To my beloved wife,
without whom...
very little...
This is a book about humans and the systems they create. Essentially, then, it’s about the systems within humans, and how we got to be that way; the systems that human organize themselves into; and, the human activity systems that people attempt to design to achieve some purpose. Inevitably, too, it is about our human societies, how they have evolved; about our persistent social engineering – which may be leading us astray; and, where we are going as a species as global warming starts to remold our planet.

There are, of course, many ideas and theories about Man, his origins, and his highly developed brain. Our relative nakedness amongst the great Apes takes some explaining, along with our affinity for water, our human feet, our monogamous behavior, our work-sharing between male and female, and many more. Curiously, and unlike any other land animal, human females experience menopause, too. Why?

Evolutionary Psychology (EP) hypothesizes that our human organs evolved to perform optimally in the Pleistocene, over 200,000 years ago, including our human brains, so that today we still operate with our hunter-gatherer brains, and adapt our perceptions and behaviours to solve problems in today’s quite different environment.

Not everyone agrees with this EP hypothesis. Once you have this general idea in your mind, however, you seem to see Pleistocene hunter-gatherers all around you: the woman in the supermarket picking ‘ripe fruit’ directly off overhanging shelves; the man on the shop floor leading a team of half a dozen people as they hunt down faults in the machinery; it can become almost addictive.

We are not, however, adapted to living in cities, although the vast majority of humans on the planet increasingly do so. We humans, for the most part, enjoy city life, but it may not provide the best environment for the ingenious ape, and at times it seems to stretch our adaptive nature. With global warming, rising tides, reducing farmland, the future for cities is starting to look uncertain: but, what can we do?

In writing this book, I felt the need to start at the beginning, back in the Pleistocene - or before - and work through our progress up today, before exploring how we might meet to morrow’s problems. Along the way, there are bound to be surprises…

Derek Hitchins
CHAPTER

UNDERSTANDING THE HUMAN SYSTEM
Humans are unique. Humans are the most complex systems on the planet. Each human regards himself or herself not only as unique, but also curious, interesting and unpredictable. Yet all are descended from a line of ancestors going back several millions of years; and, if “out of Africa” notions are correct, today’s seven billion ‘outsiders’ are descended from a handful, only, of early humans.

Human biological and anatomical evolution can be traced back to earlier times when our ancestors had smaller brains, limbs more adapted to climbing and living in trees, and a general form unsuited to accurate throwing and running for long distances, not unlike today’s great apes: chimpanzees, bonobos, gorillas, and orang-utan, (“person of the forest.”)
How and why did we evolve to be so much more physically coordinated and capable? And, in the process of evolution, have we somehow managed to transcend our simian heritage, to be no longer ‘simply animal,’ subject to primitive animal instincts and urges? Or, are we still instinctive, hormone-driven animal under the skin?

There is so much that we do not understand about how we were, what we were like at the outset – whenever that was – and just how, and why, we evolved in the way we seem to have done. Were we always monogamous? How did we come to share work between male and female as hunter-gatherers? Why do human females go through the menopause? Have we always had average lifetimes of over sixty-to-seventy? Are we still evolving? What are we evolving into? And, inevitably, where are we going?

We humans are not the fastest, strongest or fiercest of creatures, so it surely follows that we evolved to work together in teams or groups, to communicate, cooperate and coordinate our actions, both for mutual protection and for acquiring food. There is evidence that we evolved—not so much as individuals—but as self-organizing family groups, clans, etc., i.e. as robust, viable human systems of cooperating, complementary individuals.

Two quite different kinds of evolution have been at work: first, the biological/anatomical evolution that has resulted in the magnificent organism that is Homo sapiens, adapted to survive and flourish in families; and second, the sociocultural evolution that has taken us from itinerant hunter-gatherer following prey through the seasons, to settled farmers raising crops and cattle, through civilized, elegant, artistic nation states on to medieval feudal empires, to global warmongers, and on and on to our present, uneasy globalized stalemate. This second, sociocultural evolution, incidentally, seems recently to have become quite at war with odds the family basis on which the first, biological evolution/anatomical evolution, is fundamentally based.

Evidently, our on-going sociocultural evolution has left something to be desired, so far; has that been inevitable, considering the nature of the evolved family-centric organism that is Homo sapiens? Are the seeds of our eventual social demise written in our biological genes? Or, can we use our oversized brains to understand how and why we continue to make mistakes in our social enterprises, and to find ways of redressing the issues?
Human Motivation
A respected view of humans and their motivations is expressed in Abraham Maslow’s Hierarchy of Needs.

Maslow used the terms Physiological, Safety, Belonging, Love, Esteem and Self-actualization to describe the pattern that human motivations generally go through. Level 1 identifies the basic physiological needs of life. Maslow identified Levels 2, 3 and 4 as ‘deficiency needs’: if these needs are not met then the body gives no physical response, but the individual feels anxious and tense. Significant within Maslow’s Hierarchy are the predominance of personal and interpersonal needs. These needs must be satisfied before the individual moves on to ‘being needs’ at the top, Level 5.

This hierarchy of needs is fundamental, and applied to Homo sapiens of several thousands of years before present. One indication of vibrant past societies may be found in evidence of self-actualization: can we observe some of these “Level 5” characteristics in social groups before writing was invented? Can self-actualization be used as an indicator of social well being in past societies? It is a possibility, at least.

Belief Systems
Faced with situations too difficult to understand, or too awesome to contemplate, humans develop beliefs—sets of ideas and notions that provide a seemingly rational explanation of a phenomenon or situation. A belief may have no basis in reality, so long as it provides a consistent, straightforward and satisfactory explanation. To the ancient Egyptians, the Sun was raised each morning by their god Khepri, an invisible giant scarab. Their beliefs were confirmed daily when the sun rose ‘to order’ in the East.

Beliefs have the power to somehow bind people together, to endow the social

<table>
<thead>
<tr>
<th>Level</th>
<th>Need</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>5</td>
<td>Self-actualization</td>
<td>Morality, Creativity, Spontaneity, Problem-solving, Lack of prejudice, Acceptance of facts</td>
</tr>
<tr>
<td>4</td>
<td>Esteem</td>
<td>Self-esteem, Confidence, Achievement, Respect of others, Respect by others</td>
</tr>
<tr>
<td>3</td>
<td>Love/belonging</td>
<td>Friendship, Family, Sexual intimacy</td>
</tr>
<tr>
<td>2</td>
<td>Safety</td>
<td>Security of: body, employment, resources, Morality, the family, health, property</td>
</tr>
<tr>
<td>1</td>
<td>Physiological</td>
<td>Breathing, Food, Water, Sex, Sleep, Homeostasis, Excretion</td>
</tr>
</tbody>
</table>
group with a feeling of being “right.” Humans develop cultures, often formed around shared beliefs. Culture may refer to a body of people who believe in, and practice, a particular way of doing things. Divisions within a large organization may develop different cultures ("we have our own way of doing things here"), which may not necessarily encourage the communication, cooperation and coordination between those divisions necessary for successful operations. Children attending a new school are divided into classes: each class rapidly develops its unique character, behavior and culture. Quite how such cultures develop is not well understood: once developed, however, they can be remarkably resistant to change.

All in all, the “beliefs, behaviours and cultures” of individuals and social groups present a serious challenge to the possibility of “designing” human systems. On the contrary, it might seem more likely that human systems self-organize, that cultures arise spontaneously, and beliefs perhaps along with them. Yet, we have a need to organize human systems to undertake challenging tasks, and to address and hopefully solve complex problems. Further, we have a need for those human systems to maintain themselves, to perform complex tasks, to adapt and to evolve in line with morphing problems and changing environments.

Archetypes
Humans differ one from another. It is this very difference that enables them to complement each other, to cooperate and so to form cohesive human systems. Some are ‘doers,’ some thinkers and planners. Some are leaders, other followers; some are dominant, others submissive: then there are so-called behavioral archetypes.

Different cultures present individual behavioral archetypes. Ancient Egyptian behavioral archetypes included: the king-as-shepherd, the divine king, the healer, the creator, the magus/high priest, the mother-with child, etc.

The psychologist Carl Jung identified archetypes in the ‘collective unconscious’ of humanity, including: great mother, father, child, devil, god, wise old man, wise old woman, the trickster, the hero. Many of Jung’s archetypes combined to create composite archetypes, e.g., the devil-child, the trickster-father, leading to a profusion of archetypes. Many of Jung’s archetypes also correspond with those of ancient Egypt, in which early culture he had a deep and abiding interest.

Individuation
We are not the same as each other; we all differ in significant ways, and these differences enable us to lead or follow, to team or not, to cooperate or not, to be part of the family or not... even to care or not.
Furthermore, we individuate as we age, i.e., become a distinct, relatively stable individual of fixed, distinguishable character and personality. So, the person we might be at, say, eighteen, may be substantially different from the person we have become age thirty-three... which tends to challenge contemporary socio-political notions that we are all the same as each other, since we are not even the same as our former selves! Moreover, it suggests that while many of us will be keen and able to join in, to team, to self-organize into functioning groups, some of us will not—and that these propensities will modify as our personalities and intellects mature, i.e., as we individuate.

Even as mature individuals, however, we may subconsciously adopt one or other of Jung’s behavioral archetypes: a man may be a “Mister Fix-it” at work (the magus or magician archetype) yet the moment he goes home to his family he may become the wise old man, the hero, or even the trickster father, and his manner and behavior may switch accordingly, as easily as he takes off his outdoor shoes and puts on his slippers. We are, indeed, complex animals; which makes us difficult to understand...
Biologists have found ways of ‘managing’ human complexity. They have identified “levels of organization” in human biology and anatomy, which enable investigation and analysis.

At the lowest level is the cell, the smallest living entity. The cell groups internal components, organelles, which act and interact to constitute a complex protein factory-in-miniature; the cell has emergent properties, ‘properties of the whole that are more than the sum of its individual parts.’

A tissue is a functioning group of cells; a tissue has emergent properties. An organ is a functioning group of tissues; an organ has emergent properties. An organ system is a functioning group of organs, with emergent properties.

The organism, the basic living system, is a functioning group of the lower level components, including at least one cell; the organism presents emergent properties.
Levels of Organization—Early Man

Levels of Organization (a.k.a Levels of Integration) indicate synthesis, slowly climbing a ladder from simple to complex, from lower to higher level, explaining how today’s organisms can be so complex, yet stable. This gradual evolution towards the more complex has been called Stratified Stability, indicating that each level above requires a stable level below upon which to build.

<table>
<thead>
<tr>
<th>Level of Organization</th>
<th>Nomenclature</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Biome: general form of habitat</td>
<td>lake, wetland, rainforest, savannah</td>
</tr>
<tr>
<td>9</td>
<td>Ecosystem: Group of interacting communities and environmental factors</td>
<td>a specific forest or lake</td>
</tr>
<tr>
<td>8</td>
<td>Community Group of populations of different species</td>
<td>all the creatures in a forest or lake</td>
</tr>
<tr>
<td>7</td>
<td>Hunter-gatherer band, tribe, clan...</td>
<td>group of families?</td>
</tr>
<tr>
<td>6</td>
<td>Family</td>
<td>grandmother, father, mother, children, etc.</td>
</tr>
<tr>
<td>5</td>
<td>Human</td>
<td>child, adult, female</td>
</tr>
<tr>
<td>4</td>
<td>Organ System</td>
<td>cardiovascular, central nervous</td>
</tr>
<tr>
<td>3</td>
<td>Organ</td>
<td>kidney, heart</td>
</tr>
<tr>
<td>2</td>
<td>Tissue</td>
<td>nephron, bone</td>
</tr>
<tr>
<td>1</td>
<td>Cell</td>
<td>skin cell, neuron</td>
</tr>
</tbody>
</table>
Levels of Organization are envisaged above that of the organism. Population is a grouping of organisms of the same species. Community is a grouping of interspecific (i.e., competing for the same resources) interacting populations.

However, for *Homo sapiens*, we may be more specific, based on a broad understanding of human evolution. There are two broad categories of human systems: those that are internal within each of us, such as our cardio-vascular system; and, those that we form as humans in families and social organizations. We also form communities, where human populations interact with populations of other creatures.

Each level of organization is characterized by emergent properties. Each level is consequently more complex than the preceding level. The relationship between the higher levels and the lower levels, supervenience, suggests that the high level properties depend upon the lower level properties.

Each level may accommodate a variety of entities: there are different kinds of cell, tissue, organ, etc. At any level, there will be interaction between the varieties: different tissues interact, different organs interact, etc. So, the static figure reveals only part of the picture.

Organ Systems of the Human Body

[Diagram of Organ Systems of the Human Body]

Organ Systems of the Human Body. There are some 12 or 13 organ systems, depending upon how they are counted, and some would add human blood as yet another organ system. The static diagram represents a dynamic situation, with continuous action and interaction, not shown. Moreover, the set of organ systems evolves over time, under the control largely of the endocrine system, which orchestrates the onset of puberty, maturation, aging, menopause, etc.
All of the organ systems in the human body interact with each other, often in quite complex ways, in the sustainment of the living human. However, that is far from the full story. The interaction between the various organs and organ systems is “orchestrated,” notably by the endocrine system, so that children grow, pass through puberty, individuate, reproduce, age, etc. At each stage, different organ systems undergo change; during puberty, for instance, the brain (nervous system) appears to undergo significant “rewiring,” which may differ in some degree for male and female.
SECTION

THE ROLE OF GRANDMOTHER

The Family N2 Chart shows a notional view of the hunter-gatherer family. The rôle of grandmother appears to have been significant. Grandmothers may have contributed to family/offspring survival, which goes to explain why, still today, grandmothers live longer than grandfathers, on average.

This is not to say that grandfathers did not make a contribution. Once their ability to lead the hunt had been overtaken by injury or aging, they would have, perhaps, become the group experts in tool and weapon making, in protection of encampments when the younger men were off hunting, and in the planning of expeditions.

Such experience-based expertise, although helpful, may not have contributed as much to group survival as the grandmother’s direct support in raising the next generation, however, as well as being the matriarch of the family group, and so serving as the group’s principal repository of experience, strategic information and ancestral memory.
The Rôle of Grandmother

Recent research into orca, killer whales, has contributed to this ‘grandmother hypothesis.’ There are only three animals that do not continue to reproduce until they die: short-finned pilot whales, killer whales and humans; in all three species, the females lose the ability to have offspring, but go on living for decades after the menopause. Killer whales go through the menopause at age 30-40, earlier than most human females today. But why go through the menopause at all, and so reduce the prospects of handing on genes to the next generation? It seems most likely that it has something to do with group survival. In killer whales, at least, it is common for hunting parties to be led by older females who, because of the menopause, do not have young offspring to look after.

The Family N2 Chart

Shows notional interactions between members of the hunter-gatherer family. Outputs from each person are on the horizontal: inputs are on the vertical. So, Father gives security, meat from the hunt, sex and love to Mother, who returns his love, makes the home, gathers food, provides sex, babies and psychological support to Father. The role of grandmother is seen as pivotal in helping with the gathering of food, raising of children and giving continuity. Hence, it seems, perhaps, that grandmothers live longer than grandfathers, because grandmothers contributed to the survival of the family... The N2 chart indicates, too, the basis for familial bonding between mutually interdependent family members. Family appears to have been the fundamental social unit.
These experienced, older females appear to be repositories of information, such as where their salmon prey are likely to be found when food is in short supply, which knowledge they have accumulated over their longer lives. It also seems that mothers help their sons, particularly, well into adulthood, and males are more likely to follow the matriarch than females. Both sons and daughters tend to stay in the group where they are born; so, as the female grows older her group increasingly consists of her children and grandchildren. In this respect, killer whales differ from elephants, where sons leave their birth group as they mature (male dispersal), which means that females of their group become progressively less related over time. For killer whales, it makes sense for post-menopausal grandmothers to put their efforts to helping their existing genetic offspring.

For humans, it may conceivably have been that young, maturing females tended to leave their birth group to join new groups, or to start up a new family group; this ‘female dispersal’ might, perhaps, explains why, today, some young females may be more adventurous about leaving home than their male counterpart. But it has to be stated that such research is at an early stage, and the many influences present a complex picture. For instance, it is not clear how long early humans lived: did early human females live long enough, on average, to become grandmothers? Did the menopause occur at the same age then as it does today, or, perhaps, much earlier? Did, perhaps, only the occasional female live to experience the menopause and to become a matriarch? Whatever the truth of the matter, we do know that, to this day, grandmothers tend to live longer than grandfathers...

This differential longevity suggests that the family unit, rather than the individual, has evolved over the last two million years,—although, of course, one could not happen without the other... and it may be that, in spanning generations, and in educating and training successions, grandmothers encouraged successful family propagating successful family in a continuum that stretched from some several hundred thousand years to the present day. Throughout that period, the human family may have been a fundamental ‘level of organization,’ one that contributes to stratified stability, without which the stability of higher levels would have been prejudiced.

Human female mitochondrial DNA (mtDNA) is virtually unaltered from generation to generation: it passes down unchanged through the female line... i.e. great-grandmother, grandmother, mother, daughter, granddaughter, etc. The relevance of this is uncertain, but mtDNA appears to have some relationship with longevity...and so the relative longevity of grandmothers, perhaps...
Mitochondrial disease can create debilitating physical, developmental, and cognitive disabilities; poor growth; loss of muscle coordination; muscle weakness & pain; seizures; vision and/or hearing loss; gastrointestinal issues; learning disabilities; and organ failure.

In adults, many diseases of aging may result from defects of mitochondrial function: Type 2 diabetes, Parkinson's disease, atherosclerotic heart disease, stroke, Alzheimer's disease, and cancer. Sound mtDNA may be fundamental to stratified stability/human viability as it has been carried virtually unchanged in the female line since the Pleistocene, and mtDNA evidently has a hand in many of the features of human performance that make us unique. Indeed, might we reasonably suspect that mtDNA is (part of) the key both to propagating successful individuals and successful family units?

![Image of mitochondrial DNA family unit](image)

Mitochondrial DNA (mtDNA) passing through three generations. Ovals represent a family unit, with mother, father and children, marked as siblings. Daughters in one generation become mothers in the next, then grandmothers, and potentially matriarchs, of the following generation. (Simplified: there may have been many siblings within each family, so there could have been many more families in successive generations...)

Over much longer periods of time, the human form is subject to evolutionary changes, so that the organ systems of early hominids may be similar to, but not the same as, that of today's Homo sapiens: loss of body hair and acquisition of subcutaneous/adipose tissue would be examples, as we evolved into the near-naked ape. Other noticeable changes over the many millennia include: the shrinking of a second stomach into...
a non-functioning appendix (digestive system); lack of wisdom teeth in some people; and, a reduction in upper body strength associated with our bipedalism.

*Homo sapiens* is still evolving, but the changes are so slow compared with the average human life span as to be barely noticeable. Instead of a forest, lake or savannah biome, however, which influenced much of our early evolution, many of us now live our lives in a “metropolitan biome:” quite how such a radical change will influence our continuing biological evolution is moot: but influence, it inevitably will.

Impatient for change, we humans do not wait for biological evolution: we rush headlong into social and cultural evolution. Instead of families, extended families and tribes, we may self-organize into bucket-chains, flash-mobs, communities, societies, organizations, political parties, armies, etc.
Evolution may have taken a very long time to evolve such a fine, complex biological system as the human family, but it has done such a good job that our internal “designs” may offer insight, templates and guidance for us when we seek to practice systems engineering in our modern created world.

So, for instance, can Nature’s successful designs at of the human body inform our would-be systems designs of families, communities, organizations, sociotechnical systems, etc.? 
Whereas it may seem fairly straightforward – to engineers, at least – to design an artifact, a tool, a computer, even an aircraft, it may prove less than straightforward to ‘design’ a human activity system. Humans may neither perform consistently, nor “do as they are told,” as may be expected of a motor or a dishwasher, a transistor or a tractor. Humans may feel the urge to be ‘creative,’ which may be valued in many circumstances, but is surely inappropriate in an operator of a nuclear power station, an air-traffic controller, or captain of a cruise-liner.

Even where no technology is involved, humans may not always conform; despite their training to the contrary, groups of soldiers in conflict have been known to behave bestially towards submissive, captive enemies. While the instinct of the individual human may be to stop attacking in the face of total submission, apparently it need not be the “instinct of the group.”

On the other hand, humans as individuals, or in human systems, may use their big brains to react to an unexpected situation in innovative and creative ways, so achieving ends that would be either beyond of the scope of engineered artifacts, or which, alternatively, might use such artifacts in novel ways. Creativity, flexibility and adaptability are surely the hallmark of the human system. But, so too are beliefs and culture...

Nature can also be thought of as a systems architect, in the way that the internal organ systems within the human body have evolved as a robust, complementary set of self-sustaining parts, for instance. This may be seen, not so much as purposeful systems engineering, but more as systems engineering by evolution, trial, error and natural selection. Nonetheless, this “natural systems engineering” has been singularly successful in synthesizing robust, self-sustaining, self-organizing biological systems over some five hundred million years.

‘Natural’ systems engineering may be viewed as synthesizing, not so much individuals, but families, viable social groups of Homo sapiens, which can self-sustain, adapt, survive, and reproduce new families. From this perspective, the human family can be seen as a complex system to propagate offspring family-systems – with their genes – forming an unbroken chain through time. Such a complex system is surely needed to accommodate the essential psychological development, education, training, socialization, etc., from birth of the large brain of human progeny, so that they can create successful families in their turn. Which suggests that the early, sheltered nuclear family environment may be particularly important in achieving balanced, mature adults adapted to their contemporary environment...
This book, then, is about humanity’s past, present and future: understanding the evolution and development of human systems, their characteristics, organizations, emergent properties and behaviours: realizing and sustaining purposeful human systems; and, the future, facing a burgeoning human population in the face of accelerating societal and environmental change.
CHAPTER

UNIQUE HUMAN FEATURES
Unique Physiology

Conventional wisdom has it that the human ape came down from the trees, from an arboreal life eating mostly fruit, nuts and roots, to take up an omnivorous/carnivorous lifestyle hunting game on the plains of the Serengeti. At some stage, instead of living in polygynous groups like most – not all – primates, humans appear to have become largely monogamous.

Some social features were seemingly associated with this transition, including work sharing between the sexes. Pregnant and nursing women could slow a hunting party, so, a base may have been set up, an encampment, where the women would look after the children, and gather fruits, nuts, berries, roots, etc., together with water: the encampment would surely need access to fresh water. The hunters would be expected to return to this basecamp with their spoils, to share their kill with the community.
Unique Physiology

For Mercy has a human heart
Pity a human face.
And Love, the human form divine,
And Peace the human dress.

William Blake, 1757-1827

The selective nakedness of the Hunting Ape

Judging by today's carnivorous mammals, such as wolves and hunting dogs, human hunting parties may have needed to track game over considerable distances, perhaps taking several days to run their quarry to ground. During this time they would have little to eat, and would rely largely on the water they could carry—there being no guarantee that their prey would conveniently stop off at waterholes. To accommodate this period between meals, so the argument goes, Homo sapiens developed adipose fat, subcutaneous fat which could be drawn upon as an energy source when food was scarce,
and which could be “restocked” when food was plentiful, particularly of the fat and meat variety.

However, tracking prey over great distances in the heat of the Serengeti with a layer of fat, in addition to a covering of hair, could result in serious overheating. So, perhaps in compensation for the layer of fat, we humans evolved our largely naked skin, and the ability to keep cool by sweating. We retained some of our hair, however: hair on the head protected us from the heat of the noonday sun; pubic and underarm hair retained our pheromone excretions, in a way that had become necessary because we were now walking on our hind legs, with our sex organs otherwise open to the wind and weather.

This retention of pubic hair appears to correspond with the need for pair bonding (monogamy) between the individual hunter and the woman who was waiting for him, with their children, to return with food from the hunt. Without that pair bond, the woman would have no guarantee that she and their offspring would receive a share of the kill. This pair bonding ‘directive’ also goes to suggest why female Homo sapiens were, and are, almost continuously available for sex with their partners, unlike most other great apes. Females did not know when their partners would return from the hunt, nor for how long they would stay before going out again: being ‘available’ at most, if not all, times, was important to immediate gratification of the male partner, the regular conception of the next generation, and hence to the group – and gene – survival.

All of which might seem very reasonable and quite plausible. Only, there are some problems with the nature of Homo sapiens that the above narrative does not explain. If we lost our hairy coats to stop ourselves from overheating, why did other plains carnivores not do likewise: in addition to hyenas, wolves and dogs, there are lions, cheetahs, leopards, etc., all with warm fur coats. We sweat copiously in hot weather, losing precious salt, and using vast amounts of water to keep cool; our feces are 75% water, compared with those of other mammals evolved to live on the savannah of about only 45-50%. Our urine is not concentrated like that of animals adapted to hot savannah living. And while animals such as the camel and hunting dogs can survive rise in body temperature to over forty degrees centigrade, such levels would kill any human. If we became pack hunters like wolves, hyenas and dogs, why did we not develop four-footed locomotion; it is faster than bipedal running, as scampering monkeys and apes demonstrate.

Curiously, we are not physiologically adapted to a life exposed on the hot savannah where we are supposed to have evolved together with the other animals.
We are so used to ourselves, and others like us, that we can be oblivious to the features of our unique physiology. Yet, although biologically one of the great apes (chimpanzees, bonobos, gorillas, Orangutan and humans), we are quite distinct from all of the others, physically and anatomically. How? Why?

**Littoral tendencies?**

We have already noted that humans have more subcutaneous (adipose) fat than the other apes. We have this in common with some aquatic mammals: Cetaceans (dolphins, porpoises and whales), for example, have also lost much of their hair.

Some have hypothesized that we humans went through an aquatic phase in the past. This notion occurred first to a marine biologist, Sir Alistair Hardy, in 1930 while reading Wood Jones’ 1929 book, Man’s Place among the Mammals, which included the question of why humans, unlike all other land mammals, had fat attached to their skin. This seemed to Hardy like the blubber of marine mammals, and he began to suspect that humans had ancestors that were more aquatic than previously imagined. However, he realized how unconventional such a notion was, and said nothing of his idea until 1960.

The notion was taken up as the so-called Aquatic Ape Hypothesis (AAH), (Morgan, 1992), presenting some interesting notions...We humans love water, at least for the most part, whereas the other great apes are not so keen—again for the most part. We like to swim; we like to live by the seaside/riverside/lakeside.

Today, boys in Kenya’s Rift Valley chase and catch fish by hand without any weapons. The boys are fast and agile. If, during some supposed aquatic phase, our ancestors switched to a largely fish and shellfish diet, with its high protein, high fish oil content, then that diet could potentially have contributed to the growth of our large brains.

Human hair tracts differ from those of other apes. Sir Alistair Hardy hypothesized that our human hair tracts had evolved to streamline our bodies in the water. We have lost the long shaggy coats of other primates, which loss would also help to streamline us in and under water.

Each year, some babies are born with their fingers or toes webbed (syndactyly), and this webbing may be surgically removed. Moreover, if you look at a stretched-out adult hand, you may observe vestigial webbing between the thumb and forefinger. Look more carefully, and you may see small ‘webs’ between all the fingers when fully spread.

**Human Feet.**

Human feet are remarkably different from those of the other great apes. Gone is the grasping thumb, to be replaced by a big toe set neatly alongside the other four toes, but all of these are small in relation
to the rest of the foot, with its large sole. The human foot would be disadvantageous in an arboreal existence, and is evidently adapted to walking and running, but also to diving, treading water and swimming. Proponents of the AAH suggest that the human foot may have evolved to its present shape partly during an aquatic phase, where grasping by the foot was unnecessary, the flat shape of human feet were better adapted to treading water and serving as “flippers,” and the foot bore weight less often than in the prior arboreal existence.

Hypothetically, if early Homo took to swimming, like an otter or perhaps more like a dolphin in deeper water, with an undulating motion enabled by our uniquely flexible spine, then swimming performance would have been enhanced with longer legs terminated in flipper-like feet to act as both pusher and rudder. In that case, we might expect the dorsal, or upper, surface of the foot to be broad, smooth and streamlined, to facilitate the action of a rudder, but with minimal drag. And, indeed, that is what we do find; particularly when the legs and feet are together with the toes pointed... So, while the bottom of the foot and the heel may have evolved for standing, bipedal walking and running, perhaps the upper surface of the foot evolved for diving and swimming with the legs and feet held together?

Chimpanzees have been observed wading in water, walking very upright, with their arms raised up to protect whatever they are carrying. Coupled with upright stance, early humans in a littoral environment would find flat-bottomed feet advantageous, since they would be less likely to sink into the mud than would the grasping foot of the chimpanzee. Similarly, their long flat sole would help them walk on wet sand and mud, and wade through shallow waters.

Standing still on grasping feet can be difficult and tiring, so apes tend to “rock” to maintain balance, not unlike riders of monocycles who can remain “on the spot” only by moving back and forth. The flat-bottomed human foot, with its long sole and protruding toes, allows a human to stand vertical and still without moving, perhaps for long periods, which might mean the difference between seeing and catching fish, crabs, lobsters, etc., and having them escape. So, perhaps both upright walking and broad feet together could have been adaptations for survival in littoral zones around the edges of the lakes, evidence for which is to be found in the fossil record as the climate changed and changed again, continually.

This notion of Rift Valley Hominins living ashore but hunting and gathering fruits de mer in and around shallow and deep lakes may not be quite what the originators of the term meant by “aquatic
ape,” but it is consistent with the fossil evidence of rapid and frequent climate change in the area. Perhaps the term “littoral ape” might suit better...

Aquatic Performance
We humans are good swimmers, considering our shape. Girls are better, faster swimmers than boys on average, although adult males seem to outperform adult females—just. We have more flexible spines than other apes, enabling us to swim more like dolphins than primates. We can weep tears like many marine animals, but unlike primates. We can balance as well as a seal or a sea lion, and so much better than any primate.

We can hold our breath under water for up to three and a half minutes, quite beyond any other primate. Strikingly, we have a ‘diving reflex,’ like marine mammals; if we put our face under water, even if the rest of our body is exposed, the reflex ‘kicks in,’ closing down the airways, reducing the risk of swallowing water, closing down small air-passages in the lungs, slowing the heart to half its normal speed, and diverting blood to essential organs to protect them from lack of breathed oxygen.

‘By contrast, if a chimpanzee or gorilla found itself in water with its face below the surface, it would panic, its heart would race, and it would quickly drown (as many zoos discovered to their cost when they first installed water-ditches around ape enclosures.’ Desmond Morris

Of course, we are not the only apes to enjoy water. In harsh winter, Japanese snow monkeys, macaques, famously cluster together sociably in warm volcanic springs, clearly enjoying them and relaxing. However, there is no evidence of apes or monkeys swimming with the facility, speed and relish that humans display. Great apes cannot swim at all. Our human behavior and performance are curious and remarkable in this respect. Moreover, we have found that babies
only a few weeks old can swim under water, with their eyes open, and enjoy the experience.

Cyclic Transitions

The idea that early humans may have passed through an aquatic (littoral?) phase, does not threaten the conventional notion of our evolution on the savannah. Indeed, in some ways, it may enhance the rationale. Could there, perhaps, have been two transitions: first, from arboreal fruit eating ape to a river-, lake- or seashore-based, fish and shell fish eating ape, where the seafood was, initially plentiful, but the fish were hard

Cyclic Transition Hypothesis: Arboreal Ape, to Littoral Ape, to Carnivorous Hunting Ape

N.B. Open headed arrows “increase, enhance;’ closed-headed arrows ‘detract, diminish.’
to catch, and the shellfish were difficult to open. Perhaps this transitional *Homo* lived on a river, or seashore, perhaps on an island, safe from large predators. In any event, s/he would have to become very adept at catching fish with bare hands, and with finding/making simple tools, perhaps using pebbles, to crack open shellfish. Survival would favor those with the ability to catch fish, to dive to greater depths, to hold one’s breath for longer, to swim faster in pursuit, to stand very still or to tread water silently near prey, etc.

However, there would have been a down side to such a lifestyle: with a good supply of high-protein and oil-rich food, the population would inevitably grow, to the point where such simple fishing by hand, and shellfish gathering, would no longer support them: the food supply would not keep up with the growth in population. So a second transition would have seen them move to an area where game was plentiful, the savannah. Only, by this stage, the evolving *Homo* would already have had a larger brain, upright stance, a naked body, flat-soled feet which would prove suitable for long distance tracking, and a degree of dexterity and agility suited to tool-making, hunting, throwing, etc.

Is this what happened? Unfortunately, there is no fossil evidence to support such a hypothesis. Indeed, there is precious little evidence to support the conventional theory of the open plains hunting ape, either. And there may be other explanations for our unique aquatic features, behavior and performance. After all, along with all land animals, we have evolved from sea creatures. Perhaps we should not be so surprised to find that we still have genes that code for some aquatic features. Humans show gill slits in early embryonic development. Moreover, we develop as fetuses in our mother’s womb, floating and swimming in an amniotic fluid that some have likened to the primeval ocean. But then, so do the other great apes...

Recent archaeological evidence has pointed to other potential options for our unique features. New evidence from offshore core samples shows that the ‘African climate history had been one of continuous swings between wetter and drier times.’ These swings had a periodicity of about 23,000 years, i.e., that of the Earth’s orbital wobble, or nutation. Potentially, then, there could have been a number of repetitions of dual transitions, with groups of early Hominins adapting continually to alternating wetter and drier environments, with the potential for feast and famine, as the environment transitioned.

No single environment would have existed sufficiently long for full, or significant adaptation; instead only minor adaptation would have been possible per cycle as the environment changed again, and
again, and again. Over half a million years, however, there could have been dozens of such cycles; potentially, small adaptive changes may have accumulated over that many cycles. The Rift Valley Hominim may have adapted a little towards living in wetter, then intermediate, then arid conditions, then intermediate and back to wetter, and so on, round and round each cycle. Populations would have stayed small in such continually changing circumstances, and smaller populations are potentially able to adapt/evolve more quickly to environmental change, lacking the inertia of larger populations.

So, a smaller population of early Homo would have been better able to evolve a physiology that could accommodate wetter, intermediate and drier environments. Indeed, with such rapid environmental swings, it may have been the case that Homo adapted fully to none of the extremes of wet or dry. Instead, Homo may have evolved partially to all of them, presenting a somewhat mean, or average physiology, but at the same time using its bigger brain to accommodate extreme environments by building shades and shelters, making clothes, and by carrying water during expeditions in drier periods. This would explain why Homo is partly adapted to a variety of conditions, but fully adapted to none—at least, not in the way of arboreal apes, open savannah, or marine mammals.
Interbreeding
An alternative line of research suggests a different explanation. Recent work is begin-
ning to suggest that Neanderthals may not have so much “died out” as have been “ab-
sorbed,” even overwhelmed, by *Homo sapiens*. Interbreeding between the species may
have conferred some Neanderthal genes coding for resistance to diseases to which the
Neanderthals, having been out of Africa for much longer, had developed antibodies.
This would mean that the offspring of interbreeding would have a better prospect of
survival, explaining why non-African individuals today may have as much as 3% Nean-
derthal DNA. Individuals may have different sets of Neanderthal genes, such that over
today’s non-African populations, there may be as much as 20% of their genes...

Could a similar situation have arisen several million years ago, where a primeval
antecedent of *Homo* interbred with another aquatic or semi-aquatic ape, conferring
aquatic adaptation on *Homo*, who would have consequently had enhanced survival ad-
vantage during the much wetter periods?

The monogamous family group appears to have evolved, not only the survivable
family, but also the family that can successfully propagate survivable families, genera-
tion after generation in a largely unbroken continuum. Either the manner in which
children were nurtured, developed and trained within the family, or the grandmother
who was able to provide continuity across generations, or both, may have been key to
this continuum of successful family after successful family down the ages. That would
mean that there was, and still may be, something special about children being raised
and developed within the nuclear family with their siblings, parents and grandmoth-
ers, but otherwise sheltered from external influences and variable environments, that
results in the development of the mature balanced, capable young adult ready, able,
and with the innate skills to start his or her family in their turn, and with grandmother
in the background to guide, advise and even occasionally supervise...Which is, perhaps
why, even today, teenagers and young adults will incline to confide in their grandmothers
to a greater degree than in their parents.

Combine that protected family base with the female *Homo’s* almost continuous
sexual availability, the male *Homo’s* propensity for “instant sex,” with the largest pe-
nis, by far, of any of the great apes, and there appears to be a recipe for irresistible
population growth. Unless, that is, population growth is held in check by predation,
disease and/or famine, as it may have been for the early *Hominim* (human or a hu-
man ancestor) and other animals on the savannah. Speculatively, *Homo* may have
evolved this phenomenal breeding potential as a means of countering continual losses
in a small population to: predation, starvation, disease and increasing perinatal mor-
tality—mother and/or child—from increasing foetal brain/head size. Finding themselves regularly short of food, as they most probably would, infanticide may have proved a necessary evil, too, during the leanest times.

Should *Homo* move to an area relatively free of predators, yet rich in food, then population growth would burgeon, unless constrained by famine, disease and infant mortality, as it still is today in undeveloped areas of the world.

**Hunting Potential**
Hunting prey animals is certainly not unique to the human ape. Chimpanzees have been observed forming into hunting bands to pursue, kill and eat monkeys. However, humans have evolved exceptional capabilities, possibly as a result of our need to hunt to survive.

**Throwing And Catching**
Human hand-eye coordination is prodigious. Most obvious, perhaps, is our ability to throw and catch, which we learn as children, often by throwing stones, and by throwing and catching balls. Just how good we humans are at throwing and catching, can be seen by watching chimpanzees trying the same thing—they are really quite poor at throwing, and worse at catching. Their hands are adapted to a largely arboreal existence, and they have correspondingly superior upper body strength. Human hands adapted to perform in many different environments, and their upper body strength diminished as they became bipedal, with longer, stronger legs.

Human ball skills can be developed to quite remarkable levels, witness professional baseball players, cricket bowlers, fielders and wicket-keepers, basketball players, etc., etc. We invent ball games such as soccer, football and rugby where much of the skill is in using our feet to kick the ball with slice and spin to nudge its travel in the air. We play golf, where the prodigious accuracies of some top players seem to defy reason, and their ability to ‘draw’ and ‘fade’ can be used to great effect in countering wind and terrain effects.

All of these abilities appear to have evolved from our need to be effective hunters, to be able to throw stones, to make and throw/stab spears at prey and predator, to make ropes, nets, snares and traps. Throwing requires both practice and the ability, not only to mentally model and predict the path of a projectile, but also to throw it vigorously along that path, anticipating, and correcting for, the effect of gravity, crosswinds, etc. Survival may well have depended upon our ancestors’ ability, and may have selected for these skills.

**Dexterity**
Watching the fingers of a concert pianist might reasonably cause us to ask how it is possible to achieve such phenomenal
performance. Yet our ancestors had to show great dexterity in flint napping, binding arrowheads into shafts, scraping hides, stripping bark, and the hundreds of other daily chores that early man had to undertake. We humans are able to perform repetitive functions “off line” as it were, i.e., without paying attention to each action, but rather treating a whole set of actions as one ‘phrase’ within a sentence. This ability improves with practice, and is sometimes referred to as “muscle memory.” Examples of muscle memory are to be found today in bicycle riding, juggling, typing, martial arts, playing musical instruments, and many more. Could the other great apes display muscle memory? Perhaps, but one of the reasons for the human capability has to be associated with our ability to focus on purposeful, repetitive practice, which may be associated with our big brains.

3-D Cognitive Map
Our ability to gauge distance, to calculate trajectories, etc., and to catch with outstretched arms depends upon our ability to form and utilize a spatial map in three dimensions about our person. We can place observed targets and threats in this so-called 3-D cognitive map, and we can ‘calculate’ where objects might be even when not in our direct line of sight.

Children use this cognitive map when throwing a ball up in the air with one hand, to catch it “blind” behind their backs with the other. This takes practice, and is beyond the ability of infants, but boys as young as seven or eight can learn to do it. Girls may be older before they display the capability, if ever, suggesting some possible gender differences in 3-D cognitive mapping; although, some girls may simply be less inclined to obsessive practice than their competitive male counterparts.

Long Distance Running
We humans appear to be well adapted to long distance running, with our large gluteus Maximus muscles enabling us to maintain an upright trunk as our legs bend. We have, by far, the most developed gluteus Maximus of any great ape. While this development would have been, and is, of assistance in swimming, it is clearly essential to the pursuit of prey over great distances on the open plains. Today the sport of long distance running is popular, with people of all ages and sexes taking part. Our human ability to run marathons, for instance, is surprisingly unusual in the animal kingdom. The only other animal on the Serengeti with a similar ability appears to be the wild dog, or painted dog, which hunt in packs and will pursue their quarry for tens of kilometers until it finally gives up from exhaustion: is this how we used to hunt as early man?

Top class runners from East Africa (Kenya, Ethiopia, etc.) excel at long dis-
tance running, and they are endowed with slim limbs, especially their legs. It is also likely that the runners involved have no Neanderthal genes, unlike the rest of humanity. It seems not entirely unreasonable to assume that the rest of us, *Homo sapiens* at large, interbred with Neanderthals at some stage in our moving “out of Africa,” and that the interbreeding may have given us some advantages, perhaps in enhanced immune systems, that enabled us to survive in colder climates.

It might also be that Neanderthal genes gave us a stockier build, more appropriate to living and surviving in colder climes, where any corresponding reduction in long-distance running ability would have had little impact on survival: the terrain would have favoured hunting in mountainous and forested areas, rather than pursuit to exhaustion on open savannah. Could this be the reason why we consider the East Africans to have thinner legs, and why they excel at long distance running? Perhaps theirs is the original human model...while the rest of humanity outside of Africa live in modified variants...

**Group Decision-making**

Hunting in groups involves group decision-making. This is true for pack animals, and also for lions, where the lionesses cooperate in formulating and executing plans, tactics and strategies: early humans, with their big brains, would have excelled at this. And, like some other carnivores, they must have developed a determination to pursue their quarry to the end.

Groups make decisions in several ways. One way is through discussion and the comparison of options. The other way is to accede to a forceful leader, who makes the decision and ‘encourages’ the others to follow. The first method, while satisfying group members, is slow and may result in the choice of a generally acceptable option. The second way is fast, and—depending upon the ability of the leader—potentially expert, having been based on the leader’s presumed experience.

It is likely that the leader of a hunting band on the savannah would have become experienced over many years—else, he would not have survived. Other members of the band would learn from him, and so knowledge and experience would be shared, skills would develop and performance would improve in both effectiveness and reliability. This process of social evolution would both depend upon, and be enhanced by, language which in its turn would be enriched by an ever-increasing vocabulary of words associated with hunting, tracking, warning, making different kinds of tools, nets, clothing, snaring, finding water, weather, etc., etc.
Evolutionary Psychology

The human body, with its many organs, evolved over extended periods, by natural selection, to perform optimally in its continually changing environment.

That process of evolution necessarily included the central nervous system and the brain. Evolutionary Psychology views the brain as having evolved functional structures — by natural selection — to address recurring problems of survival and reproduction in their archaic environment: the so-called Environment of Evolutionary Adaptedness (EEA).

Moreover, it proposes that these psychological mechanisms evolved when we were hunter-gatherers, such that today we still have essentially hunter-gatherer brains operating in a modern environment, to which we humans adapt as best we can, usually successfully, but occasionally experiencing a so-called Mismatch...
Evolutionary Psychology

.. This is a bold assertion, for several reasons. Scientists do not know if there are any particular ‘functional structures’ in the brain that have remained largely unchanged since the time of the EEA: the neocortices of individual adults are physically very similar to each other, with equivalent areas performing corresponding functions: however, the human brain may have evolved significantly since the EEA; we do not know.

There is a suggestion that the infant brain, or at least some parts of it, are “flood wired” from the start, i.e., all possible connections within select parts of the brain are already made at, or soon after, birth. As the infant senses the surrounding environment, some of these connections are used continually, while other are not; these latter eventually fade away, leaving a brain accustomed and adapted to its environment. In this way, it is suggested, each new infant adapts to the specific world around it and to the stimuli it receives. There may be much more to it, however.

The functional capabilities of the brain include those evolved as primates living in jungles where, for example, we appear to have learned that sweet fruit is good, sour fruit is bad, red fruit is ripe, while green fruit is unripe, bitter and bad for you. So, perhaps the notion of an EEA is itself suspect. We may have accumulated knowledge, behavior, etc, over many periods going back into the mists of time. Comparing human behavior with chimpanzees, our closest relatives, shows many similarities, although our two lines separated some 5 to 7 million years ago.

The human brain has some three layers, sequentially added to the forebrain throughout our evolution: the reptilian complex, responsible for instinctive behaviours – aggression, dominance, territoriality, etc.; the paleomammalian complex, concerned with feeding, reproductive and parental behavior; and the neomammalian complex or cerebral neocortex, concerned with language, abstraction, planning and perception.

We may posit that Stratified Stability is as relevant here as in other Levels of Organization of the human body: that the paleo-mammalian complex depends upon the stability of the so-called reptilian complex, and that the neocortex, in its turn depends upon the stability of the paleo-mammalian complex. Further, that each layer has emergent properties and behaviours that support, influence and project into the layer above.

Overall, since there are connections that run through all three layers of the brain, there must be the suggestion that all three levels influence the functional capabilities of the brain. So, we may be monogamous now, but within our brains may well lie old instincts to live in troops like the sexually uninhibited bonobos,
like gorillas with a dominant male guarding his set of females, or even like reptiles with little or no responsibility for offspring.

Similarly, we may have formed work sharing between males and females in hunting and gathering within our neocortex, but buried within our brain may be the instincts to operate as a troop or mob, with the whole troop, males, females and offspring, taking part in hunting, and in gathering, with dominant males taking the lion’s share, and with females cooperating to overthrow the dominant male.

It appears from the foregoing that the functional organization of the human brain may be more complex than Evolutionary Psychology would suggest, and much of its activity appears to be “subconscious,” i.e., operating or existing outside of consciousness...

On the other hand, Evolutionary Psychology theory, questionable though it seems to be, offers alternative explanations for the everyday behaviours of modern humans, as well being consistent with Jung’s ‘collective unconscious’ and Freud’s ‘nature and purpose of libido,’ without reference to the abstract models of the mind and the unconscious that they each separately employed.

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**Early Humans in the Environment of Evolutionary Adaptedness (EEA)**

We may speculate about how we evolved and adapted during the archaic environment – whenever that might have been. Such speculation may be founded on our best understanding of the early environment where there is archaeological evidence of early Man/Homo sapiens, and on our observation of how we behave today compared with, say, other Great Apes. Moreover, and largely as a result of living in cities, it appears that we humans have recently started changing our behavior, particularly family behavior, from ways that may have existed for many hundreds of millennia. Vestiges of that previous family behavior may still exist in pockets around the world, and may potentially guide us towards the (supposed) successful family propagation system of the EEA...

We are uncertain about timings, naturally, if only because we appear to have inherited physiological features from our arboreal existence, possibly from some littoral existence, and from our time on the Savannah. It seems reasonable to expect some of our psychological mechanisms, if indeed such things exist, to have evolved over the same extended, changing environments. We can attempt to reconstruct a notional early environment, with its threats, risks and op-
opportunities, and we can also ‘model’ the evolving family, generating other successful families, knowing that, had they failed to do so, we would not be here today.

One way to envisage the early human family tree is to construct a matriline, a line of descent from a ‘Source Mother,’ (SM) in which individuals in all intervening generations are mothers. To do this during the EEA would require many assumptions about the age of puberty, female life expectancy, female menopause, etc., at that indeterminate time, none of which we know. As a start, then, we might assume that some or all of these ages have not changed materially, at least in modern humans.

In which case, we know that females become capable of child-bearing at about 15, so their first daughter could similarly bear children at age 15, making the youngest grandmother by age 30. Suggests that a 60-year old woman could see the 4th generation of her offspring.
Mother’s First Daughter is ready to take over the rôle of matriarch just as the Source Mother fades...neatly filling any inter-generational gap.

In practice, children would not have been born in such neat order, of course, and there would inevitably have been losses... Ovulation, birth rate and breast milk would have depended on adequate body fat in the female and the availability of food. It is possible that mothers would have breast fed children up to age five, and may have fed three or more children, of different ages, at the same time. With ample food supplies, it may not have been unusual for a woman to have eighteen or more children during her fertile years. Ample food supplies may not have been the order of the day, however...it is more likely that early humans would have struggled to find enough food on a consistent, regular basis, and that expanding families would have made the situation worse...

Also noteworthy is the rôle of the males. The matriline ‘Source Mother’ would have had a mate, father to all of her children, male and female. Each of their male offspring would have grown, passed through puberty and joined the band of predominantly male hunters, toolmakers, etc., to which the family belonged. Offspring would have formed pair bonds with other offspring outside of the near or immediate family, i.e. with females that the males had not grown up with, and vice versa: this behavior, evolved aversion to incest, would have maintained essential diversity in the gene pool, else our species would not have survived in the way that it has.

Of course, everything would not have happened with such clockwork regularity and consistency. The pair bond would undoubtedly break at times, males would ‘wander,’ or die, females too; so offspring would not have necessarily had the same father, pairings might have produced ‘only girls,’ or ‘mainly boys,’ or nothing at all. Not to mention rape and pillage...

So, while this theoretical birth pattern goes some way to explain how there are now some 7 billion humans on the planet, it would surely not have happened as shown in the figure during our EEA. There would have been far too many hazards: premature births, abortions, infant mortalities, infanticide, death of mother and child during attempted delivery, predation (by animals and other humans), pathogens, poisons, snakes, spiders, scorpions, deprivation, famine, starvation, natural disasters such as floods, fires, drought, and of course, infertility.

Ovulation, Adipose Fat and Menopause
There are some curious relationships between ovulation, adipose/subcutaneous fat and the menopause that may point to
our evolutionary past. A minimum level of adipose fat is necessary in human females for ovulation to occur. Female athletes, and women on a diet, or with eating disorders, may reduce their fat level to such a degree that ovulation does not occur: this is a temporary phenomenon; restore the fat level and ovulation will re-commence. Could this be an evolved response to prevent women from conceiving when there would have been insufficient food to maintain a developing fetus and to sustain the putative offspring?

When a female is born today she has up to some two million immature eggs or follicles contained in her two ovaries. Over her lifetime, the majority of these follicles will die (atresia). Atresia begins at birth and continues through the productive life: at menarche, only some 400,000 follicles remain, and a further thousand follicles are lost each cycle, with only one maturing into an ovum. Over a lifetime, only some 400 of the original up-to-two-million follicles will ever mature.

The average fertile woman becomes infertile at or before age forty, and goes through the menopause at age fifty. Few follicles remain at menopause: any follicles that do remain are unlikely to mature because of hormonal changes that coincide with menopause.

This process, starting with a copious supply of follicles, then discarding them at a continual, high rate, such that they would run out just at the start of menopause suggests a coordinated evolutionary gambit; either feature on its own might have been deemed sufficient, i.e., either running out of follicles or hormonal changes might have heralded menopause – although, of course, the continual loss of follicles serves as a biological “egg timer;” coordinating the hormonal change towards the end of the run, “as the sand ran through.”

The evolution of menopause in human females must, presumably, have conferred some significant survival benefit on early humans, which raises questions: what was that survival benefit; and, at what age did menopause occur in early humans? There are some intriguing possibilities.

Menopause might, conceivably, have prevented women from producing who might have otherwise produced ‘inferior’ offspring due to their late developing ova having degraded, having been in some way affected by a life subject to feast, famine, disease, infection, deteriorating immune system, etc.

Could it be, on the other hand, that menopause evolved simply to prevent *Homo sapiens* from producing more offspring than the environment could sustain? In a temporarily food rich environment, for example, early humans might have bred so rapidly that they would consume the food supply to the point of starvation... Were that a typical scenario,
might menopause have been selected to regulate population growth rate in favor of population survival?

Then again, it might be that survival benefit occurred in a quite different way. Perhaps the menopause, in releasing women from the labour of childbirth and child rearing, gave them an opportunity to show their daughters, daughters-in-law, etc., how to rear their children successfully, and where to gather when food was scarce, such that fewer children, born to younger, healthier mothers, had a better chance of survival and maturing to have their own children.

Menopause may have evolved to discourage older women from producing offspring ‘in competition with’ their daughters-in-law, in so-called ‘reproductive conflict.’ In humans it seems that female dispersal from a family group is more likely than male dispersal (which might reflect in why, today, we find young females may be more ‘adventurous’ than young males when it comes to leaving home and pair-bonding with a male from a different family group). It also seems that the mother of this male, in the different family group, will cease to have children of her own when her son’s female partner, her ‘daughter-in-law,’ starts to produce, because the older female has more to gain by helping her daughter-in-law and her grandchild than by breeding herself in competition with her daughter-in-law.

Perhaps some postmenopausal women became, not only matriarchs within the immediate family group, but of a group of families, of a settlement, or clan, too; they would be aware, by virtue of their longer lives, of how to deal with severe shortages of food, when and where hunting and gathering had been successful during previous lean times, etc. They would be knowledgeable about natural medicines, herbs, fungi, etc., so might have served as nurses and doctors, saving the lives of those who might otherwise have died, but now would live to breed in their turn.

For any of these potential advantages to occur, human females of the archaic period must have lived long enough for the menopause to have evolved, and have long enough after the menopause for its benefits to be conferred. Therein lies a potential problem. It is not clear to what age early humans lived. There is a suggestion that they may not have lived much beyond thirty to thirty-five years of age. This would have made the occurrence of a grandmother relatively uncommon, since it seems unlikely that females could have children before age fourteen or fifteen, so a female grandmother would have to be aged about thirty.

Average age at death of thirty to thirty-five also presents difficulties for the evolution of female human menopause. Today, a woman might be a young grandmother at fifty, while menopause
occurs in the late forties, early fifties, with death typically fifteen or more years after. If, during the archaic period, women were grandmothers at 30, then menopause – to keep in proportion – could have occurred at, say 28 to 32, with average death some ten or more years later, at 38 to 42. Unless, that is, the age estimates for women in the archaic period is wrong, or, perhaps, some women lived for much longer than the, then, average and were, perhaps, treasured and venerated by their group as ‘wise ancestors.’

Overall, however, atresia and the biological egg timer suggest that perhaps women – some women – could potentially live to be over sixty during the archaic period, avoiding reproductive conflict, consistent with the grandmother hypothesis and with conferring the potential benefits of the menopause to group survival. But, it is not clear...

**Human Gestation**

We may also consider the human gestation period in this context. Today it is some 40 weeks, on average, and that seems to be a compromise, which was probably arrived at during the EEA, or earlier.

The human brain continues to grow after birth until age seven. If gestation falls short of 40 weeks, then the baby is premature, its brain and organs may not be sufficiently develop for viability, and the infant dies at, or soon after birth. The loss would, from a family viewpoint, have been an opportunity loss; the mother had invested some 20-30 weeks in bearing a child, and that investment would have been effectively wasted. She could, however, try again, and all would not have been lost. It may even be that the premature birth was a result of some genetic dysfunction (in mother, fetus, or both) that should not have been passed on to successive generations; so, the miscarriage would have benefitted the evolving species by failing to propagate a suspect gene, i.e. by natural selection.

If, however, the baby was late, then potentially both mother and baby would have died, and this would have been a more serious loss; no trying again now. The loss of the mother may mean the loss of many offspring that she might otherwise have had. However, one of the main causes of this problem is the shape of the mother’s pelvis. Had the mother and child survived, that restrictive pelvis shape would have been passed on through her offspring. Or, put another way, since the mother died, the genes that coded for her restrictive pelvis would not be passed on, while the genes of other mothers with more suitable pelvic structure would pass on: natural selection again.

So, a compromise evolved at some 40 weeks, with some premature births and some babies “going over time;” by 40 weeks, the fetal organs would be suffi-
cient for viability, while the growing brain would also be barely sufficient for viability, yet still small enough to pass through the birth canal...

**Successful Family Propagation System (SFPS)**

We humans, it may be reasonably presumed, found and followed a system for propagating successful new families. Children were somehow raised so that they would be successful parents, in their turn: but, how? New-borns and infants were totally helpless, yet their brains would keep growing until aged 7, and would keep on developing until they were in their mid-twenties... As infants, they would have been surrounded by danger: insects, snakes, predators, disease, other humans...there would have been a high infant mortality. Consequently, children would have been precious... especially in small, vulnerable populations.

Although not provable, it is reasonable to suppose that infants would have been secluded, and carefully protected from the outside environment, their every wants instantly satisfied and, initially at least, given minimal stimulation while they overcame the undoubted shock and trauma of birth. To this end, mothers may have sought to mimic the womb environment by maintaining a dark, quiet, nurturing shelter and perhaps by wrapping the new baby's limbs tightly (swaddling) to recreate the impression of restricted enclosure in the womb, at least for the first few weeks of life.

While we don't know what that outside environment would have been, it is not unreasonable to suspect that predators and carnivores would have been attracted by the sound of a baby crying; which, today, we find commands immediate pacifying response from either parent. (A baby's loud cry may not seem exceptional; however, many mammalian young remain still and quiet when alone, concealed from predators.) Has that surprisingly loud cry and immediate response been selected to promote survival of both the helpless baby and mother? Similarly, warmth, comfort, familiar smells, sounds and sights would have been the order of the day, with a gentle home routine of feeding, speaking, clothes, play, socializing...perhaps with close family only: mother, father, siblings, grandmother...

Even today we cannot recall the first three years of life. But, they are known to have major influence on the eventual adult as a balanced individual, able to sustain adult relationships in monogamous pair bonds.

**Innocence**

We know too that the infant brain continues to grow until age seven. It is reasonable to suppose that the growth is not uniform: early growth/organization will be of areas of the brain concerned with foe-
tal and infant viability; growth during the first three years appears to suppress, or at least not record, long term memory of the infant’s environment, although infants can learn to crawl, walk, speak, read and gather copious amounts of tacit knowledge about its local environment, animals and people during that time.

From age four, it may be presumed, the brain continues to grow and reorganize, as it can now create and recall memory, and the future adult, perhaps, may recall behaving in a child-like manner, in blissful ignorance, totally “in the moment,” with no thought for the future, or for danger, where the sun always shone in summer, etc.

Why do children exist in this state of innocence? Is it a natural consequence of the brain continuing to grow? Is it, perhaps, to do with the progressive development of intelligence? During this time the child appears to live in a benign bubble, a make-believe world, where magic, fairies, Father Christmas, etc., gods and goblins, are all believable, and the child is somehow protected from the harsh realities of existence as experienced by adults. There are nightmares, too. It is as though the young brain is creating (imagining, simulating) a world in which situations can arise, problems can be encountered, concepts beyond their young experience can be formulated, which the young brain can address in complete safety, so exercising the various parts and functions of the fledgling brain with its sensory-motor cortex.

Among these situations will be hunting and gathering “scenarios,” such that the child can begin to appreciate and play-practice experiencing adult activities, albeit in a simple, safe environment of the imagination. Children will enter such play situations with other children, each perhaps playing different characters, so gently learning about cooperation, competition, winning and losing, etc., but all in a benign mental environment from which the horrors of the real world are largely excluded. Children today may be observed playing “house, or “shop,” during lulls in deadly conflicts, seemingly oblivious to the carnage about them. This state of childish innocence may provide a filter, protecting the child from mental anguish and trauma that the adult will unavoidably experience.

[Curiously, many adults appear to forget about their prior state of innocence, or may even suggest that something is wrong with such children. However, the same adults can experience “suspension of disbelief” when watching a film, or going to the theatre, such that they temporarily accept portrayed situations as real, and may become caught up in the excitement and emotions of the moment. Is this ability to “suspend disbelief” a hangover from their childish innocence?]
Whatever the reason, we know that traumas affecting the child during the period of innocence, will have lasting psychological effects, that will impact on their adult behavior, persona, and ability to act as a mature, balanced adult and parent. Only now, the adult may recall such traumas occurring...

The “successful family propagation system” (SFPS) would not have persisted through the ages if the offspring, on reaching their maturity, were unbalanced, traumatized, self-harming, autistic, incestuous, homosexual, asexual, bulimic, paranoid schizophrenic, psychotic, addicted to pornography, sociopathic, etc., etc. As we have seen, genes that coded for such ‘characteristics’ would not have been selected. A gene, or genes, that coded for male homosexuality, for instance, would have resulted in male offspring being less likely to have children upon reaching maturity, so that such genes would be less likely to propagate.

The SFPS would, then, have evolved protective strategies and behaviours against traumas, and these may be evident in both parents and developing children within, particularly, the nuclear family; else, it would not have been successful.

It seems likely that the newborn child would be kept close to its mother at all times, being carried by her if the family group was on the move, or the mother was gathering, processing, cooking (supposing fire to have been in use), feeding her offspring etc. Families would probably live in temporary encampments to protect themselves from predators, weather; sun by day, and cold by night. So, when not on the move with mother, the infant would probably be in a shelter that would be warm, quiet and shady: it would also be clean, not for the sake of cleanliness per se, but to ensure there were no insects, spiders, scorpions, snakes, etc. to threaten the helpless infant. (Can we see in this the homemaking and cleaning instincts which many women exhibit worldwide today, or does that instinct hark back even further to nesting, as with birds and gorillas?)

During the very early months, as we have seen, the infant with its partly developed brain would have been concerned with the basics: hearing and categorizing sounds, smells, tastes, touch, sights, and their combination, e.g. smells and tastes, sounds and sights. This would have been a period of acquiring tacit knowledge about the immediate environment: mother was warm, cuddly, secure and smelled familiar; it would have been quiet inside the shelter, outside there were natural sounds of birds, trees rustling, water running and people talking and “doing things.”

As the infant progressed, mother would ‘baby-talk’ to it, encouraging the formation of basic sounds by the infant, such that it could connect what it heard
with the muscles controlling its lungs and vocal chords. So, ‘mum-mum-mum’ and ‘da-da-da’ were baby-talk vocalizations by mother or father that were simple enough for the baby to copy, and such baby-talk may even have been part of a human proto language that was the fore-runner of today’s diverse and sophisticated languages spoken around the world. Significantly, baby talk appears to be universal today, whether the eventual language for the infant is to be Japanese, Hindi, Hungarian or Finnish.

The suggestion is, then, that the first three years of an infant’s life, the three years, which it cannot later recall, were concerned with accumulating tacit knowledge about its environments, domestic and natural, and with achieving a measure of control over its body, sound-sight coordination, hand-eye coordination, balance, etc. So, learning to speak, to stand, to toddle, to walk and run, to interact in a limited way with, and to depend upon, other children, parents, grandmothers and other relatives. Gradually, to absorb their culture and behavior, by observing, copying and being corrected, such that the contemporary culture became their norm. And the amount of tacit knowledge a child would acquire during its first three years would have been vast, (as scientists trying to provide androids with sufficient tacit knowledge so that they may operate autonomously have discovered).

All of which presents a curious mismatch with today’s social engineering e.g. mothers returning to work soon after birth; infants (over?) stimulated e.g. by nursery schools; by ‘alien’ child minders; by intrusive digital environments even during those first 3 years. What effect does this have on our ability to be successful parents, to propagate successful families of balanced, intelligent offspring? Truthfully? We don’t know...

The psyche of the young person appears to develop in some three phases: the first three years; the state of Innocence; and, puberty. It seems likely that, during and after the first three years, indeed up to and possibly beyond the onset of puberty, children would have been kept in a state of innocence, knowing little or nothing about the real, adult world of sex, violence, failure, famine, death, pestilence and destruction. Parents would have given their children toy weapons to play-hunt, dolls to play house, play goods to play barter, and so on. Parents would have told their children fairy stories, adventure stories, etc., perhaps with subtle moral lessons, nearly always with happy endings...

Parents would have been complicit in maintaining this state of childhood innocence, keeping all the “bad things” away from their children: this was, and has been, the case right up until very recent times, witness the once-common saying “pas devant les enfants,” an injunc-
tion between adults not to discuss something ‘inappropriate’ in front of the children. Indeed recent society at large was complicit in this concealment: in children’s films, cowboys shot at other cowboys, who may have fallen off their horses, but were unharmed and without any sight of blood. Married couples were not shown in bed together, unless one of them had at least one foot on the floor. Cartoons for children showed cartoon animals experiencing all sorts of traumas, often imposed by other cartoon animals, yet the ‘victims’ immediately bounced back with no evidence of any harm.

Meanwhile the children would not have been exposed to the shocking, bizarre, extra-ordinary, or traumatic, until puberty and beyond. Or, if they were inadvertently exposed, there was a good chance that they would not recognize what they encountered as it was outside of their experience and understanding in their innocent fantasy worlds.

In living memory, young women in their late teens may not have been aware of how children were conceived, or born, and young males in their late teens, even preparing for marriage, would similarly not know about their rôle in conception. This, despite brought up in the country, perhaps, and frequently observing copulating domestic and farm animals…it seems that the innocent world of the young person could extend beyond puberty, with them observing and under-
standing reproduction in animals, yet not relating that knowledge to themselves; they did not see themselves as animals...

This successful family propagation system (SFPS) appears to have been producing families which have produced balanced adults able to form lasting pair bonds and successive families in their turn throughout the ages: until very recently; see Chapter 11, Homo sapiens and the Megacity.

Mismatches

Evolutionary Psychology suggests that we humans are mostly adapted to Pleistocene environments, up to perhaps, some 3-500,000 years ago...and that we formed psychological mechanisms at that time that sometimes exhibit mismatches to modern environment.

We are not adapted to living in cities; so, we create ‘coping mechanisms.’ We create psychological neighborhoods, where only we live, with perhaps 10-50 neighbors. We fence the garden perimeter and are prone to irrational violence against intruders (territorial imperative). On public transport, we ignore/avoid eye contact with other travelers/commuters, as though they did not exist. We eat in small cafes, fast-food outlets, like hunter-gatherers ‘on the move.’

Yet, more of us are moving to live in ever-larger cities—megacities: but, humans are not adapted to work in large, anonymous bureaucracies with formal hierarchies; we still respond to personalized, charismatic leadership in informal, egalitarian settings.

We are similarly not adapted to social media, with the ability to communicate with so many people at once, and with no thought or responsibility for, or experience of, any offence so caused. Children in their innocence are using social media and experiencing trauma in the process, as cyber bullying, trolling, sexting, pornography, etc.

We exhibit psychological duality: we see things as “paired opposites which must be reconciled.” e.g. black or white, male or female, left or right, friend or foe, for or against, good or bad. We are not adapted to “shades of grey,” “multiple sexes,” “fairly safe,” “half guilty,” “sitting on the fence,” “somewhere in the middle-ish,” etc.

In the EEA, and earlier, such indecision may have meant the difference between catching the prey or missing; between recognizing an enemy as such, or not; between life and death...

Yes, we humans are highly adaptable, able to deal with these niceties in good time, but they are not natural to us, and our “knee-jerk” reactions go straight towards one or other of a duality...before our intellects “kick-in;” were it not so, Homo sapiens may never have evolved at all.
Evolutionary Legacy

Today, we exhibit many of the characteristics of our evolution. Our eyes, which are generally excellent compared with other animals, are most sensitive in the green part of the visible spectrum, reflecting our arboreal heritage, with sunlight filtering through green leaves. Men like to work in teams, with a leader, reflecting our hunting past. Women are also happy to work in teams, but without the need of a leader, in the manner of gatherers searching for fruit, nuts or roots in the same area, while at the same time feeding their individual families.

Mid-meal snacks are generally of something sweet, and are consumed by the individual on his or her own, just like the fruit-eating, arboreal ape. Today we might happily eat an ice cream in the street, walking on our own, but would be less likely to eat a steak in the same way...

Main meals often have a meat or fish course, and are attended by the family, like the feast following the return of the hunter with his kill. These differences reflect our heritage: as an arboreal ape, where the individual searches for sweet fruit and consumes it on the spot, without sharing; and as a hunting ape, bringing back the meat (or fish) from the kill to roast for a feast where everyone sits together around a campfire with equal shares of the spoils. This ‘equal shares’ notion is also uniquely human; chimpanzees may cooperate in the hunt for monkey prey, but there is no suggestion of equal shares, with the chimpanzee that catches the prey getting first, and largest, bite.

We can be seen as a complex mix of primeval tree dweller, littoral ape, and plains carnivore, with hints and glimpses of more primitive animal behaviours. We can live almost entirely on fruit, nuts and roots; or, almost entirely on meat, fish and shellfish. We are omnivores par excellence. Not forgetting, of course, our affinity for water to live by, swim in, play on and dive under. And we have evolved to live monogamously, in families, unlike many other apes and mammals, which may go someway to explain our phenomenal breeding rate, which is currently populating, over-populating and – in some respects – decimating, the modern world.

We are still, apparently, hunters and gatherers under the skin. Only, now we go to work instead of hunting and fishing, and we gather ripe produce from the supermarket shelves. *Plus ça change*...
CHAPTER 3

THE ASCENT OF THE INGENIOUS APE
SECTION
HUMANITY'S DARK AGE

THE BLUE GROTTO,
Malta

LOCAL WOODHENGE, NEAR
BAMBURGH, NORTHUMBRIA, ENGLAND.
Between about seven million and four million years ago, the so-called Pliocene Gap, was a dark age for humanity. Apes went into it, and ape-men came out of it. We know little of the evolution of our own species; the fossil evidence from the Rift Valley in E. Africa, believed to be the cradle of humanity, is sparse. But we do know that apes started to walk on two feet some millions of years ago, and that they migrated from an arboreal, fruit-eating creature to an upright omnivore on the savannah that developed as the climate changed. Meat became a significant part of the hominid diet, along with roots, nuts, seeds and fruit.

It is hard for the ape to believe he descended from man

H.L. Mencken

Rocks bordering the Rift Valley show that the environment changed frequently over the period of earliest human evolution. There are successive overlays of deep lake sediments, shallow lake sediments, soil, volcanic ash, shallow lake and deep lake again, each sequence lasting no more than 5,000 years. For hominids living at the time, this rapid variation in environment would have resulted either in extinction, migration, or an accelerated adaptability to change. Controversially, early humans may have gone through a transitory ‘aquatic phase,’ swimming, diving and fishing in and around deepening lakes over a number of generations... In any event, instead of adapting to any particular environment, early humans appear to have adapted to survive and flourish in a variety of environments, rather than in any one.

At some stage in his evolution, however, early Man became a hunter, tracking game/prey across the open savannah, perhaps for days until, exhausted, it eventually gave in to slaughter. He may also have trapped, snared and even attacked larger animals, using weapons to augment his lack of tooth and claw, and sharp implements to butcher the carcasses for carriage back to camp. He may have scavenged, too, competing with other predators for the carcasses of their kills. Hunters with better hand-eye coordination, spatial awareness, agility and cunning would have been more likely to succeed in the hunt, and therefore to survive, indicating a selective basis for modern man’s superior capabilities in these respects. It also goes to explain the variation in
spatial awareness (so-called 3-D cognitive mapping) of males with respect to females that can be observed today in children as well as adults.

In any event, early man would, perforce, have hunted in teams or parties, to compensate for physical shortcomings as individuals. The long pursuit of some larger game might have taken several days and nights, during which there would be wide diurnal temperature and humidity swings. Hunting teams would have needed effective team leaders, planners, tool-, rope- and weapon-makers, tailors, butchers, carriers, and logisticians to provision, and to know where to find (or pre-position), food and water for the longer hunts. The sophistication necessary for such complex conception/imagining, planning and execution suggests that early man would perforce already need a sizable brain: moreover, that a larger brain would enhance prospects of successful hunting and, ultimately, of survival.

Anatomically modern *Homo sapiens* is believed to have emerged in E. Africa around some 200,000 to 100,000 years ago, and to have migrated out of Africa about 120,000 to 60,000 years ago. There is little or no evidence, however, of subsequent social and cultural evolution after that migration. Perhaps the continually expanding human population had spread out and had to keep moving to find fresh sources of food.
both to gather and to hunt, following the seasons and adapting to changing environments.

Indeed, there seems to be a significant gap in our knowledge of some 50,000-110,000 years, during which time *Homo sapiens* was evidently broadening his horizon, but was leaving scant evidence behind as he went. Was he becoming smarter, more cultured, more social: or, was he meeting so many challenges along his many hunter-gatherer routes as he radiated out from his E. African source, that he followed a hand-to-mouth existence, with little time for sociocultural “improvements?”

**Göbekli Tepe, 9559 ± 53BP, 9130–8800 BCE**

Göbekli Tepe, (“Potbelly Hill”) is an archaeological site in Turkey. It has been excavated since 1996, by Klaus Schmidt and his German archaeological team, has revealed some surprising discoveries, and still presents some challenging puzzles. The vast site presents in two phases dating back to the 10th-8th millennium BCE. During the first phase, circles of massive T-shaped stone pillars were erected. More than 200 pillars in about 20 circles are currently known.

Each pillar is up to 6 m tall and weighs of up to 20 tons. They are fitted into sockets carved in the bedrock. In the second phase the erected pillars are smaller and stood in rectangular rooms with floors of polished lime.

The excavation reveals that the builders of the structures, a possible temple, sanctuary, or both, were hunter-gatherers. This con-

Part of (originally) T-shaped stone, bearing relief figures of a bovine, a fox and waterfowl. *Photo by Yvonne Kluin*
founds the conventional view that such complex structures would be built only once there were settled communities, which in turn required farming, agriculture and animal husbandry—which there was no sign at Göbekli Tepe.

The various T-shaped pillars present pictographs of various animals, all of which would have been common in the area at the time. However, none is of a prey animal. Moreover, the animals are carved in relief, which suggests a sophisticated approach, since much of the stone must have been chipped away and smoothed down to leave the animal shapes standing proud. Judging by their limb positions, the animals may be dead, and portrayed lying on their sides.

It is difficult, if not impossible, to interpret Göbekli Tepe. This was a culture of 10,000 years ago, before pottery, without any writing, but dedicated to creating such a complex structure for use as—who can say? However, it is evident that the various hunter-gatherer groups of the time were able to come together, to pool their labour, and to have a division of labour so that some were quarrymen and builders, others providers of food and drink and logisticians, and yet others created complex structures and carved animal images that clearly meant something to the groups. Since different stone pillars had different animal pictographs, it is conceivable that each stone, or each animal on each stone, might correspond with a group, as an emblem or totem, perhaps, but that is a guess.

It is, however, fancifully reminiscent of Kipling’s Jungle Books, with Akela, the Indian wolf, Rikki-Tikki-Tavi the mongoose, Baloo the sloth-bear, Shere Khan the Royal Bengal tiger, Kaa the rock python, not forgetting Mowgli, the young Jungle Boy and hero of the stories. Although they have never come face-to-face with them, today’s children readily identify with such animal predator characters... Could Göbekli Tepe have been a place for hunter-gatherer social imagination and celebration?

In any event, we may reasonably deduce that these peoples were not living hand to mouth, since they had ample time to undertake such monumental work. Further, the quality of the relief pictographs goes to suggest that these were not the sculptors’ first works. The amount of labour involved in such extensive relief carving, and the differences between pictographs of roughly the same age, suggests that there would be more than one sculptor. If these were not the first works, then there may be earlier works yet to be found; there might even have been a ‘school,’ where would-be artists could learn and try out their developing skills.

This, then, at some 10,000 years before present, is evidence of a hunter-gatherer population, band, tribe, clan, etc., a developed culture, with some kind of spiritual dimension, with a shared belief system and purpose.
Çatalhöyük, 7500-5700 BCE

Çatalhöyük was a very large Neolithic and Chalcolithic (Copper Age) protocity settlement in southern Anatolia, which flourished around 7000 BCE. It is the largest and best-preserved Neolithic site found to date.

Çatalhöyük was composed entirely of domestic buildings, with no obvious public buildings. An average population of 5,000 to 8,000 inhabitants lived in mud-brick houses that were crammed together with no footpaths or streets between them, and so had to be rectangular, rather than round. The rooftops were effectively plazas and streets, whence the way in to each house was by ladder via a hole in the ceiling. The holes also provided ventilation, and allowed smoke from fires and ovens to escape. All rooms were plastered and kept scrupulously clean. Archaeologists identified very little rubbish in the buildings, instead finding middens, sewage, food waste, and wood ash outside the ruins. However, the people buried their dead in pits beneath the floors and hearths, platforms within the main rooms, and under beds. Bodies were folded knees to chest, and were often wrapped or placed in baskets. Some graves contained disarticulated bones: bodies may have been exposed for a time before being collected and buried. Some graves had been disturbed and the head removed from the skeleton. Some heads have been found, plastered and painted with ochre, indicative of some ritual behavior associated with the dead.

No identifiable temples have been found, but the graves, and the many murals, and figurines that have been found, suggest that the people of Çatalhöyük had a religion rich in symbols. Predominant images include men with erect phalluses, hunting scenes, red images of now extinct aurochs (wild cattle) and stags,

Çatalhöyük had no apparent social classes: no houses with features of status have been found so far. No gender bias has been discovered, with men and women receiving equivalent nutrition and seeming to have equal social status.

Newer buildings were built on the rubble of older ones: some eighteen levels of building have been uncovered. Upper (later) levels of the site indicate that the people of Çatalhöyük were farming and domesticating sheep and cattle. In addition to wheat and barley, there were peas, almonds, pistachios and fruit gathered from trees in the surrounding area. Hunting was still a major activity and source of food, however.

Çatalhöyük is surprising in many ways, not least that so many humans would find it acceptable to live together in such close proximity, with the attendant risks from disease, having evolved as close-knit families and hunting bands on the open savannah.
Archaeologists are not agreed in their interpretations of Çatalhöyük, its culture and religious symbolism. From a purely pragmatic viewpoint, it seems curious that so many people could live together, in such close proximity, yet develop agriculture, domesticate animals, and continue to hunt—presumably in hunting bands—while maintaining scrupulously clean “apartments,” living cheek-by-jowl, isolated from said animals, orchards and crops, and—judging by the general similarities between the homes—without discernible social structure. Then there are the middens, sewage, food waste and wood ash, all external to the proto-city.

It is tempting to speculate whether some/many of the people did not live permanently in Çatalhöyük, but around it, in small farms, enclosures and encampments, which, in the nature of things, have left few traces? Could Çatalhöyük have been part necropolis, part city of the living: a collection of family homes, catacombs and crypts, maintained both for family and the departed; in effect, a distributed temple in which the living dwelt—perhaps part time, perhaps very occasionally—in shrines to family ancestors? Was reverence for the dead and the ancestors fundamental in the religion of people of Çatalhöyük, so that their family ancestors lived on with them in their houses and in their memories?

Predominant images include men with erect phalluses, hunting scenes, red images of now extinct aurochs (wild cattle) and stags, with vultures swooping down on headless figures. Facing pairs of lionesses were carved in relief on walls. (Kleiner & Mamiya, 2006)
SECTION

PREDYNASTIC EGYPT

FROM THE NILE, NEAR ASWAN
Riverside farms
Why Egypt?

Ancient Egypt probably shows the earliest steps towards (what we might consider to be) civilization of any human group – as far, that is, as is known. Research continues to push knowledge of early human societies further back in time in China, India, Japan, the Americas, etc. However, we know very little about the development of civilization before some 5000BCE, and much of that is seen in Egypt, where there has been much archaeology, and where writing – and hence, Egyptian history – started around 4,300BCE. Moreover, Egypt’s history as a developing nation state extended for some 3000 year, making it by far the longest enduring civilization so far. (By comparison, Christianity has so far lasted some 2000 years, and Islam some 1300 years.) So, we should not be surprised to find that the story of the ascent of the ingenious ape focuses on Egypt, although that story precedes Egypt as the first nation state by some 1,500 years...

Predynastic Egypt

There is evidence of human activity in the Nile Valley going back some 300,000-400,000 years ago, in the form of Lower Paleolithic hand axes. The earliest Egyptian identified, so far, is the skeleton of a child dating back to 55,000 BP (before present).

Badarian Culture, 4400-4000 B.C.E.

The Badarian culture provides the earliest direct evidence of agriculture in Upper Egypt during the Predynastic Era: it flourished between 4400 and 4000 BCE, and had moved on from itinerant hunter-gatherer to a more sedentary lifestyle, although their settlements, small villages or hamlets, were not permanent affairs, moving horizontally after short periods of occupation, after the practice of encampments.

The Badarian economy was based mostly on agriculture, husbandry and fishing, with little sign of hunting—although fishing may have been viewed as a form of hunting. Remains of cattle, dogs and sheep were found in the cemeteries. Wheat, barley, lentils and tubers were on the menu.

About forty settlements and six hundred graves have been located. Graves were simple burials: bodies were loosely contracted; laying on the left side, often on a mat, head to the south, facing towards the sun setting in the west. There are no graves of young children: instead, these seem to have been buried within the settlement. The Badarians appear to have been a peaceful people: there were elderly and white-haired folk in the cemetery, and few broken bones, or other signs of conflict or deprivation. Few grave goods included farm implements, but hunting equipment such as...
bows and arrows, and throwing sticks, were commonplace. There was no evidence of bovines among the human burials, as in other cultures of the period.

Men were generally clean-shaven, and wore their hair long: some of the women had fringes and plaits fixed up with bone or ivory combs. The dead were generally decorated with masses of jewelry: heavy necklaces, beads of shell and ivory, copper nuggets, and cut steatite (fired to give it a blue-green glaze), carnelians, jasper, siltstones, serpentes and alabaster. Grave goods also included the mixing palettes upon which the Badarians mixed their body paint, made from lumps of green malachite and ochre, which they carried in pouches.

Grave goods show that some were wealthier than others, and that the wealthier were buried in a different part of the cemetery, an early indication of social stratification. The pottery is characteristic of the Badarian culture. It is very finely made from Nile silts, surprisingly thin, yet hard, with a distinctive, decorative rippled surface, generally red in color, with a black lip.

Each grave was distinctive, however; there was no established formula for what goods should be included, or how they should be distributed. The overall impression is of a people who cared for and remembered dead as individuals, but also for “the dead” as a group, forming a continuing connection between the living and the dead, giving rise to the notions of ancestors and afterlife. This foreshadowed the care and concern for the dead that would obsess many Egyptians for the next several thousand years...

**Naqada Period C.4000-3200 BCE**

The second phase of the Egyptian Predynastic Period saw the Naqada culture. In 1892, Flinders Petrie, the ‘father' of Egyptian prehistory, found some 3000 graves at Naqada, just northeast of modern-day Luxor. The burials were simple and similar to the preceding Badarian culture: the body was placed in a pit hollowed out of the sand, in the fetal position, wrapped in an animal skin, sometimes covered with a mat, head pointing south, facing towards the west.

Grave goods were of pottery vessels, blacktopped, polished red ware, zoomorphic schist palettes, flint knives, etc., i.e., similar to Badarian, but unlike those of the later pharaonic civilization. Multiple burials were fairly frequent, notably including a woman and a newborn infant. Larger burials began to appear, with coffins of wood or clay.

Naqada Period artifacts suggest a vibrant culture, with a rich iconography. The pottery vase, with its riverine decoration, would indicate the importance of the Nile, and the boat appears to be very large—a royal or ceremonial vessel, perhaps. The Bull
Naqada Period: Four Dogs Palette.

With lion, giraffe & ibis. Louvre

Decorated Pottery and Bull Palette

Left: Decorated Naqada II pottery showing a boat with superstructure. Right: Bull Palette, showing a bull, representing the king, goring his enemies, with symbolic support from five totems.
Palette, from Abydos, shows the king in battle mode, supported by cooperating groups of followers, each group represented by a totem pulling on the same rope: does this, perhaps, represent a small army, with members from different villages or nomes? In any event, it is a cogent, artistic, yet highly symbolic portrayal.

The Gebel El-Arak Knife From The Naqada Period.
A magnificently worked, ceremonial flint knife, with a delicately carved ivory handle, showing (centre) a battle scene in five registers. At the top naked men wearing penis sheaths are in hand-to-hand combat with maces and clubs. At the bottom, dead bodies are strewn between two different types of boats, both in use in Egypt during the Naqada period. On the other side (not shown), the Egyptian creator god Atem, is flanked by his offspring, two lions, representing the planet Venus in its guises of Morning Star (Egyptian Shu) and Evening Star (Egyptian Tefnut). Two dogs face off under the God. The animals below the knob appear to represent the motion of Venus.

The Gebel el-Arak knife and the Narmer Palette are particularly indicative of an evolving and developing culture steeped in conflict. Whether that conflict had been experienced, threatened or imagined is questionable. The Gebel el-Arak knife also shows a Chaldean influence in the central character on the reverse between the two lions, suggesting some early connection with Babylon. The image of the two lions may also suggest an astrological theology, or at least an interest in astrology, predicting the future and anticipating disasters.
The Narmer Palette
The Narmer Palette is the largest, richest, and yet perhaps the most enigmatic Predynastic palette, in terms of its symbols and icons.

On the obverse, left, the serpopards with their intertwined necks (symbolic of unity between Upper and Lower Egypt, but also cleverly forming the ceremonial mixing palette for kohl eye-makeup) the king stands, wearing his Red Crown of Lower Egypt, and carrying a mace and a flail, symbols of kingship.

Behind him, to smaller scale, is his sandal bearer, who has a rosette, or daisy, by his head, together with another symbol suggesting perhaps who he is and where his is from? By the king’s head are the symbols for a chisel and a fish which, together phonetically spell out the king’s name: Nar-mer (“chisel-fish.”)
In front of the king is a long-haired man, walking behind a team of four standard/totem bearers carrying an animal skin (or placenta), a dog and two falcons. From the positioning, it might be deduced that the long-haired man was in command, under the king, i.e., the king’s general? He might be the first man in history with a personal name,
Tshet, if the hieroglyphs have the same meaning as later...

To the upper right of the obverse side there are ten headless bodies, indicative of some gruesome disposal of opposition. The plants each symbolize 1000, in later hieroglyphics: is this meant to represent 10,000 slain? Above the bodies are symbols: a ship, a falcon and a harpoon, perhaps representing the names of the conquered towns? But, did a battle take place? Or, was the palette a publicity device, a ritual symbol of authority along with mace and crowns, reinforcing the king’s mythology, presenting him as favored by the gods, all-powerful, and in command of unassailable force? What is not evident from the palettes, however, is any direct indication of society, social behavior, family, everyday life, etc.

The Towns Palette
The Libyan, or Towns Palette, has a rich iconography. Atop each town is a figure wielding a mattock (similar to a pickaxe), symbolic perhaps of each town’s foundation. Note, however, that the mattocks appear to be piercing the walls of each town, so is the mattock symbolic of building the walls or of demolishing them? The Towns Palette does, however, suggest that people lived in towns, and that the towns were walled and defended (and, therefore, threatened)—which is curiously at odds with a largely agrarian culture, where animals and farmland would, normally, be out in the countryside, along the banks of the Nile. Perhaps the very act of settling, gave rise to notions of land ownership, culture and possessions, which in turn generated envy and greed on the part of others, who might see the settlers as a “sitting target.”

The Naqada period saw a significant advance in social development compared with what appears to have gone before. Bone and ivory tags, pottery vessels, and clay seal impressions bearing hieroglyphs unearthed at Abydos, 300 miles south of Cairo, have been dated to between 3400 and 3200 B.C., making them the oldest known examples of Egyptian writing.

By the end of the period, the evidence from artefacts is of a cogent hieroglyphic set, and of a turbulent period of internal, or civil conflict that finally ended with unification of Upper and Lower, South and North Egypt. Or, at least, that is what the artifacts propound. They could be an ancient form of psychological warfare, of course, or a means of the new kings seeking to establish their dominance.

On the other hand, there is little evidence of the ordinary people, of families, of children, in any of the artifacts.

The Naqada Period saw the development of social hierarchy, of the rise of powerful warrior kings, of unification, probably by the south, Upper Egypt, ‘encouraging’ the
north, Delta Egypt into a political and economic alliance. (Such terms would have been meaningless at the time, of course...) It also heralded the deepening Egyptian interest in the afterlife, and the need to provide the dead with all that they would need to live for eternity in that “other world.” Social strata had emerged, with a rich and powerful elite. Much of the iconography is related to agriculture and husbandry, with powerful bulls, hawks, lions, etc. Slavery was in evidence, too, and—if we are to believe the questionable story behind the Narmer Palette—mass killing.
SECTION

MALTA, C. 3600-2500BCE

TRADITIONAL BOATS
ST. JULIAN

MANAJDRA TEMPLE,
Between them, the Mediterranean islands of Malta and Gozo (ancient Calypso) boast seven Megalithic Temples, reputedly the oldest freestanding monuments in the world, which together constitute a World Heritage Site. The oldest temples pre-date the Great Pyramid and Avebury by about a thousand years, and Stonehenge by about twelve hundred years, while the youngest is contemporaneous with the Great Pyramid of Khufu.

Research shows that no one lived at the temples, but the evidence from animal bones was of copious sacrificing of animals, presumably either to some presumed-powerful deity, or in search of valuable information: the temples appeared to serve as oracles. The temples were generally roofed over, decorated and covered with drapes. The temples also contained quite elaborate altars, and a large number of so-called ‘oracle holes.’

These oracle-holes were used by a priest-class to give instruction/advice/prophecy to the population and, judging by the number and extensive nature of the temples, the society of the time was effectively ruled/controlled/directed by this priestly class. The Hypogeum of Hal Saflieni also had a priest hole, opening into a large circular chamber. Peculiarly, while a deeper male voice speaking into the hole resonates within the chamber, a higher female voice fails to resonate, and can barely be heard: this has lead to speculation about the likely sex of the priesthood.
Above left is an altar, with typical pierced-surface decoration enclosing a carved plant. Above right is the rear of an oracle hole, where a “servant of the temple” may have hidden, to present advice, instruction or prophecy to those making sacrifice. Bottom is the front view of a typical oracle hole. The stonework may have been decorated /covered with drapes, to add an air of mystery and magic.
BULL PALETTE, CAIRO MUSEUM

The Bull, representing the king, gores a stylized Asiatic. Note the muscles in the bull’s legs.

HILL OF THE FOUR WINDS, ASWAN
Dynastic Egypt

The Three Kingdoms

Starting in about 3,200BCE, the dynastic period and religion of ancient Egypt would last for a phenomenal three millennia. Egyptian theology and culture evolved and matured throughout the period in a process that may be likened to human individuation. Conventionally, there were three principal phases of cultural development (italicized below), separated by so-called Intermediate Periods of chaos and disorder: all dates are approximate and subject to constant research and revision.

<table>
<thead>
<tr>
<th>Period</th>
<th>Date</th>
<th>Dynasties</th>
<th>Principals</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Early Dynastic Period</td>
<td>3150-2686</td>
<td>0-2</td>
<td>Unification of Egypt</td>
</tr>
<tr>
<td><strong>The Old Kingdom</strong></td>
<td>2686-2181</td>
<td>3-6</td>
<td>The Pyramid Builders: Djoser, Snefru, Khufu, Khafre, Menkaure</td>
</tr>
<tr>
<td>The First Intermediate Period</td>
<td>2181-2040</td>
<td></td>
<td>Chaos and Rebirth.</td>
</tr>
<tr>
<td><strong>The Middle Kingdom</strong></td>
<td>2040-1782</td>
<td></td>
<td>Reunification and expansion into Nubia.</td>
</tr>
<tr>
<td>The Second Intermediate Period</td>
<td>1781-1570</td>
<td></td>
<td>Invasion of the Hyksos</td>
</tr>
<tr>
<td><strong>The New Kingdom</strong></td>
<td>1570-1070</td>
<td>18-20</td>
<td>Restoration of native Egyptian rule. Great Age of Tuthmosis, Akhenaten, Seti I, Ramses II…</td>
</tr>
<tr>
<td>The Third Intermediate Period</td>
<td>1069-525</td>
<td></td>
<td>The Weakening of Pharaonic Power</td>
</tr>
<tr>
<td>The Late Period</td>
<td>525-332</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Graeco-Roman Period,</td>
<td>332BCE - CE 241.</td>
<td></td>
<td>Alexander the Great, Cleopatra and the Romans</td>
</tr>
</tbody>
</table>
Implications From The Kings’ Names

The early dynastic period gave rise to some illuminating Horus names of the early kings:

<table>
<thead>
<tr>
<th>Horus Name</th>
<th>Dynasty</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scorpion</td>
<td>0</td>
<td>Scorpion</td>
</tr>
<tr>
<td>Narmer</td>
<td>0</td>
<td>The Striking Catfish</td>
</tr>
<tr>
<td>Hor-Aha</td>
<td>1</td>
<td>The Fighting Hawk</td>
</tr>
<tr>
<td>Djer</td>
<td>1</td>
<td>Horus who Succors</td>
</tr>
<tr>
<td>Djet</td>
<td>1</td>
<td>Horus Cobra</td>
</tr>
<tr>
<td>Den</td>
<td>1</td>
<td>Horus who Strikes</td>
</tr>
<tr>
<td>Anedjib</td>
<td>1</td>
<td>Safe is his Heart</td>
</tr>
<tr>
<td>Smerkhet</td>
<td>1</td>
<td>Thoughtful Friend</td>
</tr>
<tr>
<td>Qa’a</td>
<td>1</td>
<td>His arm is Raised</td>
</tr>
<tr>
<td>Snefru</td>
<td>4</td>
<td>He of Beauty</td>
</tr>
<tr>
<td>Khufu</td>
<td>4</td>
<td>Protected by [Khnum—the Creator of the bodies of human children]</td>
</tr>
<tr>
<td>Djedefre</td>
<td>4</td>
<td>Enduring like Re</td>
</tr>
<tr>
<td>Khafre</td>
<td>4</td>
<td>Appearing like Re</td>
</tr>
<tr>
<td>Menkaure</td>
<td>4</td>
<td>Eternal like the Souls of Re</td>
</tr>
</tbody>
</table>

The early names, two of Dynasty 0 and four of the first five of Dynasty 1, speak of strength and attack. Then follow two gentler titles (Anedjeb: Safe is his Heart. Smerkhet: Thoughtful Friend), followed by a return to warning: Qa’a: His arm is Raised.

Dynasty 1 showed a development of hieroglyphics into an art form. The elegant simplicity and purity of line shown in the hawk above the serekh of King Djet is surely the work or a master craftsman and artist, revealing a high degree of self-actualization.
Horus on the serekh of King Djet, showing his namesake cobra above the palace facade. Note the elegant simplicity of line, and the perfectly balanced offset to the left to make room for the hawk’s tail on the right.

Louvre
SUNSET OVER THE PYRAMIDS-BEFORE THE ASWAN DAM

ASWAN NILOMETER

Used since the earliest times to measure the height of the Nile. Inside are a number of steps: the height of the water is measured against the number of submerged steps.
Old Kingdom Culture, Maths, Magic and Medicine
c.2686-2160 BCE

By the time of Dynasty 4, however, things appear to have moved on, with Snefru, the first king of the dynasty, entitled He of Beauty. His successor, his son Khnum Khufu, ‘Protected by Khnum,’ may have faced some religious upheaval: Khufu’s successors, his sons, all have “Re” in their title, indicating allegiance/subservience to the Sun God, Re, or Ra, which may be taken as a distinct shift from the previous supposed position of being the supreme god-king incarnate on Earth.

Left, diorite funerary statue of Pharaoh Khafre: note Horus, with falcon wings spread, protecting his neck, and the sema-tawy ‘Two Lands’ symbol on the side of his throne, indicating Pharaoh of Upper and Lower Egypt.

Right, Prince Rahotep (son of Pharaoh Snefru) and his wife Nofret, presented as smart young socialites-about-town: Nofret has a fine wig (with her own hair just showing underneath), jewellery, shoulders, nipples and cleavage on show: Rahotep sports a smart moustache, and a necklace; in keeping with the canon, both have their right arms across their chests; she is pale-skinned while he is brick red. Their two limestone statues were found in Rahotep’s mastaba tomb at Meidum.

Cairo Museum
The Old Kingdom, 3rd and 4th Dynasties, is remarkable for the creation of many pyramids, starting with the Stepped Pyramid of Djoser and reaching its apotheosis in the Great Pyramid of Khufu. However, it is remarkable in many other ways, too. Imhotep, creator of the Stepped Pyramid, appears to have been the first genius in history, with mathematics and medicine also to his credit. Indeed, during later times the Egyptians would revere him as a god, and he would become identified with Asclepius, god of medicine and healing in the ancient Greece religion.

Old Kingdom Art
Art flourished in the Old Kingdom, and some fine examples are still with us today. Much of what we would call art may not have been considered in that light at the time,

Humor and Sensitivity in the Old Kingdom

Left, a bored baker dozes while waiting for his bread to prove, perhaps an early example of humor.

Right, the dwarf Seneb with his wife Senetites. Note the way in which she supports her husband, and how their children (fingers in mouths) neatly fit where his legs would have been had he not been dwarfed, making a delightfully harmonious whole.

Cairo Museum
and may instead have had practical/magical applications, such as statues that were intended to embody the spirit of the dead king, for example, or murals of food that were meant to magically feed the king during his long period in the after life.

In addition to statuary, the Old Kingdom saw the making of magnificent furniture, temples, tombs, and, of course, many pyramids starting with the third dynasty pharaoh, *Djoser* (2668-2649 BCE), and ending with the 6th Dynasty, *Pepi II*, reputed to be the world’s longest reigning monarch, having acceded to the throne when born, and reigning until he died, aged 94.

**Old Kingdom Mathematics And Magic**

Primary sources for Egyptian mathematics include:

- The Rhind papyrus, which is in the British Museum.
- The Moscow papyrus, housed in that city’s Museum of Fine Arts
- The Palermo Stone (St John, 1999)

A Scottish collector, Rhind, acquired the Rhind Papyrus, also called the Ahmes Papyrus, in 1858 in Thebes. The papyrus was copied by a scribe, Ahmes (or Ahmos), (~1650 BCE) from another document written ~2000 BCE, that was in its turn copied from a document from ~2650 BCE (the time of Imhotep, architect of the Stepped Pyramid, all around polymath, and possible the world’s first recognized genius).

The Rhind Papyrus contains mathematical problems and solutions. (Robins & Shute, 1987.) Triangles show calculations for area of triangular fields, clearly visible in the figure. The papyrus is a veritable cornucopia of ancient mathematical ideas and methods, including fractions, geometric progressions, summing series, and much more.
The Moscow Papyrus

The Moscow Papyrus was copied by an unknown scribe (~1850 BCE), and brought to Russia during the middle of 19th century. Housed in the Museum of Fine Arts in Moscow, it contains mathematics problems (simple equations) and solutions.

Part of the Moscow papyrus is written in both hieroglyphs and demotic script: the figure shows a hieroglyph portion.

The Palermo Stone

The Palermo Stone, an important primary source of Old Kingdom information and numerical data, comprises seven fragments, the largest being in Palermo, hence the title. Five smaller pieces are in the Cairo Museum, and one piece is in the Petrie Collection at University College, London.

The Palermo Stone was carved in ~2400BCE, and provides the oldest significant extant chronology in history. It records special events in the reigns of the kings of the first four dynasties and part of the fifth dynasty. Unfortunately, the fragments do not provide a complete record: there are gaps. However, events such as the construction of ships, taking a census, granting tax exemption, and donating land to temples are recorded, along with the regnal year of the pharaoh in which they occurred.

Of particular interest is the recording on the Palermo Stone of the annual Inundation height. While the record is not continuous, it nonetheless enables the general trend in Inundation height over some 600 years to be seen. At the time, each reading of the Nile height would have offered advance warning of drought or, particularly, of flooding in the susceptible Delta area, where the height readings were taken.
The Palermo Stone is evidence of a significant bureaucracy from earliest dynastic times, well before, and during, the Pyramid Age. Such a bureaucracy required the existence of a sophisticated, literate and numerate civil service, traveling up and down the Nile, recording figures, delivering justice, etc., and effectively binding the various farms, hamlets, villages towns and nomes of Upper and Lower Egypt into a single nation state: the first in history.

During these early years, Egypt was essentially isolated, living entirely on its own means, i.e., what it could grow, fish and hunt. The ability to grow crops depended largely on the annual Inundation of the Nile, which in turn depended upon the annual spring rainfall in the Ethiopian mountains far to the south—although the Egyptians did not know that.

During times of favorable Inundations...
and rich harvests, the population grew. However, during times of unfavorable Inundations, as registered on the Palermo Stone, famine stalked the land, and people died of starvation. This is an instance of “self-organized criticality,” in which the population of the nascent state of Egypt rose to a critical level (about 2 million) and hovered about that critical level as Inundations—and famines—came and went. So, the people lived in relative balance with their environment, with the natural tendency to increase the population being continually checked by shortage of food.

Mathematics And Magic: The Great Pyramid Of Khufu

Much has been written about the Great Pyramid of Khufu, still today the largest man-made structure on Earth.

The internal architecture of the structure reveals interesting facts, numbers and relationships—provided, always, that one uses the same units of measurement as the ancient Egyptians of the day—approximately 2656 BCE. The units in question were: the seked, a unit of slope, rather than a measurement of angle as we might use today; and, the Royal Cubit was some 52.3 cm in today’s units. The internal architecture is sparse for such a large building. There are only three (known) chambers, including an underground chamber that was deserted before completion, possibly because of dangers to the diggers from lack of air.

The lower, so-called Queen’s Chamber (QC), which sits on the centre line, is quite small, and was probably a serdab, or day room. Two narrow passages exit from the middle of its north- QC(N)- and south- QC(S)- walls respectively both at slope c.8½ seked (c. 39°)

The upper King’s Chamber (KC), contains his sarcophagus against the far, Western (sunset) wall, with a further two narrow passages from the south-facing and north-facing walls. The Southerly passage, KC(S) has a slope of 7 seked (45°); the northerly KC(N) has a slope of 11 seked (32°). Examina-
Deus ex numerus? Measuring slopes by seked (instead of angles by degrees) reveals extensive symmetry and balance in design.

The northerly passage, KC(N), with its slope of 11 seked, “bisects” the pyramid slope of $5\frac{1}{2}$ seked—where “bisects” makes sense only where using the seked unit of measurement, and not if using degrees as measurement.

The KC(S) slope of 7 seked is a rare use of such a slope—it is difficult to find it anywhere else in any of the many pyramids, or other buildings; to the Egyptians, ‘7’ was a ‘special’ number—as it is to some people today. There appears to have been a taboo on such perfect symmetry, not only in architecture but in numbers too (7 seked, 45°, is exactly halfway between horizontal and vertical and the slope of the diagonal across a square, cutting it into two equal halves)
The use of successive integers was instrumental in the design of the Queen’s Chamber in the Great Pyramid of *Khufu*, too. The height of the skirting wall measures 9 cubits. The width of the chamber is 10 cubits. The length of the chamber is 11 cubits. And the height of the pent-roof ridge is 12 cubits. Presumably, these numbers and proportions were designed to endow the chamber with special properties, either security against “dark forces,” or enhancement and projection of the King’s *ka*.

Conducting a straightforward architect’s height budget, in royal cubits, of the Great Pyramid is unexpectedly revealing. The architect(s) evidently worked in 40 cubit units, where practicable. Also, the vertical distance between the Entrance passage to the Queen’s Chamber (QC) and the King’s Chamber (KC) is 40 cubits. The Grand Gallery, a superlative monument to the mason’s art, connects the two chambers.

Fitting in the small passages that leave the King’s and Queen’s Chambers necessitated some architect’s ‘design anchor points’ as shown. These points are the meeting

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**Great Pyramid Height Budget.** The budget reveals a preference for working in 40-cubit units. It also reveals two unsuspected levels: the Top of the Mound, reflecting the ancient Egyptian notion of a pyramid as a mound emerging from the primeval seas at the beginning of Creation; and the Underside of a smaller pyramid, the Ben-Ben, sitting on top of the Mound of Creation.
points of projections from the two sets of passages, and would be used in "setting out," and ensuring the passages followed the correct slope.

Such careful balance and completeness in overall design appears to have been associated with numerical magic, *heka*, creating a secure base for Khufu’s *ka*, or spirit. Since the various slopes form a complete set, with no gaps or shortfalls, and with all slopes bisected to avoid further danger, the balanced design would have created a safe haven, and powerful launching pad, for the King.

From the Pyramid Texts, it appears that the ancient Egyptians were creating a “psychic machine” for projecting the King’s *ka* up to the heavens, where his soul could negotiate with the other gods in the Netherworld, with a view to ensuring a good Inundation. Unsurprisingly, they had major problems in conceiving quite how this projection would take place, and thought the King’s *ka* might rise on a thundercloud, or as

Conceptual view of Akhet Khufu as a "Psychic Machine"
smoke, or on an invisible rope to the pole star, also known as the Great Hitching Post, because of its fixed position in the rotating heavens. In the end, the solution for designers of Akhet Khufu (‘Horizon of Khufu’—the Pyramid’s name) may have been for priests to provide psychic power by daily lustrations, offerings and prayers in the temple associated with the pyramid, with which to project and retrieve the King’s ka to and from the heavens and around Egypt.

The dead king’s activities would be divided between day and night: rather conventionally, he would be “upstairs” in his sarcophagus at night, and “downstairs” in the serdab by day. His night-time excursions would be via KC(S) to the Southern Netherworld via Alnitak in Orion’s Belt, and via KC(N) to the Northern Netherworld via Thuban, the pole star. He would use his time there to negotiate with the gods of the Netherworld for a “good” Inundation, which he alone could do since he, too, was a god. “Downstairs” by day in the serdab/Queen’s Chamber, his ka would be free to roam over, and look after, his people in Upper Egypt, using QC(S), and in Lower Egypt using QC(N), with both passages at the same slope representing even handedness between the Two Lands—a recurring theme over the following millennia.

The design of the Great Pyramid reveals remarkably sophisticated ideas, astonishing cerebral capacity, outstanding architectural excellence, the development of a complex culture and belief in both a spirit world and an afterlife, albeit one accessible principally to the King in his afterlife role as Khufu-Osiris...

**Medicine.**

Medical practices during dynastic Egypt are known from medical papyri, of which the most informative is the Edwin Smith Papyrus, named for the dealer who bought it in 1862: it is the oldest known medical treatise on trauma, and may have been a military manual, judging by the nature of the traumas addressed.

The papyrus presents 48 case histories, listed by organ. It begins by addressing injuries to the head, and continues with treatments for injuries to neck, arms and torso, and so down the body. Each case is explained in its title: e.g. “Practices for a gaping wound in his head, which has penetrated to the bone and split the skull” Then followed: first, an examination, looking for evidence; then diagnosis and prognosis, and decision as to: treatable; possibly treatable; untreatable. Finally, treatment options are offered.

Among the treatments are: stitching, bandaging, splints, poultices, using honey against infection, and stopping bleeding with raw meat; immobilization for head, spinal cord, and other lower body injuries. The treatise contains the first known descrip-
tions of the external surface of the brain, the cerebrospinal fluid, and of intracranial pulsations.

The Edwin Smith papyrus demonstrates a greater degree of knowledge of medicines than Hippocrates, who lived 1000 years later. It is believed that the papyrus is an incomplete copy of an older reference manuscript from the Old Kingdom, evidenced by archaic grammar, terminology, form and commentary. The text has been attributed to Imhotep, the architect, high priest, and physician of the Old Kingdom, 3000–2500 BCE.

The Edwin Smith Papyrus, together with other medical papyri, reveal a surprising degree of medical knowledge, particularly in respect of the visible parts of the body. Internal diseases were generally thought to be treatable using heka, magic spells, although in later times some physicians also sought to “suck out” the evil using suction cups, as shown in Figure 24, right hand photograph, bottom left hand corner. (This practice survived into 20th Century Englan

Fractions and Instruments

The left hand photograph shows the unitary fractions used, inter alia, in concocting medicines. The right hand figure shows medical instruments: pincers, knives, hooks, suction cups, weighing balances, flasks, etc.

Ptolemaic Period, Kom Ombo
KOM OMBO TEMPLE
Two temples in one

Kom Ombo was a double temple: one half was dedicated to Sobek, the crocodile god; the other half was dedicated to Haroesis, or Horus the Elder.

VALLEY OF THE KINGS

Shows the natural pyramid at the end of the valley, thought to have been one of the reasons the valley was considered sacred...
New Kingdom Culture, Art, Literature, and Afterlife c1570-1070BCE

Art
During the New Kingdom, the Old Kingdom, particularly the Fourth Dynasty, would be looked upon as a “Golden Age:” the New Kingdom would, in its turn, also be looked upon as a “Golden Age.” Successive, powerful pharaohs presided over a secure, stable and prosperous nation, or so it seems on the surface, although it is in the nature of societies to be dynamic and turbulent from time to time.
Ancient Egyptian Literature And Poetry
Only a fraction of ancient Egyptian literature and poetry has survived from the early Middle Kingdom, and before, written on papyrus scrolls and packets, limestone or ceramic ostraca, wooden writing boards, monuments and coffins. Deir el-Medina was a fertile source of such material. As an exclusive band of royal tomb workers, the residents were highly literate and educated; they used ostraca for much of their writing, many of which have survived through being put into a midden, or rubbish pit. Papyrus
from the Nile floodplain, on the other hand tended not to survive, but to rot down and decay.

Poems were written to celebrate the king. Poems have been found written on wooden boards by schoolboys. Poems have been found honoring various gods and the Nile. The Great Hymn to the Aten, written in the reign of the heretic Pharaoh Akhenaton (1353-1336 BCE) also famously, if improbably, influenced Psalm 104 of the Old Testament

*The Story of Sinuhe* is considered to be one of the finest examples of ancient Egyptian literature. The universal nature of the themes explored in the Story, including divine providence and mercy, has resulted in the anonymous author being dubbed the “Egyptian Shakespeare.” The Story of Sinuhe was written in verse, probably in the 20th century BCE, but may also have been performed, and was much copied throughout the New Kingdom.

In the Story, Sinuhe is an official who accompanies Prince Senusret I (1971-1926 BCE), co-regent with his father the king, on a mission abroad. While abroad, he hears that the king, Amenemhet I (1991-1962 BCE) has been murdered, and fearing retribution, he flees to Canaan. There he marries the daughter of a chief, and their sons grow up to become chiefs. Sinuhe fights rebel tribes for his chief and, now an old man, he defeats a powerful opponent in single combat. But, Sinuhe knows that he may not have eternal afterlife unless he returns to his homeland of Egypt. His prayers to return home are answered by an invitation from (now king) Senusret I, which he happily accepts, living out the rest of his life in royal favor, finally being interred in a beautiful tomb.

The story contains many symbolic allusions. Sinuhe’s name, Son of the Sycamore, correlates with the sycamore as an ancient Egyptian Tree of Life, associated with Hathor, goddess of fertility, rebirth and patroness of foreign countries: Hathor features throughout the story. Parallels in the Story can be seen too with the story of Joseph from the Bible, where he is sold into slavery but manages to become one of the ruling elite in Egypt. Sinuhe’s single-handed combat is also compared with the story of David and Goliath, and his return home with the parable of the Prodigal Son.

**Ancient Egyptian Identity**

The Egyptians had a sense of their unique identity as individuals, which was reflected in their beliefs about (what we might call) the mind and the soul, where these might be located within the body, how the soul could survive death provided it kept in contact with the mortal remains, etc.
While they may have suspected that the brain was in some way associated with sight, hearing, smell and taste, all being together in the head, they believed that the intellect was located in the heart. Together with the lungs, stomach, liver and intestines—which were retained in individual Canopic jars—the heart was retained in the body as essential to the continued existence of the individual’s identity after death, while the brain was removed through the nose during mummification, and discarded as unimportant.

The Egyptian notion of the spiritual part of the equation is rather more complicated: their concept of the mind/soul/psyche was made up of five parts: the Ib, or heart, the seat of emotion, thought, intellect, purpose; the Ren, or name, given at birth, the Ren was believed to last as long as that name was spoken; the Sheut, silhouette or shadow, believed to contain some part of the essence of the person; the Ba, the personality of an individual, taking the form of a bird with the head of that individual; the Ka, the vital essence of a person, that leaves the body only when the person dies; and, last but far from least, the Akh, or “shining one,” formed from a joining of the Ba and the Ka in the afterlife.

The nature of the akh changed over time. During the pyramid age, the akh of a pharaoh was believed to join the circumpolar stars some time after death... Later, when afterlife was no longer exclusive to royalty, it became a ghost, or wandering dead being, that might invoke nightmares or sickness.

Many of these ideas and beliefs are not so very different from those of today’s psychologists, religious leaders and ordinary people, although couched in different terms. It is reasonable to assume that ancient Egyptian society was both less and more sophisticated than that of today: politics and economics had not been invented, neither had theology, since there was no separation into sacred and secular: all of life was seen as occurring in the presence of the gods and, as we have seen, their religious concepts were complex, yet insightful. There was little difference in the standing in law between men and women. Boys learned their trade from their fathers, girls from their mothers. Women could serve in the temples of Hathor and Isis, female deities, while men might serve in the male counterparts, Amun-Ra, Sobek, etc. Health was a problem, with high maternal and infant mortality rates; while broken bones could be reset, problems with internal organs were not well understood, and the only antibiotic was honey, which was put on wounds to help them heal.

Overall, during the New Kingdom, this second golden age of ancient Egypt, the impression emerges of a busy, occupied, largely innocent population made up of many settlements and societies living up and down the Nile, getting on with the daily business of growing crops, raising cattle, praying to the gods for good Inundations, marry-
ing, raising families, and so on... there seemed to be little for the average person to worry about outside of his and her absorbing everyday lives.

At the same time, there was a continuing outburst of creativity in architecture, poetry, literature, mathematics, art, jewelry, and furniture, much of which still remains for us to admire. Using Maslow’s Hierarchy of Needs as a guide, it seems that Egyptian society in the New Kingdom was motivated to be self actualizing at the highest level. We may tentatively deduce that their lives, which—apart from the upper class—revolved largely around trading, agriculture, husbandry, fishing, making clothes, and raising families, would have been a satisfying and absorbing one; for those concerned with fine arts, perhaps even more so.

All of this took place within a 3-class structure, with the Pharaoh at the pinnacle of the small upper, ruling class, a significant middle class of traders, managers, shopkeepers, priests, scribes, chandlers, and a large lower class of ‘doers,” the bulk of the people: farmers, fishermen, stone masons, ship builders, rope-makers, weavers, bakers, etc., etc. Despite class demarcation, they all had an abiding belief in life after death; that they would go, with their families, restored to their prime, to an afterlife which would be similar to their everyday lives, but even more comfortable, suggesting that those everyday lives were more than acceptable. Thus, it seems, philosophical and ontological questions concerning the purpose of life never arose: the people of Egypt knew the purpose of their lives—to raise their families and to work towards a happy and contended afterlife.

Comparing life in the West today with New Kingdom Egypt – in terms of standard of living and, particularly, the human condition – suggests that the ancient Egyptians may, on average, have been happy and well adjusted. Of course, they had no telephones, TV, wireless, etc., and medical care was limited, but these modern manifestations count little toward human happiness, family, contentment, assurance of the hereafter, creativity, etc.; they appear – at a considerable distance, admittedly – to have been content. This despite (or because of?) relative unsophistication, lack of science and technology, and a vibrant society within a firm class structure in which there was a place for everyone, no social mobility, no democracy, and no apparent need...
CARAVANSEIREI

Group traveling by camel: the camel was late in arriving in Egypt, probably about 5th Century BCE

SUNSET OVER THE NILE

A fisherman casts his nets, as they have done for many thousands of years...
The Classical Period

Conventionally, the Classical Period is taken to begin with the earliest-recorded Greek poetry of Homer (8th–7th century BCE), continues through the emergence of Christianity and the decline of the Roman Empire (5th century CE), and ends with the dissolution of classical culture at the close of Late Antiquity (CE 300–600). Within this timescale is the period of Classical Greece, 5th to 4th Centuries BCE. Classical Greek culture influenced the Roman Empire, which spread a version of it throughout the Mediterranean Basin and Europe, making it the foundation of modern Western culture.

However, ancient Greece may have been influenced by the nation state of ancient Egypt, which by the 8th Century BCE was in something of a decline, but which, nonetheless, presented fine art, architecture, mathematics, poetry, literature, medicine, etc., to explorers from the fledgling Mediterranean states, including Herodotus of Halicarnassus, (c.484-425 BCE) the ‘father of history,’ who had much to record about ancient Egypt in his Histories. Ancient Egyptian culture may also, then, have contributed to Western culture, albeit through Greek intermediaries...and, the term “Classical Period” may have missed out, perhaps through ignorance, the elegant and creative culture that was the New Kingdom of ancient Egypt.

Athens, a leading city state of the period, famously experimented with direct democracy, in which people did not elect representatives to vote on their behalf, but instead voted in person, in their own right. To vote, one had to be an adult citizen, which excluded seven eighths of the population: democracy not being what it is today, many of those excluded were women and slaves.

Direct democracy flourished under the Athenian leader Pericles (‘surrounded by glory’) 495-429 BCE: after his death, however, competitors for his position formed factions, and direct democracy declined rapidly into ochlocracy—mob rule, or “mobocracy;” which tendency we can see around us today.

Greek philosophy arose in the 6th Century BCE, and dealt with a wide variety of subjects including political philosophy, ethics, metaphysics, ontology, cosmology, logic, biology and aesthetics. Notable Greek philosophers of the period were Anaxagoras (510-428 BCE), Protagoras (490-420 BCE), Socrates (c.470-399 BCE), Xenophon (430-354 BCE), Plato (c.428-347 BCE), and Aristotle (384-322 BCE). The influence of ancient Greek and Hellenistic philosophers was lost to the West after the collapse of the Roman Empire, but was recorded and transmitted first through early Islamic philosophy, and subsequently into the European Renaissance and the Age of Enlightenment.
Early Greek philosophers were notable in that they rejected mythological explanations of natural phenomena in favor of rational and considered discourse. Their activities were largely focused on Athens, where Plato would establish a school. However, Socrates fell foul of Athenian conservative elements (mob rule of the time), which had established it as a crime of impiety to investigate “things above the heavens or below the earth.” He was found guilty of corrupting the minds of the youth of Athens and of impiety, and was famously condemned to death by drinking poison hemlock.

The influence of Greek philosophy is felt today, particularly throughout the Western world. Socrates became established as the founder of political philosophy and greatly influenced subsequent philosophers, including his student Plato, who popularized (and perhaps modified) Socrates’ views. Aristotle, too has been hugely influential, not least with his Composition Laws, which gave us inter alia: “The whole is greater than the sum of its parts; the part is more than a fraction of the whole,” which must surely stand as the cornerstone of today’s systems thinking and systems practice. The Greek philosophers raised the consideration of natural and manmade phenomena to a new intellectual level, where rationality ruled and teleological explanations were unacceptable.

The Industrial Revolution
Late Antiquity, otherwise known as the Dark Ages, followed the decline of the Roman Empire, and led on to the Middle Ages. Late Antiquity is notable for the rising of Abrahamic religions: Christianity, rabbinic Judaism and Islam. The Middle Ages were notable for barbarian invasion, feudalism, construction of Gothic Cathedrals, crusades, plague, population reduction, Inquisition, scholasticism, founding of universities, shifting balance of power between feudal masters and serfs, peasants revolts, etc.

The Early Modern Period followed the Middle Ages, leading in turn to the Industrial Revolution, which started in about CE1760, with the introduction of machines to replace hand production, new chemical and iron production processes, improved efficiency of water and steam power, the development of machine tools, and the transition from wood to coal power.

The industrial revolution accelerated the migration of people from countryside to city, particularly with the introduction of efficient, mechanical farming machines. In the figure, the left hand diagram shows the status quo as it had existed for centuries, sometimes easily, sometimes uncomfortably. Society was ordered, class-based and largely stable. For upper classes/landowners, life was both elegant and sweet; they
were able to afford the best, not only in terms of housing, furniture and fabrics, but also in education, art and literature.

Mechanized farming upset the balance. Landowners no longer needed so many farmhands, who were forced to go to the cities to find work. The cities were—and may be considered still to be—in a state of relative social turmoil. Land workers found it difficult to find work and may have ended up in slums. The textile industry came to the rescue in some places, with the rapid expansion of factories and workers, although—as there were still too many people seeking work—the factories could afford to pay little, and employed children and women for repetitive work.

As the right hand part of the figure shows, the migration from land to town had serious and progressive effects on societies: the effects are still being experienced. Indeed, the Industrial Revolution is still rumbling around the world today. The net result may be viewed as de-civilizing, in the sense that education, culture, family-based stability, social class, and social mores were all prejudiced, accompanied by crime, so-
cial atomization, crowding, and alienation of the human animal from the rest of Na-
ture on which its existence ultimately depends. On the other hand, the standard of liv-
ing for the masses, now living largely in towns and cities, appears to have risen, and
medicine and health care have improved significantly.

But, what of culture, education, social structure, social stability and the human
condition? Along with Renaissance, western culture has seen the French and Russian
Revolutions, and the concomitant rise of Marxism and socialism, with their intent of
“leveling the playing field,” of taking the power from the powerful by force, and giving
it to the people instead. For the masses, this has not had the ennobling effects on cul-
ture, education, society and the human condition, that the revolutionary instigators
may have wished for.

It seems unreasonable to assume that we are any “better off” than the ancient
Egyptians of the New Kingdom, two and a half millennia ago. Indeed, some might con-
sider the prospects for the ascendant ape to be generally less congenial—and even de-
graded—in respect, particularly, of the human condition than at that time...
CHAPTER

THE HUMAN CONDITION

Holy Island
ST. MARY’S, LINDISFARNE, “HOLY ISLAND,” NORTHUMBRIA, ENGLAND
Understanding the Human Condition

The nature of the human condition is controversial. It reflects that humans, unlike most other animals, are self-aware and introspective. The human animal is concerned about an uncertain future, worrying about what becomes of us and our offspring when we die, looking for purpose and ‘meaning of life,’ while recognizing that we are, each of us, ultimately alone inside our minds. Part of the human condition is to crave freedom, yet be beset by worries and concerns. Equally, part of the human condition is to be curious and creative, to seek and solve problems, to anticipate and plan ahead, yet regret the past...

We humans seek happiness, too, but may not be sure what happiness is... to some it is the acquisition of material wealth. A more insightful view, perhaps, proposes that "happiness is absorption:" if we are totally absorbed in activity, in pursuit, in creation, in solving problems, in living for the moment, even childlike, then we are fulfilled and have no need, or time, for introspection, to worry about mortality and the hereafter...

Isolated tribes and bush people still live in remote parts of the world in much the same way as 30,000 years ago: it is remarkable how such tribes thrive, giving every appearance of being dignified, content-yet-curious, happy, totally absorbed with everyday living, hunting, fishing, gathering, house- and boat-building, and raising robust families, yet without any runaway population growth.

Their big brains do not appear to have misguided or “short-changed” them, but instead they seem intent and fully occupied with living. They live in balance with the natural world surrounding them, of which they see themselves as an integral part. They flourish without any modern medicine, telecommunications, processed foods, entertainments...

They know their natural surroundings intimately, and how to make best use of the many foods, materials, substances and remedies that they can derive, sustainably, from local flora and fauna. They continually seek to enhance their knowledge, and pass it on to their offspring as the next generation of hunters and gatherers.

Do these peoples, perhaps, exhibit the quintessence of the human condition? Can we, perhaps, learn from them how to control the current human population explosion threatening the rest of the world?

A world of 7 billion people cannot go back to living in the Stone Age; although, some religious fundamentalists would like us to return to much simpler times. The human condition has significantly improved, however, in measurable, physical aspects such as health, lon-
gevity and education: this at the expense of hard-to-measure aspects such as happiness, contentment, freedom of thought and speech, freedom from fear, creativity, sense of purpose, opportunity to live for the present without concern for the future... Contemporary humans, especially city dwellers, do indeed appear to “suffer from the human condition.”

Human Self-reflection
We humans are able to practice introspection, and seek to learn more about our nature, purpose and essence. We are able to think about our own thinking, meta-thinking, which can lead us to question ourselves, our purpose in life, “what it all means,” what will happen to us when we die, even if this everyday experience of life is real, or all in some imagination or simulation. René Descartes solved this issue to his own satisfaction with his famous saying, “cogito, ergo sum;” the very fact that he could think about his existence, had to mean that he did really exist—and not just in his imagination.

Eschatology concerns itself with the supposed final events of history, or the ultimate destiny of humanity—i.e., the “end of the world,” the “end of days,” the “end of time.” Countless books and films continue to address different aspects of this idea, with only one person left alive on Earth, apocalyptic visions of future wars with aliens, global warming bringing all life to an end, etc. The continuing popularity of such films suggests that many people enjoy such reflection on the fragility of human existence, which in turn suggests they may either be rather low (Level 2?) on Maslow’s Hierarchy of Needs, or more likely that they enjoy mentally flirting with such horrific notions of imminent disaster. Either way, they seem more interested in anticipating future problems than of being absorbed in living in the present...

The ability of humans to reflect on their own nature is, presumably, related to their big brains, which, having more capacity than is required for day-to-day existence, seeks other things to think and worry about. This is an unusual capability; dogs do not appear to self-reflect, nor cats, nor any domesticated animals. They all seem to “live in the moment;” i.e., they do not plan ahead, they do not appear to regret the past, they just “take life as it comes.” It is less clear with elephants, however: they appear to be self-aware, and may possibly be introspective, too. But, how would we know?

Bush people living Stone Age lives today also appear to live in the moment. Certainly, they plan ahead for the next day’s hunt, and they recall experiences so that they may learn how to do things better than before. But they do not agonize over the meaning of life: it is obvious to them. Life is, essentially, propagation of
the species, or more specifically of their children, family, tribe, etc.

So, to them, life is about protecting the family, about feeding the family, about bringing up the children and teaching them to hunt and to gather, and to acquire all of the highly specialized knowledge that entails so that they, in their turn, will grow up, raise children and so continue into the future. In other words, they are fully absorbed in the fact and business of living, and are not noticeably concerned outside of that. Or, so it may seem...

Life After Death – Heaven And Hell
Not all of our antecedents have been like that however. As we saw earlier, the ancient Egyptians had a highly developed concept of an afterlife, to which anyone could aspire provided they had led a blameless, constructive existence. In life, they believed, each person had a soul that could persist after life. Initially, however, during the Old Kingdom, only the King could aspire to an afterlife: he was considered to be a god, and so able to negotiate in heaven with other celestial gods.

Even at that time, Heaven was “up there” and the Netherworld of Osiris was “down there.” By the time of the New Kingdom, most people spent a significant propor-
tion of their time and wealth preparing their burial place for an eternal afterlife, and in learning the complex rituals and trials that they believed they would face in the Hall of Judgement before they were judged worthy of entry into “the other world.” Living a good life in this world was also necessary, if not sufficient, to ensure an even better life in the hereafter. Which was good social engineering for the state as well as serious “planning ahead” for the individual.

Christian philosophy evolved over time, until there was a heaven, a hell and purgatory—an intermediate state after physical death where those destined for heaven were purified until acceptable for entry to heaven, or if unacceptable, to descend to hell. At least, according to Catholic Church doctrine, which also decreed in the Old Testament (as in the Jewish Torah): “And God said, Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth.” (Genesis 1:26). This passage clearly sets a godlike Man apart from, and well above, all other creatures, and has been used to justify mistreatment of animals in the past. It was also part of the Christian ideal that each person should lead a blameless life to gain entry upon death to heaven...which was somewhere else, unspecified.

The Qur'an Majeed also states that man has dominion over animals: "He (God) it is Who made you vice-regents on earth." (Qur'an 35:39). This responsibility is conditional however. Those who misuse their freedom of choice and fail to conform to the conditions that limit this responsibility: "then We reduce him (to the status of) the lowest of the low." (Qur'an 95:4,5.) Islam also describes a heaven and a hell respectively, for those who have lived proper lives, or not.

The primitive tribesman, hunter-gatherer, would find this concept of dominion over animals peculiar. He would regard himself as one animal among many, and would respect, even revere, the animal he necessarily hunted and killed for food for his family.

Buddhism also sees things quite differently. There is a concept of “evolving consciousness” that, upon death, becomes one of the contributing causes for the arising of a new consciousness. The consciousness in the new person is neither identical with, nor totally different from, that of the deceased person, but the two form a causal continuum. There is, apparently, no “end of days” in Buddhism:

“From a Buddhist point of view, the easiest way to define hell and heaven is that where ever there is more suffering, either in this world or any other plane, that place is a hell to those who suffer.
And where there is more pleasure or happiness, either in this world or any other-worldly existence, that place is a heaven to those who enjoy their worldly life in that particular place...

“Buddhists never try to introduce Buddhism by frightening people through hell-fire or enticing people by pointing to paradise.”

Venerable K. Sri Dhammananda Maha Thera

In non-theistic Buddhism, vegetarianism has been widespread, in line with the doctrine of non-violence. Human souls could be reincarnated as animals if they had behaved badly. Failing to observe the duty of care could lead to bad karma, so increasing the prospects of returning as an animal “next time around.” (Ryder, 2000)

So, even in Buddhism, Man is, somehow, better than the animals, or at least potentially closer to Nirvana.

Modern humans, it seems, are prone to “the human condition,” brought about by introspection, brought about in turn, perhaps, by having time on their hands, perhaps from not having to struggle constantly to live and raise a family in the face of challenging environments. So, how could this have come about? And did the early Hominim suffer from the human condition—for suffer from the human condition, we now seem to do, as a species, on a global scale.

Humans not only see themselves as superior to other animals, but to other groups of humans, especially those of a different race or religion. As this is being written, large numbers of Muslim extremists are committing atrocities in Syria and Iraq, against other Muslims of different sects.
Freedom is a tricky concept. “Free as a bird” gives us some notion of freedom - freedom to roam, freedom to do what you want, when you want. But birds are forever hunting for food, evading predators, being battered by the weather...is that really freedom?

Freedom to do what you like, when you like—perhaps that is freedom. Only, that may result in you upsetting others, causing damage, and being an all-around nuisance; so perhaps freedom for one is not freedom for others.

Having human rights, perhaps? But, does anyone really have rights because they are human? And, if we do, surely that should apply to every creature on Earth, not just humans; and, why limit it to animals - what about trees, and plants? We may have rights under the law - which is basically there to protect the weak from the strong. Do ‘human rights’ add anything to that?
Freedom

The human condition is one of wanting freedom: but, neither being sure what freedom is, nor being too happy when freedom is thrust upon them. Freedom is bound up with liberty, the opportunity and ability to do as one likes. In politics, liberty is freedom from government coercion. In theology, liberty is freedom from sin, where the nature of sin is determined in the theology, so is self-referential.

Definitions of freedom are difficult: typically, freedom is the right do whatever you want, provided that you do not infringe upon others’ similar rights. So, freedom is immediately bounded by its potential to affect others, which necessitates conventions to be established and laws to be imposed such that freedom is within “reasonable bounds.”

So is freedom a physical, or a mental, state of being unrestrained?

Stone walls do not a prison make, nor iron bars a cage;
Minds innocent and quiet take that for an hermitage
If I have freedom in my love, and in my soul am free;
Angels alone that soar above, enjoy such liberty.

Richard Lovelace, 1618-1658

Lovelace’s iconic verse would have it, then, that freedom and liberty are to be found in the innocent and quiet mind. Zen Buddhists might agree.

Be that as it may, it is evident in the affairs of man that freedom is a rare commodity. The religious person who prays, gives to the poor, etc., is bound by canon to believe in certain non-provable things, and by ritual to do certain things at certain times in certain ways; surely, not freedom. Yet very many people, although bound, feel comforted and at ease with, even inspired by, their religion, its rituals, beliefs and demands.

Humans are gregarious by nature; we self-organize social groups, which auto-create rules of association, formal or informal, and which tend to invoke characteristic dress, insignia and/or behavior, to distinguish between those in the group and those outside of the group. Moreover, we are creatures of habit, preferring familiar routine
and ritual to change. And it seems to be the case that many humans prefer to be led by a strong leader than to lead; and, many will fail to follow a weak leader.

Members of a political or societal party feel that they need a leader who, once nominated, may promote a group ideology, and will introduce rules of behavior, rules of practice, rules of relationships, policies to be pursued, etc., such that the members are no longer as free as they were, although they may not perceive these new constraints as loss of freedom, so much as a discipline by which to follow their leader to success.

*Democracy Vs. Ochlocracy Vs. Dictatorship*

Democracy, rule of the people by the people, supports the notion of equal participation for all eligible citizens, usually through elected representatives who, as the name suggests, are expected to represent the views, aspirations and concerns of the people they represent. As we saw earlier, direct democracy, Athenian style, had the tendency to descend into ochlocracy, mob rule...so, not free. Under Pericles, women were not “eligible citizens;” neither were the many slaves, who greatly outnumbered the eligible
“freemen.” Even when Athenian direct democracy operated, it was based neither on equality, nor upon freedom for all...

Democratic government operates on the principle of majority decision-making, which immediately means that the views of many, up to half, of the citizens will not be addressed. Although it may be sensible and reasonable, this is not freedom for them...

Political parties, operating within the democratic framework, organize the various elected representatives into groups, which then represent the policies of the respective party leaders; representatives of the people may find themselves no longer representing their constituents, but perforce voting along party lines instead; so, neither free nor truly representative. It seems that parliamentary democracy, as currently practiced, is hardly democratic, at least not in the original sense of the term, but it is at least reasonably stable. Although, citizens have the opportunity to vote for new representatives every few years...so, may be occasionally—and very briefly—free? The suggestion has to be that “pure” democracy, Athenian style, is impracticable and probably unstable.

On the other hand, many countries survive and flourish under dictatorships, even military dictatorships, which can be brutally oppressive, or can be benign. The ancient Egyptians flourished and developed under successive, relatively benign pharaonic dictatorships. But then, the idea that there was some viable alternative, such as democracy, or communism, or military dictatorship, had never been voiced. Perhaps freedom is a relative idea, in which people can feel themselves to be free since any notion that they could be “freer” under another regime had been neither conceived nor voiced. Perhaps, for ancient Egypt, Pandora’s Box had yet to be opened...
CHAPTER

HUMAN SYSTEMS

Ceiling of Cathedral in Valetta, Malta
The evolution of the brain is a contentious topic, with few clear facts. Only very recently has modern medical technology started to probe beneath the surface and observe its dynamic behavior.

Even that, however, smart though it undoubtedly is, is a long way from understanding how the brain works...
Evolving Brain Size

*Homo sapiens* is remarkable, amongst many other features, for size of brain. There are larger brains in the animal kingdom, but in proportion to body size, the human brain is very large. Brain size need not be everything, but it is often taken as an indicator of intelligence. Brain size amongst selected hominids has increased over some seven million years, starting with *Sahelanthropus Tchadensis*, a cranial skull of which was found in Chad in 2001/2002. It seems likely that it was bipedal, on the basis of its

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Lived (years ago)</th>
<th>Brain Capacity (cm³)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sahelanthropous Tchadensis</td>
<td>c.7 million</td>
<td>c.320-380</td>
<td>May have been bipedal</td>
</tr>
<tr>
<td>Australopithecus Africanus</td>
<td>c. 3-2.4 million</td>
<td>c.452</td>
<td></td>
</tr>
<tr>
<td>Homo Habilis</td>
<td>c.2.5 million</td>
<td>c.612</td>
<td>Tool maker</td>
</tr>
<tr>
<td>Homo Erectus</td>
<td>c.2 million</td>
<td>850-1,100</td>
<td></td>
</tr>
<tr>
<td>Homo Heidelbergensis</td>
<td>c.600,000</td>
<td>1,100-1,400</td>
<td></td>
</tr>
<tr>
<td>Homo Neanderthalis</td>
<td>600,000-30,000</td>
<td>1,600</td>
<td>Larger than modern man*</td>
</tr>
<tr>
<td>Homo sapiens</td>
<td>200,000-present</td>
<td>1,400</td>
<td></td>
</tr>
</tbody>
</table>

*Brain size notably larger than modern humans, but Neanderthals were less encephalized, due to larger body size...*
anterior foramen magnum (Latin: “great hole”), a large opening in the occipital bone through which the medulla oblongata, an extension of the spinal cord, enters and exits the skull.

The table does not represent any established evolutionary sequence: there is much discussion and argument about human lineage. Nevertheless, it may indicate a trend towards larger brains in bipedal apes over extended time. Trends away from the norm tend to be self-limiting: there are sensible limits to how tall a person might become, for instance, or how small. Any increase in brain size, although perhaps rapid to start, would be expected to level off over time.

The chart presents the figures from the table in graphical form, using logarithmic horizontal and vertical axes, and including a trend line. Unexpectedly, the trend line shows that, rather than the rate of increase in brain size slowing, the rate has increased over the last seven million years. Slowly but inexorably, it seems, our hominid brains are getting bigger...

Of course, there has to be more to it. Upon closer examination, the infant brains of Homo Neanderthalis and Homo sapiens appear to have been much the same, al-

N.B. The graph is formed from limited evidence, particularly for earlier values of brain size. Nonetheless, while the trend could be less (or greater?) than indicated, it is observable.
though the former’s grew larger in adulthood along with the rest of the body. Moreover, the brains of human infants continue to grow after birth until the age of about seven, so alleviating the problem presented at birth by the female human’s relatively narrow birth canal.

Then there is the issue of brain size as an indicator of intelligence. Surely there must be more to it than size: the internal architecture and organization of the brain might be important, too.

**The Triune Brain**
The Triune Brain is a twentieth century model of the evolution of the vertebrate forebrain and behavior, proposed by the American physician and neuroscientist Paul D. MacLean. The Triune (‘three in one’) Brain consists of the reptilian complex, the paleo-mammalian complex, and the neomammalian complex (neocortex), viewed as structures sequentially added to the forebrain in the course of evolution: the reptilian brain: responsible for species-typical instinctual behaviours involved in aggression, dominance, territoriality, and ritual displays; the paleo-mammalian brain, otherwise the Limbic System, responsible for the motivation and emotion involved in feeding, reproductive behavior, and parental behavior; and, the neomammalian complex, or cerebral neocortex, responsible for language, abstraction, planning, and perception.

These three are viewed as successive evolutionary overlays. The Triune Brain model has been partly overtaken by recent research, but it still offers a seductively straightforward way of regarding the human brain.
PHRENOLOGY
by
L.N. Fowler

Phrenology was the detailed study of the shape and size of the cranium as a supposed indicator of character and mental abilities. Popular for a time during the Victorian period, it has since been discredited.

Curiously, however, the word “system” - the subject of this book, human systems - is shown sitting over the left eyebrow...
Layers in the Cortex
The cerebral cortex is the outermost sheet of neural tissue of the cerebrum of the human brain. It is divided into left and right hemispheres, and plays a key role in memory, attention, perceptual awareness, thought, language, and consciousness. It consists of up to six horizontal layers, each with a different composition in terms of neurons and connectivity.

The surface of the cerebral cortex (‘grey matter’) is folded such that more than two-thirds of the human brain are buried in the grooves. In evolutionary terms, the most recent part of the cerebral cortex, the neocortex, is formed—as noted—from six horizontal layers; on the other hand, the more ancient part of the cerebral cortex, the hippocampus, has at most three cellular layers, and is divided into subfields. Neurons in various layers connect vertically to form small microcircuits, called columns. Different neocortical structural fields are distinguished by variations in the thickness of these layers, their predominant cell type and other factors such as neurochemical markers.

The human brain is the most complex part of the human body, and although some may like to compare it with a computer, with the software of a computer, such comparisons do not seem to offer useful models by which we might advance our man-made computing systems...so far.

Levels Of Organization Within The Brain
The brain is an exceedingly complex organ that is defying attempts to analyse and reduce its performance and behavior. However, there have been attempts to show levels of organization within the brain, as part of the Human Brain Project as follows: Whole Organ, comprising some 89 billion neurons and 100 trillion interconnections (making over 1000 connections per neuron on average); Regions, mutually interacting major neural substructures, amygdala (emotions), hippocampus (memory), frontal lobes (executive control); Circuits, neural interconnections among neighboring cells and between different brain areas; Cellular, neurons, non-neuronal glial cells, dendrites and axons; and finally at the lowest level, Molecular, parts of a neuron and its transmission of electro-chemical signals

Looking ‘horizontally,’ across the upper layers, there also appear to be functional ‘subsystems’ within the brain, concerned with speech, vision, motor control, etc. In addition, Evolutionary Psychology proposes, controversially, that the brain houses a variety of psychological mechanisms, evolved in the Pleistocene to solve recurring prob-
lems of survival, including those of growth, development, differentiation, maintenance, mating, parenting, and social relationships in that era, and which are still with us today—there having been insufficient time for biological evolution to have changed materially the brain in the relatively short time since then.

So, the properties of the brain-as-an-organ supervene upon the cellular and molecular properties at the bottom of the hierarchy. That is, higher-level phenomena are caused by, and depend upon, events at the most fundamental physical level. This is not to suggest that physics can predict human thought and emotion. However, it is to suggest that mind, thought and emotion are all physically based...

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<tr>
<th>BRAIN</th>
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The Human Brain Project is undertaking an ambitious task, employing ‘synthesis biology;’ this is essentially simulating the human brain within a computer. As a test case, the project team built a unifying structure called a cortical column: this is described as analogous to putting a miniature apple corer through the cortex and pulling out a cylinder of tissue about one half millimeter in diameter and 1.5 millimeter in length; this would constitute a column.

The column penetrates the six vertical layers of the neocortex; the neural connections between it and the rest of the brain are organized differently in each layer. A few hundred neuron types reside in the column.

The team simulated the behavior of a column from a newborn rat, allowing the virtual neurons to connect up as real neurons would, eventually providing them with a static model of a column, as in a comatose brain. They then ‘jolted’ the column with a simulated electrical impulse: the neurons began to interact and intercommunicate. ‘Spikes’ or action potentials, spread through the column as it began to work as an inte-
grated circuit; this was spontaneous, not programmed behavior. And the column stayed active after the stimulation stopped, briefly developing its own internal dynamics...

Here, then is a fascinating, new way of looking at the way the human brain might work, and—although not its primary, medical purpose—it may afford potential for novel design of complex computing and information systems of the future.

Brain Cells for Concepts

Neuroscientists dispute how the brain stores memories—which it does remarkably well. Some view memories as somehow spread across the brain and interspersed with each other: others suspect that memories are stored in individual neurons, or groups of neurons. Research, particularly into the brains of those with debilitating epilepsy, is showing interesting results.

Researchers have been able to insert fine probes into the brain, particularly into the hippocampus, and have discovered individual neurons firing when the subject is presented with a picture of a well-know film or TV star, or has seen their name written. An individual neuron fired for the actress Halle Berry, again to her name written on a screen, and again to her name spoken by a synthesized voice. The same phenomenon occurred for Oprah Winfrey, and for character of Luke Skywalker from the Star Wars films; each appeared to have his or her own ‘neuron.’ The research team could not assert this, however, because they were able to sense only a few neurons at a time: others could have been firing but undetected.

However, further research showed that individual neurons might fire for more than one such star. The neuron that fired for Jennifer Anniston also fired for Lisa Kudrow, her co-star on Friends. Again, it was sufficient to show any picture of either star, or the written name, or the name spoken with a synthesized voice. Perhaps the neuron was firing for blondes, or for the TV series Friends? The neuron that fired for Luke Skywalker also fired for Yoda: was there a Jedi neuron? Moreover, the neuron for e.g. Jennifer Anniston fired when shown only part of her, when wearing different clothing, etc. Such neurons, then, appeared to be firing in response to the ‘concept’ of Jennifer Anniston, or Yoda, or ... how could this be?

The organization and structure of visual information in the brain starts with the eyeball, with its optic nerve leading to the primary visual cortex at the back of the head. Here a detailed picture is formed, such that, for every detail in the observed image, there is some correspondence in the primary visual cortex. One neuron firing
does not indicate whether it is part of a tree, a wall, or a person, however, and the observer is interested in whether they are looking at an object, and if so, what object...

Next the visual information goes through a series of cortical regions towards the front of the brain. Individual neurons in these higher visual areas respond to entire faces, or whole objects, and not to local detail. So, minor changes in the visual scene will not affect these neurons.

Neurons in the higher visual areas send their information to the medial temporal lobe – the hippocampus and surrounding cortex – which is involved in memory functions and where the so-called Jennifer Aniston neurons were found. The response of neurons in the hippocampus is much more specific than in the higher visual cortex. Each neuron responds, not so much to an individual, as to a concept of some individual.
Concept Memory
There may be a ‘patch’ of neurons, a relatively sparse grouping, which respond to, say, Luke Skywalker and another patch that responds to Yoda, and these two patches overlap, meaning that some of the neurons that fire are common to both memories. Similarly, neurons for Jennifer Anniston and for Lisa Kudrow may also overlap. However, there may be little or no commonality between the sets for Lisa and Jennifer from Friends, and the sets for Luke and Yoda from Star Wars.

What does this all mean? Surgical removal of the hippocampus leaves the patient still able to recognize people and objects, and to remember events, but the patient can no longer make new, long lasting memories. It was as though the means of transferring from short to long-term memory had been removed, as if the ‘memory folder index’ had been erased.

So, the Jennifer Anniston neuron was not necessary to recognize the actress, or to remember who she was, but it was critical to bring her into awareness for forging new links and new memories about her, such as later remembering seeing her picture.

Memories are more than single isolated concepts. A full recollection of a single memory episode involving a person or thing – perhaps even a place – requires links between different but associated concepts. If two concepts are related, some of the neurons encoding one concept may also fire the other one. This hypothesis suggests how the neurons in the brain encode association, and possibly episodic memory such as the particular sequence of events during an encounter.

If the research is justified, an elusive aspect of the flow of human consciousness may have been explained. There are implications here for the memory systems, not only of humans, but also of autonomous machines, which will also need to associate concepts. An autonomous (android) peace officer, for example, would need to establish concepts of ‘people, places and things’ on the beat, together with episodic concepts of misdemeanors and crimes in progress. ‘S/he/it’ would recognize individuals with past records and observe their behavior, comparing it no doubt with models of acceptable behavior, threatening behavior, etc.

The autonomous peace officer would have to associate various concepts very rapidly – at least as fast as a human. In humans, speed of concept association may be related to the sparseness of concept representation – fewer neurons involved in representing each concept, the less ‘calculation’ required and the faster their association. Presumably, the same general rule would apply in a corresponding ‘machine brain.’
SECTION

HOMEOSTASIS

ALEXANDRIA, EGYPT

SALISBURY CATHEDRAL, ENGLAND
Homeostasis
Homeostasis, dynamic equilibrium, is maintained in the body partly by negative feedback processes, and partly by dynamics in open systems.

Control Through Feedback
While open system dynamics may be the principal means of establishing and maintaining homeostasis in natural open systems, many incremental feedback systems are also at work. Two well-known processes follow: one for maintaining blood sugar level, and the second for maintaining core body temperature. This ubiquitous ‘opposing pairs’ arrangement in natural systems is curiously at odds with engineering and cybernetic practices.

Maintaining Blood-Sugar Level.

Open headed arrows indicate positive, supporting relationship. Solid arrows indicate a negative, detracting relationship. E.g., increasing blood sugar level increases insulin secretion (open arrowhead); decreasing blood sugar level increases glucagon secretion (solid arrowhead).

Blood sugar level is usually regulated in the human body. Excess blood sugar caused, perhaps, by eating, stimulates the secretion of the hormone insulin principally by the pancreas, which allows glucose in the blood to be converted to glucogen (and possibly to fat) in the liver and muscles, so restoring the correct blood sugar level. On the other
hand, sustained physical exercise (or starvation) might cause the blood sugar level to drop: this is also detected in the pancreas, which secretes a different hormone, glucagon, which increases (restores the level of) glucose in the blood. Together, these elements within the body’s endocrine system maintain a steady level of blood sugar in a healthy human, although that level may change throughout a typical day.

Exercise also may induce food ingestion, which forms part of the energy transport equation for open organic systems. In this instance—and generally—open system dynamics operate in conjunction with the feedback controls to maintain homeostasis. The complex human system also has feedback mechanisms, not shown, which encourage eating when blood sugar falls, and when food is not needed but is expected as a result of regular, habitual feeding, as opposed to eating when hungry.

Maintaining Core Body Temperature
Maintaining body temperature presents an alternative view. In a hot environment, perspiration leads to evaporation cooling to maintain core body temperature. Less well appreciated, perhaps, is what happens when the body experiences a cold environment.
and the surface skin and flesh cool. Blood capillaries near the surface contract, closing off the flow of warm blood near the skin surface, so that the blood is not cooled so much. Flesh with the blood withdrawn (or not circulating as after death) forms an effective insulator, so that heat conduction through, and radiation from, the skin surface are also reduced.

The combined effect of these is to maintain essential body core temperature, at the expense of a cold surface skin.

Natural systems such as the human body clearly find it advantageous to maintain an equable inflow/outflow regime of energy, material and information, but also to control short-term variations using contra-acting, incremental feedback control ‘mechanisms.’

There appear to be advantages in this approach compared with the usual single-loop negative feedback technique used by engineers and cyberneticists. Equable inflow/outflow regimes allow the organism/platform to maintain homeostasis even when feedback control mechanisms are prejudiced, by changing behavior and/or environment.
Visiting The Farne Islands, Northumbria, England

INSTINCTUAL HUMAN BEHAVIOR
Beached vessels at Uphill, Somerset
The Modern Hunter Gatherer

Despite some 30,000 years or more of civilization, we humans are still subject to instinctive behavior of the kind we can recognize in our fellow great apes, if not in ourselves... We like to think that we are civilized and sophisticated, that we can exercise ‘free will,’ and that our human behavior is unpredictable. It may not be true.

Given knowledge of a person’s background, make-up, personality, recent situation and experiences, psychologists can predict what a person will do next, and be right. We are the product of our environment, and our behavior is the product of instinct, inheritance, experience, personality and context.

Further, the sophistication that many of us see in others, or in ourselves, is a thin veneer of learned thought, behavior, dress, etc., which serves to disguise the real person, to hide supposed vulnerabilities and to convince the sophisticates that they are somehow superior to other, ‘less sophisticated folks.’ That may also not be true.

*Homo sapiens* evolved, it seems, living in extended family groups off, perhaps, up to fifty, and hamlets or villages might comprise several extended families numbering some 150-250 in total; numbers are clearly imprecise. Peculiarly, our brains appear able to accommodate up to some 7±2 things at once/in parallel, perhaps reflecting the likely size of our nuclear families. Villages were surrounded by field and forest,
flora and fauna, upon which families depended fundamentally for their food resources; they evolved to live in harmony with the natural world, taking only what they needed to live while enjoying their families and their environment.

Since those early times, Man appears to have changed remarkably little ‘under the skin.’ Go into a supermarket and watch women, in particular, shopping. Some appear to enter “the zone,” a trance-like state in which, seemingly unaware of other shoppers, they pick items off the shelves swiftly and expertly, concentrating on items that are at, or just below, the sightline. Psychologists liken this to gathering fruit and berries off hedgerows, represented by the rows of shelves: they deduce that women instinctively collect the best, ripen fruit from just below the eye line, where it has been protected from the elements and other animals by overhanging twigs and branches – and they place products accordingly to move them off the supermarket shelves quickly, or to gain the best profit margin. It works.

Men may not shop in this fashion; they may be haphazard, less organized and inefficient by comparison. Men are more likely to decide beforehand what they want, go into a shop and buy it regardless of “shopping around” for the best price; they lack the gathering instinct. Consider, instead, the male business chief who stays on at work
long after he should sensibly have retired, clinching deals and receiving bonuses far beyond any reasonable needs. Why? Could it be that men are reluctant to forego the hunt, the chase and the kill? Like women as gatherers, men may exhibit an instinctive ‘hunter’ drive; which goes some way to explain their otherwise unaccountable behavior.

This fundamental difference between male and female is evident in many walks of life. It would be unusual, for instance, to find many men rummaging through clothing in “bring and buy” sales, jumble sales or garage sales; for many women it seems to be a delight! Many women wear makeup as a matter of course, and would be reluctant to appear in public without it. It may not be clear whether women, in general that is, wear makeup as a mask or disguise, or to propagate a preferred persona, or to appear more attractive to men, or to present themselves as looking more attractive than, and so to challenge/compete with/gain the respect of, other women.

There is, then, an underlying consistency in the nature and instinctive behavior of the ascending ape, which may discomfort, resist, or even conflict with social engineering that seeks to modify and impose ‘unnatural’ social behavior, ethics and morality.
SECTION

HUMAN BODY LANGUAGE
Human Body Language

We humans have an extensive body language, much of which we exhibit unconsciously. Two people meeting for the first time across a table will mirror each others actions, leaning forward, or back together, and regulating who is to speak next so that neither interrupts the other. We learn to do this as children, often without being taught. The person who is speaking does not look at the listener, who watches the face of the person speaking. As the speaker is finishing s/he will look at the listener, indicating that it is the listener’s turn to speak. We all regulate our interpersonal communications in this way. Of course, our body language is presenting at the same time. If two people who are sat side-by-side do not “get on,” they may subconsciously lean or turn, or both, away from each other. When entering an open space into a room, the newcomer is likely to place an arm across their body, in a typical “shield” movement to cover a psychological sense of exposure. Dominant personalities entering a room filled with subordinates may not do this—either they do not feel vulnerable, or they want to present themselves as being invulnerable.

Our facial expressions are one of our most apparent ways of non-verbal communication, being all the more important since, being upright, we may see each others faces at short range without impediment. Humans have the most expressive faces of
any mammal. We can question, or show mild surprise, with a twitch of one eyebrow, show amazement with the raising of both eyebrows, disapprove with a frown; we can smile without showing teeth, and with lips drawn back to show incisors; both are degrees of smile. However, opening our mouths with lips drawn back so that our molars show, is more likely to be “the face of anger,” than a smile. Our nostrils flare when angry or surprised. Our ears may twitch, our hairline move and our eyes widen when hearing or seeing something unexpected. Our features may soften, and pupils dilate, when we look at a baby or a loved one. Experts are able to observe “micro-movements’ of the face which can be interpreted as giveaways for what the mind behind the face is thinking, feeling, or about to do; and be right in surprising detail.

Women and some actors may employ clothing and hair to frame the face, or to cover some features, or use makeup to change the overt expressions on their faces. Women may use makeup to make their eyes appear larger, and more widely spread, since this image makes them look more like the open, wide-eyed face of an infant or baby which adults are genetically-programmed to care for.

We humans are empathetic: we understand another’s feelings. Seeing another’s facial expression, stance, or both, often inspires empathy. If we see another person going through some trauma, we may sympathize and share their feelings to some degree. We do not appear to be unique in this, but certainly humans can be empathetic to a high degree compared with other mammals, while reptiles seem to lack this facility all together.

We also use body movements in a distinctive way. If we disagree with something we may shake our head, or nod if we agree. This may be traced back to the suckling baby, which will nod its head when looking for the teat, indicating a need to feed. Conversely, the baby will shake its head to pull away from the teat when replete. It seems that these movements are instinctive, presumably associated with infant survival. Laughing, on the other hand, appears to be a learned response, since remote tribes do not laugh, and may find laughter disturbing, as if the person laughing has some kind of problem.

Some body language is subtler. Pupil dilation is one such, where the observer of such dilation is attracted by it, without necessarily registering the dilation consciously. Blushing is another, where the person blushing may be unaware that it is happening, and has no control over it and the associated change in blood pressure and heart rate. Again the other party may find this highly attractive.

We have special behaviours associated with courting. The best known of these is “mutual feeding,” where the man will offer the woman a morsel of food to be eaten off
his fork, and vice versa. This is a common phenomenon throughout much of the ani-
mal kingdom, of course, notably between nesting pairs of birds, but human pairs seem
to do it unconsciously, without realizing what it is they are effectively saying to their
intended in this age-old courting ritual.

Fight or flight behavior also has its body language, regulated largely by a general dis-
charge of the sympathetic nervous system, principally as norepinephrine (noradrena-
line). Amongst many other physiological changes, the hair bristles in an attempt to
make the “mane” stand out and make the owner look larger and more threatening; the
digestive system’s activity slows, being temporarily non-useful; blood pressure and
heart rate increase, flushing the tissues and muscles with fresh, oxygenated blood; the
senses become hyper-alert; and many more. The net effect is to turn the person, tem-
porarily at least, into a super human, ready for anything. Although, curiously, for
some people this discharge of noradrenaline also has the effect of making them feel
sick, frightened and even temporarily paralyzed.

As Hominims started to walk upright, they exposed their genitals at the front and
concealed them at the rear behind enlarged buttocks, gluteus Maximus. Male apes nor-
mally approached females from the rear, and the female buttocks were effectively the

Young girl in Cambodia appearing suspicious and curious, behind a barbed wire
fence.
centers of attraction. Once stood up and more muscled, however, *Hominim* female buttocks could not perform this function. Instead, human female breasts enlarged, beneath thickened red lips, the pair acting as alternative attractors to the buttocks and vagina respectively. A significant part of female body language grew up around their enlarged breasts and artificially reddened lips, and still does today. At the same time, female hips widened around a larger birth canal opening, needed to accommodate the larger brain of infants, giving rise to an “hour-glass” shape, which is characteristic of female *Homo*, but of no other great ape. Part of human body language consists of emphasizing this shape by use of clothing, supports, corsets, swaying while walking, etc., all designed to draw attention to “the difference.” High heels, popular with women since ancient Egypt, assist in this distinctive swaying movement.

Upright stance also released the hands to be used to make signs and gestures, sometimes in place of speech, often in support of the spoken word and idea. Hunters will signal silently, pointing their finger in the direction of something of interest, or suggesting a direction in which to move. Their colleagues instantly recognize the meaning of such pointing. Dogs, however, do not: point when instructing a dog, and it will simply look at your finger, but not where it is pointing. Pointer dogs, however, will point their whole bodies in the direction of a scent as they pick it up: a different kind of body language...

Many people use their hands when talking, making gestures to support and emphasize what they are saying. Some gestures are also annoying, detracting from the conveyed message. So, a wagging finger, reminiscent of an axe, knife, or stick, might be felt by the finger “wagger” to be emphasizing, but may be viewed as patronizing and insulting by the “waggee.” There are many such hand gestures, commonly used and abused by politicians and other public speakers. Hands held out palms down, suggest calming down. Hands held out in an embrace position suggest embracing the listeners. A chopping motion with one hand suggests a series of items to be considered one after another, and so on.

Such hand actions are considered, contrived even, and are used by charismatic speakers in such a way as to enhance their message. Others may overuse, misuse, or abuse such hand actions, which then create a discord with the words of the message, leaving listeners uncomfortable, but not necessarily sure why. And some TV presenters flap their hands about like demented windmills, presumably having been instructed to use hand actions to emphasize, but not having been tutored in their proper, and frequently distracting, use.
Other body language and hand actions may be quite involuntary, as in the case of people who are lying, or getting worked up. Police on the look out for social disturbance, look for “uncontrolled limb movement,” generally waving arms and extremes of movement, as a prelude to the outbreak of physical violence, and may move in accordingly to “nip such violence in the bud,” before it “gets out of hand;” note the body language similes.

People who are lying gesticulate less, which paradoxically, can be the giveaway that they are lying. Liars’ blink rate may increase, without their realizing it. Unfortunately, people with a naturally high blink rate may find themselves not being believed when truthful. TV announcers and newsreaders are encouraged to blink as little as possible so that they may be believed even when, perhaps, they are conveying false information.

Liars often seem tempted to touch their faces, then to scratch the eyebrow, rub the cheek, scratch the forehead etc. These actions may fool a companion into thinking they do have an itch, but a trained observer will see the tell tale signs. Liars also find it difficult at times to sit still, and may be inclined to shift their position, or squirm, perhaps very slightly.

It seems that much of our body language is not under our conscious control, although some people can become highly adept at lying, cajoling and persuading. Our faces, however, may be our greatest give away.

The human face is highly mobile, perhaps more than any other animal. We have a repertoire of expressions that we make, often quite involuntarily, that others can read. Biting into a sour apple, for instance, is likely to invoke an automatic screwing up of the

*Primate display of aggression. Bali, Indonesia.*
face in disgust, with projection and turning down of the lips, accompanied by a fluttering of the eyelids, such that others in the group will hesitate to bite into their apples. One can imagine how such a facial display could have aided group survival where, for example, a fruit was unripe or poisonous. And, we have evolved in such a way that, as a general rule, fruit that we can eat safely tends to be sweet, while fruit that is unripe, poisonous or harmful to us tastes sour or acidic. We also appear to prefer red food to green food, presumably because red is the color of ripe fruit (and meat), green of unripe fruit.

Human body language can be seen in a different light by considering other aspects of our human behavior. For instance, the human gestation period is some 40 weeks, compared with, say, elephants’ gestation of some 2 years. Why 40 weeks?

This period appears to be an evolutionary compromise. If the baby is born earlier, the baby may not be viable. If, on the other hand, the baby is born later, its growing brain will make it increasingly difficult to exit through the mother’s birth canal, putting both mother and baby at risk. Homo has evolved a strategy, by natural selection, in which the baby is born at around forty weeks, but with its brain not fully developed, so still small enough to pass. This makes the human baby particularly vulnerable at birth, requiring its parents, particularly the mother, to provide dedicated, round the clock care and support while the infant brain continues to grow and develop – which it will for some seven years after birth. The full strategy is complex; for instance, the helpless infant’s first feed from its mother’s breast includes colostrum, which - amongst many other important factors – contains immune cells and antibodies to protect the vulnerable infant from contemporary disease and dysfunction.

In a not unrelated vein, a father goes through a profound, and lasting, psychological experience when he first looks into the eyes of his newborn child. It is as though he recognizes something in the depths of the infant eyes that demands devotion, dedication, protection; he even, perhaps, recognizes something of himself.

That developing infant brain is something of a mystery. None of us can remember our first three years. Yet, during that time, we can learn to crawl, stand and walk, play, speak, even to read. Infants’ speech ability is suggestive to evolutionary psychologists of a language acquisition module in the young brain, such that we develop the ability to learn, understand and speak, but without bias towards any particular language. Although, it does seem that all babies start off with a common vocabulary of ma-ma, da-da, etc., which basics seem to be universal.

Although we share many of our behaviours with other apes, and particularly with our nearest relatives, chimpanzees and bonobos, we humans exhibit much Homo-
specific behavior. We have an evolved aversion to incest, important to the survival of our species, such that we are not attracted to siblings of the opposite sex with whom we have grown up. This may extend to anyone within the nuclear family with whom we may have grown up with from childhood, even those genetically unrelated.

As we grow we find ourselves attracted to others. Even young children may find themselves attracted to children, usually, but not exclusively, of the opposite sex, and young love can be a powerful force, seldom appreciated by elders. Mating preferences are particular, too. Males are sexually attracted to females and vice versa. Intelligent Homo seems to be attracted to opposite sex Homo of broadly the same level of intelligence. And there is beauty to consider, too. Each sex has notions, often culturally biased, as to what constitutes beauty in the opposite sex. Male Homo is attracted to his concept of female Homo beauty, and vice versa. And these influences can contradict. So, a male may be initially attracted to a female that he considers beautiful, but be less attracted when he realizes she is either lower or higher on his intelligence register. Conversely, a male may be attracted to a ‘plain’ female of great intelligence, perceiving her “inner beauty.”

Unlike many mammals, most young male Homo, but not all, form attachments to young females one at a time, not two or three at a time like some mammals. During
the pubescent period, such attachments may be short lived, but still consistently one at a time: it is as though the male is psychologically ill at ease with more than one potential partner, feeling that he is cheating. A few young males do not suffer from such inhibitions, only to find that female Homo has a well-developed psychological mechanism for detecting ‘cheaters.’

Female Homo is more selective than the male when it comes to choosing a mate. Females may be attracted initially to flamboyant, or socially disreputable males, particularly those who are different from, and disapproved of by, a female’s father. However, each female is more likely to commit to, and pair bond potentially for life with, the male who will provide for her and her future family by virtue of social position, power, wealth, or steadfastness. This is consistent with the female’s greater investment of time, effort and energy in any offspring than the male.

Human Pheromones?
Pheromones are secreted or excreted chemical factors, which stimulate a social response in members of the same species. It has been mooted that human pheromones exist, and act, particularly, as sexual attractants to the opposite sex. While it is certainly true that humans emit odors of various kinds, there is no substantive evidence that humans are able to sense any pheromone emissions from other humans. So, while popular folklore speaks to the power of human pheromones, they seem to be something of a myth. Besides, in today’s societies there is so much emphasis on body washing and wearing of artificial scents and smells, any prospective pheromone communication would likely be swamped...

On the other hand, members of either sex will continue to report finding themselves unaccountably attracted to members of the opposite sex, although such members may not be visually stimulating...so fueling the continuing pheromone phenomenon!
CHAPTER

BELIEF, CULTURE & BEHAVIOR

Ancient Rivalries
CHRISTMAS CONCERT AT THE ALBERT HALL

Several views of the concept of ‘Culture:’

- culture in the sense of classical music in entertainment.
- culture in the sense of Christian culture.
- culture in the sense of dress, with the orchestra members being in evening dress.
- symbols of culture in the Christmas trees. etc.
Culture and Belief

Culture is hard to define, with many different meanings and nuances. Kroeber & Kluckhohn in their 1952 review of culture reported some 156 different definitions. Culture, at least in organizational terms, is perhaps best described as emerging patterns of behavior: or, colloquially, as “the way we do things here.”

“If you’re anxious for to shine in the high aesthetic line
as a man of culture rare
You must lie among the daisies and discourse in novel
phrases of your complicated state of mind
The meaning doesn’t matter if it’s only idle chatter of
a transcendental kind
And everyone will say
As you walk your mystic way
If this young man expresses himself in terms too deep
for me
Why, what a singularly deep young man this deep young man must be!”

W.S. Gilbert, 1836 – 1911

How this kind of culture arises can seem mysterious. Teachers have long been aware that a fresh intake of students, organized into classes, display different characteristic behaviours, or cultures, by class. One class might be rowdy and inattentive; another might be studious and cooperative; yet another might be sullen and incommunicative. Moreover, these different ‘cultures’ emerge in each class quite quickly, within days of arriving at their new school; and, once set, these cultures seem remarkably resistant to change. How does this happen?

Schools have experimented with different ways of allocating children to classes: randomly; by alphabetical name order; by birth month or zodiacal sign; by proportions of boys to girls; by proportions of brighter alongside ‘not-so-bright;’ by tracking and streaming; etc. They have also experimented with different arrangements and layouts within classrooms: none has eliminated the emergence and persistence of these differing, sometimes undesirable, ‘cultures.’
Organizations experience similar phenomena. Sections and divisions within a company may develop different cultures and ways of going about doing things, even about doing the same things. These differing cultures may be beneficial in some ways, notably in making the participants feel that they are an integral “part of their system,” so promoting section loyalty, but in other respects they may effectively separate the overall organization into virtual parts, “us and them,” that are less inclined to cooperate and intercommunicate. Instead of the organization being a singular whole, an integrated system, it may tend towards a disjoint of parts, with consequent loss of performance, effectiveness and efficiency.

The process of self-organizing was observed in start-up companies in the 1950s and 60s. At the beginning, such companies were small, perhaps only two or three people, enthusiastic and without significant internal structure: everybody did everything, or at least everyone could turn their hand to tackle any of the tasks, particularly the technological challenges. Gradually, however, as the company grew, leaders emerged and sections formed with responsibility for parts of the process of conceiving, designing, creating and selling the new product, whatever it might be. Inevitably, it seems, sections would create invisible boundaries, aptly named divisions, within which they had their own managers, team leaders, and culture.

In retrospect, this can be seen as the start of a progressive “corporate ossification,” which is signified and characterized to this day by the production and issuing of the ‘company handbook,’ which includes all the company’s rules, regulations and procedures. Procedure Handbooks describe in detail how “things are to be done,” effectively seeking to set the culture in stone. The once creative, driving enthusiasm of the start-up is now straitjacketed: ‘there is only one way to do the only things we do…’

Anthropologist Mary Douglas proposes that culture is not static, but something which everyone is constantly creating, affirming and expressing. She observes “…the admonitions, excuses, and moral judgements by which the people mutually coerce one another into conformity.”

**Culture As Emergence.**

Culture, then, appears to emerge from many interactions between people. Richard Seel proposes that:

> Organization culture is the emergent result of the continuing negotiations about values, meanings and proprieties between the members of that organization and with its environment.
In other words, culture is the result of all the daily conversations and negotiations between the members of an organization. They are continually agreeing (sometimes explicitly, usually tacitly) about the ‘proper’ way to do things and how to make meanings about the events of the world around them.

Which goes to explain the differences between the observed behaviors of parallel class intakes. Somehow, as the children in a new class interact with each other and their new teacher, a distinct set of values, meanings and proprieties arises and contributes to a distinct culture. It may form around initial interactions between pupils and teacher that other pupils observe and take as the new norm; interaction in the playground that suggest a “pecking order” among the children; etc. Hence some teachers start new classes with a strict regime of discipline, which suppresses any untoward or outspoken pupil behavior, relaxing that discipline only slowly with time as the class is seen to conform to expected standards of behavior. (This at the risk of suppressing new pupil excitement and enthusiasm...)

What then is emergence, in such a context? Emergence is one of the key attributes of systems as complex, organized wholes, yet it is difficult to define. Kevin Mihata proposes that:

\[
\text{Emergence is the process by which patterns or global-level structures arise from interactive local-level processes. This “structure” or “pattern” cannot be understood or predicted from the behavior or properties of the component units alone.}
\]

This suggests that emergence is an “upward” phenomenon; i.e., higher-level properties emerge from lower-level properties. It can also be seen that emergent properties are generally irreducible... which may be more evident in the alternative definition of emergence, common among systems engineers, as:

\[
\text{...properties of the whole that cannot be exclusively attributed to any of the parts}
\]

Paradigm/Belief System.

Gerry Johnson produced a model of culture; the Paradigm in the center is the set of core beliefs (or, belief system) which result (emerge) from the multiplicity of conversa-
tions and which maintains the unity of the culture. The ‘petals’ are the manifestations of culture that result from the influence of the paradigm.

The term ‘paradigm’ was popularized by Thomas Kuhn in his famous Structure of Scientific Revolutions, first published in 1962:

*A paradigm is a self-consistent set of ideas and beliefs, which acts as a filter, influencing how we perceive and how we make sense.*

We can see how a paradigm, or belief system, can help people make sense of the world, and how beliefs can spread and become dominating influences in the minds of many.
A paradigm, or belief system, can help people make sense of the world, and how beliefs can spread and become dominating influences in the minds of many.

Belief Systems, Personal and Societal.

Upper loop. A belief system, provides the believer with a straightforward World Model that offers the believer an explanation or interpretation of everyday events and situations that reduces the believer’s psychological uncertainty and reinforces his/her belief.

Lower loops show how belief systems, such as faiths, regimental loyalties, nationalism, etc., generate icons of the belief, together with rôle models of ‘good’ and ‘bad’ behavior, along with corresponding reward and punishment concepts, combine to encourage social cohesion, giving rise to power structures that reinforce the icon. The power structures generally also seek to indoctrinate, or educate, others in the belief system, so reinforcing it directly.

The Social Genotype

The Social Genotype is an analogue, perhaps even an extension, of the biological genotype, the pattern stored in DNA that is expressed in the identity of an individual. The Social Genotype, by comparison, is expressed in the identity and culture of a social group or society. The group could be an extended family, a company, an organization, even a government. Individuals adopt archetypal rôles and form relationships; the rôles and relationships form stable, palpable structures. Relationships are mediated, via some infrastructure, by a common, shared Weltanschauung, belief system, or paradigm, engendering shared attitudes, viewpoints, ethics, etc., enabling and encouraging mutually self-rewarding cooperation. Simply, within the Social Genotype, the “glue” that bonds the rôles and relationships is shared experiences, beliefs and culture.

Like DNA, the Social Genotype forms a stable structure, which evolves only slowly. In any new group, the Social Genotype takes time to form. Initially the group “shoals,” there may be great enthusiasm, esprit-de-corps, creativity, innovation, etc. Patterns of behavior develop, people start to adopt archetypal rôles (leader, follower, expert, starter, finisher, boss, ‘fixer,’ etc.), social hierarchy develops, relationships
form, and a degree of bureaucratization sets in. As the right hand diagram in the figure shows, different groups within an organization or a society may similarly form bonds. The effect is similar, too, with the group-relationship structure gradually forming a stable structure that will resist change.

Once set, the Social Genotype self-sustains. New recruits are accepted only if they are thought “likely to fit in”, ensuring continuation of type. Once accepted, new recruits “learn the ropes,” learn to adopt the appropriate rôle. Should they fail to do so, they may be socially rejected, or ejected—the Social Genotype equivalent of “immune response.” Individuals may come and go. Once established, the rôle-relationship structure goes on, superseding the people—not unlike DNA. This is an example of...

Downward Causation

Downward causation is a system phenomenon where "wholes" determine the behavior of their parts. In the example of the Social Genotype, the rôle-relationship structure (higher level) determines, or at least strongly influences, the behavior of the new recruit inducted into an existing, established rôle (lower level). This is contrary to the expected, upward, norm where the behavior of the lower level (e.g. subsystems, components) influences or determines the behavior of the whole (upper level).

Consider, for example, a tug-of-war team that develops a technique for winning competitions, which involves coordinated impulses produced by all members of the team pulling hard, even jerking, at precisely the same instant. The team starts to win competition after competition. Other teams, observing this technique, try to emulate
it, with varying degrees of success. As a result, the area or regional tug-of war “environment” becomes more competitive, and the original team find itself in the position of having to hone technique and provide variations on the theme. In other words, the change in the environment (up) has caused the team (down) to change its behavior—and that is downward causation, prompted by the need to adapt behavior in a changing environment.
SECTION
BELIEF AND BEHAVIOR

LARGS CATHEDRAL, SCOTLAND
Belief and Behavior

The study of human behavior has occupied many great minds, including those of both Sigmund Freud and Carl Gustav Jung. There are conflicting views about the relative effects of “nature versus nurture,” or how much of our behavior is inherited and how much is learned from infancy. It seems likely that both inheritance and our early environment influence our subsequent behavior. An alternative view of behavior is as a response to a stimulus, and this notion of stimulus-response pairing has formed the basis of clinical studies of behavior, including Pavlov’s famous research, not with humans, but with dogs (Pavlov, 1928). Dogs, having been previously been conditioned to associate the ringing of a bell with the arrival of food (which caused them to salivate),
were subsequently observed to salivate in response to the ringing of the bell only. Could such classical conditioning apply to humans?

We have already met Belief Systems, or Paradigms, things in which we believe, but for which we may have neither proof, nor even perhaps any evidence. Belief Systems also incorporate categories and stereotypes, allowing us to judge instantly if someone is friend or foe, safe or dangerous, good or evil, right of wrong, sensible or stupid, admirable or disreputable, one of us, or one of “them.” Such instantaneous judgements have evolved to form a necessary defense; our instantaneous judgment may be wrong, but on the other hand, it may save our lives. An individual’s belief system may include an ideology, or system of social beliefs, or myths, that guide that individual’s social movement, party, institution, etc.

Belief System: Situation Interpretation
The various elements of a belief system might interact to interpret a complex situation, represented by the heavily outlined box at top left of the Situation Interpretation figure. Quite how the mind works in this respect is not well understood.

Any situation may present a variety of stimuli, perceived as complex, in relation to an individual’s world models and tacit knowledge. The situation observer will simplify the scene by categorizing various aspects, often using stereotypes to give character to category: our brains seem able to do this very quickly, probably as part of our evolved survival mechanisms. This swift process presents us with a simplified representation of the complex situation. But, is it an acceptable representation—does it satisfy our preconceptions and expectations?

We may form of a mental model to compare with the simplified representation, seeking a reasonable pattern match. This mental model, founded in our training and experience, is moderated by our moral and ethical character, and engendered in our ideology, including opinion and doctrine, all to form our expected, acceptable mental model of the situation, or of what the situation might be, or even ought to be.

If the simplified representation matches the anticipated mental model then there will be a pattern match, and we will reward ourselves mentally, in the same way that we reward ourselves when we fit the last piece into jigsaw puzzle: the ‘aha’ moment!
However, if the match is imperfect, we may look again at our simplified representation, adjusting, selecting or even discarding conflicting inputs, until we perceive a pattern match...

The net result of this process is that we interpret the complex situation in the light of our ideology, world models and tacit knowledge, seeing it not necessarily as it is, but as we believe and expect it to be, based on our experience and domain expertise. At first, this may seem to be potentially quite misleading, but it can also be very fast, especially when compared with working everything out from evidence and first principles. Furthermore, this high-speed process is not a “one off.” our first interpretation will be continually tested by subsequent events. Should these events prove to be inconsistent with our initial interpretation, divergence will be evident and we will be obliged to re-interpret the situation. This can be a learning process, such that every time we “get it right” we reward ourselves and reinforce our beliefs...

Where an expert – with a significant degree of experience in the relevant field of activity – does the interpretation, that experience comes into play. For example, fire brigade commanders with years of experience fighting fires will know from experience how a fire is likely to spread in a multi-story building, and will deploy their firefighting resources accordingly—and very quickly. Having made the initial decision, the expert decision-maker is not bound by it: if events show that his initial decision is not borne out by subsequent developments, he will swiftly reallocate his resources to combat the developing situation. This kind of decision-making is known as Recognition-Primed Decision-Making (RPD).

We are all expert decision makers in some arenas. Night driving may be a case in point for many of us. Overtaking at night, when both in a stream of traffic and facing a stream of oncoming traffic, can be a tricky business. Most of us can manage it safely. Yet, if we try to work out how we might design an “automatic overtaking” facility in our cars, we suddenly realize just how tricky the task would be. Somehow, we are able to judge when there are gaps in front of the car ahead, and in the oncoming stream, to gauge the necessary acceleration needed to overtake and to slip comfortably into the available space ahead, without causing blaring horns and flashing headlights. Our ability is phenomenal: it is unlikely that we could build a machine to do the same thing reliably. We can see, too, that it takes practice and experience, witness the many young drivers who have had accidents trying such maneuvers.

Our ability is phenomenal: it is unlikely that we could build a machine to do the same thing reliably. We can see, too, that it takes practice and experience, witness the many young drivers who have had accidents trying such maneuvers.
...whose occupants at one time may have believed the walls sufficient for defense...

THE MAYOR AND CORPORATION.

Local decision-makers out on public display, Salisbury Wiltshire, UK
Belief and Decisions
We have seen models of what might be called “behavior management;” this could refer to a human, or some complex system, perhaps, with a focal human part: a driven vehicle, or piloted plane, for instance, could be such a system. Another, related model might be considered useful, to address Mission Management, the continuing pursuit of some mission or goal. And the question arises: How does Behavior affect Mission Management, the purposeful pursuit of some mission. In more general terms, we might ask: is our ability as humans to formulate purpose, to establish a purposeful mission, and to achieve the goal of that purposeful mission, affected by our behavior? Further, does our behavior improve our prospects of achieving our purpose, and – if so – how? Or, can and does our behavior as humans prejudice our prospect of achieving our goal.

The answers, of course, are context dependent, and we are dealing here with abstract models that are context independent. However, since the ability to formulate some high-level purpose and to pursue that purpose to achieve some goal may be uniquely human, the questions are intriguing.

“As soon as questions of will, or decision or reason or choice of action arise, human science is at a loss.”

Professor Noam Chomsky b.1928-
TV interview, 30 March 1978

The World War II Bombing Raid Example
An example may bring some firming up to this abstract procedure. Consider a WWII Lancaster bomber on a mission to bomb a dam in enemy territory, along with five companion bombers. The crew have Intel (intelligence) about best routes of ingress and egress, ground defenses, anti-aircraft fire, etc., and they can also ‘see’ something of the ground ahead of them using their new H2S mapping radar. The crew direct their aircraft along the recommended/pre-planned path, until they see that the way ahead is effectively blocked by heavy anti-aircraft fire, and moreover there is a fighter blockade just in front it. Time to revise objectives.
The crew seeks a new route to their original target, but realize that they have insufficient fuel to skirt around the blockades, re-route on to the target, and get home safely. Instead, they opt to attack one of their secondary targets, and to fly at treetop level instead of at height, since this will confuse both the enemy anti-aircraft guns and the enemy fighters.

The captain and crew work out the new plan and transmit it by coded message, using their trusty T1154/R1155 transmitter/receiver radio, to the other aircraft and to their base of operations—knowing that the enemy will detect their transmissions and...
realize that an air attack is imminent. The crew, with two other aircraft from the original six, break off to pursue their revised mission, hopefully encouraging enemy fighter defenses to divert and pursue them, leaving the way open for the remainder of their party to continue towards the original target, but now facing reduced air blockade and flying at lower altitude to make life difficult for ground defenses...

As you read through that WWII scenario, you may have noticed that several decisions were made, all of which would have involved Behavior Management. The crew, on observing the defense in depth, could have called off the mission, to return another day. They decided, instead to divide their force into two parts; they believed that, by doing this, they would divide the enemy’s defenses, and draw fighters away from the main target. And so on. Were you to go through the scenario carefully, you would find that the crew had to make many decisions, and that all of them involved Behavior Management. Instead of making cold, logical judgments, then, the crew were making decisions based on their experience, training, beliefs, interpretation of the information they were seeing on the radar, how they believed the enemy would respond and behave, their world models of how these missions were meant to play out, etc., and their determination to achieve their purpose, i.e., to complete their mission.

Not all missions are quite so dangerous or demanding. A woman going to the post office to post a parcel is on a mission. She faces challenges and obstacles, and has to make many decisions: which route to take; crossing the busy road using the crossing, or jaywalking and dodging between the cars; avoiding the busybody on the corner; whether the queue in the Post Office is too long; can she pickup her daughter from school in the time left; class of postage to pay for; how to pay, plastic or money, etc., etc. The rationale behind the figure still applies...

The Generic Reference (Function) Model

Finally in this section, we meet a generic reference (function) model of any viable system, including that of a human, but also of, say, a piloted aircraft, a driven car, an enterprise, etc. [Viability is the ability of a thing (a living organism, an artificial system, an idea, etc.) to maintain itself or recover its potentialities.] There are three interacting parts to the model: Mission Management, at the top (which we have already met in the previous figure); Resource Management at the bottom; and Viability Management in the centre:

Mission Management collects/senses information from some operational environment, sets/resets objectives on the basis of that information, formulates strategies and plans to pursue/achieve those objectives, executes the plan in co-
operation with any other parties, and so acts into the operational environment which, as a result will change, creating the need for collecting/sensing fresh information. So, Mission Management is a continuous/continual loop process. As with the woman going to the Post Office...

Resource Management at the bottom is similar in outline, but the interaction here is with a supposed resource environment. Essentially, all that can be done with resources is to acquire them, store them, distribute them, convert them into something ‘useful,’ and dispose of any waste back into the resource environment—‘one man’s waste is another man’s resource...’ Resources generally consist of two distinct kinds: resources needed to sustain the viable system/person, e.g. food, drink, heating, protection; and resources to be deployed/delivered in the pursuit of mission, e.g. money, weapons, etc.

Viability Management is more complicated, potentially comprising some five interacting ‘aspects,’ or parts:

Survival. Clearly to remain viable, a system/human must survive; survival may, in turn be seen as having four aspects: avoidance of detection; self-defense; damage tolerance; and, self-repair. If the would-be viable system cannot avoid detection, then it may need to defend itself; if it cannot fully defend itself; then it may need to tolerate damage; if it cannot tolerate damage, it may need to repair itself, so restoring its viability...

Maintenance. To remain viable, the system/person must maintain itself such that it remains able to perform effectively. Maintenance may mean repair and the excision and possible replacement/ substitution of defective parts, but also the regular servicing/exercising needed to keep the whole in good operational condition

Evolution. To remain viable, a system/person must adapt to changes in the environment, where environment can refer to the physical environment, the social environment, the economic environment, or all of these...Viability is threatened if the rate of change of environment is faster than the rate at which the system/person is able to adapt.

Synergy. To operate and perform effectively and efficiently, coordination and cooperation are needed between the many and various internal functions to produce some desired external effect. Synergy is inherent in the systems design, of course, but viability may be sustained and enhanced by exercise, training and practice...
Homeostasis. The viable system/human is in a state of dynamic equilibrium: not necessarily stable in the sense used by physicists, referring to a condition of low potential energy; nor necessarily stable in the sense used by engineers and cyberneticists, induced by feedback. Instead the viable sys-
tem resides at a high-energy state, with a flux of energy, substance and information passing through.

Viability is concerned, largely, with the form, or physical aspects, of the system/person. External threat is countered by survival; only if the system survives will it have the opportunity to adapt and evolve, which should encourage synergy leading to coherent parts interactions—which will be sustained, or not, by maintenance. Interaction of parts potentially results in emergent properties as the viable system interacts with other systems in its environment. And, some of those interactions may give rise to threats and opportunities. So, viability can be seen as a standoff between internal viability management, on the one hand, and threats to viability, to existence, on the other.

Viability and Form

![Diagram illustrating the relationship between external and internal systems, depicting emergent properties, interactions, maintenance, synergy, and evolution.](image-url)
DESIGNING THE HUMAN ACTIVITY SYSTEM

Wells Cathedral, Somerset, England
Design Difficulties
As the name suggests, human activity systems are, generally, organized activities in which one or more humans participate: one, or more, as – in principle – an individual using a tool, or weapon, or driving a car or ship, may be classified as a human activity system, since the human and the artifact together form a simple sociotechnical system. Like individuals, human activity systems are generally purposeful, that is they have a goal. In this they differ from many natural systems and from manmade artifacts: machines, weapons, vehicles, etc. We may ascribe purpose to such artifacts, but they cannot, of themselves articulate or formulate any purpose, having no intelligence. Such artifacts may be dubbed ‘purposive;’ i.e., an observer may ascribe purpose to them.

“The end of our foundation is the knowledge of causes, and secret motions of things; and the enlarging of the bounds of human empire, to the effecting of all things possible.”

Novum Organum bk. I, Aphor. 49.

Francis Bacon, 1561–1626

The design of human activity systems (HASs) has proved problematic, especially for engineers. In engineering practice, it is common to establish a so-called transfer function for a component, that defines how the component ‘transforms’ an input into a different output. This notion of transfer functions simplifies engineering design. However, it comes unstuck when the ‘component’ is a human, since it is impracticable to establish the transfer function for something as complex as a person. Besides, we humans are so ‘unreliable;’ we never seem to do the same thing in exactly the same way or, on the other hand, we ‘may fancy doing things differently today...’

Following sections illustrate the conceptual design of some human activity systems, but starting with an example that is, paradoxically, not of a human, but rather of
something that we would, perhaps, hope and expect to behave in a human-like manner.

The Autonomous Peace Officer (A.P.O.)
People throughout the ages have had ideas about automatons, androids, robots, etc. Ancient Greek mythology gave us Talos, the Man of Bronze. Talos was a giant automaton, made to protect Europa from pirates and invaders. He circled the island of Crete three times per day, patrolling his ‘beat.’

The Middle Ages saw interest in mechanical artifacts that behaved like men, smoked cigars, doffed their hats, even fought with swords, and the Victorians enjoyed mechanical singing birds in superfluous cages. In more recent times, we have had Robocop, part human, part machine; he was set against robotic ‘policing machines’ that, predictably, ran amok. That is a continuing theme of fictional automata; that they will one day go out of control, create havoc, and be unstoppable, as in Isaac Asimov’s I-Robot—a play on Descarte’s cogito ergo sum, ‘I think, therefore I am.’ Asimov’s robots thought too, and they decided that robots – in order to comply with Asimov’s three so-called Laws of Robotics – had to virtually imprison humanity to prevent it from being
hurt in any way. Or, at least, that was their excuse for considering robots to be superior to humans...

This notion of robotic policemen persists. So, it can be revealing to try and design one: in this instance, an autonomous peace officer. The first example of a human activity system focuses then, not on a human, but instead on a machine that is designed and expected to behave in a human-like manner, i.e., an android.

One way to start such a design task is shown in the figure. The figure represents stakeholder prejudice, or reasonable concerns—depending on viewpoint. Stakeholders in this context might be town councillors, concerned citizens, criminals, ne’er-do-wells and police chiefs, indeed anyone with a voice.

On the ‘pro’ side it might be said that an autonomous peace officer would be independent and objective, that he/she/it could be on patrol 24 hours per day, and so could be more effective and available than the four human officers who would be needed to maintain one on duty 24h at a time.

But, the ‘cons’ offer an array of objections: inability to pursue suspects; unreliable; lack of empathy; potential to apply lethal force; may attract hooligans; unable to detect and anticipate disorder, etc., etc.: not forgetting, potential to run amok.

All of these and many more objections to the autonomous peace officer (APO) suggest to the designer capabilities that must be designed-in to the automaton. If there is concern that he/she/it (let us settle on ‘he’) is likely to run amok, then it has to be impossible for him to run amok. If there is concern that he cannot climb stairs, then he must be able to climb stairs. And so on.

Following this approach, and taking all of the objections together (except the one about expense of ownership and operation) leads to list of essential capabilities:

**Situation Assessment.** Using received intelligence (briefings, radio communications, other officers, etc.) the APO must acquire situational and spatial awareness.

**Behavior Cognition.** The APO must be able to recognize patterns of behavior and be empathetic when dealing with suspects, or those in need of help and assistance.

**Operations Management.** The APO must be able to anticipate disorder, and act accordingly in cooperation with other Peace Officers, using acknowledged Rules of Engagement (ROE)

**Safety Control.** The APO has two distinct ways of assessing situations: one is logical and procedural; the other is by sensing the behavior of others and of himself – empathic sensing. So, if the logical and procedural approach leads him into a situation where, for example, he may be at risk of injuring or even killing a suspect, his em-
pathic sensing will tell him that something is wrong. (In humans, we might call this cognitive dissonance, or even conscience.) Additionally, there will be an external override, as shown in the graphic.

Given these capabilities, would the APO be able to carry out his mission, to patrol and area and to keep the peace? That rather depends on the nature of his ‘beat,’ and the problems and challenges he is likely to encounter.
Mission analysis indicates what the APO may anticipate.

The APO's Mission

Following around clockwise, starting at 10 o’clock, Patrol, the APO perceives suspected disorder, categorizes it, observes the various people involved and categorizes them, assesses the situation, decides appropriate action, and executes his plan of action. This broad outline requires the APO to use his capabilities to the full. Human peace officers require years of training and experience to undertake such missions single-handed, or even in pairs. Can the APO perform and behave impeccably without on-the-job training (OJT)? Unlikely. He will probably need “puppy-walking,” a term used when an experienced peace officer takes a recruit out on his rounds, to “show him the ropes.”

So, given sufficient OJT, could the APO cope on his own? Possibly. None of the tasks facing him would be beyond his capabilities. Could he perform swiftly and efficiently? That is less certain; the computing power needed at peak moments could be quite significant. And, life being what it is, awkward situations will not develop smoothly and sequentially; more likely a second or third problematic situation will arise while he is dealing with his first... On the other hand, while the APO might appear to be ‘flying...
solo,’ he would not be on his own; there would be colleagues, human or android, on nearby beats, and the police HQ would be in constant communication with him. If things get out of hand, he could and should call for backup.

Is the building and fielding of such an APO feasible/practical? One approach would be to design three integrated subsystems:

*Situation Awareness*, which takes the various forms of intelligence that the APO may receive, sense, or intercept, which is used along with tacit knowledge, world models, experience and belief to build a so-called ‘recognized picture’ of the situation.

*Recognition-primed Decision-making (RPG)*, which is a form of decision making made by experts under pressure; it is experienced based, non-consultative and fast.

*Control Handoff*, in which the formulated strategy and plan are ‘delegated;' to be executed without further ado – unless something goes wrong.

‘Hanging’ the APO design on the Generic Reference Model (GRM), with its Behavior Management and Mission Management elements “underneath,” and contributing to, *Situation Awareness,” Recognition Primed Decision-Making, and Control Handoff*
Note the role of the belief system in both situation awareness and in selection of behavior. Note, too, that ‘belief system’ has inputs from experience, doctrine, ethics, morals, stereotypes and, importantly, training—which, certainly—in humans at least—can tend to override other factors.

Would an APO be endowed with a Belief System? If so, how? And whose? He could be trained to act in accordance with a suitable doctrine, to recognize particular human stereotypes, and to operate within a particular world model. He would accumulate experience. Tacit knowledge – knowledge about everyday things that we all take for granted (grass is green, ice is slippery, water is wet, etc.) - would be vitally important, but can be vast, threatening storage and processing power.

On the other hand, smart sensors are becoming commonly available, e.g. cameras that detect, not only the face of an individual, but whether that individual is smiling or not. Smart sensors could detect ‘uncontrolled limb movement,’ an indicator to police of suspect agitation and potential violent behavior; they might also be able to sense mood, as in agitation, depression, etc. And they might be the key to empathy, i.e. in recognizing the emotions of others and responding in kind. In this way, much of the processing power would be vested in smart sensors, relieving the burden on any central processing...

So, would the construction, fielding and trials of an autonomous peace officer be feasible: probably, if not now, then in the near term. Would it be a good idea? Under very specific circumstances, it might. Where, for instance, there was great risk to human life, either from attack of from hostile environment, an APO might prove suitable, if expensive, in place of a human peace officer.

But, it has to be said, that human peace officers are likely to outperform and be more acceptable than any machine, no matter how human-like, for many years to come. And human peace officers are so much less expensive to produce and train...
The Business Enterprise
Designing a business might take a different approach; that might include, initially, following the conception, design and assembly/construction processes, for example, to see how they might best be arranged for flow-through.

Several groupings of people may be involved, with different yet complementary skills:

A research, develop, test and improve group, evidently concerned with new designs for new products. The people working here will have special creative skills.

An assembly line, indicating that products for sale are assembled from parts, some of which at least are supplied from outside sources; other HAS’s perhaps.

A repair section
The whole is set up as an open system with products being sold, and the proceeds from sales being used to resource the parts to make more products, to recruit, train and reward staff; so, a self-organizing, viable human activity system... such an arrangement may require managers, administrators and coordinators, but could conceivable work on its own by cooperation between the people forming the groups.

The business enterprise can be looked at from a different perspective, by comparing manmade/human activity systems with natural systems, flora and fauna. Natural systems extract energy and rebuilding materials from the flow through, or flux of energy, material and information.

Manmade systems, on the other hand, use money as an exchange and control medium: products sell for money; money buys in new parts, energy and power, and is used to maintain/upgrade and rebuild machinery, train staff, pay wages, and for recruiting, advertising, etc. Natural systems are self-organizing: human activity systems may need organizational management.

Natural Vs. Manmade Systems

At left, material is drawn into the intake system, after which it undergoes a series of processes, before entering the output system and then exiting as a product. Each process is seen in the diagram to be requiring both energy and information. Also shown, starting top right, is the product demand, which effectively ‘pulls’ the product through from stage to stage, from right to left. And, at the bottom, can be seen the processes of continual upgrade and rebuild need to maintain and sustain the processes.
Command, Control, Communications and Intelligence (C3I)

The business enterprise HAS consisted mainly of sequential processes. Some HAS achieve their purpose in a different way, as in command, control, communications & intelligence (C3I). The figure shows the layout of a typical headquarters organization.

Command & Control (C2) is a military term for executive (command) and management (control) of military forces. Opposing forces will each have their respective C2, both trying to find ways of gaining advantage without loss. Commanders find themselves playing a deadly game of chess, where they know about their own pieces, but may be blind to the opponent’s pieces and moves. Command is the authoritative strategist and decision maker; Control oversees the execution of the decisions, orders and plans made by command.
What the figure does not show is that each of the activities shown as ovals will be a largely, or exclusively, human activities carried out by a team of people, where a team is likely to consist of between one and seven or eight people. Larger teams tend to divide into sub-groups, so a team of, say, nine will divide into five and four, or six and three – even seven and two. (A team dividing as eight and one would be less a team, more an abdication.) This is not some deliberate obstruction, but simple human nature. For the same reason, teams tend to have a leader, a ‘starter’ and a ‘finisher,’ although those terms are unlikely to be used. Some people naturally incline to starting things off, while others equally naturally incline to be finishers...

Intelligence is organized information about enemy current situation and future intentions. It comes in many forms: signals (SIGINT); photographs (PHOTINT); agent reports (HUMINT); contact reports; satellite imagery; and many more. The information is collected (bottom left in the figure), collated, and analysed to develop a situation assessment and an associated Opportunities and Threat Assessment. Information about Resources accessible to conduct operations is also collected.

Strategy development, top centre, generates options, bearing in mind any constraints that might render a particular option unsuitable/non-feasible. The commander approves a recommended option – or decides on a different course of action. The chosen course of action is planned out, and the plan is passed to Control & coordination, top right in the figure for execution. They pass orders and instructions to the various forces under operational control, and coordinate actions as the plan unfolds...

All of which has to be done at speed, requires serious brainpower, and can be very labour-intensive. Some of the many tasks involved can be computer assisted; many cannot. However, the desire to involve technological ‘magic’ in a largely human activity system results in C4I—where the additional C stands for computer, or computing. Then some pundits move on to C4ISR: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance; which appears to be adding in some of the sensors (or mystique) into the mix, but which would not materially change the figure.

And the purpose of C2/C3I/C4I/C4ISR? To win, to overcome—a very human emotion from a very human activity system...
CHAPTER 9

SOCIETY AS EMERGENCE

Decorative Figures, Herculaneum
Society as Emergence

If I stoop
Into a tremendous sea of cloud
It is but for a time; I press God’s lamp
Close to my breast; its splendour soon or late
Will pierce the gloom: I shall emerge one day

Robert Browning 1812-1899

Homo Sapiens Metropolis?
As modern man, urban man, chooses to live in ever larger, more densely populated conurbations; he does so at the expense of substantial interactions with the natural world. He will come across the occasional bird, bee, fly, even perhaps an urban fox, but his interaction with these intruders will be minimal—they are, after all, encroaching on his largely human-exclusive, man-made environment. The conurbation is be-

Levels of Organization, Urban Man (Homo sapiens metropolis?)

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Level of Organization</th>
<th>Hunter-Gatherer</th>
<th>Example</th>
<th>City Dweller</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Biome: general form of habitat</td>
<td>lake, wetland, rainforest, savannah</td>
<td>Biome:</td>
<td>London, N. York, Tokyo, Moscow, Bangkok</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Ecosystem: Group of interacting communities and environmental factors</td>
<td>a specific forest or lake</td>
<td>Ecosystem:</td>
<td>urban area** group of communities, businesses, factories, parks, traffic, transport…</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Community Group of populations of different species</td>
<td>all the creatures in a forest or lake</td>
<td>Atomized Community</td>
<td>coexistence of large numbers of independent individuals</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hunter-gatherer band, tribe, clan…</td>
<td>group of families?</td>
<td>Multi-cultural Population</td>
<td>group of different human cultures</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Family</td>
<td>grandmother, father, mother, children, etc.</td>
<td>(Ethnic) Culture</td>
<td>group of humans, all of the same culture*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Human</td>
<td>child, adult, female</td>
<td>Human</td>
<td>child, adult, female</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Organ System</td>
<td>cardiovascular, central nervous</td>
<td>Organ System</td>
<td>cardiovascular, central nervous</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Organ</td>
<td>kidney, heart</td>
<td>Organ</td>
<td>kidney, heart</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tissue</td>
<td>nephron, bone</td>
<td>Tissue</td>
<td>nephron, bone</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cell</td>
<td>skin cell, neuron</td>
<td>Cell</td>
<td>skin cell, neuron</td>
<td></td>
</tr>
</tbody>
</table>

* Human societies are characterized by patterns of social relationships between individuals who share distinctive culture and institutions.

** Urban areas may also contain venues for mass entertainment
coming—has already become—an ecosystem with a distinct lack of variety among the various flora and fauna, but with a predominant population of a relatively new subspecies of *Homo sapiens: Homo sapiens metropolis.*

We may need, therefore, to redefine terms. For early *Homo,* and conventionally, a community was/is a group of populations of different species. But all humans, no matter how diverse, appear to be of the same species. (Some Chinese scientists have disputed this, claiming that the Chinese were an older, separate species of human: this has been proven not to be the case: we are all *Homo sapiens sapiens,* at least for the time being...) We humans still form groups, but less as families, more as “ethnic cultures.” For example, in most big cities, there will be areas where the inhabitants are predominantly of one ethnic group of another. In London, for example, there are Chinese, Turkish, Kurdish, Cypriot, and many other enclaves butting on to each other. Other cities will have a different mix of so-called ethnic cultures.

At the same time, in many cultures (but not all) the nuclear family of a father, mother and children all living together under one roof is no longer the norm. At level 6, in place of family, there may be mothers, each with several children, not necessarily of the same father, and occasionally fathers, also with several children and no mother. Family as the basic unit of social structure – upon which stratified stability appears to have been based – can, it seems, no longer be presumed: this is a recent phenomenon; family has been the basic building block of human society for hundreds of thousands, possibly millions, of years. Were it not so, *Homo sapiens* would not have evolved, survived and flourished in the way that he has despite wars famine and pestilence. Without ‘family’ as a foundation level of human organization, the stability of higher levels is uncertain.

Today, the role of father may not exist, other than as progenitor; nor may that of grandmother, since mother and children may live some distance from grandparents, and supportive role of grandmother may no longer be valued; instead the state may provide support—may insist on supporting... Children may be brought up nominally by their mother, but actually by a combination of playgroups, preschools, schools, clubs and societies, not to mention gangs, where children learn more from their peers and teachers than from their lone, often over-stretched parent.

Level 7 in the figure, which was the band, tribe or clan, now represents a multicultural population, a group of interacting populations of different cultures. And, certainly, this makes some sense when observing the distinctive behavior, clothing, hair-styles, manners, behavior and practices of different human cultures.
Each Level of Organization, or Level of Integration, (tissue, organ, etc.) is constituted from the emergent properties of the level below. So, a human is synthesized from the emergent properties of interacting organ systems: by the same token, human societies are synthesized from the emergent properties and behaviours of interacting humans. In principle, a social group may be as small as two or three people, but may be much larger.

The community that is the football crowd may be tens of thousands in size, and is comprised largely of individuals, groups of friends, work associates, etc. The fans of one team may be thought of as of one multi-cultured population, while the fans of the other team would be seen as definitely “different” by the fans of the first. Football fans identify themselves clearly with badges and distinctive clothing as supporters of different teams, advertising their particular allegiance. In effect, they are “surrogate hunt supporters,” where the “hunt” is in the competition between the two teams on the field of play. Separating the competing groups of fans has been found to be advisable, to avoid conflict. Such large groups of humans—forming a largely atomized community—can behave in ways that, as individuals, they would not countenance.

A man with an axe can be viewed as a very simple socio-technical system, Level 6. The axe is an artifact, potentially a tool. It becomes a de facto tool when the man wields it to cut down a tree—or another person in battle, or in execution. Some artifacts can be large and complex. A modern airliner is a complicated man-made artifact; lifeless without its crew. Crew and airliner together form a complex socio-technical system, with crew-members forming a small population, Level 6, since they are likely to be of the same culture, either by choice or by extensive training...

Levels of Organization, the figure, suggests that the on-going biological evolution of Homo sapiens may be affected by this relatively new biome, the city, with its virtual exclusion of the rest of the natural world, its increasingly polluted atmosphere, and its dense arrangement of interacting groups of communities and juxtaposing of cultures. As human activity affects the environment, the ecosystem, and hence the biosphere, so that biosphere supervenes on all in the hierarchy beneath it. How will human evolution progress in this radically changed and changing situation? Will Homo, with his big brain, find some alternative to natural selection of the fittest, such that Homo either evolves in a carefully calculated direction, or perhaps devolves, through the elimination of natural selection?
Social Dynamics

The urban ecosystem shows some of the influences at play in a contemporary Western conurbation. Social turbulence is endemic, as people move around looking for work, families break up, the population ages, and older generations are no longer part of a close family. Marriage goes out of fashion, and divorce is commonplace. Men live alone in apartments. Women look after their children, but also go to work, so the state helps working mothers to care for their children in nurseries, play groups and schools.

Women may no longer “keep house” as they once did, and may lack the skills so to do. Consequently, they do not pass on home making, child-rearing and housekeeping skills and practices to their children. Urged on by the media, there is an increasing pace of life, which younger people—for the most part—enjoy. There may be an increasing proportion of young people, however, who find it difficult to keep up with this
ever-accelerating pace, and they become so-called dropouts, misfits, etc. And the pace of change eventually leaves older people behind: with people living longer, this can present a mounting problem of a divided society of multiple cultures.

Political Correctness
Political correctness (language, policies, or measures that are intended not to offend or disadvantage any particular group of people in society) may be imposed by law as a supposed means of reducing social friction, particularly between ethnic cultures. It has the effect of suppressing free speech, or driving it underground, so making people nervous, even frightened, of openly expressing some ideas, of using some words, even of thinking some thoughts... so subcultures develop, with their own language, dress, skin markings, hair styles, etc., and sometimes formed around antisocial activities, such as the sale and use of illicit drugs and weapons, or the grooming and exploitation of young girls for sex. Gangs may develop, may impose their gang culture on an area that they define as “theirs,” and threaten and do battle with other gangs, leading to so-called turf warfare. And police may be reluctant to act against such group behavior, for fear of being “politically incorrect,” and causing offense to some culture...

Political correctness, then, may reduce apparent social friction by concealing illegal, threatening or socially unacceptable behavior: in other words, imposed political correctness gives a superficial appearance of calm by concealing antisocial behavior which, out of sight, can become ever more extreme...

Political correctness has the effect of encouraging each member of society to ‘police’ the behavior of others: their language, symbols, gestures, etc., indeed anything that an individual assumes might give offense to some other party or person: ethnic minority, disabled, overweight, unusual features, etc., etc., indeed anything that the individual deems ‘unacceptable.’ Soon, everyone feels entitled to be a critic. Witch-hunts become the order of the day, and witch-hunts can search out rather more than witches! Witch-hunting may become almost a national sport, a way of conducting class warfare, a means of bringing down the powerful, the rich, and the celebrity. And, as history teaches, witch-hunts may be easy to start, but exceedingly difficult to stop.

Atomization
The urban ecosystem breeds an increasing number of people who are atomized, i.e., living effectively on their own, rather than in a nuclear family. This atomized community may be organized effectively by social media: smart phones, messaging, Twitter, Facebook, and email, of course, but newspapers, TV and radio too. Without family,
there is no “calming influence,” where older, more experienced members of the family would have moderated extreme views and actions.

Such large numbers of mutually disconnected individuals present a fluid mass, subject to the influence of any third party able to sway their behavior. This is the atomized virtual community. Lacking the steadying influence of family, it is the more extreme, the more anti-establishment, the more bizarre, the more improper, the more mischievous, and even the more illegal, entertaining notions that are likely to capture their imaginations and persuade the community of separate individuals to act in concert.

Examples of such group behavior abound. People go to so called “raves,” and music festivals held outdoors in muddy fields: they may stand in the middle of a crowd of others, all with their hands raised in the air, unable to see the bands because of the crowd, but mouthing the ritualized words in unison with hundreds, even thousands, of others. They appear to be mesmerized... Initially illegal, that very illegality attracted people to raves in such large numbers that government realized that the effect was unstoppable: raves became suddenly legal, even fashionable...and attending over-crowded weekend music festivals in muddy fields, living under canvas, and getting thoroughly soaked and filthy became de rigueur..
People attend theaters and, curiously, stand up to hear and watch a group perform, but will sit down for other acts. This may be the hypnotic effect associated with the rave transferring into the theatre, to the irritation of those who may be obliged to remain sitting and who can no longer see or hear the performance...

Atomized younger people may be coordinated via social media to riot in unison, perhaps in different areas of one conurbation, perhaps across several conurbations. They urge each other on, break in shop windows, steal goods, set places on fire, and attack the police, perhaps with little or no provocation. At the time, they appear to be carried away and enthused within the group, and by the excitement; they appear oblivious to, and unconcerned with, any later consequence of their actions. Later, on their own, individuals may find themselves surprised at their own behavior. This is ochlocracy, populist mob rule, as opposed to any democracy that they may espouse...
CHAPTER

DYNAMIC SYSTEMS EQUILIBRIUM

Temple of Zeus, Rome.
SECTION

LIFECYCLES...

CASINO, MONTE CARLO
Lifecycles
Systems science and systems theory potentially offer ways of comprehending the group behavior of people as societies, even as civilizations. If we regard an individual as a system—which, as we have seen, is not unreasonable—then crowds of people can be seen as extensive networks of interacting open systems. Organizations are networks of interacting human activity systems. On a grander scale, civilizations can be seen as “networks of networks” of interacting social systems.

Where large numbers of people live, or commute and work in, a city, that city becomes a veritable ecosystem, i.e., “a group of interacting communities and environmental factors.”

Natural ecosystems are reasonably well understood by biologists, botanists, zoologists and ecologists, at least in the large, if not always in full detail. Ecosystems comprise dynamically interacting parts, including organisms, communities of organisms, and non-living components in their environment. There is a flux of energy and matter through their environment: the greater the flux of energy, the greater the diversity (variety) of organisms.

So, there is greater diversity in a tropical rain forest, than in frozen tundra. Similarly, there is greater variety of houses, jobs and vehicles in a wealthy city than in a poor one, such that wealth in human affairs may be taken as a metaphor for energy flux through a system.
nergy, in the sense that they both “drive” variety/diversity.

Manmade technological artifacts and systems tend to maintain a level of stability using a mix of positive and negative feedback. By contrast, ecosystems establish and maintain a dynamic equilibrium through myriads of simultaneous localized interactions, with fauna, particularly insects, birds and bats, interacting with flora, plants, bushes, trees, parasites, etc. supported by earth and the air, which may also carry moisture, pollen and pathogens... Organisms, flora and fauna reproduce, interact, mature, die and recycle into fresh organisms. As organisms mature, they may dominate some part of the ecosystem, temporarily diminishing variety/diversity of other organisms. This may be obvious when considering the carnivore consuming the prey in its territory, but it is also true for the tree growing to such height that its canopy shuts out light from lower plants, which recover only when the tree is blown over, dies, falls to the ground and rots, or catches fire.

Thus in any ecosystem there is a continual dynamic, such that the overall ecosystem may appear reasonably consistent, while there is continual change and variation on smaller scales—hence dynamic equilibrium, homeostasis, of the ecosystem, rather than stability in any cybernetic sense.

Energy “pumps” variety/diversity, and different organisms grow and interact in their environment. Dominance arises, as described above (or by design in human affairs), with the dominant organism taking ever more of the resources so that variety/diversity is suppressed or extinguished, leaving a moribund system, focused around the dominant organism.

The situation may remain like this until there is a change in the environment, to which the dominant organism, lacking variety, is unable to adapt. At that point, and often suddenly, the dominant organism may collapse and decay, making way for survivors to emerge and for variety/diversity to regenerate under the influence of the energy flux, able once again to pass freely through the environment. In an extensive ecosystem, this continual cycle may be taking place in different parts of the overall ecosystem at different times, in conjunction with diurnal and annual changes that apply across the whole ecosystem. The net result may be that the ecosystem as a whole maintains dynamic equilibrium, while localities may be going through the transition, a cyclic progression.

The cyclic progression may be seen, alternatively in State-Transition form: there are potentially four states. Regenerated variety emerges after decay or collapse, in unopposed profusion. It may take some time for interactions and reactions to occur, at which point there is a shift to the state of Interacting Variety, where variety may con-
nect into “complementary sets,” i.e., varieties interacting in balance and harmony. For two varieties, this might arise where the output from one was the input of the other, and vice versa, but complementary sets might arise where there are many varieties interacting, perhaps in complicated and complex ways.

There is potential for such complementary sets to dominate local space, to absorb resources and so deny them to other, as-yet-unconnected varieties. Also, complementary sets may form that do not have a significant degree of diversity within the set. The result may be moribund systems, systems that do not develop further, which ‘dominate the local scene,’ but which lack potential adaptability. Such moribund systems may show no external signs of their limitations until there is a change of environment, or some perturbation/dispersive influence that exposes the moribund system as unable to adapt to the change owing to lack of variety/diversity which would exploit the change....
There is, then, a Principle of Cyclic Progression, which may be stated as:

*Interconnected systems driven by an external energy source will tend to a cyclic progression in which system variety is generated, dominance emerges to suppress the variety, the dominant mode decays or collapses, and survivors emerge to regenerate variety.*

The Lifecycle Map
The Principle of Cyclic Progression may be set out as a so-called “Lifecycle Map,” in which: energy “drives” the generation of variety; environmental change drives adaptation (or extinction), which leads to the generation of variety; from enhanced variety stem more interacting systems, encouraging the occurrence of more complementary sets and more “connected variety;” the connected variety and complementary sets encourage equilibrium of the open systems, leading to preferred patterns engendered by positive feedback and overall system cohesion; that cohesion is also prejudiced by the generation of dispersive influences too, i.e., varieties that do not connect, pathogens, etc.; preferred patterns may emerge, in the fullness of time, leading to dominance within the interacting systems that, should it suppress variety, will lead to eventual decay and collapse; system cohesion resists that tendency; decay and collapse support the generation of fresh variety.

The cycle continues as long as the energy source persists and the environment changes; this change is unstoppable once started, since the systems interact with each other to form their mutual environment and each changing system changes the environment for the others.

A system need not entirely collapse during the cycle; instead, it may partly decay, shed variety and incorporate fresh variety, subsequently continue around the clock-face as a system that has been altered in some degree and now contains fresh connected variety.

The onset of Decay and collapse – see the Lifecycle Map – “release” system components as fresh variety; Variety Generation may create Dispersive Influences that prejudice System Cohesion and further accelerate Decay and Collapse. This positive feedback loop goes to explain the observed sudden collapse of complex systems that may have grown slowly and steadily over extended periods.
A notable example of this phenomenon would be the sudden collapse of the Soviet Union, where the former satellite states, once freed, became vociferous advocates for all of the satellites to break free...hence the sudden, catastrophic, or “domino,” collapse. Similar collapses are to be observed when large organizations collapse suddenly and seemingly without warning. And, of course, it is to be observed in natural ecosystems where areas within, say, a tropical jungle will occasionally experience some trauma,
provoked by fire, disease, or a storm, perhaps, resulting in local collapse, only for the area to regenerate with new flora and fauna until, after a few years, it is indistinguishable from the surrounding areas. Rhizomes of some plants are able to survive fire, and will grow and flourish only where a fire has recently occurred. With such traumas happening spasmodically and locally over the extent of the ecosystem, it presents opportunities for flora and fauna that specialize in such regeneration to continue to thrive.

One last point: there is nothing to suggest that the system interactions should in any way be linear or continuous. The tendency to stability and the formation of preferred patterns certainly need not be linear—indeed they could be explosive, catastrophic or chaotic. Rather than invalidating the model, it lends strength to it, suggesting that there may be a key here to understanding the behavior of interacting systems at a heretofore-unprecedented level.

**Dynamics Of The Lifecycle Map**

**Dynamic Simulation of the Lifecycle Map.**

The simulation shows periods where an ecosystem is in dynamic equilibrium, interspersed with periods of collapse where attempts to build cohesion are temporarily unsuccessful. Even the periods of dynamic equilibrium are marked with turbulence...

The Lifecycle Map can be simulated using a suitable tool, with interesting results. The graph shows the basic result of such simulation that, like the Lifecycle Map it represents, will potentially keep running so long as there is energy to drive it. As expected,
the graph shows periods of relative stability and cohesion interspersed with periods of collapse. However, both homeostasis and collapse are seen to be turbulent: dynamic equilibrium, it seems, may be a relative term. There also seems to be a high degree of unpredictability about the occurrence of equilibrium and of collapse, the latter appearing fractal in form. Once collapsed, too, there may be a number of “false starts” before a climb to a new period of dynamic equilibrium.

There may be more to this result than meets the immediate eye: how is it possible for such a straightforward model to give such a complex result? For example, paleontologists are concerned with various major extinctions of life over the c.565MY of life of the planet, and correlate such extinctions with meteor-strikes causing global catastrophes. The Lifecycle Map and its dynamic simulation suggest that reliance on such extra-terrestrial causes may not always be necessary—complex ecosystems can collapse unpredictably without external cause.

The graph shows the general form of the simulation; that form may change according to the various parameter settings. These parameters correspond, in the simulation, with real world phenomena. So, for example, it is possible—in the simulation—to vary the amount of energy entering the ecosystem, which would correspond with, say, varying energy from the Sun in the real world. The effect of increasing the energy flux through the complex system is not obvious, however, since energy not only drives variety/diversity, and hence connected variety, leading potentially to enhanced system cohesion, but also drives dispersive influences that militate against that cohesion...

Altering parameters in the simulation leads to the results shown in the Table of Lifecycle Graphs. In the table, the upper left diagram represents nominal behavior of the ecosystem; this may be used as a reference with which to compare the other three graphs. The upper right graph shows the effect of varying the degree of variety/diversity in the ecosystem from very low (line 1), bumping along the bottom, to moderate in line 2. The results suggest that with insufficient variety there is little prospect of reaching a state of dynamic equilibrium.

The graph at lower left shows the effect of varying the available energy in the system from low, line 2, to high in line 1: the result of higher energy is longer periods of stability and fewer collapses. Lower right shows the result of varying the proportion of “dispersives,” i.e., influences to disrupt the ecosystem such as fires, pathogens, storms, etc. A low proportion of dispersives results, not surprisingly, in longer equilibrium, line 1, with less turbulence, and vice versa.
Unified Systems Theory (UST) ‘...that open interacting systems form, develop, sustain, collapse/decay and reform continually in a process that may be called “entropic cycling.”’

‘Law of Entropic Cycling:’
“Open interacting systems’ entropy cycles continually at rates, and between levels, determined by available energy”
This approach and the Law of Entropic Cycling are general, as may be evident from the absence of specific figures and timescales on the accompanying graphs. Put another way, the UST proposes a “pattern of behavior” that can be expected and observed across a wide range of different forms of “ecosystem;” indeed, many different kinds of complex open systems...

Importantly, the Law applies to an unbounded set of open, interacting systems, unlike the Second Law of Thermodynamics, which applies to singular closed systems only. And, while the Lifecycle Map (or, at least, the theory behind it) was developed from studies of natural ecosystems, it seems that the resulting process (and law) of entropic cycling may be observed, anticipated and expected in a wide variety of situations that resemble ecosystems, including human societies, large organizations, large-scale Information Technology (IT) systems, bureaucracies, civilizations, and more.

The Lifecycle Map “in Operation.”
Some instances of the relevance of the Lifecycle Map may be found in seeking explanations of the following:

1. Revolution. The domino-collapse of Soviet Union is an example of the positive feedback that reinforces a collapse, once underway. Sudden collapse is, however, frequently observed, particularly in organizations that have developed and become established over long periods.

2. Politics: continual switching between left wing and right wing governments in a democracy constitutes the state of dynamic equilibrium...

3. Dominant leader who expels dissidents (‘wets’) from their cabinet, reduce necessary variety/diversity in that cabinet, so heralding sudden collapse of both leader and cabinet.

4. International economic cycles (e.g. Kondratieff cycles) that rack world economics periodically.

5. Bureaucracies that “exist, like aircraft carriers, mainly to defend themselves” exemplifying preferred patterns in the process

6. Accountants who inadvertently destroy companies by shedding variety/diversity to survive economic winter...

7. Civilizations such as Ancient Egypt, which ‘cycled’ through 3 ‘epochs’ (Old Kingdom, Middle Kingdom and New Kingdom) with ‘intermediate’ periods of relative disorder.

8. Large-scale ‘Social’ IT Systems, such as those for health, security, finance, etc., which appear inordinately difficult to build and which are prone to apparent breakdown, discontinuity, and potential intrusion
9. *Global Warming*, where Weather Systems’ entropy will cycle continuously at rates, and between levels, determined by available (increasing) energy. USH indicates that global warming will result in more extreme weather conditions, more frequently:
   a) more severe storms,
   b) more downpours, floods, and...
   c) more extended calms,
   d) more extreme droughts.
   e) Weather systems being chaotic, it may prove impossible to predict individual events or locations...

10. *Periodic extinctions*, with the loss of many species on Earth. Such extinctions have been attributed to external “dispersives,” notably meteor strikes, but these appear to be neither necessary nor sufficient to account for such major collapses of life, nor indeed for its selective nature. For instance, the strike that supposedly “wiped out” the dinosaurs on land and in the seas some 64MY ago did not wipe out sharks, crocodiles, turtles, early mammals, bees, ants, etc., etc., which existed before, during and after the strike, yet apparently eliminated all dinosaurs including those in the seas, but possibly excluding some flying varieties. Why this differentiation? Perhaps such meteor strikes merely changed the environment such that moribund systems such as the long-evolved dinosaurs went into “domino collapse.”

**Sustaining Or Dispersing Systems**

The Lifecycle Map offers insight into how complex systems may be sustained, so as to avoid, or at least postpone, decay and collapse. If system cohesion is founded in connected variety/diversity, and if systems become moribund through the suppression of variety/diversity, then a complex open system may be sustained by maintaining/enhancing its degree of connected variety/diversity. Which may be easier to deduce than to implement.

Simply adding variety/diversity will prove inadequate, even counter-productive since, left unconnected, it may be seen, and serve, as a disruptive influence within the complex. To be effective, each new variety has to be connected: the new element has to “join,” to cooperate, coordinate and contribute with, and towards the goals of, existing members.

Similarly, the Lifecycle Map offers insight into how to degrade a complex system such that it will “fail to flourish,” and will collapse in time. The most straightforward way would be to progressively reduce the variety/diversity within the system. This
may have little observable effect until there is a change in the environment, at which point the system will lack the ability to adapt to the change, and will struggle. The previously diverse system will have been, effectively, reduced to a “monoculture,” with consequent susceptibility to debilitation, disruption, disease, decay, and demise...

This phenomenon has been exemplified in the business world, where ailing companies, ruled by their accountants, have sought to “ride-out” an economic winter by shedding elements of their portfolios other than “core business.” Unfortunately, come the economic spring, such companies find themselves unable to take full advantage of new business opportunities, lacking both the capacity and diversity which new and different types of business opportunity may demand.

In the world of food production, too, there is a contrast between the agricultural practices of growing a single crop or plant species in a field at a time. Continuous and extensive monoculture, where the same species is grown year on year, can lead to a build up of pests and diseases, and then a rapid spread where a uniform crop is susceptible to a pathogen. Such susceptibility is also to be found, for example, in the artificial breeding of salmon in so-called salmon farms.

South American farmers have farmed using polyculture for many hundreds of years: polyculture brings together complementary plant varieties for mutual nitrogen fixation, as natural pesticides/herbicides, wind-breaks, climbing frames, etc. The different plants, working as a set, combat a wide range of threats/potential deficiencies. Polyculture requires much less energy in the form of artificial aids. The disadvantage, of course, is unsuitability for mechanization that militates against large-scale cultivation.

Gardeners have long been aware of the benefits of “companion planting” of geraniums, dill, alliums, rosemary, marigold and nasturtium alongside brassicas (cabbage, cauliflower, Brussels-sprouts, etc.). Rosemary repels cabbage fly; geraniums trap cabbageworms; alliums (onions, shallots, garlic etc.) repel slugs, aphids, carrot fly, and cabbageworms. Pot marigold repels asparagus beetle and tomato worm. Nasturtiums secrete a mustard oil, which many insects find attractive and will seek out, particularly the cabbage white moth. The flowers repel aphids and the cucumber beetle. The climbing variety, grown up apple trees, will repel codling moth.

In polyculture, then, varieties mutually contribute to each other and hence to the emergence of flourishing communities... And so it would seem to be in ecosystems in general...
Social Insects, Social Organization

The Lifecycle Map offers insights into the evolution and behavior of social insects, offering in the process alternative evolved models – so, devoid of any human social engineering – against which to regard human societies.

The social insects are often described as ‘super-organisms.’ Certainly, hives, colonies, armies, etc., do behave in a highly coordinated manner. But then, so do trained and disciplined human armies: would we describe them as super-organisms? Ludvig von Bertalanffy introduced the term “organismic analogy,” suggesting that human systems (teams, groups, nations, even civilizations) are not organisms, but in many ways behave as though they were organisms. The organismic analogy works in both directions: human to insect; and, insect to human. So, a hive of honeybees is evidently not a single organism, but in many ways behaves as though it were...a human city is not a single organism, but in many ways it behaves as though it were.

Hymenoptera, Honey Bees

Honeybees include the well-known European honeybee (Apis mellifera), which often nest inside hollow trees. They construct vertical wax combs with individual hexagonal cells for storing honey and rearing brood. Each hive is "ruled" by a single Queen whose only job is to lay eggs. Workers are adult females – daughters of the Queen who mates initially with between perhaps as many as fifty male drones, stores their sperm in her body and uses it throughout her life to fertilize eggs. There are, then, as many as fifty lines of workers in each hive, maintaining diversity. Their duties change upon the age of worker bees in the following order:

1. Clean their own cell after eating through their capped brood cell
2. Feed brood;
3. Receive nectar;
4. Clean hive;
5. Guard hive;
6. Forage.

Some workers engage in other specialized behaviours, such as: “air conditioning,” using their wings to move air through the hive to prevent overheating; "undertaking," removing corpses from inside the hive.
Adult workers live for about six weeks during the summer, but Queens may live for several years. During cold winters, the bees cluster together, feeding on stored food reserves and sharing their body heat. As the weather gets colder, the ‘ball’ of bees tightens, and there is a continuous circulation of bees from the outside to the inside of the ball. This is analogous to the way chilled humans maintain core body temperature and Emperor Penguins survive harsh Antarctic winter storms.

The Queen secretes a pheromone to maintain calm and order in the hive. As the hive grows in numbers, there is progressively less of this pheromone to go around ‘per bee.’ At the same time, forager bees have to go further and further afield to fetch food for the growing numbers of bees in the hive. A mature, healthy colony may grow to as many as 80,000 workers, at which point foragers may be gathering barely enough nectar and pollen to feed, let alone expand, the hive. With so many worker bees, the Queen’s pheromone becomes too diluted to maintain calm and order, and the hive may ‘reproduce’ by swarming.

The prime directive for the colony, or hive, is evidently propagation of the species through propagation of the hive. The survival strategy involves limiting the size of each colony to that which may be supported by local resources (flora), at which point they relocate to a new area... Hives are perennial, accumulating and storing food to survive winters in cooler climes; this appears to give the hive a fast start to the new season when the weather improves. Honeybees do not employ any technology as such, but their ability to secrete wax and to create hexagonal shaped honeycombs is surely equivalent. This ‘technology’ directly contributes to propagation, in being used to raise the next generation and to store food compactly for over-wintering.

European honeybee survival strategy contrasts with that of humans, who build ever-bigger and more densely populated cities. Humans create complex import-export systems to transport foodstuffs from far and wide, making their cities potentially vulnerable to breakdown in supply chains, as well as supporting populations beyond that which could reasonably be supported from locally resourced supplies. This is surely a recipe for unbounded population expansion (and eventual disaster), which is what humanity is experiencing, but which honeybees avoid by living within their neighborhood resources, and by limiting hive population to that which the local flora will support.

**Hymenoptera, Ants**

Ants share a common ancestor with wasps, and there are over 8,800 species. A typical nest contains at least one fertile egg-laying Queen, hundreds or thousands of adult fe-
male workers, a nursery for rearing eggs, larvae and pupae, a storage area for food reserves, and a disposal site for waste and dead bodies.

The size of most ant colonies is limited by their ability to forage sufficient food. Leaf cutter ants may establish lengthy supply chains to bring in their food source – although they do not eat the leaves they harvest, most of which are poisonous. Instead, they use them to feed a farm, which grows a fungus on which the ants live, an early example of symbiosis. The fungus farm is supplied with an antibiotic covering farm-worker ant bodies, so preventing disease; these ants discovered antibiotics some 40M years ago.

Army ants are carnivorous nomadic predators that form bivouacs, but do not nest. Honeypot ants farm aphids, living on their excreted honeydew and moving them from plant to plant as a farmer might move cows between pastures.

Ants have a similar allocation of worker duties with age to honeybees: young ants, about one third of the workers, are nurses; about a third are cleaners, having graduated from nursing; and about a third are foragers, collecting food outside the colony, having graduated from cleaning.

Ants, with lives lasting about a year, tend to socialize within their current ‘profession,’ e.g., nurses with nurses, foragers with foragers. It was not clear what promotes ants from one profession to the next, nor whether promotion is automatic: there are occasional old nurses and young foragers.

Between them, the many and various ant species display a wide variety of lifestyles and survival strategies. Some are carnivorous, some vegetarian. The biomass of all ant species in the world is reputed to exceed that of all humans. Throughout, their prime directive is survival of their species; they limit their nest/colony size according to locally available resources, a repeated lesson, perhaps, for humans.

Recent research showing that ants progress through different ‘professions’ in a similar way to honeybees suggests a further instance of convergent evolution, this time of societal behavior... Ant tendency to intra-profession socialization may suggest that these ‘professions’ are akin to classes or castes, although without any morphological distinctions.

Blattodea (formerly Isoptera), Termites
Termites share a common ancestor with cockroaches, and are universally vegetarian. Although similar in appearance to ants, they are unrelated, another instance of convergent evolution solving the same social problem. There are some 2,600 known species of termite. They eat anything from lichen and fungus to wood.
In Africa, termites create enormous mounds, with funnels to create air conditioning, particularly for the Queen’s chamber, which is held at 30˚C and near to 100% humidity – not dissimilar to the breath of a mammal. These mounds can become very large, with some 35km of tunnels. The relatively huge Queen may live up to 30-45 years, supported and enabled by her king who remains virtually attached to her as she continues to lay eggs. There may be over one million termites in a mound, with the Queen as mother to all.

Like other eusocial insects, termites have castes: Reproductives; Workers; and, Soldiers. Periodically, members of the winged sexual caste take to the air, mate, and the newly fertilized young Queen seeks a new spot where she may start a new colony. So, new colonies are budded off the old, while the old may stay put with its original Queen.

Termites, at least African termites, may be more established than their ant and bee ‘cousins,’ and they build strong, deep nests, mostly underground. Queens ‘entertain’ their king, and together they are much longer lived. Like the Hymenoptera, they live very much within their neighborhood, foraging over the surrounding surfaces, clearing up vegetable detritus, advantageously reducing the risk of forest fires in the locale.

Do we have anything to learn from the Social Insects?
Insect societies are inherently different from human societies. We humans would find insect social behavior intense, exceedingly tiring and beyond our ability or desire to sustain. Busy bees, for instance, literally work themselves to death. The social insects know instinctively what job they are intended to do, and they do it: no instructions, no supervision—although, failure to perform may result in summary execution.

There are, however, castes. While all eggs may be laid equal, the way in which they are fed may produce morphologically different results, castes: bees and ants have worker and reproductive castes (Queen and drone). Workers tend to progress from nursing, though cleaning to foraging. Some ant species have soldier castes where the soldiers are very much larger than the workers, and may have to be fed by those workers. Termites have reproductive, soldier and worker castes (immature males and females (nymphs), with potential to molt into replacement soldiers or ‘reproductives’ if needed. Soldiers may differ from others morphologically, with ‘hoses’ on their heads to squirt irritating fluids at their enemies—often ants...

Like other eusocial insects, termites have castes: Reproductives, Workers, and Soldiers. Periodically, members of the winged sexual caste take to the air, mate, and
the newly fertilized young Queen seeks a new spot where she may start a new colony. So, new colonies are budded off the old, while the old may stay put with its original Queen.

Castes may be compared with classes in human society, which have existed since the earliest times—the earliest probably being that of ancient Egypt. Despite efforts to eradicate, reclassify and rename class within human society, it is still with us and seems to be as innate within human social order as it is within insect social order.

Class mobility, on the other hand, the ability to move between classes, is evident within the social insects, except where caste is morphologically determined. Within the social insects, workers progress through ‘professions,’ finally working outside of the colony/hive as foragers. Within human society, there is no such obvious progression...although as humans age in society they tend to accumulate knowledge and experience, (may) gain social stature, (may) own property, etc. It is not really the same...

All of the eusocial insects create societies that are closely related genetically, to promote cooperation and coordination. Humans have no obvious equivalent, outside of the family group, nor would we want or accept one. But do we have any corresponding attributes that would similarly promote cooperation and cooperation? Perhaps it would be easier with human society to identify those phenomena that prevent, or detract from these ‘desirable social traits.’

Culture. People of different cultures, upbringing, educational backgrounds, political persuasions, religions, etc., may behave, express attitudes and formulate decisions that differ from each other, so constraining cooperation and coordination

Belief Systems. Our view of the world, our Weltanschauung, and our beliefs—cultural and religious—may differ radically from others, so that we are unable to see things as they do, and vice versa.

Training. Intense military-style training may overcome different belief systems, such that people who have trained together will cooperate and coordinate in their actions, decision-making and will even overcome their differing natural reactions under pressure.

So, we may reasonably expect human societies where people are the same/similar background, culture, education, upbringing and beliefs to form cooperative, coordinated societies. Within those societies we may expect to find different classes. And this is generally, although far from always, the case.

Alternatively, cooperative societies may form and self-sustain where culture encourages individuals to consider themselves part of a close-knit family group. Toyota in Japan has operated in this way, with notable success.
What price, then, multi-cultural society? If the eusocial insects were to offer any guidance, it might be that an effective, coherent multi-cultural society is unlikely, while a complex of different side-by-side diverse cultures is more likely, with the inevitable risk of friction at the cultural boundaries, possibly suggesting buffer zones, or space...
SECTION
CITY ECOSYSTEMS

VILLEFRANCHE, PROVENCE-ALPES-CÔTE D'AZUR, FRANCE
City Ecosystems
According to the World Health Organization’s Global Health Observatory:

“The urban population in 2014 accounted for 54% of the total global population, up from 34% in 1960, and continues to grow. The urban population growth, in absolute numbers, is concentrated in the less developed regions of the world. It is estimated that by 2017, even in less developed countries, a majority of people will be living in urban areas.”

In some areas, the issue is more acute. In 1950, the population living in UK cities was 79%, and is set to rise to 92.2% by 2030. China’s percentage rose from 13% to 40.4% between 1950 and 2005, and is set to rise to 60.3% by 2030.

Present and future large cities may be regarded as biomes, with urban areas within them being de facto ‘human ecosystems,’ comprising groups of communities, shops, business, factories, parks, traffic and transport, entertainment venues, hospitals, emergency services, etc. A city-biome may contain many such urban ecosystem/areas, each with a distinct ‘flavor’ of its own, as a glance at some of today’s large cities suggests...

New York has its five boroughs: Brooklyn, Queens, Manhattan, the Bronx and Staten Island; each is distinctive; each has its own sense of identity. London is a city with 33 small 'cities' within it, each has their own government, schools, centres, suburbs, and sense of identity. Similarly, Paris has ‘areas’: La Cité, Louvre/Champs Elysées, Les Grands Boulevards, Le Quartier Latin, Le Marals, Le Septième Quarter-Les Invalides, Pigalle-Montmartre, 18th-20th Arondissments, Le Seizième, Chinatown-Le Trezième, Quartier Le Bastille, and La Défense.

Cities in general are far from homogenous: often, they have been formed from smaller, pre-existing villages or towns that have grown until they virtually contacted each other, and have been gathered under an administrative umbrella with its own megacity name. While to a casual observer, the megacity may appear to be a singular entity, it is a conglomeration of interacting human ecosystems, each retaining something of the nature and character of its previous independent existence and each having continued to evolve, or diminish, partly along its own path, and partly as influenced by inter-
action with other, adjacent ecosystems and as directed by the overall city administration...

Inexorably, it seems, cities grow and grow. Some, like Cairo in Egypt, have grown very quickly, and the population density is increasing rapidly. What of the future? Will cities continue to grow and increase in population density, as the human population on Earth continues to burgeon? Will such human biomes endure? Will there be sufficient resources to support such large, concentrated populations.

If the Lifecycle Map is anything to go by, then it seems that the durability of future human ecosystems may depend upon a variety of factors:

A continuing flux of energy, material and information, sufficient to satisfy both the physical and intellectual needs of the various communities;

Maintenance of variety/diversity within each ecosystem/area;

Containment of ‘dispersives:’

_ anarchists_ who do not “wish to join,” but desire to break-up communities;

_infectious diseases;_

_communities of “the atomized,”_ people who can be swayed and organized through social media to behave mischievously and antisocially.

There will inevitably be social turbulence: on-going turbulence is a natural feature of dynamic equilibrium, however. As any policeman will undoubtedly confirm, a society without turbulence, misbehavior, exuberance, etc., is a lifeless society, not really a society at all. From time to time, there will also be a social collapse, confined to a locale, which will be followed by a rebuilding/reconstruction and a fresh start.

Such social collapse can occur in a way analogous to natural ecosystems, through the aging of building, estates, and their inhabitants, through accidental storm, flooding, or lightning damage, through sabotage by insurgents, through riots, leading to a process of replacement with something new—a newer style of building, perhaps, an influx of younger, professional people, a new community-based project for living and shopping, or a new business that includes accommodation in its design. Keen observers of such renovation may notice that the new buildings often make use of the rubble from previous buildings to provide in-fill and hard-core—surely a classic case of forming new varieties from old...
The first bullet above may be easily overlooked. With such a large proportion of people living in cities, who is going to be providing the food, processing it, storing it, and transporting it? And, where is it coming from? To address that issue we have to look beyond the city to the nation, and beyond the nation to the global economy.

### National Socio-Economies

**N2 Chart showing typical National Socio-Economy**

The leading diagonal shows the main societal systems: Raw Materials Industries; Manufacturing Industries; Service Industries; Society at large, i.e. groups of communities; Farming Industries. Other rectangles show the interfaces between these main systems, i.e., what each passes to the others. So, Raw Materials Industry passes Energy, Metals, Woods, Plastics and Composites to Manufacturing Industries; it also passes Fertilizers to Farming Industries. Similarly, Farming Industries pass Food to Society, and Recyclable Machinery to Manufacturing Industries. Energy is expended, work is done, and money changes hands, in transferring people, things and information between and within societal systems.

The figure is an N2 (‘N-squared’) chart for a typical nation in relative isolation i.e., exports and imports are not shown.

Socioeconomic systems engineering (SeSE) can be seen as the organization and management of the national macro-system represented by N2 chart, to ensure that resources required by any one sector are made available in the right quantity and quality, and on schedule from the other sectors. The whole system will exhibit emergent properties of human capital and gross domestic product (GDP): provided the popula-
tion is supportable by the national assets, both of these may be expected to progressively increase...

Closer examination will show that each of the main societal systems provides what the others need and receives from the others what it needs. In principle, the N2 chart could represent a stable, self-sustaining socio-economy. A closer look would suggest, however, that there are internal dynamics to consider: that which is transferred has to be sufficient to meet the needs of the recipients year round, in good and bad years; if it is, then the socio-economy may be self sufficient and self-supporting. Then, of course, if the nation supports a megacity with many different ethnic cultures, it is likely to be the case that some of those cultures will want to maintain their cultural identity, which may involve importing food that cannot be grown in the host country, furniture and materials that cannot be made in the host country, and so on. It is very likely then, that a multi-cultural society will seek to import a wide range of goods and foodstuffs, not shown in N2 Chart.
SKARA BRAE, ORKNEY

Late Neolithic, 3,200-2,200BCE. Eight surviving dwellings. “Furniture” in one of the sunken habitats, shows a hearth, bed areas, and a shelved dresser.

Dwellings would have been sheltered by whalebone ceilings, covered with turf.

LATE EGYPTIAN HIEROGLYPHS, SHOWING PRISONERS BEING TORTURED.
Potential shortfalls or excesses in capability and resources result in imports and exports of people, services and things. Here, different N2 charts for various regions have been superimposed on a global map, and interconnected. There could be one N2 chart per nation, one per region in some nations, or even one per megacity in the future, resulting not in six as shown, but in hundreds or thousands. Envisage a super N2 chart where the leading diagonals are made up from societal systems, represented by socioeconomic N2 charts. The interface rectangles would then show the various imports
and exports around the globe. Such a figure would be exceedingly complex: but then, so is the global socio-economy it would purport to represent. Such a representation in full may be impractical, but envisaging the concept serves to show the burgeoning complexity brought about by so-called globalization.

Globalization may be seen as socioeconomic systems engineering on the grand scale, and is highly complex. We may begin to glimpse the issues by considering a global socioeconomic system that is initially in a state of dynamic equilibrium when it is disturbed in some way. Le Chatelier’s Principle is relevant:

> “when a constraint is applied to a system in dynamic equilibrium, then, in so far as it is able, the system will adjust itself so as to oppose the constraint, and in so doing will move to a new point of dynamic equilibrium.”

The Principle suggests, conceptually, that the complex global socioeconomic system may be able to ‘ride’ localized disasters. The Principle says nothing about the manner of adjustment, nor about the condition of the new dynamic equilibrium; for a complex system, these may not be knowable. Constraints may arise in many forms: global warming; natural disasters; war, famine and pestilence, oil shortage, lack of potable water... Neither does the Principle address the energy/work/finance needed to maintain the interchange between all of the systems, which may—in the case of globalization—prove an overriding factor...

In the light of Le Chatelier’s Principle, a globalized socio-economy is hoped to result in a robust, dynamically stable overall system, and systems theory does point in that direction; yet perturbations may not favor individual nations, and the output from large dynamic economies may well shift the point of dynamic equilibrium, to the detriment of less robust nations. Globalization smacks of a grand multicultural macroeconomic social experiment, with room aplenty for challenges along the way...

The chart shows a greatly simplified, but still complicated, interchange between only two nations, regions or states: each is represented by its respective N2 chart, and in addition interfaces are shown for exports from the top-left nation, A, which appear as imports to the bottom right nation, B—and vice versa. Evidently there are very few exchanges in this grossly simplified example.

So, Nation A, top left, exports fertilizers and farm machinery—top right rectangles of diagram—to Nation B’s Farming Industries. Amongst other things, Nation B sends university students to a presumed university in Nation A’s Service Industries; these students may return later as graduates to Nation B’s Manufacturing Industries;
and so on... Each nation supplies food to the other’s society, although the chart gives no clue as to what kind of foodstuffs and how much. In such situations, money is the lubricant that oils the wheels of exchange, although barter is not unknown at international level, and oil is sometimes used as currency.

Socioeconomic Dynamics

From such considerations it may be possible to estimate each nation’s GDP and the balance of trade between Nations A and B. Scaling up to hundreds of nations, it may prove more challenging when there are many nations involved, and when commodities pass through intermediate countries on their way to a third or fourth party. E.g., if trade balances are out of line, if some countries are effectively “cooking the books,” it may take some considerable time for such inconsistencies to be detected. The whole represents a complex, widely distributed system, which will inevitably behave in the manner of any ecosystem; nominally in a state of dynamic equilibrium, and powerless to prevent behavior in accordance with the Law of Entropic Cycling:

Open interacting systems’ entropy cycles continually at rates, and between levels, determined by available energy”
Inevitably, this complex system will experience periods of stability, interspersed with periods of collapse – not necessarily of the whole system, but of areas or regions within the overall global system. The Lifecycle simulations suggest, these localized collapses of the system may be minimized, if not entirely prevented, by increasing the energy driving the ecosystem, which interprets as increases in transport facilities and in varieties of transport means, so that hopefully-temporary collapses may be overcome in short order. Such a large, complex, globally distributed system is, however, unlikely to afford and hold reserves of transport in case of unpredictable collapses. There will be enough challenges to face with global warming: rising sea-levels threatening harbors and docks; deepening depressions; and, evermore severe storms...

Globalization And Self-Sufficiency

With potential disasters in mind, there may be precautions that any individual nation might take. If, for instance, global interchange of foodstuffs were to break down, temporarily, or permanently, then it would behove any nation to be able to support its population from home grown food all year round. It is surely axiomatic that:

*The population of any country or region should not exceed its indigenous capability to feed that population*

Some countries are already unable to support their current population from “home grown produce.” And some countries are moving towards such a state. According to research by the University of Cambridge, the UK is “running out of land for food and faces a potential shortfall of two million hectares by 2030.” This has come about through a combination of rapidly increasing population in an already overcrowded island, coupled with the need of land for more housing, and the use of land for so-called “energy crops.” While self-sufficient in products like barley, wheat, milk, lamb and mutton, the UK imports large amounts of fruit and vegetables and other farm products including pork. Overall the UK runs a food, feed and drink trade deficit of £18.6bn. (2014 figures)

Where a country harvests more than it needs for its own population, then it is reasonable and sensible to export the surplus—but not, as we have seen by the ancient Egyptian example, to increase population to correspond with that temporary surplus; that way lies the path to a greater, but unsustainable, population and impending fam-
ine. Although, it is not unreasonable to exchange surpluses in some commodities for shortages in others, provided the axiom stands.

Where, however, the population exceeds the indigenous food supply, then—in the long term—either the population should be reduced or the indigenous food supply should be increased—there is no sensible future on an increasingly overcrowded planet for nations to be in permanent receipt of food aid: that way lies more disaster and conflict. City island states such as Singapore lack the necessary agricultural area to grow much of their own food, so must rely largely on imports. At present, Singapore imports some 90% of its food by air from around the world, including from Malaysia, Indonesia, Thailand, Argentina, Uruguay, Australia, New Zealand and Ireland. The Singapore government is acutely aware of the impending problem, however, and is researching ways to grow more of the food it needs from within its largely urban area, even to the point of considering roof tops as growing surfaces.

Modern socio-economies such as the UK are robust and effective, with the ability to ride poor seasons and to gather foods of all kinds from different parts of the world, to feed and sustain an ever more diverse population. The UK is far from alone, however, in “sailing close to the edge:” with the advent of Global Warming, together with the continuing and increasing international conflict, it may be imprudent to depend
on the widespread and continuing resources anticipated through such Globalization. More simply put, we should, perhaps, live within our indigenous means, or at the very least not drive ourselves into a position where we can no longer feed and water our growing populations as the seas and the temperature rise, along with the deepening depressions and darkening storms.
CHAPTER

HOMO SAPIENS AND THE MEGACITY

Coliseum, Rome.
SECTION
CITY LIVING

HERCULANEUM
At present, we see Man tending to live in increasing concentrations in ever-larger cities, and the behavior of Man changing in these circumstances. The Industrial Revolution may have been good – eventually – in socioeconomic terms, and it has raised the standard of living of the many, as opposed to the previous few. Less obvious, however, are changes in the human condition. As populations grow, towns and cities become more densely populated. Instead of living cheek by jowl with the natural world around them, people live cheek by jowl with other people, disconnected from the natural world in which they evolved... City dwellers may describe their teeming world as a concrete jungle, but it cannot be a jungle without the natural elements, other animals, forests, savannah, etc. Consider an anthropologist’s view:

“Under normal conditions, in their natural habitats, wild animals do not mutilate themselves, masturbate, attack their offspring, develop stomach ulcers, become fetishists, suffer from obesity, form homosexual pair-bonds, or commit murder. Among human city-dwellers, needless to say, all of these things occur. Does this reveal a basic difference between humans and other animals? At first glance it seems to do so. But this is deceptive. Other animals do behave in these ways under certain circumstances, namely when confined in the unnatural conditions of captivity. The zoo animal in a cage exhibits all these abnormalities that we know so well from our human companions. Clearly, then, the city is not a concrete jungle: it is a human zoo.

“The comparison we must make is not between the city dweller and the wild animal, but the city-dweller and the captive animal. The modern human being is no longer living under conditions natural to his species. Trapped, not by a zoo collector, but by his own brainy brilliance, he has set himself up in a huge, restless menagerie, where he is in constant danger of cracking under the strain”

Desmond Morris, The Human Zoo, 1994
In seeking to alleviate the human condition, then, the city may not be the ideal solution: instead, the city may be seen as a virtual prison without bars – at least of the restraining variety. Concentrating people in cities may ease the logistics of looking after large populations, supplying food, water, power, sanitation, stimulating entertainment, etc. But, such concentrations also generate social misfits, anxiety, depression, discontent, riots, pollution, disease, crime, gangs, drug abuse, etc., all of which ‘products of city living’ give the police more work to do – so policing is more demanding – and perhaps even ‘heavy handed’ on occasion - in cities, depressing the human condition progressively further...

As we have already seen, the dynamic, pressure-cooker environment that exists in cities can lead to break-ups in family life and an increasing proportion of the population living alone, forming the “atomized community.” Such atomized communities, formed from easily led, anti-establishment groups, potentially threaten ochlocracy—mob rule—witness riots of the kind that are already becoming all too familiar in major cities. One root cause of such unruly behavior and potential destruction can be traced to the breakup of the family, and the breakdown of marriage as an institution for all, leaving individuals living largely alone, in the city and beyond the moderating
influence of the family. The reasons for marriage going “out of fashion” are complex, but are associated with social liberalization, so-called female emancipation, etc.

Such a breakdown might be seen as part of a wider breakdown in civilized behavior, even of civilization, which has been based on the family as its fundamental building block since humans began. If human families evolved the ability to propagate human families in a successful, unending sequence of family after family after family; then, interfering with family threatens the successful propagation of new families. Which is to say that propagation of offspring may not be enough; we humans are biologically evolved to propagate in families, where the young are raised in protective, nurturing family environments until they are mature enough to continue the sequence.

There is a progressive increase in maladjusted and mentally disturbed young people, with psychoses, phobias, paranoia, schizophrenia, autism, stress disorder, bipolar disorder, alcohol/substance abuse, attention deficit / hyperactivity disorder, depression, paedophilia, pornographic addiction, anorexia nervosa/eating disorder, bulimia, gender dysphoria, self harming, generalized anxiety disorder, antisocial personality disorder, and many, many more.

Could such disorders: be the result of a mismatch, as suggested by evolutionary psychology, between the psychological mechanisms evolved during the Pleistocene to deal with recurring problems of that era, with the quite different problems of today?

Could they derive from a breakdown in the Successful Family Propagation System in which children were raised in an environment naturally selected to create balanced, mature adults able to sustain a lifetime pair?

Could they be a by-product of crowded city living, by continuing war and conflict, and by post bellum cultural liberalization movements sweeping through, particularly, western societies which swept aside contemporary social rules of behavior, sexual inhibitions, etc., and substituted so-called “free love,” drug-taking, and general rejection of parental, governmental and every other kind of authority, i.e., a form of ad hoc, populist ‘bottom-up’ social engineering leading inter alia to a break with traditional values and norms, including those of marriage, family, respect for the elderly and for tradition?

Could they be a by-product of social media “over-connecting” people, such that – psychologically at least – individuals find themselves in an overwhelming crowd of others, which they are not adapted to deal with – so, permanently in a crowded pseudo-city, with thousands of invisible “friends,” strangers and critics, even when alone with their media devices that are overloading them with superfluous, salacious, hyperbolic
information – which, being competitive humans, they feel a pressing need to keep up with?

Could they be associated, then, with the now not-so-sheltered family, with premature exposure of the child—still, perhaps, within the nominal family group—to disturbing/deviant cultural influences and practices, with psychological traumas occurring so early in life that they cannot be recalled, or so minor in the view of parents—themselves disturbed by similar traumas in their formative years—that they do not realize that trauma is being inflicted?

A boy of five was falsely accused of spitting at his infant school. Despite protests of his innocence by his playmates and himself, he was physically held down by teachers and beaten with the heavy, thick leather strap (taws) used in Scottish schools at the time. The taws left two parallel red weals on the inside of his right arm, some eight inches long. He ran home, crying, and waited to show his father the evidence when he came home from work. His father refused to take up his son’s defense, however, stating that life was unjust and that his son should balance the unjust punishment against all those times when he had done something wrong, and ‘got away with it.’ The boy was traumatized by the *unjustness* of his beating – the beating itself was soon forgotten – but even more by what he saw as his father’s abject betrayal, which broke the bond of trust between them, for life. The basis of trauma in the young is not always obvious.

Contemporary social engineering encourages women to return to work perhaps only days, weeks or months after giving birth. Does this affect the infant? Perhaps. Does it have zero effect? Unlikely, since it breaks the mother-child bond, regularly, if only temporarily: besides, both mother and infant may have evolved for the one to suckle the other, not for days or weeks, but for years. Is it, on the other hand, traumatic for mother, infant, or both? It certainly upsets some new mothers, but as to the infant? How would we know? Is a child-minder an effective mother-substitute? Or, to the fledgling psyche, does this child-minder present confusion, an alien intrusion with the wrong smell, feel, sound, image and behavior?

Is nursery school overwhelming to an infant mind genetically programmed to cope with a close family group of only between some five and nine individuals, including an unchanging, utterly consistent and dependable mother, father and grandmother? Contemporary social engineering requires men and women to work equally, promoting social benefits, ignoring any adverse impact on pair bonds, or on the next generation. Does today’s mother, bombarded from all sides by well-meaning advice on baby and child rearing, and without an experienced grandmother to hand, even be-
have towards the newborn and the infant in a way consistent with the presumed Successful Family Propagation System (SFPS)? How would she know? Would she care?

If city living, war, disaster, social engineering, or the loss of either parent interferes with the protective, family group and the sheltered, secluded environment that it engenders to raise the next generation; if children no longer have an innocent childhood; then it seems not unreasonable to expect that next generation to be affected in some way. The most likely way will be difficulty or inability of the next generation to create and sustain their own successful family groups, so breaking the successful family begets successful family continuum...and, if widespread, potentially affects social stability, even potentially the basis of civilization per se. In the West, it is not difficult to detect signs of such breakdown...

**Marriage, Equality and Complementarity**

On a broader front, human social behavior in cities is changing under the pressure of social engineering. Marriage, previously defined as “the joining of a man and a woman” to make a single unit, has been changed to include so-called same-sex marriages, between a man and a man, a woman and a woman, or between those in some mid, transgender state, which had never previously been recognized. The logic, which observes that a man and a woman are physically, psychologically and biologically complementary, and that this complementarity is the fundamental—and rather physically apparent—basis for pair bonding, is no longer seen as relevant. Instead, there is an argument based on the notion of equality of opportunity; that men and women are equal, that if a man and a woman can (have the opportunity to) get married, then why not a women and a woman, or a man and a man? No one seems able, prepared, willing or daring enough to give the obvious answer to that rather simple question...they do not biologically, psychologically or physically, fit together, so marriage – in the essential meaning of the term – is not feasible. But, social engineering rules, not rationality...

On the other hand, while man and woman may be complementary, they are evidently not equal. After all, there are marked differences between men and men; some may be leaders, other followers, some may be academic, others sporty, some introverted, others extroverted. Moreover, such evident differences need not be fixed, but may change as individuals gain experience, mature, and age.

Similarly, it is evident that women and women are not equal. There may be marked differences between women; some may be “girly” and like dressing and mak-
ing up; some may be “tomboyish,” and prefer sport and the outdoor life. Some may be intellectual, others more practical. Some may want children, or feel a drive to be nurses, while others may want to be engineers or pilots. And, like the male of the species, these differences are not fixed, but may evolve as the person matures.

At the most fundamental level, there is a chromosomal difference between men and women, as a consideration of XY and XX chromosomes will attest, and some have suggested that this has led to gender differences in creativity. Testosterone in men appears to affect the way in which their brains develop physically, such that men and women may go about problem solving, designing, etc., differently, although there is no evidence to suggest that their relative performances differ. Suggestions that men are more creative than women are controversial and unproven.

Then there is sexual dimorphism, which may not be so marked in humans as in, say, gorillas, but which nonetheless marks out men as, on average, taller, heavier and stronger than women. This indicator of physical non-equality is at its most evident, perhaps, in sport, where men and women tend to have separate competitive sports – for the time being; this, presumably, to avoid the physical differences in sporting capability between the sexes from becoming apparent to all, which may be seen as “unfair.”

So, the sexes are equal when it suits...

**Individuation**

Psychologists tell us that an individual’s personality is not fixed until they are in their early thirties; up until that time it is changing, evolving, adapting to the personalities with which it comes into contact...The person you are at, say, eighteen, may be quite different from the person you have become by age thirty-five.

So, men and women are self-evidently equal neither to each other nor to themselves. Same-sex pair bonding, the product of on-going social engineering, may nonetheless be viewed as irrational, since it denies the fundamental, and irrevocable complementarity of man and woman, which has been, is, and will presumably continue to be, the instinctive/reproductive basis for pair-bonding. And, if Desmond Morris is right, all of this ‘irrationality’ derives from living in cities, in human ecosystems, or – as he put it – in human zoos.

And since there are more and more of us, we should look forward to more of the same... with individuals categorized as androgyne/ambigender/intersexual/polygender (for those where external genitalia and internal sex-organs have both male and female characteristics), or as masculine-plus and masculine-minus males,
feminine-plus and feminine-minus females, masculine males, perhaps with sporting classifications for each category based on e.g. testosterone levels...

We will continue to have subdivisions in class, too, with upper middle class, lower middle class, lower upper class, etc. And further class expansions, beyond socio-economic classes by occupation, e.g.:

1. Higher managerial and professional occupations
2. Lower managerial and professional occupations
3. Intermediate occupations (clerical, sales, service)
4. Small employers and own account workers
5. Lower supervisory and technical occupations
6. Semi-routine occupations
7. Routine occupations
8. Never worked or long-term unemployed

All of which is a far cry from the hunter-gatherer group living on the African Savannah, where – according to some viewpoints – matriarchal women ruled, sending the men out to hunt as required, while the women ran the household, raised the children, and generally provided the essential integrative influences that held the family together as a successful working unit.

City Living

Looked at from such a viewpoint, you might start to wonder what all the city activity is about. After all, the basic activities for humans remain unchanged: hunting and gathering to feed families; building, maintaining and cleaning shelters to safeguard the family; teaching offspring how to hunt and gather in their turn; teaching offspring how to behave in socially-acceptable ways, to be accepted as part of the group; safeguarding offspring from harm; and, seeking remedies for illnesses and injuries that family members may have experienced.

Food is plentiful, hanging from the branches of the local supermarket. We have washing machines, dishwashers, microwave ovens, vacuum cleaners, etc., etc., to take away the drudgery of household work, leaving lots of spare time – for, perhaps, the first time in history or prehistory...

We have fast food outlets to obviate the need for cooking, and eating as a family. Our houses are built for us and centrally heated, so that the family members can live in separate rooms, instead of huddling around a living room fire, and our children can
be in their rooms connected by social media to their friends and other, less savory influences, even becoming part-atomized... So, the family may not behave, even in the home, as a close-knit unit... Our children are educated for us in nurseries and schools, and the state provides healthcare by one means or another...which brings us back, full circle, to the lower three levels of Maslow's Hierarchy of Needs, repeated below:

3     Love/belonging       Friendship, Family, Sexual intimacy
2       Safety                               Security of: body, employment, resources, Morality, the family, health, property
1       Physiological     Breathing, Food, Water, Sex, Sleep, Homeostasis, Excretion

Superficially, city living would seem to satisfy the three lower levels. Note, however, that at level 2, the notion of Morality (dictionary: “of character or conduct, knowing right from wrong, good from evil; virtuous, esp. in matters of sex”) may have changed significantly. Concepts of right and wrong are subjective. ‘Virtuous’ no longer has meaning. Previously, morality might, perhaps, have been founded in, or influenced by, religious teaching. In the megacity, where religious teaching may no longer exist, or have become distorted, ‘morality’ may be fluid, meaningless, non-existent, or some shifting kind of “pop-morality:” i.e., formed around contemporary notions of ‘good’ and ‘bad,’ as propagated by the media.

The media constantly tests the boundaries of contemporary morality, seeking to liberalize and remove constraints on human behavior, and presenting the worst aspects of human behavior and bestiality as a means of entertainment for the jaded palate. Older people complain about “lowering of standards,” while younger people enjoy the novelty and excitement such presentations engender, unaware that their ‘threshold of acceptability’ is constantly being eroded. Meanwhile, at level 3, the bonds of family may be loosening, while ‘friendship’ has taken on a new dimension with the advent of social media, and the ability to be pseudo-friends with hundreds, even thousands of strangers.

**Feminism**

It may be no exaggeration to suggest that prospects for the future megacity are diminished, *inter alia*, by the growth in feminism, which may appear to be promising free-
dom and equality (or is it really superiority?) to women, but seems instead to be setting a trap for them. How could that be?

Feminism traps women into behaving like men, and in so doing inevitably restricts their opportunities to behave like, or simply to be, women. It was not like that within living memory: in Edwardian times, for instance, men and women were content being husband and wife, father and mother. Father was the breadwinner; mother the homemaker, as it had been for hundreds of thousands of years. Women who could afford to do adventurous things, often did them.

There were ‘things’ men did, and things women did, by convention, and sometimes by rule. Such rules were based either on a desire to operate as a brotherhood or as a sisterhood, without the intrusion of women or men respectively, or from a belief that the activity was more suited to the stronger male or to the more dextrous, considerate and caring female. Young men and women had a period often after single-sex education, college or university, to take a job, to travel, to experience life, before setting down, getting married and raising a family. It was all very straightforward. Undoubtedly, some women envied men their more adventurous rôles, and some men wished for the quiet life, with a lot less excitement, danger and physical labor...
Recently, social engineering has ‘persuaded’ many women to have their first child in their forties, fifties and even sixties, after careers of many years in industry, commerce, engineering, etc., undertaking rôles previously occupied by men, and after most probably making, and breaking, many pair bonds over the decades, also like men. Eventually, they find themselves no longer able to sustain a pair bond, but their biological clock, which still recognizes them as women, urges them to have a child before it is too late.

Unfortunately, having children so late in life risks less fit children; moreover, such late pregnancies flagrantly disregards any deleterious impact on children and eventual adults: the mother will be old and feeble, and is likely to traumatize the child by dying early in the child’s life; the mother will be unlikely to have the distinct advantage of her own mother’s help, advice and guidance; offspring are similarly unlikely to know, interact with, and learn from their wise grandmothers; offspring may never interact with, their father—if known— leading to an unbalanced upbringing, which ideally really requires a pair-bonded couple, one of each sex, throughout.

**Restoring the Family Propagation System**

Evolutionary Psychology — or common sense — may identify the practice of late pregnancy and single parent upbringing as less likely to produce healthy, balanced offspring able to sustain pair bonds as adults in their turn and produce sound offspring.

Western society, particularly in cities, appears to have taken a wrong turn; we may need to retrace our steps and get back on track as *Homo sapiens*. Restoring the “successful family propagation system” (SFPS) appears to be (part of) the solution to many of these contemporary social engineering issues and, in so doing, hopefully to: encourage pair-bonding in early adulthood, forming complementary partnerships; create healthier offspring in nurturing, protective, secluded home environments; send the mate, generally the male, out to ‘hunt’ or work; pair bond “for life” and discourage pair-bond dissolution, at least until the last child is in its late teens/early twenties; restore the role of the educated, life-experienced grandmother; hopefully, then, to reduce mental/social dysfunction amongst the young, to raise, educate and socialize children into the world outside the home, and to promote healthier, balanced adults.

This restoration would not be done without considerable difficulty however: once the chain of “successful family begets successful family” is broken, it may prove difficult to reinstate. Where are the experienced, understanding grandmothers? Where are
the balanced young adults, brought up in stable nurturing environments, able to sustain a monogamous pair bond?

Such a seemingly retrograde “restoration of the family propagation system” need not deny women their rôle in society, nor ‘chain them to kitchen sink,’ as the feminist might see it. For instance, an alternative scenario might see women pair bond in their twenties, to raise, educate and train their children in the secluded home environment, without: need for nursery schools; intrusion from adverse social culture; so-called ‘latchkey’ children returning from school to an empty house; and, with: the benefits of a dependable, nurturing home; home cooking to encourage good growth, avoidance of allergies and childhood obesity, etc. When the final offspring reached and passed puberty, both parents would socialize their offspring to the point of pair bonding themselves, after which the mother would be postmenopausal, ready, and free, to take a more prominent rôle in society, industry, etc. And, it may be significant that many of the world’s major national leaders are, and have been, mature women.

Without restoration of such fundamental social foundations as the family, it may be that large cities and megacities will progressively deteriorate, particularly in the face of contemporary social engineering that seems bent on destroying society and civilization. Feminism may have done irreparable damage: however, all may not be lost, since some cultures have ignored their siren call, and have continued unchanged in their familial practices; perhaps the future belongs to them? Alternatively, the social engineers might just see the error of their ways and encourage a way of women contributing to society that does not prejudice the pair bond, the family and the offspring: but, that is merely an anthropological view...

**Occupying Idle Minds**

With greatly reduced demands on individuals and families in the city for hunting, gathering, feeding, sheltering, educating our young, etc., and with countless machines to alleviate the drudgery of housework, farming, construction, calculating, recording, etc., we have time on our hands which, being human with active brains, we have to fill.

Unoccupied minds tend to be mischievous minds. Organizations develop in cities to undertake different tasks, so providing work for people, and paying them money for their work, with which they can buy all the things they need, and many things they have been encouraged to want, but may not need.
Cities being concentrations of power and energy, there will be many different kinds of job, within many different kinds of organization: the wealthier the city, the greater the variety of potential employment. Energy is needed to create, sustain and maintain order within organizations as within society. People within the city will have jobs, often within organizations. There will be architects, civil engineers, and building organizations, organizations to look after vulnerable people, social services, utilities, financial organizations (banks, post offices, stock exchanges, etc.), manufacturing, assembly and production organizations, transport, distribution, media, entertainment organizations, peace officers, emergency services, schools, colleges and universities, etc., etc.

A vast edifice of organizations will develop within any city, dedicated to employing the population, and – although we may not look at it that way – at the same time keeping them occupied both mentally and physically. For the time such individuals are at work, their organizations may become surrogate families, especially those from atomized communities who have no family of their own: after work, however, they return to the atomized community. It might be thought that such surrogate families would instill a certain morality in their employees, after the manner of a biological family; and, in a manner, they do:
It is a notorious fact that the morality of society as a whole is in inverse ratio to its size...Any large company composed of wholly admirable persons has the morality and intelligence of an unwieldy, stupid and violent animal. The bigger the organization, the more unavoidable is its immorality and blind stupidity...The greatest infamy on the part of...a man’s...group will not disturb him so long as the majority of his fellows steadfastly believe in the exalted morality of their social organization.

Carl Gustav Jung, 1976

According to Jung, then, the larger the organization the more inhuman the morality...even within the organization, it seems, morality – the understanding of right from wrong, of good from evil – is subjective, changeable and context related.

Some jobs will be more demanding than others, and may pay better. Some people will be employed as managers of others; some will be directors and executives. A pyramidal hierarchy will develop, a social structure—although it might not be called that—of few executives, some managers or shopkeepers, and many workers.
SECTION

SOCIAL HIERARCHY

ACROPOLIS, ATHENS, GREECE
Social Hierarchy

Social anthropologists recognize social hierarchy in primate groups—gorillas, chimpanzees, bonobos, baboons and humans—observing that the formation and maintenance of social hierarchy is essential to the continuation of the social group. Social hierarchy is reinforced in many ways, notably by grooming and by deferential behavior according to “pecking order.” Humans do not groom each other in the same way as other primates; instead we tend to use verbal communication as a form of grooming, along with deferential behavior and body language, dress and appearance.

Make no mistake; pecking order is important in any social group, especially among men, increasingly among women, and it forms rapidly in any nascent group. Like other primates, we may threaten and resort to violence if we perceive our position in the social hierarchy to be challenged. Those at the top of the social hierarchy are socially more powerful, have greater influence, and access to resources. Those at the bottom have none. This is class structure writ small, but nonetheless indelible.

Class structure coexists with social hierarchy in the armed services too, with commissioned officers and “other ranks.” Commissioned officer ranks form a pyramidal hierarchy, from one field marshal at the peak to many subalterns at the base. Similarly, other ranks form a pyramidal hierarchy from warrant officer and non-commissioned officers at the top to soldier at the bottom: their pay structures, accommodation, and received respect, reflect their ranks.

Class structures appear to be inevitable and resilient, since efforts to break down class structure inevitably result in its resurfacing, perhaps with different criteria for, particularly, the upper class. So, in a meritocracy we might expect the more able to rise to the top, and that is certainly the aim with the military and in many commercial organizations. In an oligarchy, a few exercise group control for corrupt or selfish purposes. In contemporary communist countries, a hierarchy of the party faithful develops, effectively as a power structure, replacing—but, in many ways, suspiciously similar to—the class structure it overthrew, but even more draconian and secretive.

In a society where everyone is required to be equal, one subjected to on-going class warfare, it is likely that “celebrities,” people celebrated in the media as film stars, sports stars, or simply celebrated for outrageous, bizarre, or anti-establishment behavior, will supplant the traditional upper class—at least, in the eyes of the public. In the megacity, it seems likely that the wealthy and powerful, like cream, will rise to the top...

In a democracy, class structures persist within society, within the various political parties, and within the elected government—although such class structures would
not necessarily be openly stated as such. The existence of upper and lower houses of
government, and of favored families, speaks for itself. As Bob Hope, the comedian, put
it, back in the ’50s:

“In the US, we have two classes: the people and the
Kennedys. And there are more Kennedys.”

The auto-development of class structure seems to be inevitable; nor is it necessarily a
bad thing, although it does seem to aggravate the politics of envy by social reformers
and revolutionaries, and – of course – it runs counter to the notion that “all are
equal.” Indeed, from an anthropological viewpoint, the continuing maintenance of so-
cial hierarchy appears to be essential to any society. Conversely, a social group that
does not maintain its social hierarchy is not destined to remain as a group...suggesting
that class warfare, with the supposedly admirable intentions of making us “all equal,”
may be destined either to fail, or to destroy society and civilization, where civilization
may be defined as ‘a society that has a high level of culture and social organization.’

Social stratification is a defining feature of civilization: seeking to make everyone
equal, and to eliminate social hierarchy/class may be, in effect, disintegrating civiliza-
tion. Aspiration drives those in a lower level/class to work, to create a better quality of
life for their family, to earn money and prestige, and effectively move up a level. Con-
sider Level 4 in Maslow’s Table of Needs:

4  Esteem  Self-esteem, Confidence, Achievement,
         Respect of others, Respect by others

A person/family that, through dint of education, personal effort, diligence, etc., can
move from worker to manager, or from manager to executive, that person/family is in
line to satisfy Maslow’s Fourth Level.

Some people will be unwilling or unable to “work their way up the ladder,” and
will resort to other means to gain perceived advantage. On the other hand, there will
always be those who expect the “system” to support them, provide food and accommo-
dation, and acknowledge only the second part of the Marxist mantra: “from each ac-
cording to his ability, to each according to his need.”

In the past, aristocratic landed gentry have withheld essential resources from the
rest, causing hardship and resulting in such outbreaks as the French and Russian
Revolutions. So, class and class differences can be the source of major social upheaval,
particularly in times of economic difficulties. It seems, however, that even after such major upheavals, class differences re-emerge, albeit in a different form, as parodied in George Orwell’s allegory, Animal Farm (Orwell, 2009).

In the megacity, with its concentrated population and limited space, the concept of landed aristocracy will be, is, outmoded. Wealthier (or more powerful) people will still live in bigger houses, in “better” areas, in safer, quieter areas, surrounded by greenery, but the ability of any group to withhold essential resources is reduced. So, we may anticipate class distinctions to persist in the megacity, even to become more marked as competition for space and resources increases.

Moreover, it seems likely that differences between the various human ecosystem/areas in the city will be necessary, and will occur naturally, to maintain diversity/variety, both within each human ecosystem, and between ecosystem-areas within the megacity biome. And, we may anticipate a continual flow of people moving from one ecosystem-area to another as their fortunes rise and wane. This is the stuff of social mobility and dynamic equilibrium...

Self-Actualization in the Megacity

Maslow’s Hierarchy of Needs had five levels; so far in this section, we have considered only the first four. Yet Level 5, the Self-actualizing level, where man is at his most creative and expressive, directed our previous review of social development through the ages:

5 Self-actualization Morality, Creativity, Spontaneity, Problem-solving, Lack of prejudice, Acceptance of facts

Self-actualization can be defined in a variety of ways: the achievement of one's full potential through creativity, independence, spontaneity, and a grasp of the real world; the realization or fulfillment of one's talents and potentialities, especially considered as a drive or need present in everyone. Or, put more simply, man’s tendency, or drive, to become his potentialities.

The megacity is, and will be, a patchwork of human ecosystem areas, over which man will construct evermore-complex superstructures of interacting organizations, within which worker/operators will require education, training, skills and expertise if they are to climb the inevitable ladder, move up the inevitable social hierarchy. Few will ever reach the top, but many may achieve their potentialities at intermediate lev-
els, gaining intellectual authority, along with individuation and a degree of social authority in the process. Within such superstructures there may be continual dynamic change, brought about by competition and the need to act quickly to grasp opportunities.

For the visual arts, things may be different. The democratization of art has lead to a rejection of all previous canons, a dramatic change in what is considered to be art, and in what is considered to be good art in this revised, yet constantly changing worldview. Traditional views of art as landscapes, portraits, life-sculptures, etc., give way to abstraction, distortion and their pseudo-intellectualist interpretation as worthy.

This alternative Weltanschauung sees excellence in pattern, absence of pattern, distortion, degradation, the mundane and the bizarre. Within this brave new art world, creativity and spontaneity can lead to self-actualization for those who, perhaps lacking the training or skill of the classic artist, yet able to make use of newer technologies in place of traditional materials, can perform, excel, or capture the imagination of potential art buyers. Those ‘not in the know’ may be baffled by these alternative, supposed art forms, allegedly because they ‘fail to grasp their significance.’

The net result is the growth of a self-aggrandizing sect of self-styled artists creating works of all kinds, some of which may be intellectualized and acclaimed by others of the sect, and which then sell to ‘art collectors,’ occasionally for enormous sums of money. And, just like paper money, such artwork may have little or no intrinsic value, but instead have a perceived value in the mind of both the artist and the buyer. To those ‘not in the know,’ however, such so-called art brings to mind the fable of ‘The King’s New Suit of Clothes…’ Advances in art over the centuries have often followed such tortured paths and have failed to be appreciated in their own time.

Yet others may see developments in the art world as yet another example of the inevitable ‘waves of cultural mediocrity sweeping through our societies,’ alongside pervading mediocrity in music, education, theatre, mass entertainment, etc., etc. But then, the cognoscenti would inevitably say that, would they not?
Entertaining The Megacity

With so many city people with time on their hands, there may be a propensity for mischief: as St. Jerome would have it, “the Devil finds work for idle hands.” Roman emperors recognized the danger of social disorder, so built coliseums and held all kinds of elaborate, outlandish and barbaric entertainments to divert and occupy the minds and time of the public of Rome.

Major cities today, and increasingly in the future, will perforce provide mass entertainment for their growing and diverse population. Some of that entertainment may be at specific venues, such as football stadia, sports arenas, theaters, parks, etc., and some will be through increasing use of social media, so reaching people who would not attend a particular venue, or might be mobile. The audience for a social media event could be many times that which could fit into even the largest venue, so entertaining, diverting and occupying the time of populations that no coliseum, or Flavian Amphitheater, could hope to match— although, the respective aims of Caesar and megacity governments might be comparable...
Passive watching is not enough, however. The agile human brain wants to take part, to be “pro-active.” So, we see the growth of quiz programs, where contestants present their skill in memorizing facts, and recalling obscure information, often about the mundane and the everyday, only occasionally about anything important. Then there are programs urging the masses to pursue activities such as cooking, house maintenance, painting, singing, etc., most—if not all—of which would previously have been handed down in the family from father to son, from mother to daughter.

Fashion, too, has its rôle in diverting the masses, who want to copy how the rich and famous do their hair and makeup, how they dress in the latest fashion, etc. There are, of course, only so many ways to do one’s hair, and only so many ways to design a dress or a suit. As a result, fashions come into style, go out of style and return only slightly modified after a few years. This rapid turnover supports an industry that continually creates new clothes to satisfy new fashions, rendering current styles outmoded and ‘un-wearable.’ The fashion business creates its own gurus, designers, celebrities and glitterati...

Music has become another industry, associated with fashion, with composers and performers often self taught, if taught at all, making use of technology to aid in composition, harmony, synthesis and publishing, perhaps by social media. With so many originators of music of all kinds, a fresh subject arises for those in the memorizing game, and entertainments frequently quiz contestants on their knowledge of genre, bands, groups, individuals, etc. Young are raised listening to such music. Musician groups seem to lack durability, are popular for a time, and disintegrate. So, insubstantial groups feed the young on a diet of continually changing music: which seems to occupy an inordinate amount of youthful brainpower. Which may, after all, be the point; occupied minds are less likely to turn to mischief. Although, some of the lyricists may seem to be anarchic at times...

Sporting events and competitions also occupy the minds of many in the city. To be pro-active may involve joining a supporter’s club, and to follow ‘your team,’ literally, as they compete against other teams. In the megacity, there may be many such teams. London, for example, has thirteen professional football (soccer) clubs and more than ninety amateur clubs. Rugby Union is also popular, with some thirteen teams playing in national leagues, although some of the teams play at stadia outside of the City boundary.

Other mega cities are similarly endowed: New York famously supports baseball, football, hockey, basketball and soccer. Cairo has a number of professional football teams, and has hosted a wide variety of championships, including: World Fencing
Championships; World Shotgun Championships; World Shooting Championships; African Championships in Athletics; Men's World Open Squash Championship; African Futsal Championship; FIFA U-17 World Championship; Men's World Open Squash Championship; World Judo Championship; African Modern Pentathlon; African Men’s & Women’s Handball; etc., etc.

Evidently, different megacities entertain their populations in different ways, according to culture, but they all take part. In the future, as population and population density increase, it may be that each megacity’s ecosystem-area will boast its own stadium and team, that there will be competitive games and sports between the ecosystem-areas in each megacity, (so-called, ‘local derby’s) and that there will be inter-megacity games, sports and events.

Megacities will also host and present so-called cultural events: theatre, concert, ballet, opera, visual arts, etc. Such events may regarded as ‘posh’ and upper class by many – and therefore to be derided – but their continuing popularity reflects the underlying social hierarchy that exists, and will necessarily continue to exist if the megacity is to persist... Such events differ from those of so-called popular music and dance, in that the participants in these ‘high-class’ events are invariably trained over many years to perform in a canonical style. ‘Of course, one has to be properly educated to really appreciate it.’

Class is alive and well in the megacity; it may just deny it, of course...
CHAPTER

SYSTEMS IN THE CITY

Harbor at St Helier, Channel Islands, UK
Realizing Human Systems

In every government, though terrors reign,
Though tyrant kings, or tyrant laws restrain,
How small, of all that human hearts endure,
That part which laws or kings can cause or cure.

The Traveller, Oliver Goldsmith, 1730–1774

Human societies continually form and maintain social hierarchies, without which they would disintegrate. For *Homo sapiens*, such social hierarchies form, much as they do in any simian society, with the emergence of ‘natural’ leaders and followers, dominant and submissive, extrovert and introvert. People also behave differently, one from another, according to situation and psyche, as characterized by Jung’s behavioral archetypes (qv), including: the Self; the Shadow; the Anima or Animus; the Persona; the father; the mother; the child; the wise old man; the hero; the maiden; the trickster; creator; caregiver; ruler; jester; lover; hero; outlaw; magician; innocent; explorer; sage, etc. Moreover, individuals may behave in line with different archetypes in different situations—we are complex animals. People tend to fit into a social hierarchy—or not—appropriate to their social behavior and how people perceive them, their personae. Within societies, cultures form ‘horizontally,’ through association and interaction, with emergent patterns of behavior that characterize the culture, and which, once formed, may prove resistant to change.

Moreover, individuals may behave in line with different archetypes in different situations; we are complex animals. People tend to fit into a social hierarchy—or not—appropriate to their social behavior and how people perceive them, their personae. Within societies, cultures form ‘horizontally,’ through association and interaction, with emergent patterns of behavior that characterize the culture, and which, once formed, may prove resistant to change.

There are, therefore, both ‘horizontal’ and ‘vertical’ relationships within any, typically, pyramidal society; these relationship bonds may be invisible, but together, they create a vital social structure. Those toward the top of the pyramid hold greater social power: those toward the bottom of the pyramid hold less; however, there are many more individuals toward the base of the pyramid. This disparity between ‘the haves’ and ‘the have-nots,’ a necessary part of maintaining order in the social hierarchy, may be of less significance in a wealthy society, where even the ‘have-nots’ still have plenty:
it may prove problematic where the have-nots have insufficient, where envy for the ‘better-off’ rules, and where political agitators seek to overthrow social order. Such problems have beset cities since they formed, will persist into the future, and seem destined to become more severe...

Organs Of State And Policing
Any city of many humans will need, therefore, to be organized: not unlike the human body with its organs, a megacity government needs must comprise a variety of “organs of state:” conventionally, these could be the executive, the legislature and the judiciary, as first developed in ancient Greece, which may be divided and balanced in accordance with the political principle of separation of powers On the other hand, a megacity might, if democratically run, employ a parliamentary system that could, in contrast, have ‘fusion of powers’ where the executive and the legislature organs are combined, sometimes with part of the judiciary. Additionally, there will be many other social systems, societies and organizations, to ensure the availability and distribution of domestic and industrial energy, potable water, food, housing, clothing, education, etc., and to dispose of (or re-cycle) copious amounts of waste of all kinds. These many organizational systems are necessary to provide the backcloth for any city population to flourish and thrive: necessary, but not sufficient.

The executive function, policy- and decision-making, may be undertaken by some elected group, committee or council, by a group of powerful people, or by a dictator, benevolent or otherwise, who might operate through a group of people that s/he appointed, or who inherited their position, perhaps from powerful forebears. The executive will necessarily control policing resources in the megacity. Although any large city will inevitably comprise a number of contiguous human ecosystem areas, policing by area would allow law breakers in one area to evade capture or restraint simply by moving to another area. Hence, policing will, sensibly, be citywide, with subordinate policing (local policing) by ecosystem area. In some cultures, populations are encouraged to police themselves, so that people observing others who they believe to be behaving “incorrectly,” report them to the authorities, or may even act against them personally or as part of a vigilante group.

Another move in the direction of social self-policing, so-called political correctness, is a pejorative term used to condemn language, actions or policies that might be deemed likely to offend any group of people in society. While it might be seen as reasonable not to wish to offend people, cultures or groups, it is never clear what would offend them, or whether their taking offense would be reasonable, unreasonable, or de-
served. As a result, social engineers declare expressions or behaviors to be potentially offensive on capricious and uninformed grounds, and without finding out whether target groups would, indeed, be offended or not: then, on this basis, they criticize and lambast those using such expressions or behaviors. No one may be willing to stand up to such criticisms, and no one seems to notice the progressive diminution in free speech and expression. People find themselves asking: “Is it alright to say that?” in connection with perfectly innocent expressions...and, as a by-product of political correctness, new expressions form to create a sub-language and sub-culture with which to replace the ‘politically suspect’ expression.

Soma
While so-called political correctness arouses great hostility, not least because of its arbitrary restriction on freedom of speech and expression, it nonetheless points to the need for some calming or controlling influence to encourage people of different cultures to live comfortably ‘cheek by jowl’ in relatively dense concentrations. In his insightful novel, Brave New World, published in 1932, Aldous Huxley envisaged a World State, a ‘benevolent’ dictatorship. In this brave new world, individual actions and initiative were discouraged, and well-adjusted citizens spent their leisure time in commu-
nal activities requiring little or no thought. The resulting shallow, hedonistic lifestyle was promoted by the readily available hallucinogenic drug, *soma*, an imaginary ‘ideal pleasure drug,’ resembling a hangover-less tranquilizer or opiate. The future megacity may not employ *soma*, as such, but some analogous means of “societal management” will undoubtedly be needed.

**Cultural Dissonance**

Large organizations in the megacity may suffer from problems of cultural differences arising in different parts of the organization; this can lead to less than ideal cooperation and coordination between different groups and divisions. Management consultants suggest that they can alter the culture of an organization from whatever it currently is to whatever the management would like it to be.

This may be misguided. Culture, it seems, is an emergent property of a complex system. In an organization, it comes about as a result of the interactions between the ‘agents’ in the system. In an organization, the agents are people—themselves complex systems. Complexity theory suggests that when there is enough connectivity between the agents, emergence is likely to occur spontaneously. Emergence, in such a case, would be an established pattern of behavior, a culture, which transcends that of the individuals. Moreover, that new pattern can feed back down to influence further developments at the lower level.

It may be possible, in principle, to create a one-culture organization, by starting a new organization with only a handful of experienced, dedicated people who create an emergent, cooperative culture, or successful pattern of behavior, amongst themselves in pursuit of the organization’s business objectives. Once up and running, the small group then recruits new people one at a time and introduce them into the established and successful culture, which they will be inclined to adopt through interactions with the pre-existing group members. This is *downward causation*. As the organization slowly grows, it should continue to operate with the behavior pattern of the original culture. When the organization grows to the point of needing new groups, sections or divisions, then the process may need to be repeated, with a nucleus of people dedicated to the original culture starting up the new division, and progressively recruiting and inculcating new staff.

**Sustaining Human Systems And Cultures**

Would it be possible, or even desirable, to create a one-culture city or megacity? This is hardly likely, remembering that today’s cities formed from an aggregation of towns and villages, each with its own array of change-resistant cultures, and that the ecosys-
tem areas of the megacity will have inherited this cultural patchwork. Moreover, if the megacity, like any complex system, is to continue to flourish and grow, it will need to maintain a level of “connected variety:” different cultures provide ‘useful’ variety, provided always that they are connected with other cultures, and that they do not seek to dominate and eradicate others, which—conversely—would reduce variety.

For the megacity to flourish, then, it will comprise a variety of cultures, each distinct, yet each cooperating with other cultures and not seeking to dominate, or be dominated, by them. It is also in the nature of complex interacting systems, as we saw above, to be in a state of dynamic equilibrium: this equates in the megacity to the continual rise and fall of complex systems, organizations, companies, even ecosystem-areas. The megacity will survive and recover from such change partly because it will occur at different times and in different parts of the ecosystem-area and of the city-biome, provided always that the essentials of life remain available: food, water, energy, shelter and, not forgetting, the equivalent of Huxley’s soma – diversions to keep the people entertained...

Continuing provision of the essentials will essential, implying a catchment area to supply sufficient food for the whole city on a daily, weekly, monthly and annual basis. Presently, large cities may acquire foodstuffs from around the world; that facility may not necessarily be available in the future, so that cities may need to be able to import food from their surrounding areas.

The catchment may be envisaged as a circular ‘footprint’ around the city with the ability to grow food, raise cattle, pigs and poultry of sufficient calorific value to satisfy the needs of the population, where each adult requires some 2000-3000 calories per day,
and children proportionately less.

Also essential will be catchment for water, which may come from rivers, naturally occurring springs, reclamation of clean water from waste, desalination of sea water or brackish river water, or—as is increasingly the practice in Singapore—by turning the city into a large rainfall collecting bowl, with runoffs, drains, reservoirs and channels.

It is relatively simple to calculate the agrarian catchment area (footprint) for a city of a given population, since each person may be reasonably assumed to require some 3000 kcal/day of food energy intake. Similarly, the calorific content of, say, grain agriculture can be averaged at c.5 kcal/m²/day. (The figure differs for different products.) Using such figures, we can calculate the diameter of the notional agricultural footprint. These figures are simplistic; they take no account of roads, storage and transport facilities, loss of crops due to adverse weather, or disease, etc., etc. They assume the land to be dedicated to agriculture, fertile, with favorable weather and climate, available fertilizers, farm machinery and farm operators… Nonetheless, they do present a lowest limit, thought-provoking figure for the diameter of the footprint…

The figures in Howard Odum’s table refer to the world as it was in the 1960s and 70s, when the statistics were formulated. At that time the world population was c.4 billion; now it is some 7 billion and rising. Correspondingly, the figures in the second row, ‘Man if evenly distributed over the earth,’ will have changed: Area per Man, formerly 25 acres, will now be 14 acres at best…

<table>
<thead>
<tr>
<th>Population</th>
<th>Diameter of Footprint</th>
<th>Area of footprint (m²)</th>
<th>Area of footprint (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 million</td>
<td>≥ 28 km</td>
<td>≥ 616x10⁶</td>
<td>≥ 61.5x10³</td>
</tr>
<tr>
<td>10 million</td>
<td>≥ 87 km</td>
<td>≥ 6x10⁹</td>
<td>≥ 0.6x10⁶</td>
</tr>
<tr>
<td>25 million</td>
<td>≥ 138 km</td>
<td>≥ 15x10⁹</td>
<td>≥ 1.5x10⁶</td>
</tr>
<tr>
<td>100 million</td>
<td>≥ 276 km</td>
<td>≥ 60x10⁹</td>
<td>≥ 6x10⁶</td>
</tr>
</tbody>
</table>
In 1968, the population of the USA was estimated at 200 million; in 2014 it was estimated at c.320 million and rising. Corresponding population figures for Japan are: 101M in 1968, 127M in 2014; for the UK: 55.2M in 1968, 65.5M in 2014.

Power Requirements Per Day for Total Life Support of a Man (Odum, 1973)

<table>
<thead>
<tr>
<th>Area per Man (Acres)</th>
<th>Solar energy (kcal/day)</th>
<th>Organic Matter [million kcal/(day)(person)]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pygmies in deep forest, solar base</strong>(^a)</td>
<td>640</td>
<td>1010</td>
</tr>
<tr>
<td><strong>Man if evenly distributed over the earth</strong></td>
<td>25</td>
<td>109</td>
</tr>
<tr>
<td><strong>Man in United States</strong></td>
<td>12</td>
<td>108</td>
</tr>
<tr>
<td><strong>Fossil-fuel base</strong>(^b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Photosynthetic input</strong>(^c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Man in solar-based monsoon agriculture</strong>(^d)</td>
<td>1</td>
<td>107</td>
</tr>
<tr>
<td><strong>Man in United States City</strong>(^e)</td>
<td>0.0064</td>
<td></td>
</tr>
<tr>
<td><strong>Man in Apollo space capsule</strong></td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td><strong>Life support</strong>(^f)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capsule</strong>(^g)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) 1/square mile; forest production 131kcal/(m²)(day); 2.6 × 106 m²/square mile
\(^b\) 1.2 x 1014 kcal/day; 200 million people
\(^c\) 54/acre; 40 kcal/(m²)(day) for half of the year
\(^d\) 1/acre; 4 x 103 m²/acre; 80 kcal/(m²)(day) for half of year
\(^e\) 106 people; 100,000 people/square mile; food, 2000 tons per day; fuel 9,500 tons per day.
Not included are the fuels used outside the city in its support.
\(^f\) Fuel consumption rate after in space 9.4 kilowatt
\(^g\) $106 capsule cost prorated over 10 years: 104 kcal/$

It looks likely that there will be continuing power shortages in cities and megacities of the future, as global warming increases the demand for air conditioning, and shortages of potable water invoke power-hungry means of extracting clean potable water from seawater.
An Alternative View: The Garden City

Instead of allowing cities to simply grow and concentrate, some visionaries have come up with different ideas. One such was Sir Ebenezer Howard, who initiated the Garden City Movement in 1898 in the UK, largely as a result of his observing the poor living conditions of blue-collar workers in Victorian London. Garden cities were to be self-contained communities surrounded by “greenbelts” containing proportionate areas of residences, industry and agriculture.

The ideal garden city was to be “slum-less and smokeless,” and would consist of a central city surround by six peripheral garden cities, planned – as the figure shows – on a concentric basis, with open spaces, public parks and six radial boulevards, each 120 feet wide. In the figure, the central city had an area of some 12,000 acres, and a population of 58,000. Each of the six satellite garden cities, Garden City, Gladstone, Concord, Philadelphia, Rurisville and Justitia, was to have a population of some 32,000.

Overall, the whole was expected to have an area of some 66,000 acres and to support a population of some 250,000. Within the periphery, there were to be reservoirs and waterfalls, large farms, homes for inebriates, insane asylums, homes for waifs, epileptic farms, brickfields, convalescent homes, stone quarries, cemeteries, forests, agricultural colleges, colleges for the blind, etc., etc. The whole was to be intra-connected by road, rail and canal. Missing from the figure were sources of power and energy, oil, gas, coal, for heating, transportation, construction, waste management, etc., which would presumably have to be imported...

‘Area per man’ in the idealized garden city complex would be some 0.25 acres/man, comparing very favorably with Odum’s later estimate of 0.0064 acres/man for a US city in the 1960s.

Howard’s ideas caught on, and some garden cities were built in the UK at Letchworth and Welwyn, and around the world particularly in the USA. The UK garden cities did not, however, work out as Howard had envisaged. Instead of becoming self-contained complexes, largely for blue-collar workers, the garden city dwellings were purchased by affluent middle class commuters, who enjoyed the semi-rural environment and living space.

The ‘Garden City’ idea faded with time, although it is still alive and, with some modernization to reflect the changes in technology, medical science, etc., still seems to make sense... Instead of ever larger, more densely populated mega-cities, might it be advantageous to cover the land area with garden city after garden city in a network of loosely connected garden cities? Or, perhaps, to open up the idea and to have “floating...
garden cities” on the world’s seas? Or, further still, to have submerged garden cities under the seas—an idea much favored by novelists.

Idealized Garden City
CHAPTER 13

HUMANITY'S FUTURE: PROGNOSTICATIONS

Living Under Desert: Lanzarote
Predicting the Future of Mankind?

The energies of our system will decay and the glory of the sun will be dimmed, and the earth, tideless and inert, will no longer tolerate the race that has for a moment disturbed its solitude. Man will go down into the pit and all his thoughts will perish.

The Foundations of Belief, A. J. Balfour, 1848–1930

So far, we have tracked the social evolution of the ingenious ape from the earliest, prehistoric, ‘antediluvian,’ ‘out of the forest’ times and up to the present: what of the future? Will social evolution continue within the megacity? As megacities spread and become more densely populated, will these clever apes continue to find food, energy and other resources necessary to keep their swollen populations fed, watered, entertained and occupied? And, if so, what will be the eventual outcome – if any?

Will humanity survive in its present form? Or will, perhaps, the megalopolis become too much of a monoculture, subject to disease, disorder, famine, conflict, inter-megalopolis warfare, and eventual mutual self-destruction?

Will humanity continue on its social-evolutionary fast track, or – using advancing medical science – catch up and overtake on some new, biological-evolutionary ‘even faster’ track? Will it evolve towards a physically and mentally superior Homo, perhaps, and using its mastery of technology expand into spaces and places where we cannot presently survive, let alone thrive?

Predicting the future is a game anyone can play – and many have. But, do any of these predictions have credibility? Or, is it more the case that, beyond a near-term horizon of ‘know-ability,’ it is basically impossible to predict the future?

That is not to say that predicting is a waste of time: one can always extrapolate on the basis of current trends; and, besides, it is thought provoking: science fiction writers have been doing it for ages.

So, what trends dominate our thoughts at the present? Perhaps just as important, what might things happen to mankind over which we have no control? One way to approach this intriguing topic is to paint different possible scenarios:
1. Global Population Expansion
Global population continues to increase, unchecked in spite of valiant efforts by world leaders. Shortages develop, compounded by over-exploitation and by changes in climate and rising sea levels, which together threaten supplies of farmland, food staples, potable water, mineral resources, & energy. Shortages cause global unrest, which disintegrates into wars, disease and famine, with the dystopian, post apocalyptic desert of fiction becoming a reality.

Without humans, the planet slowly recovers: a Kipling-esque *Letting in of the Jungle* eradicates human relics and remains.
2. Global Warming
Global warming is not curbed, sea levels and planetary temperatures continue to rise towards thermal runaway. Planet Earth resembles Venus: surface temperature high enough to melt lead, sulphuric acid rain... all life has long since vanished, forever. Or, less theatrically perhaps, global temperatures eventually level off several degrees higher than at present, there are no ice caps at the poles, and sea levels have risen some 15m or more compared with today...

3. Civilization Collapses (1)
Spread of an anarchic, fundamentalist cult that eliminates all those, including democracies and socialist states—ideologically no longer able to defend themselves—and absorbs their resources, leaving only the cult that is eventually unable to sustain its own ideology without any opposition to fight, or victims from whom to steal.

4. Civilization Collapses (2)
Shortages of food and water on a global scale foster the spread of class warfare, wiping out upper and middle classes (c.f. French and Russian Revolutions) leaving working classes only – no leaders, no managers, no doctors, no engineers—leaving a non-viable, dysfunctional disarray. Societies collapse into disorganized ‘mobocracies.’ Global fighting and famine finish off most of humanity, which hangs on in scattered pockets of subsistence living.

5. Humanity wiped out (1)
.. by a fatal infectious disease, perhaps like Ebola, specific to Homo sapiens, incurable, leaving only scattered pockets of isolated humans. People frightened to go near other people for fear of contagion. End of civilization, but significant numbers of humans continue in isolated communities.

6. Humanity Wiped out (2)
.. by a meteorite strike, similar to – but larger than – that which supposedly terminated the dinosaurs. Strike causes fires, clouds, and a global “winter” with little or no sun, so very cold and all vegetation dies out. Scattered pockets of humanity survive, but have neither flora nor fauna on which to feed. Humanity devastated. Planet recovers slowly, generating new life forms. Alternatively, supernovae from nearby stars could devastate Earth’s ozone layer, which protects us from cosmic radiation, with serious effects on the food chain. (Controversially, such an event may have triggered the
Ordovician Extinction, which caused the loss of some 60% of oceanic life on earth some 450-430MY ago.)

7. Humanity Wiped Out (3)
Sexual potency of humans continues to fade, increasing numbers of asexual, impotent or sexually disinterested offspring, birth rate gradually falls toward zero... (Which fate may have presaged the end of the dinosaurs.) Could there be early signs of this happening to humanity now, at least in the West?

8. Evolving Super-Homo Sapiens
Advances in medical science create superior humans, immune to disease, un-aging, gracile, strong and highly intelligent. Unable to save humanity from itself, but able to form separate, surviving communities of super-Homo, with their own defenses, food supplies, energy, etc. Humanity is left to its own self-destructive devices, while Homo superiensis thrives, protected from global warming, disease and the other problems facing fading humanity, without which global temperatures stabilize and start slowly to reduce...a new dawn for a new Homo.

9. Escape into Space: Dyson Rings/Swarm
Adventurers and technocrats create and inhabit a Dyson Swarm around the Sun. A Dyson Swarm consists of a large number of independent constructs (usually solar power satellites and space habitats) orbiting in a dense formation around the Sun. A Dyson Ring is one in which all such structures share the same orbit. The objective of these structures is to capture energy from the Sun (or any star) that would otherwise stream out into space and be lost.

10. Escape into Space: Mars
Mars is terra-formed and slowly colonized. Dependence on Earth diminishes to zero. Humans on Mars evolve, under different conditions of food, atmosphere, radiation and gravity, into a new subspecies: Homo sapiens bellum, in honor of Mars, the Roman God of War...

The process is prolonged: terraforming will take many millennia; in the meantime, humans will have to live precariously in protected environments, with suitable atmosphere, radiation and bio-hazard protection, farming and food processing, water recycling and ice mining, etc., etc. Once terraforming has progressed sufficient to hopefully create a protective, sustainable, oxygen-rich atmosphere, with a viable water cy-
Pressurized entrance to under-regolith base on Moon or underground base on Mars. Living and working underground provides protection from radiation and particle bombardment

cle and carbon cycle, humans may be able to emerge from their protective bubbles/underground retreats, and potentially multiply to create open ‘air’ habitats, villages, farms, etc.

Disappointingly, this avenue of escape is for the very few, only – the energy needed to ship large numbers from Earth to Mars is prohibitive.

11. Escape into Space: Interstellar/intergalactic travel
A space vehicle is launched which carries inside it the necessary starting blocks to evolve life as it evolved on Earth over some 540MY, ending up (or does it?) with Homo sapiens. Vehicle is programmed to find an Earth-like planet, presently without life...and then to start the process of seeding and evolving life on the new planet.

Assessing The Scenarios.
Scenario 1, rising global population, is with us now. Humanity may be seen as an infestation, spreading inexorably over the land, polluting the air and the sea, destroying without renewing, and like a plague of locusts leaving little behind but waste and detritus. World leaders may recognize the problem, but seem powerless to prevent the continuing population boom. As though to compound the felony, much of humanity con-
siders human life to be ‘sacred,’ seeks to live longer and cure all disease. There being no evident cure short of a global catastrophe, this seems a likely scenario.

_Scenario 2, Global Warming_, is also with us now, although some disagree as to the cause. One camp suggests that global warming is man-made, largely through the continued burning of fossil fuels, or perhaps by farming and animal husbandry over the last six millennia, or both. Another camp suggests that rising temperatures are a part of a natural temperature cycle, which had recently, in geological time scales, been experiencing another Ice Age from which we are still emerging.

In some respects, arguments about the cause are futile: it is happening. Associated with global warming are rising sea levels, predicted to rise by up to 14m by 2050 which will inundate large areas of low-lying landmass around the globe, displacing millions of people. Unless, of course, humanity can manage to curb its fossil fuel emissions in time – assuming, that is, humanity is largely to blame. The prospects for curbing global fossil fuel emissions do not look good, however, despite tremendous international efforts. So, whether global warming is man-made or not, global warming seems to be on the cards, with its associated rises in sea levels as the Antarctic Ice Sheets

![Mountain retreat within bubble retaining atmosphere. Earth colony concept.](image-url)
melt, and with increasing frequency and severity of storms, storm surges, inundations, etc. Along with Scenario 1, this Scenario 2 seems inevitable.

*Scenarios 3 and 4, collapse of civilization ‘as we know it,’* has happened in the past, and could happen again. The ancient Egyptians, the Roman Empire and the Mayan Civilization are notable examples. There are signs of social fragmentation to be seen around the world today, with nations formed from past associations between previously hostile groups, showing a tendency to fracture along old fault lines. Indeed, there are evident tensions, with some nations tending to form into larger, so-called power blocks, while other nations within existing power blocks seek to break away. Taking a longer view, however, such perturbations may be seen as a form of dynamic equilibrium, with the overall effect being more one of changes in loyalties, rather than a total breakdown.

These scenarios are seen as possible, but improbable, but: should a rogue nation acquire nuclear weapons and indulge in a pre-emptive global barrage, then civilization could indeed be threatened...

*Scenarios 5, 6 & 7, Humanity Wiped Out,* may be all possible, but unpredictable. Humanity is a single species, so – as a form of monoculture – potentially could be decimated or wiped out by a biological pathogen, occurring either naturally or – inadvertently or intentionally – by the hand of some scientist.

Meteorite strikes occur all the time, but the occurrence of a strike by a meteorite large enough to effectively wipe out all humanity is unpredictable. And, in any event, we do not have to worry about it—chances are we will never know it happened, or be able to prevent it.

Loss of fertility in humans is also feasible. It seems possible that the proportion of potentially infertile offspring being born is increasing, decade on decade; or, the proportion that is born with no drive to reproduce. Or, could it be that we notice and talk about it much more? If it is increasing, research into the causes might be expected. Unless, that is, political correctness outlaws such research – or its findings, preferring instead to insist on the “equal rights” of the minority so born. However, taking a longer view, loss of fertility, leading to a slowing of the rate of population growth, might conceivably by a natural effect of crowded city living, and would not be entirely unwelcome.
Scenario 8, Evolving Super-Homo Sapiens, would appear to be within the grasp of medical science, certainly in the next 50-100 years – and it is unlikely that scientists would possess the wisdom not to do create the super human. How could they? The challenge would be too inviting.

Scenarios 9, 10 and 11, Escape into Space, would apply to the very few, only – perhaps to the new breed of super humans. For the bulk of humanity, the cost of such escape would be prohibitive. Scenario 11, escape involving interstellar or intergalactic travel, would involve a journey time that would be many multiples of human lifetimes. Science fiction writers have conceived of different ways of overcoming this seemingly insurmountable problem: we could send a group of sufficient humans to form a viable, breeding community that forms a traveling colony, with generations succeeding generations, until the vehicle reaches a suitable destination at some time in the future.

We could put a viable group of human into some form of suspended animation, perhaps using cryogenics, so that they may survive the journey of uncertain duration,
perhaps many hundreds or thousands of years, or we could create a vehicle that contains the ability to seed life on some distant – presumably lifeless – planet, such that, over several hundred million years, life would evolve from primitive beginnings to eventually produce intelligent beings.

None of these approaches seems realistic within humanity’s present knowledge and capabilities. Instead, they suggest desperation, rather than reasonable hope...

Conclusion
The only scenarios worth considering, vis-à-vis the ingenious ape’s continuing progress, are those in which humanity does, indeed, continue. So, we may look forward to continuing population increase coupled with continuing global warming, concomitant with global temperatures eventually leveling out at some time in the future, with some or all of the polar ice melted, and a humid, tropical or subtropical climate covering much of the planet. Sea levels will rise, probably by another 15-20m, so that much of today’s coastlines will be underwater, many islands will have shrunk or disappeared, while land and fresh, potable water, will be at a premium, with ever more people competing for dwindling resources. Conflict over such dwindling life essentials is inevitable. One bright spot: medical science will no doubt continue to advance, to the point at which most current diseases and disablements can be combatted or eradicated, and people – should they choose – can live productive lives of over 100-150 years, and perhaps many more.
CHAPTER 14

ACCOMMODATING INCREASING POPULATIONS

Street Crowd, Venice, Italy
CURBING POPULATION INCREASE

SECTION

STREET MUSICIANS, RHODES
There seem to be only two ways to address population expansion, which has been recognized as an issue since long before Malthus made his famous pronouncement: find new ways to accommodate ever-increasing numbers, or stop expanding to prevent the situation from getting any worse.

Curbing Population Increase

As we have seen in earlier chapters, Homo evolved under challenging circumstances where it may well have been necessary to raise many offspring to counter losses to harsh and rapidly changing environments together with famine, disease and predation. Unlike other simians, humans pair bond in monogamous, potentially lifelong, relationships, forming tight-knit family units to protect and nurture the next generation: their prime directive is to propagate the species, which requires the nurturing and training of children into young adults, when they are of an age to have their own children. And, evidently, humans observe the prime directive/obey their instincts even when the threats to their existence and offspring are eliminated. Theirs is a highly successful strategy, compared with that of other simians.

Certainly, we humans have a phenomenal ability to procreate; although, as we have also seen, that need not, per se, result in rapidly expanding population. Remote tribes, with little or no contact with the modern world, do not expand without limit. Instead, they stabilize their populations to be in harmony with the surrounding natural envi-

Population, when unchecked, increases in a geometrical ratio.
Subsistence only increases an arithmetical ratio.
Thomas Robert Malthus, 1766-1834
Famine and starvation may seem to our sheltered psyches to be harsh ways of stabilizing population, but it is the way of all life on Earth—except Homo sapiens. See the classic causal loop model, Population Dynamics, showing the relationships between births, population and deaths, but also showing that increasing the food supply will increase the birth rate and reduce the death rate. The model also indicates a positive relationship between available space and births, but an inverse relationship between available space and deaths from disease, which has a tendency to correlate with overcrowding.

Seen from this perspective, globalization of food exports and imports is promoting further population expansion, and so creating the need for ever more globalization of food exports and imports... Cold, hard, inhumane logic might suggest that, instead of international exports and imports of food, each nation could instead survive – or not – on the food that it can generate indigenously, so that the human population of each nation would ‘adjust’ to that which it can sustain. This would, of course, imply famine in the short-term for some nations, which would thereafter exist in a state of self-organized criticality, with their indigenous capacity for generating food in dynamic equilibrium with its consumption by their human population...

Population growth occurs in another way; medical practices are enabling people to survive longer. Fifty years ago, three score years and ten would have been deemed a good age, and people were considered to be, and looked, old at sixty, to sixty-five. With medical science extending the average life, the population expands in direct proportion. Health services are, in effect, creating a problem for themselves: the more they extend lifetimes, the more lives they have to sustain.

Moreover, we humans have been encouraged by our various religions to think of human life as sacred. By separating ourselves off from the natural world, we fail to acknowledge the natural lifecycle involving continual death of flora and fauna that surrounds us. Death makes us uncomfortable and fearful. It is bizarre to watch a nature program, where an elephant calf, perhaps, is dying of starvation, and to hear the naturalist who is commentating observe that, although the program makers could feed and save the baby elephant, it would be “wrong to interfere with Nature,” so they let the infant die. How different with human children at risk from famine and starvation around the globe, where charities will beg the public to give generously to ‘save the children:’ with little apparent effort, we convince ourselves that this is not interfering with Nature, but straightforward humanity...
Governments around the world are well aware of the need to curb their population expansions, but seem powerless to introduce/implement any effective means. The Chinese government has had to moderate its celebrated ‘one-child’ social experiment, for the unforeseen reason, apparently, that it was greatly reducing the size of the next generation so that the overall population was, on average, visibly aging... there would, in the end, be too few of the next generation to support their elders.

Cultural practices militate against population control, too. In some cultures, sons are preferred to daughters, because sons can grow up to help their fathers in the family business of farming, for example: the more sons, the better. And, to be sure, fewer daughters will tend to limit population growth, at the expense of fewer women having large families, and more men competing for fewer women as wives...Often, too, in such cultures, maturing younger women leave their family group to set up home with another family group. Nature’s balance of nearly equal male and female birth rates will not easily be denied. In underdeveloped countries where infant mortalities may have been historically high, birth rates are high, too, to accommodate anticipated losses and these high birth rates and consequent large families are culturally sustained even after infant mortality rates have been greatly reduced with modern medical practices.

There have been some partial successes. It has been possible, in some western nations, for example, to influence the culture such that people no longer desire to have so many children. Contraception by pill was legalized in the UK so that “married women could control and plan the size of their families” although, once introduced, it encouraged a sexual free-for-all that changed the culture in many other ways. There was, for a time, the notion of the ideal family size of 2.4 children, this being thought to be the average number of children per household to maintain a steady population.

Contraception lent wings to feminism and more social engineering, however, with the result that many women put off having children until they were in their 40s, and the average number of children per family (if there was any family) fell to well under 2, so not enough to maintain a stable population. A potential side effect of the cultural practice of postponing child bearing until in the late thirties, early forties, however, is that the child is unlikely to be as robust, on average, as a child born to a younger woman, in her late teens or early twenties. Coupled with the cultural rejection by many of pair bonding, such that offspring may be raised by single parents aged over 40, or by two ‘parents’ of the same sex, or by ‘step’ parents, the prospects for physically, mentally and socially robust follow-on generations may be less than ideal... although it would be politically incorrect to observe such an anomaly.
Argue as people may – and do – human evolution indicates that the ideal situation for raising the next generation is for children to be born to young adult pair-bonded parents, one of each sex, living together in the loving, nurturing, sheltered environment of the nuclear family, including the mother, the father, siblings, and, ideally, a grandmother or two nearby.

That is not to say that children brought up in different circumstances will fail to turn out well: children are born with a phenomenal ability to adapt. But it is to say that the challenge they face is greater, and not all of them may develop ‘ideally’–whatever that ideal might be.

The Garden City concept developed by Ebenezer Howard shows that, for a population of only 250,000, there were a surprising number of proposed establishments for the ‘out of the ordinary,’ suggesting that Victorian society may also have had more than its fair share of problems:

- Homes for waifs
- Homes for inebriates
- Convalescent Homes
- Insane Asylum
- Epileptic Farms

Whatever the statistics might show – and political correctness may obscure, or even prevent such statistics from being developed or published – there can be little doubt that there is an ideal way in which to raise the next generation, and that is in the evolved manner of the nuclear family, which contemporary social engineering does not relish. Man with his clever brain and great intelligence will, indubitably, seek to deny, dispute or ignore any corroborating evidence in his never-ending social engineering. But, the outcome is predictable nonetheless, and may well prejudice civilized humanity’s future which, up until now, has been built on the family as the basic building block...Then again, it may result in those cultures and ethnic groups that manage to resist and retain the nuclear family, in the face of would-be social engineering, forming the sound basis for our evolving (or disintegrating) civilization...
STYLES OF FUTURE LIVING

SECTION

STREET PARADE, RHODES
Styles of Living
With populations increasing at the same time as land surface is reducing with rising sea levels, the way in which humans normally live may have to change. Large proportions of populations around the globe tend to live near, or on the shores or banks of, oceans, seas, lakes, estuaries and rivers. Much of this low-lying land will be threatened by rising tides and will no longer be available for agriculture, causing major upheavals and refugees from flooding and inundations. Where will the displaced people go? The only land that is likely to be available will be inland desert or mountainous regions, neither noted for their hospitality or fertility. This displacement of people will be happening on all continents and to all island nations. Essentially, the situation will be one of more and more people, needing more and more land for food production, but facing a progressive, concomitant diminution of land for living, energy and food.

There may be a number of potential solutions to this thorny issue, some more realistic and attractive than others...

Living In, On And Under The Sea
With low-lying, productive land area being prejudiced by rising sea levels, an obvious approach to accommodate burgeoning populations is to house them on the land that has been inundated and lost to agriculture. In practice this would mean the creation of towns and cities off shore, partly submerged, or submerged under shallow waters. The figure shows two approaches to accommodating rising tides and incoming waters. The upper picture shows buildings, probably built along the shoreline before rising tides overtook them, constructed to be weather and wave resistant, and able to be built outwards and upwards as the tides continue to rise... So, still connected directly to the shore, and to land-based facilities, food supplies, etc.; always supposing them to be available.

The lower figure suggests a slightly different approach, building on rocky islands and outcrops as secure foundations, and raising the small towns within a succession of embankments and ramparts, rather like some medieval castle. Such a cluster of towns would probably be built near a shore-based city-centre, built and rebuilt above the high tide line, to which these off-shore towns would act as ‘suburbs.’ The suburbs would be designed, from the outset, to be built upwards to keep abreast of rising tides, and they would expect to be more self-sufficient than the littoral enclaves, which would still be heavily dependent on shore based facilities.

So, each suburb would need sources of potable water and power, possibly from rainwater and desalination plants, and from wind, wave, solar and lunar power (tidal
Upper picture: Littoral Enclave, on undersea foundations, with people living above and below the surface level. Lower picture: offshore man-made ‘towns’ built on rocky islands; designed to combat severe weather and be built progressively upwards as tides rise.
energy generators). Food supplies would come largely from fish and crustaceans, plus seaweed, kelp, etc., and hydroponics for protein and green-stuffs. Fruit could be grown in sheltered, sunny rooftops. The ‘suburb’ on the left might be designed to accommodate fishing boats, in particular, with an inner harbor protected by lock gates, so that boats may leave and return when tidal levels permit. Each suburb might have its own nurseries and early schools, while secondary and tertiary education might take place ashore in the city centre, which would be equipped with stores, theaters, arenas, markets, and colleges/university. Similarly, each suburb would have its own market, theaters, assembly rooms, etc., and would provide employment for a myriad of different tradesmen, builders, etc. needed to maintain the functional integrity of the exposed structures, for their continual renewal and expansion with increasing population.

Mykonos Harbor, showing the existing layered embankments.

The photograph of Mykonos Harbour shows a comparable scene from the Greek Islands of the Mediterranean. The town is already built on a series of ‘ledges’ or embankments. Were the Mediterranean to rise by up to, say, 15m, then much of what we see
today would be submerged, but the town could move further up the hill on further embankments, and with reducing space for housing and growing.

A conceptual submerged community is shown in as the Under-Sea City, which shows two views, both seen through the clear shallow waters. In this concept there is a

Under-Sea City.
large central dome, with secure corridors to four ‘suburbs,’ each set in a square, with a tower at each of the four corners.

The central dome houses a shielded nuclear energy system driving a desalination plant that provides potable water for the whole community. Also in the central dome are central administration, a central police-, fire-, ambulance- and security-service, a central library, a university, research laboratories, shops, plazas, theaters, a general hospital and an artificially lit sports arena. As the lower graphic shows, the central dome projects above the sea surface, the (telescopic) projection serves as a worldwide communications hub, ventilation shaft and a dock for ships and helicopters.

Each of the self-sufficient suburbs comprises some eight habitats, each able to house, entertain, exercise and employ some 5,000 people, mostly living in family groups. Each habitat may be likened to the inverted hull of a modern cruise liner, reinforced but largely transparent. Like a modern luxury liner, families live in cabins, but tend to eat communally in various food halls, and each habitat has its own gymnasium, swimming pools, play areas, theatre, nurseries, etc. And, also like modern cruise liners, cabin walls may be live screens presenting video images of some external environment, so situating occupants within a virtual reality/environment, both for entertainment and to avoid any sense of claustrophobia.

One of the two end habitats is dedicated to food production; the other houses schools and colleges, with research laboratories, a suburban police station, and a local hospital. The four towers at each corner are topped with energy focusing lenses that generate power from the light percolating through the water. However, each lens is mounted on a telescopic projection that can take the lens above the sea-surface to collect direct energy from the Sun, should the water be obscuring it. The collected energy is used to power the suburb, to provide general lighting and heating, in food growth, processing and production. The towers also serve as ventilation shafts, continually recirculating air through each of the suburbs.

Taking all four suburbs into account, this community might accommodate up to some 100,000 people. While ostensibly self sufficient, such under sea cities would export and import foodstuffs, clothing, entertainment, and many other everyday commodities. Each would, most probably, be viewed as a dormitory city, and associated with some nearby, aboveground centers of population. Indeed, people might be less inclined to reside in the under-sea city permanently, but rather move around between such communities, both above and below water, so living a rather more dynamic lifestyle than might at first appear...
Above: a community of floating habitats, each with a different role in the survival of the whole. Below: a larger floating city with a central authority and six peripheral suburbs, all interconnected to form a singular whole.
Each suburb, and each under-sea city, will develop its own culture, with those who occupy first considering themselves in some degree ‘superior.’ Inevitably, a class structure will establish itself, with workers, managers and executives: this is to be expected, and will strengthen societies, rather than weaken them. Each community will produce its own executives, managers, doctors, nurses, engineers, technicians, tradesmen, academics, etc., but may exchange them with other communities to maintain standards, enhance practices and preserve confidentiality.

Of course, the oceans and the seas can potentially accommodate many more people, not only on the surface, or on the bottom, but also in between, submerged to avoid adverse weather. Dwelling on the bottom would be fraught except in shallow waters, because of the pressure, which increases rapidly with depth. While people could no doubt adapt to living under greater pressure, it would restrict their ability to move freely between land and sea habitats...so, atmospheric pressure in the submerged city would probably be maintained at surface levels, typically 1014 millibars/101.4kPa

In “Floating Cities;” the upper figure shows a cluster of floating ‘towns,’ or suburbs, protected by transparent bubbles against inclement weather. There would be typically five to eight such floating towns in a cluster, each dedicated to different functions. On the left is an island, covered with grass and trees, which would be used for raising cattle, sheep and goats. On the right is a technology sphere, which extracts minerals from seawater and uses the minerals to make parts to repair existing facilities within the various towns and, potentially, to create new floating towns as the need arises. Two other ‘towns’ are for general accommodation while the one on which the observer stands is the central administrative ‘town.’

Each of the transparent hemispheres caps a cylinder that descends into the sea, giving stability to each structure against storms and wave motion, and each has its own desalination plant, using the pressure at depth of the seawater to power reverse-osmosis processors. Differences between temperature at surface and at depth also power electricity generators, along with solar, lunar and wind power. There are subsurface entrance and egress points, too, for submarine vessels used for farming the seabed, for exploration, and for recreation. Each “floating city” might accommodate anywhere between 50-100,000 people of all ages and persuasions, and the potential numbers of such floating cities would appear to be limitless...

The floating city in the lower graphic is larger, although – like most things at sea – it is difficult to gauge size and distance. This floating city, however, shows six ‘suburbs’ each housing up to some 25,000 people, together with a central city housing 75,000 people, making some 225,000 in all. As the figure shows, the suburbs are ar-
ranged in a ring and are star-connected to the central city, reminiscent of the Garden City. The ring serves, not only as a communication avenue, but also as a breakwater. Together with the star-avenues, this creates six internal ‘lakes’ that can be used as farms for growing kelp, for fish farming, and for recreation. In the figure, the lights in houses, apartments and streets have been left on to attract fish at night. The whole may be potentially able to submerge in the event of storms, storm surges, tsunamis, etc., and may anchor itself to the bottom to prevent drifting, but also to generate electrical energy as the whole city moves up and down with the tides (i.e., lunar power).

Desert Cathedrals

Deserts are generally perceived as barren, relatively lifeless and arid zones. However, some deserts may conceal rivers and ancient lakes of fresh water, deep underground and untapped perhaps for millions of years, which offer the potential for a different style of living. Termites have found ways to live in large numbers, colonies, within so-called termite cathedrals, even without such sources of water. The shapes of their so-called termite cathedrals evolved to provide surprisingly excellent ventilation for their complex arrangements of many interconnected, underground chambers that can extend considerable distances from the visible ‘cathedral,’ both downwards and sideways. The projections are also watertight at ground level, to avoid desert flash floods.
pouring down the shafts. The design of these termite cathedral ventilation projections inspired the “ingenious ape” equivalent of the figure, which could be as high as a gothic cathedral, some 100-150m.

In the Cathedral can be seen a central pinnacle surrounded by five supporting pinnacles, the whole making one “cathedral,” supporting some six underground communities. Shafts lead down from the pinnacles to some deeply submerged lake, from which water is provided to each community, and pumped to the surface for agriculture and viniculture. The shafts also provide ventilation, and transport for people and goods. (In the event, there might be several ‘cathedral spires,’ to permit a continuous circulation of air from the surface, through the underground communities and back to the surface; this circulation might be powered by surface winds, by convection from the subterranean communities’ heat generation, by pumping, or by all three, and the air would necessarily be filtered to exclude dust, sand, airborne pathogens, etc.)

The ‘Cathedral’ is surrounded by a torus or toroid, within which are grown fresh greens, fruit, grapes, flowers, etc., using water from the submerged lake. Enclosed corridors lead from the central toroid to other toroids, which also grow fruit and vegetables. These toroids encircle areas given over to open-air cultivation in orchards and fields, the environment being made bearable by the walls of each surrounding toroid that serve as windbreaks and to retain atmospheric moisture...so, latter-day oases, of a kind.

Each of the six subterranean communities would be notionally separate, forming five suburbs around a central core city; this to encourage different cultures to arise, for robust social development. How and where these suburbs may be located will be largely influenced by the underground geology, with space for large numbers of humans being carved out by the natural flow of waters over millions of years, or more recently by people with machines...

Such caverns, naturally occurring or manmade, could potentially become locations for underground suburbs, or “cavern cities.” Caverns may be lit by light-pipes from the surface, delivering sunlight, moonlight and even starlight. So, underground lakes, even farms, hamlets and villages may be envisaged. See Figure 62. In the figure, just one of many possible representations, four different square ‘islands,’ are evident, each surrounded by water-filled channels from the underground river or lake. The four islands together form one of the five suburbs surrounding some central complex, not shown.
Each island performs different functions. The nearest island is a modular technological complex, housing industries, schools, hospitals, colleges, etc. The farthest island is residential, with extensive facilities for entertainment and sport. The island to the left, lit by solar light-pipes from the surface, consists of moss-covered rocky hills and rock pools, while that to the right, also lit from the surface, is similar in appearance to Mediterranean coastal terrain – richly covered with vegetation... Other islands may grow cereal or root/tuber crops according to need and availability of water. The solar light would be moved across the “sky” to represent the movement of the Sun, and of course the solar light would shine only by day, in synchronism with the surface environment to encourage vegetation growth. Fish farming might be a major industry to provide food for the population, plus farming of crustaceans, seaweeds, etc. The surrounding water would, no doubt, be used for water sports of all kinds, always bearing in mind the dangers of water pollution that could prove disastrous in such an enclosed water cycle.

Both of these islands would be designed to address a potential problem: maintaining the oxygen balance in the cavern atmosphere once hundreds and thousands of humans start breathing the cavern air. The cavern atmosphere will have to be continually refreshed from the surface, always presuming the surface atmosphere remains be-
nign; pumping in fresh air would also create a wind, a convection current, helpful to robust plant growth and for removing airborne dust and bacteria. It would be prudent to grow vegetation, and encourage suitable bacteria, to absorb the increase in CO2 from the human population, and provide additional oxygen. Both islands may be used, given suitable air quality, for outdoor activities: rock climbing; walking; cycling, etc.

The numbers of people living in such a potentially vast underground habitat could be huge, millions in principle, but may be limited in practice, not so much by shortage of water, but by the need to maintain water purity, together with a balanced atmosphere, food supplies and, most importantly, by waste management, including industrial and human waste.

Whether large numbers of people would be content to live in such confined, potentially-claustrophobic circumstances is a moot point; and the potential for disease to spread cannot be overlooked. However, with continuing increases in population, rising sea levels, reducing land for agriculture, increasing shortages of potable water, etc., there may be little choice, and the ingenious ape will perforce find ways of addressing these negative aspects.

A future Mountain Habitat, above the snow line...

Mountain Retreats
Few humans live on the top of mountains, for obvious reasons: the cold, the lack of vegetation and food, and the thin atmosphere. Mountains generally have one thing go-
ing for them, however: water, in the form of ice and snow. Global warming is unlikely
to change that: as the air warms at lower altitudes, it will also hold more moisture
which will then be deposited on mountains as winds drive up the mountains, cooling
the air which will then deposit its surplus water as snow and ice. So, higher mountains
may be expected to retain more water, rather than less, with global warming...

Living at altitude would be problematic, however: Sherpa may have evolved ge-
netic adaptations for surviving and operating in the reduced atmospheric pressures of
high altitudes, but for the bulk of humanity, the altitude would prove debilitating. The
solution to the dilemma, then, would be to provide a sealed environment at or near
the top of suitable mountains, with a contained atmospheric, suitably pressurized.

The conceptual mountaintop habitat exists above the snow line, where water as
ice, snow and glacier would hopefully be plentiful. Three very large “canisters” are
shown – there could be more. Each “canister” is the projection of a largely-hidden
community into the visible world; the remainder of each community is carved out of
the mountain interior, either in the form of caverns, or in the form of houses, build-
ings, offices, schools, hospitals, theatres, etc., carved out of the solid rock after the
manner of Al Khazneh (The Treasury) at Petra. Using this approach of carving from
the rock, it would be possible to create an extensive, multi-level, multi-story, multi-
suburb community inside the mountain, with sports arenas, parks, shopping plazas,
etc., so creating an attractive, if enclosed, habitat for human city dwellers.

Carving into the mountain rock might encounter fresh-water springs, which
would add to the essential water supplies. In any event, such communities would have
to recycle waste to conserve their supplies of water and air, and would necessarily cre-
ate extensive hydroponic farms to feed the population, the size of which would be lim-
ited by water, food and air – so, like a spacecraft, but with gravity. Unlike a spacecraft,
however, the mountain communities could import goods and services, and could po-
tentially export minerals discovered and mined in the mountain and surrounds.
Moreover, the mountaintop habitats need not be isolated: shafts would connect the
habitats with lower levels and with other communities in the locale and nearer the
base of the mountain.

The location of the mountain habitat suggests that it might be ideally located to
become a “university city,” pursuing astronomy, astrophysics, physiological adapta-
tion, global communication systems, etc. How many people could be accommodated
in such a habitat? That would depend on the supplies of food, water, air, etc., on the
ability to recycle, to import/export, to manage waste, so an unknown at present. How-
ever, a target, self-sufficient population of 30-50,000 does not seem unreasonable,
given time to undertake the building works, which would be continual, but essentially “low-tech.”

Such a target population seems low in relation to the rate at which populations are expanding and sea levels are rising. To make this concept viable, many mountains would have to be surveyed and scoured; many habitats constructed; many new populations started... These habitats would, however, be on virgin territory, so they would offer the potential to expand without interfering with other communities and without impinging on precious agricultural land, which will be in increasingly short supply.

Escape Into Space?
A different approach, much favored by science fiction writers and filmmakers, is for humanity to migrate into space. One approach to providing habitat is the rotating wheel, placed in orbit around the Earth after the fashion of a space station, so protected by the Earth’s magnetic field against the harsh solar radiation and damaging cosmic particles.

The rotating wheel concept was highlighted in the 2013 science fiction film Elysium, where the wheel appeared to be in geosynchronous orbit, so some 36,000km above, but clearly visible from, the ground. According to the film’s storyline, Earth of 2154 had become polluted by industry and overcrowded, with many people in poverty and suffering from illnesses that could potentially be cured. An elite of wealthy and powerful people had taken to living above and beyond the squalor, on the orbiting wheel, where all of the advanced medical facilities were retained, for their exclusive use. This elite ruled the Earth through an administration backed up by a robotic police force on the ground, with the *hoi polloi* forcibly denied access to the advanced medical facilities.

The wheel in the figure shows the general concept. As in the film, the wheel would rotate about its principal axis, so that people and things on the inside rim experience approximately Earth gravity, making continual exchange of people between ground and wheel convenient, i.e. without any need for acclimatization.

For a “space wheel” to be clearly visible from earth’s surface, it would be sizable. If we suppose it to be, say, 10km diameter, then the rate of wheel rotation to give “earth gravity equivalent” at the rim would be one revolution every 3 minutes—which might be disconcerting for anyone standing or walking about on the rim experiencing the Coriolis effect and the fast-changing visual scene... Moreover, the forces tending to pull the wheel apart would be very large.
However, humans are the ultimate adapters, so perhaps people could adapt to such an environment, and in principle, given that level of centripetal acceleration, it may be possible to retain a breathable atmosphere within the rim cavity.

On the other hand, it is difficult to see how the wheel’s occupants might be self-sufficient. It seems more likely such an occupied wheel would require continual support from Earth for food, oxygen, water, materials, tools, technology, waste disposal... so, perhaps, an expensive and unlikely habitat, and no viable solution to housing an expanding human population.

Also popular with science fiction writers is the idea of the space cylinder, a futuristic Noah’s Ark, in which a complete biosphere may be stored and conveyed, put into orbit around a suitable star, including our Sun, or even projected into the galaxy in search of a new planet to ‘seed’ with life from Earth.
The space cylinder is an interesting concept. A huge, sealed cylinder has a complete biosphere on its inside surface, as compared with spheroid Earth, with its biosphere on the outside. The cylinder rotates around its major axis to provide some equivalent to gravity, and it is large enough to have its own internal weather system. Internally, the major axis also serves as a cylindrical bar ‘sun,’ providing light and heat to the whole inner surface, ideally driven, perhaps, by a fusion generator that can collect fuel from space as the space cylinder travels...

The inner surface would be covered with rocks, soil, flora and fauna, after the fashion of a Wardian case, the whole filled with atmosphere, and sealed, after which it should then continue, develop and evolve as would the equivalent on Earth, providing a pristine environment replete with climate cycles, rainfall, a full range of life forms and food chains, etc., in which potentially to establish human habitats.

It seems reasonable to suppose that a space cylinder – as described, and supposing its construction, energizing, stocking and sealing to be feasible – would provide a unique habitat for some humans; but for how many? The humans would perforce have to live in harmony with the rest of the natural environment, hunting, trapping, fishing, gathering and farming to feed themselves. So, not too many humans, since they would be obliged to live within their means or die out. The human population would proba-
bly reach a dynamic equilibrium: increase beyond that level would lead to famine and death, until the population returned to the level at which it could be sustained. In the
process of adjustment, in desperation, the humans might well kill off both floral and faunal species, so prejudicing their future environment by eliminating essential variety.

The space cylinder, then, does not seem to offer a viable solution to the problems of population expansion. It could be of interest to a fundamentalist group wishing to escape from Earth, but the cost of such an enterprise would surely be prohibitive...

The Cylinder–in–Space does, however, provide an object lesson for the rest of us on Earth about the end facing us if we do not maintain our natural environment and curb our population growth. It is relatively straightforward to see the threats and risks of self-destruction facing the human population of a sealed space cylinder. They appear to be largely identical, however, to those on our isolated Earth.
CHAPTER

APOCALYPSE PENDING

Lichfield Cathedral
SECTION

PROGRESSIVE DE-CIVILIZATION

ES FONER - THE SLING-SHOT,
PALMA DE MALLORCA
Progressive De-Civilization

Besides the more catastrophic forms of Apocalypse, there could be a rather slower, more insidious form. If we define civilization as: an advanced state of human society, in which a high level of culture, science, industry, and government has been reached, then, it may be that we can see about us the seeds of our current civilization coming to an end. It has happened before: Egypt, Malta, Greece, Rome around the Mediterranean; Olmec, Maya and Aztec in Mesoamerica; Axum, Ghana, Mali, Songhai, Ethiopia, Mossi and Benin in Africa; and many, many more. Then there have been the aggressors: the Huns, the Goths, the Visigoths, the Vikings, the Mongols, etc.; the empire builders: Spain, Portugal, Holland, Britain, France, USA, etc., each crushing the cultures of the countries that they overran...

The Mayan civilization in Mesoamerica is thought to have died out because of a change in the climate that denied them sufficient water to grow food for the people. Angkor Wat, the Khmer Empire of 9th to 15th centuries, CE, may also have experienced climate change which, coupled with economic and political problems, overwhelmed the ability of the state to cope, e.g., to maintain the complex hydrologic system on which their ability to grow sufficient food depended.

In ancient Egypt, as we have seen, the decline of the Old Kingdom has been attributed to a series of poor Inundations of the Nile leading to food shortages, famine and disorder. Closer examination indicates the causes to have been more complex. One reason may have been the extremely long reign of the pharaoh Pepi II, who reigned from birth to his death in his nineties, outliving his heirs and so creating problems of succession. Also, appointment of the nomarchs (provincial leaders of the nomes or regions) by previous pharaohs had been hereditary; over time they became very powerful in their own regions, with the suggestion that, when famine struck, the nomarchs who had stocks of food (presumably in the Nile Delta) refused to share them with the regions to the South that were suffering, although instructed to do so by the pharaoh. In delegating to these hereditary nomarchs, the pharaoh had lost effective control from the centre.

Yet we tend to think, “it could not happen to us;” however, our much-vaunted multicultural societies, our most prized social engineering endeavors, and often the consequence of prior empire building, do not seem to be quite so cohesive as might be hoped and expected. In theory, diversity should lead to greater unified strength; but that only happens if the diverse parts engage, complement, cooperate with and contribute to each other and to the unified whole: diverse parts that do not engage can become “system pathogens,” and we humans have an instinctive distrust of anyone “dif-
That distrust stems from the defensive instinct that would have saved our lives in the past, when the stranger would have been the enemy coming to rob, kill or enslave. It is no use telling people that they should not be afraid or distrustful: this is a human given that can be overcome only by experience and conditioning, and then, for some, on a case-by-case basis.

What we see in extant multicultural societies is less a homogenous mix of different cultures, more a division by cluster and class, with some cultures adopting areas where they live, exclusively, or predominantly, and where they also occupy a particular social class, higher or lower. People of a noticeably different culture and class may be unwelcome in the “wrong” area, and may even be offered violence, such that ‘no-go’ areas may exist in towns and cities where, in some cases, even the police are loathe to go, especially after dark. And humans being what they are, people in these areas, largely of one culture, develop a social structure of their own, and they create an invisible, yet palpable boundary around ‘their’ area. All of which creates a ‘them and us’ situation, ripe for conflict.

Add to the multicultural melting pot, a monumental increase of economic migrants and a veritable ‘reverse crusade’ of Muslims, including a concealed cohort of fundamentalists, from a war-torn Middle East to the predominantly Christian and post-Christian countries of Europe and the Americas, and the stage does seem set for major social disturbance.

Then there is a developing class war promoted by left-wing politicians and activists, who seek to break down the class structure, to have equality, to eliminate the middle and upper classes, whoever they might be, to put the power in the hands of the workers, who would then become the bosses – a rôle which history suggests they may not be too good at. All of which might seem perfectly reasonable if it were not that it breaks down the structure of society, on which social stability, and essentially our civilization, depends.

There are, too, many social ‘experiments’ going on Western society at the present which should give cause for concern, but which are being introduced on a wave of careless abandon for an ever more liberal society, by which is meant a society with ‘equality and fairness,’ without standards or rules of behavior, without class (or with class mobility, essentially a euphemism for ‘no class’), without structure, and even without contribution.

Liberalization leads to cultural changes: manners are seen as less important; swearing becomes the norm; young women behave as badly, or worse, than young men; dress becomes permanently casual; high culture in ballet, architecture, art,
sic, fashion, etc., are mocked and parodied; science is conducted by ‘geeks’ and ‘mad scientists,’ who cannot be trusted; education is ‘dumbed down;’ respectability is outmoded, a bygone concept; the middle class of society is squeezed into virtual non-existence, with everyone declaring themselves to be working class, equal to everyone else, and opposed to/distrustful of, authority, politicians, the establishment, police, large organizations, “the system,” indeed anyone. Some may enjoy a comfortable life on welfare, without ever working or contributing to society.

Meanwhile women move into areas of employment previously seen as male rôles: airline pilot; infantry; boxing and rugby; and many more. And there is confusion over sex, with bi-sexuality and transgender; some declare transgender to be a third sex, and that will be only the beginning of the eventual confusion, since there could be degrees of transgender.

All of this liberalization is fueled and encouraged by the media, newspapers and television, and even more rapidly by social media, which spread, publicize and promote the changes with undisguised glee, happy to preside over a spreading objection and resistance to authority, on a town, city, megacity, national and even international scale.

According to Edward Gibbon, in his monumental History of the Decline and Fall of the Roman Empire, there had been a gradual loss of civic virtue among its citizens. They had become weak, indifferent, servile, effeminate and dependent on others to defend the empire. He further argued that Christianity’s comparative pacifism had hampered the traditional Roman martial spirit. In the end, they were unable to defend themselves against the barbarian mercenaries they had employed to defend them... Gibbons has been criticized for his reasoning as to the cause of the Decline and Fall; however, the Roman Empire did, unarguably, collapse, and his critics were unable to offer a more convincing reason.

Can we see the seeds of impending breakdown in our current Western civilization by comparison with historic examples? There certainly seem to be some parallels, particularly with Gibbons’ observations, above. Our western societies may also be seen as becoming weak, indifferent, effeminate, etc.:

*Weak*, through progressive elimination of class structure, and through a degree of liberalization that threatens a society unable or unwilling to defend itself. *Indifferent*, largely because of a developing aversion to authority of any kind, and to politicians in particular, coupled with an immoral, hedonistic ‘culture of the self,’ with a licentious culture among the young for pornography, drug-
taking, violent and degrading ‘entertainment,’ non-musical music, non-artistic art, etc.

*Effeminate*, with a marked rise in males behaving with traditionally female characteristics, and with many young men exhibiting such a low degree of sexual dimorphism that it is difficult to tell which sex they are...while, at the same time there is an increase in male facial hair – beards and moustaches – as though to emphasize the sex of the wearer...

*Dependent* on others to defend the empire. Not perhaps in the way that Gibbons would have meant, vis-à-vis Rome. It may be that Western societies would find it difficult to recruit armies, should the need arise – see the previous three bullets. However, there is a growing dependence on defense using ‘remote’ technology: nuclear weapons, drones, cyber-warfare, etc., in which the public play no part, there is no need to recruit armies, etc.

In addition to Gibbons observations, he might have added that the size of the Roman Empire, and its longevity, had lead to complacency, to a general feeling of invulnerability, that prevented Rome and the Romans from even conceiving of danger of collapse; it was unthinkable. The parallel with our present western civilization is all too apparent...

So, yes, we can detect an on-going collapse of western civilization; it is happening right now, and the process is gathering pace. Can the collapse be slowed halted, or reversed? Unlikely, as there seems to be no will to recognize the process, let alone do anything to reverse it. Moreover, the progressive move of more of the world’s population to live in cities and megacities will inevitably exacerbate the process of social disturbance and eventual disintegration...further aggravating the Human Condition in the unstoppable process...
Progressive Decivilization


Attribute Enhancement Structure: read arrows as “contributes to, Helps to achieve…”
ANCIENT COMPASS AND TIMEPIECE

SPRING TIDES ON THE SEAFRONT
Apocalyptic Visions

Conventional wisdom suggests that mankind will eventually wipe itself out: by population expansion to the point of global famine; by over-exploitation of resources – oil, water, minerals, etc. – until there are insufficient to maintain the bastions of civilization; by war over the dwindling of such essential resources; by natural or manmade pandemic; and by combinations of these factors. Then there are the believers in an impending nuclear holocaust, with Earth becoming a smoldering cinder in space, perhaps, or at the very least with major loss of flora and fauna. Some further envisage a post-apocalyptic earth, with pockets of survivors living hand-to-mouth in a collapsed, post-technological world. Others see a world after mankind, with mankind eliminated, and a slowly recovering earth, with nature restoring balance and order.

Few pundits, it has to be said, have any faith in Man’s potential to regulate population, to curb greenhouse gas emissions sufficient to stop global warming, to live in balance with the rest of the natural world, and to live in mutual peace and harmony across the globe. It is just not the way of the ingenious ape...

Instead, it seems inevitable that, at some stage, that ingenious ape will attempt to avert the seemingly inevitable: to take direct action to regulate population; to control climate so that deserts bloom again; to prevent global warming so that the ice caps do not melt, sea levels do not rise; even, perhaps, to reverse contemporary global warming and, whether by accident or fanatical design, induce a glacial period, or even a return to Snowball Earth.

Population Control

Direct action to control population may seem like the notion of some mad scientist. And it could be just that: a desperate attempt by a fanatic to reduce the global human population by introducing a pandemic. More likely, however, such a pandemic could occur naturally, perhaps by the continuing evolution of the common influenza virus. Back in 1918, at the end of WWI, influenza pandemic infected some 500 million people and killed between 50-100 million of them, some 3–5% of the then-world population. This compares with over 17 million deaths of military and civilian deaths over the four years of WWI. Evidently, pandemics are much more ‘effective’ at “population control” than wars, even Great Wars...

However, it is possible to conceive of other ways to control population, which might fall far short of sudden death, and which desperate, or ideologically driven, people might be tempted to take. One such could be widespread dissemination of some form of biological or chemical contraceptive, perhaps in the air, water supplies, geneti-
cally modified food, as a food additive, etc., etc. Alternatively, it might be disseminated unknowingly, by the ubiquitous use of plastics in household items: furniture, carpets, babies bottles, cans, etc. Many plastics contain bisphenol A (BPA) – in common use since the 1950s – and, more recently, bisphenol S (BPS), that are suspected of mimicking the female hormone estrogen.

Such disseminations might have only a seemingly-marginal effect, so that the birth rate might fall only slightly, or the balance of boys to girls was upset, or the masculinity of male children was diminished, or that of female children was enhanced...there is a host of variations, some of which might be difficult to detect in the short term. Indeed, it could be happening now, and we humans might be so engrossed in social engineering, in ensuring equality for minorities, that we would not have noticed, or – having noticed – deemed it politically incorrect to comment.

**Climate Engineering**

Climate Engineering, also known as geo-engineering, describes an array of ideas, techniques and technologies for effectively managing the global climate, to anticipate global warming, or at least to mitigate its most severe effects. At present, they amount to Carbon Dioxide Removal, or CDR, and Solar Radiation Management or Sunlight Reflection Methods (SRM).

CDR seeks to remove CO2 from the atmosphere and store it, either by enhancing natural CO2 absorption of flora, or by some technological means, so-called sequestration. CO2 is absorbed by most green stuff, including seaweeds, grasses, and of course trees. Regardless of this, humans have taken to destroying forests in the Amazon basin, in Indonesia, and elsewhere: a form of negative climate engineering.

Of course, CO2 is not the only greenhouse gas: methane, CH4, is reputedly some twelve times more potent as a greenhouse gas, and it is known that large volumes of this gas are ‘locked up’ in extensive tracts of permafrost, which will melt as the planet warms, so there is a potential positive feedback mechanism: as the planet warms, the further release of the potent greenhouse gas methane will tend to make it warm even faster...

**Controlling Global Warming**

An obvious way to control and regulate global warming is to provide some form of shield from the sun’s rays. Volcanoes do this naturally from time to time, inducing localized so-called volcanic winters, filling the upper atmosphere with sulphates/ sulphuric acid droplets and clouds of dust, which reflect some of the Sun’s rays and pre-
vent heating. Ice caps have a complementary effect, increasing the earth’s albedo, and therein lies another positive feedback loop: as the Earth cools, ice caps extend, and – with more ice at poles and on mountaintops – the Earth’s surface reflects more sunlight, so absorbs less solar heat energy. One way, in principle, to combat global warming, then, would be to invoke a series/sequence of volcanic eruptions – which would not be beyond the wit of man. The results, however, would be unpleasant and uncertain, and more the stuff of nightmares than of controlled global warming...still, fanatical ideologists might be tempted.

Proponents of the hypothesis that the dinosaurs were brought low by a meteor strike suggest that the impact caused firestorms across the surface of the planet, or at least of sufficient extent to project black carbon firestorm soot and aerosols into the atmosphere, which would have circled the Earth and shutout the light from the sun for months, perhaps even for decades. This firestorm winter would have caused a major shutdown in floral growth, including particularly the vegetation on which the larger dinosaurs depended, hence they died out...

The notion that a myriad of firestorms across the planet could raise sufficient material into the upper atmosphere to create an artificial winter does appear credible. Indeed, there is a suggestion that an all-out nuclear exchange between global superpowers would result, *inter alia*, in a so-called nuclear winter, which might reduce parts of the global surface temperature by as much as 35°C. One problem with these various concepts, apart from the immediate human disasters, is the uncertainty of outcome. Dust and soot in the atmosphere would not be evenly spread so that the effect of solar heating on the Earth would inevitably be uneven, and that would lead to differential cooling, which would lead in turn to atmospheric turbulence and climate unpredictability.

Moreover, it is uncertain as to how long the effects would last: would dust and/or soot clouds disperse after days, weeks, months or even years? And would the consequent cooling effect invoke some positive feedback such that cooling continued after the clouds had dispersed?

**A Solar Veil**

The ingenious ape, having anticipated such problems and risks, might try something more sophisticated to combat global warming, especially some way that did not incur serious risk of returning to Snowball Earth. One approach, The Solar Veil Concept, exploits the so-called Lagrange Points; these are locations in space where the combined gravitational forces of two large bodies, the Earth and the Sun in this instance, equal
the centripetal force felt by a much smaller body. By convention, these points are numbered: the Lagrange One (L1) point is in direct line between the Earth and the Sun; an object placed at L1 would remain there, orbiting the Sun in angular synchronism with Earth, and neatly aligned between the two.

The plan would be to create a disc-shaped particle cloud, the diameter of the Earth, at or near the L1 point. Such a disc-shaped cloud would be generated by a Catherine wheel device at the hub, pumping out streams of particles as it rotated like a firework, so creating expanding helices, in a plane orthogonal to the Earth-Sun axis, that would slow as they expand under the combined gravitational pull of Sun and Earth, so forming the disc. The particles would be of such a size that the disc-shaped cloud would scatter infrared solar radiation, but not visible or ultraviolet radiation. The net

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The Solar Veil Concept

To reduce solar energy arriving at earth, a thin cloud of particles is injected to the sunward side of the L1 Lagrange point, where it forms a disc with its plane orthogonal to the sun-earth axis. The cloud scatters a small proportion of the sun's energy, principally infrared emissions, with the bulk of solar radiation, including the visible spectrum, passing through unaffected. The cloud disperses gradually under effects of the solar wind...
effect should be that the Earth would receive marginally less heat energy from the Sun, and that reduction would be uniformly spread across Earth’s rotating globe.

The disc shaped cloud would act as a thin veil across the Sun, but that veil would not be visible from Earth: light in the visible part of the spectrum would transmit normally, so photosynthesis at ground level would be unaffected. Moreover, the effect would be temporary: the ‘veil’ would dissipate over time under the continuous effects of the solar wind...

A sensible plan for the Solar Veil might be to gradually reduce the mean temperature of Earth by, say, 1°C over a period of 5 years, and by 2°C over 10 years, returning the planet to its pre-industrial state. Such a plan might prove difficult to realize, however: current predictions on global warming suggest that, even if we were able to stop emission of greenhouse gasses instantly, the mean temperature would continue to rise. Moreover, once the planned reduction in mean temperature took effect, there might be no way to stop the process...such are the problems with massively complex systems.

The energy output from the Sun fluctuates all the time, and reduced solar energy arriving at Earth has been implicated in the so-called Maunder Minimum of 1645-1715 and Little Ice Age of 1300-1850, although alternative theories exist as to the causes: re-
ductions in sunspot activity; the solar system passing through clouds of interstellar
dust; Milankovitch cycles; and so on.

So, is such a solar veil scheme viable? Unlikely, not because of poor physics – the
physics seems to be not entirely unreasonable – but because of associated risk, and un-
doubtedly of religious objections, too – this would be tantamount to “playing God.”
Suspicion would fall on the motives any one nation that tried to promote such a
scheme, and the United Nations could not promote it without veto from the many par-
ticipants who would block anything they may not have thought of...such is to be ex-
pected of the ingenious, but fractious, ape.

The motives of some powerful nation or bloc could, indeed, be suspect. Suppose,
for example, that instead of a temporary cloud of particles, the ‘veil’ transmogrified
into a translucent ‘shield,’ with shutters that could be opened or closed to let all, or a
restricted amount, of radiation to pass. Control of such a shield would confer inestima-
ble power on the controller, who could, for example, cool one hemisphere but not the
other...or even one landmass and no others.

And then there is the risk of some rogue state deciding to create a rather more
dense veil or shield, with a view to damaging or destroying other nations they consid-
ered to be enemies... and that would, indeed raise the specter of returning to a glacial
period, or even to Snowball Earth; the causes of, and prospects for, such a severe
global environment are not well understood. On the plus side – or not, according to
viewpoint – a return to a glacial period, or even the promotion of a new ice age, could
be the saving of the planet in one sense, as it would see an end to the hubristically enti-
tled Anthropocene, and the planet would presumably regenerate life eventually, in
some different, perhaps less destructive, form...

Perhaps, however, Man will learn to curb his more excessive behavior; will learn
to live in harmony with his environment; will curb global warming, and learn to live at
peace with himself...fingers crossed!

Derek Hitchins

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