aggressive.

By late Pleistocene times, aided by language as a co-ordination technology, hunter-gatherer groups had acquired well-developed social technologies for protecting and exploiting 'the leverage of collective action' within the group and, to some extent, between groups (eg, inter-marriage, trade). Within the group, behaviour would have been regulated by rules of co-operative conduct (eg gift exchange) which were partly instinctual and partly learned. Co-operation is best thought of as a strategy for amplifying the benefits of what can be achieved by individuals acting alone. Pooling of muscle-power, food, memory and artifacts are examples relevant to a tribal society. The kinship system can be thought of as a technology which, by creating an extended family, secures everybody's co-operation.

But, if it is to survive, co-operation has to be monitored to ensure that its dividends are fairly distributed. Co-operation based on direct reciprocity (immediate mutual aid) presumably evolved at some stage into a memory-dependent system of indirect reciprocity where co-operative behaviour could be legitimately rewarded at a later time and by people who had not benefited directly from the initial altruism. Indirect reciprocity is clearly an efficient rationale for co-operation but how, or if, it could have evolved through natural selection is a matter of some debate.

The role of aggression and hostility *within* the group is mainly to establish hierarchical standings and to protect the male-female pairing relationship, both behaviours which can be argued to have adaptive value. Having a leader is the extent of hierarchical organisation in tribal groups. A group with a courageous, skilled and aggressive leader stands to multiply and gain the security of greater numbers and a

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[77] (Berger and Luckman p 165) Fromm ref Little Albert?

larger territory at the expense of other groups. Conversely, the efficiency of hunting and gathering for acquiring food declines beyond a certain group size. Tribal groups therefore tend to have upper and lower limits on their size and much of our species' social behaviour is adapted to living in groups of, say, less than a hundred where all are known to each other.

The important conclusion emerging here is that a code governing co-operative behaviour and a code governing confliction (some would call it competition) were the twin foundations of tribal and inter-tribal social organisation. Indeed, both can be seen as aspects of an even higher-level strategy, namely inter-dependent decision-making. The further genetic role of these codes was in maintaining the system of small isolated groups which has been an ideal setting for rapid biological evolution. Both of these codes are elaborately adapted to the hunting and gathering mode of food production which hominids have followed for 99% of their history.

But in the Holocene era, starting with a switch in the mode of food production to herding and cropping, these deeply engrained, largely unconscious, behaviour codes---probably what most people mean by 'human nature'---were increasingly required to guide behaviour in circumstances under which they had not evolved. As food surpluses per field worker increased, first under village agriculture and then within the irrigation civilisations, niches were created for both conflictual and co-operative strategies, both within and between societies.

While surpluses meant increased possibilities for communities to co-operate with each other through trade, stored food surpluses also became a new primary energy source for marauders. Here was a novel way of extracting energy from the environment, one that yielded the human energy of slaves as well as food. Marauding was a conflictual technology which evoked countervailing technologies such as improved weaponry, static defences, larger settlements and, in time, standing armies. It was marauding which evolved in time into inter-state and inter-empire warfare.

Simultaneously, the new surpluses were also evoking both co-operation and confliction within the growing communities themselves. Surpluses allowed a division of labour and skills between field workers and those who managed and protected the new production systems. This division of labour was an important co-operative or co-ordinating technology which allowed all participants to get more than they could alone or in smaller groups. But, over time, what had originally been a reciprocal exchange tended to become unbalanced with members of the management class accumulating more benefits than field workers, including economic and political power. Despite the risk of killing the goose that lays the golden eggs, it seems that once a group has obtained control over how surplus energy is used it is unwilling to return to a more equitable co-operative organisation of society.

By developing a suite of coercive, persuasive and belief-shaping technologies, ruling elites were able to extract maximum energy surpluses from their domesticated majorities for much of the Bronze Age. But while most people are accepting of authority in their lives they also have a limit to their tolerance of inequality and there

was a high, but little recognised, level of resentment and revolt in many agrarian societies.[78]

Along with the invention by Bronze Age states of conquest and empire-building as a technology for acquiring food and human energy (slaves) came the scaled-up use of coercion to increase food production and to transfer maximal surpluses to the conquerors. Diverse technologies for the prosecution of war and the management of colonies emerged to support the use of conflict to secure energy supplies.

For further understanding of the roles of confliction and co-operation in shaping technology mixes across Eurasia in the millennia before the Common Era, it is helpful to think of *H. sapiens* as organised into pseudospecies, more commonly in conflict with each other than co-operating. Thus warring and trading states and empires were behaving as pseudospecies and, within individual states, powerful ruling classes and the masses they dominated also functioned as pseudospecies. Notwithstanding the waste and misery of all this, we have here a system of social organisation which was stable (ie persisted) for most of the Bronze Age. It was only for a brief time, starting with the axial age religions and limited democracy in the Greek city states, that post-tribal humans moved a small way past seeing societies as naturally divided into all-powerful rulers and masses with minimal rights.

Once a society has split into pseudospecies---groups with divergent interests---the tendency is for each pseudospecies to develop social, material etc technologies which further its own interests and, where they can, to suppress technologies which threaten those interests. For example, while new material technologies proliferated in the egalitarian societies of the early stages of the Neolithic revolution such innovations were quite rare for much of the Bronze Age. Given a surplus of raw human energy (slaves and serfs) in the irrigation civilisations, it was not in the rulers' interests to encourage unsettling innovations which might have reduced workloads for food producers. On the contrary, social technologies for absorbing labour, building monumental structures for example, were developed. Such projects, like many social technologies are simultaneously co-operative (people working to a common end) and conflictual (enforcing co-operation). But whether such conceptualisations were consciously recognised at the time seems doubtful.

Recapitulation

A basic framework for understanding eco-cultural evolution can now be drawn together. It starts from a recognition that humans have long been organised hierachically into 'larger' social groupings, each of which is made up of multiple 'smaller' groupings; and each smaller grouping is further divisible into even smaller groupings. Discussion above was limited to larger groupings called states-empires and smaller groupings of workers and elites within states, but could have been extended to a consideration of various categories of workers and elites or, indeed, to families and individuals.

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[78] (Richerson and Boyd (1998, 1999) p227). Le Blanc 2003

Humans are all one species we know, but calling each grouping, large or small, a pseudospecies captures the idea that groups, as well as independently pursuing their members' security and quality of life, interact co-operatively and conflictually with other groups of not too dissimilar size and energy flows---just like species in canonical ecosystems. The result has been a kaleidoscopic history of groupings which, throughout the portion of the Holocene of present interest, have stagnated, stabilised, grown, regressed, branched, amalgamated etc. Each pseudospecies persists for a time through the repeated use of a mix of technologies (material, social, cognitive, communicative) which more-or-less satisfies their material, social and psychological needs.

In parallel, each pseudospecies' technology-mix keeps evolving (sometimes by acquisition, sometimes by an endogenous process of variation and selective retention) as it attempts to adapt to the vagaries of the natural environment and to the threats and opportunities of its broader social environment as constituted by other pseudospecies. While we have canvassed a wide range of factors (energetics, inertia, initial conditions…) which play a part in determining what technologies, if any, might emerge in specific situations, none stand out as being strongly predictive of what will eventuate. The best we can say is that, retrospectively, one should be able to invoke these factors to plausibly explain particular innovations. Putting this more positively, a knowledge of their historical context is needed to understand and be unsurprised by contemporary events.

Coevolution of pseudospecies

How important is coevolution (mutual adaptation) between pseudospecies in this abstract descriptive model of eco-cultural evolution? Is there pattern in the way that relations between pseudospecies evolve over time? As above, it is difficult to predict what will happen in specific situations but, provided that two (or more) interacting pseudospecies are embedded in a larger environment where energy flows are relatively stable, you would at least expect any ongoing interactions between those pseudospecies to 'grope' towards more co-ordination. And that will be so even when one has much more social (military, political etc) power than the other.

Being co-ordinated means that each pseudospecies has standardised, perhaps formulaic, responses to particular behaviours on the part of the other.[79] Because standardised behaviours (habits) are energy-conserving, even tacit co-ordination is a form of co-operation. Nor is co-ordination necessarily incompatible with conflictual relations. Even wars are loosely governed by rules which limit damage. Pseudospecies whose core behaviours are closely co-ordinated tend to become inextricably interdependent and therefore stand to be significantly disrupted by disturbances to their inter-relationships. This is the downside of too much co-ordination; unforeseen disturbances readily threaten stability. Note the parallel to the short-sightedness of natural selection in biological evolution. In such situations, if decision-making were to be centralised under one controlling agent, individual pseudospecies, while losing some of their identity, might be protected from their own inflexibility. For example, if two warring states are integrated into a larger empire, they will be precluded from tit-for-tat war and given the opportunity to interact more

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[79] Berger and Luckmann

productively. New forms of co-ordinated and centralised behaviour are discovered by experiment, either purposeful or playful. When such experiments produce 'improved' behaviours, these are retained---a process of trial and success. Societies stand to add a new hierarchical level each time newly centralised groupings of pseudospecies begin another round of co-ordination.

A sufficient set of ideas?

In this chapter we have reviewed, briefly and patchily, the eco-cultural evolution of human societies in Eurasia from the time of the hunter-gatherers who walked out of the last ice age through to the increasingly conscious civilisations that appeared in the wake of the Bronze Age in the centuries prior to the Common Era. This 10 ky period saw three fundamental cultural shifts. One was the shift by Neolithic village communities to using domesticated plants and animals as their primary energy sources. The second, based on the achievement of regional food surpluses, was the further shift to a pattern of stratified urban societies in which surpluses were used to support populations of specialist workers, including priests and soldiers. Grafted onto this urban revolution was the widespread use by urbanised states of warfare, colonisation and enslavement to (it was hoped) secure, protect and enlarge their energy supplies.

The Bronze Age ended with the breakdown of what had become a shifting pattern of warring empires due, maybe, to both natural causes (climate change, earthquakes?) and, for what were still tribal minds, the unmanageable complexities of empire. The tribal mind had failed to cope with what it had created and, in its place, built on two co-evolving technologies of the most fundamental kind, there emerged the modern mind. One was a form of writing which had symbols for vowels, a communicative technology which could capture and store speech. The other was the self-aware reflective mind, a cognitive technology embodying the skills to formulate and choose between alternative ideas and courses of action. This was the third revolution, what I earlier called the consciousness-cognition revolution. It was a revolution which strongly shaped the cultures of the Greek and Roman empires while they lasted but had less impact elsewhere. Nonetheless, the seeds of individualism had been sown, and sat quietly through the Dark Ages, ready to sprout during the Renaissance Spring.

The question we end on now is whether the coevolutionary processes that have been identified and developed as tools for explaining and understanding what happened to human culture in the Holocene, prior to the Common Era, will suffice to explain and understand cultural change thereafter. Our hypothesis is that the types of eco-cultural evolutionary processes identified in the Holocene-to-date also outline the possibility space within which those same processes could unfold in the Common Era. There is no reason to suppose otherwise, even though it is true that the last 2000 years have seen massive and accelerating changes in population, energy-materials use, environmental impacts, human knowledge and relationships within and between pseudospecies. Cultural capital, meaning stocks of material, social, cognitive and communicative technologies has similarly grown. There have been revolutions galore including transport revolutions, fuel revolutions, the scientific revolution, the industrial revolution, the electronics revolution, the computing revolution, political revolutions, values revolutions…

Many of these changes have been surprising to those living through them. Others have crept up on people. But, looking back, none are mysterious, not even consciousness if one can accept this cognitive technology as an expression of increasing language skills. A multiplicity of causal factors complicates understanding of some major changes and a simple lack of information draws a veil over others. Notwithstanding, it has been possible to tell a rich plausible story about eco-cultural evolution up to the common era. As the next step towards building a *practical understanding* of the contemporary world, and taking a similar approach, we turn now to an overview, brief and patchy still, of eco-cultural evolution during the Common Era.