EVOLUTION AND THE FUTURE OF HUMANITY

HOMO SAPIENS' GALACTIC FUTURE

George F. Hart, Ph. D.
Professor emeritus,
Louisiana State University.

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Authors notice

This book contains references to god. The concept of a god, or of any underlying supernatural identity such as a spirit, is scientifically unproven; and, indeed has no scientific basis whatsoever. Reference to such an entity should be approached from the viewpoint of cultural myths and legends, and critically considered, within the framework of humankind's current stage of development.

To Clare:
My wife and life partner, whose patience, tolerance, love and unlimited support has made my life possible.

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PREFACE

A drinking hole: Lhasa, Tibet 1987

"My own adventure through life has been a wonderful journey and I would love to do it again but know that I am too early. I hope my descendents will have a choice, and that is what this book is really about. The message is to not be afraid of the future but to embrace it for humanities sake." The author.

In the early 1990's I gave a lecture, at the Colorado School of Mines, on the future effect of sea level raise on coastal Louisiana and concluded with "…from the viewpoint of science and technology the future looks bright for Humanity and the Earth System in general. The only cloud on the horizon is political – in the form of Muslim Fundamentalism – which could disrupt the entire evolution of society." Today, a dozen years later, the meanings of both sentences are apparent. Science and Technology are directing global society into an astounding future; and, at the same time Muslim Fundamentalism is triggering responses that are both authoritarian and totalitarian. These responses threaten both individual and group freedoms and it is even more imperative that we understand the essence of society and what controls its evolution. This book examines these questions but unlike those written by humanists in the fields of social, political and economic studies I view the problems from the viewpoint of the interbreeding population [the physical gamodeme] that comprises individual competing, and interacting political, social and ethnic populations [the cultural gamodeme]. Cultural gamodemes respond to the same or similar laws in their evolution as do physical gamodemes. They respond to environmental pressures as do biological species.

At its core the book is about the future of humankind: both as the species Homo sapiens; and, of the accumulated evolutionary traits that we call humanity. Part of it concerns those developments in human engineering that will allow ***Homo sapiens*** to deliberately be evolved into a galactic species; and, part concerns the evolution of humankind's social structure to allow expansion beyond the near-Earth environment.

Our descendents need knowledge to allow them to understand what they are, both as genetic entities and as containers of humankind's value. This is necessary in order to see what they might be, and where they might go, in their future. The key lies in a greater understanding of science and of our true nature.

Evolutionary theory has applications in understanding and improving humankind's cultural gamodemes. In particular, it can form the basis for establishing scientifically derived ethical guidelines, whereby society can develop in a logical manner as it adapts to the changing cultural environment. To accomplish this scientific reasoning must be the basis of developing the future global cultural gamodeme; and, for establishing those that will exist extra-terrestrially.

The similarities between physical and cultural evolution are highly comparable. Physical evolution concerns the interbreeding population. Cultural evolution concerns the interacting population. In physical evolution, the 'survival of the fittest' rule applies; and, in cultural evolution, the 'meritocracy' rule should apply. Just as in physical evolution the carnivores, parasites and pathogens developed, alongside semi-stable species, so in cultural evolution the criminals, the manipulators and the murderers developed alongside semi-stable populations.

The essence of humankind is encompassed by the concept of humanity. Unfortunately, despite a long history of attempts, there is still no consensus on what truly defines humanity. One approach is to proscribe a definition that relates it to those traits common to the collective consciousness of humankind [figure 1 & figure 2]. Consciousness and an enhanced introspective ability is the combined exception that sets the concept of humanity apart from other traits of living systems. The New World View holds that we evolved naturally from matter over a three to four billion year period of time. Moreover, we are only the latest biological experiment of nature, descended from a long line of vertebrates [supplementary reading] which finally achieved consciousness and self awareness and eventually led to language, social evolution and civilization.

"We now know how to write poetry, solve algebraic equations and create plasma televisions with reality TV shows on them. Wow! If you think that's amazing, we've also figured out chemistry, electricity, sub-atomic physics and plate tectonics [we can prove with incredible elegance, how South America and Africa used to fit together like a jig-saw puzzle]. Along the way we created incredibly beautiful myths to help us explain or at least

acknowledge the deep, and profound, mysteries of the Universe we were born into. While technologic progress has allowed us to explain much of what we feared early-on we can still acknowledge the many profound mysteries of creation. The mysteries are simply further in the past or further away in distant galaxies, but we are still humbled by the question: why does our Universe exist?"1 .

Thus, humanity becomes a collective trait of Homo, involving the adaptability of the human mind. As with other traits, it is a consequence of selection pressure.
A future for our phylogeny for the next thousand years can be quite clearly seen in broad outline even though the details may not be resolvable. Human engineering is set to modify our species and the social fabric of which we are a part. We are destined for a post-human future that will involve the incorporation of genetic modifications into our genome, such that we evolve chimera as adaptations to the variety of conditions existing within our Solar System. Moreover, to become a galactic species, humankind must evolve into a robotic entity; and, to do this we must understand what our humanity derives from, and what of it needs to be perpetuated.

Today both the structure and consciousness of ***Homo sapiens*** are natural. We are heading towards becoming a species that has a natural consciousness but a designed structure: a truly bionic human. We may commence with artificial hearts and limbs, and germinal choice technology [Stock, 2002] but in time a set of common characteristics will allow scientists to define at least one new species which will be a combination of designed, manufactured structure and natural consciousness. As biological and mechanical changes are incorporated into the structure of ***Homo sapiens***, a biological variety ***Homo sapiens var roboticus*** will be definable. Eventually, this will become the bases of a new biological species Homo roboticus [the technical definition of a species is provided later]. ***Homo roboticus*** may coexist in the Solar System with ***Homo sapiens*** but evolutionary theory indicates that once the physical gamodeme [the interbreeding population] of either species become geographically isolated in Space the gene pool of the isolated gamodeme eventually will drift far enough to create entirely new biological species: irrespective of deliberate design changes. Indeed, the biological definition of a species may become a moot point because with spatial and temporal separation from the parent species neither ***Homo roboticus*** nor ***Homo sapiens*** will be able to interbreed with other spatially and temporally isolated living systems. I believe that within less than 100 years ***Homo roboticus*** will exist.

The real thrill of examining the future evolution of humankind is that some time after the development of ***Homo roboticus*** the introduction of a creation with both a designed structure and a designed consciousness will occur2. This I call Robotico earthensis [the robot from earth] in the belief that a new genus grouping will be necessary to encompass this novel kind of 'organism' [Robotico], and a new species name [***earthensis***] will be appropriate for these different kinds of individuals that belong to the genus. In this way, I see the Hominid phylogeny [an evolutionary line] extending from the ancestral genus Australopithecus, through our genus ***Homo*** to the descendent genus ***Robotico***.

The key feature of ***Robotico earthensis*** is not simply a manufactured body but, most importantly, a manufactured consciousness. The need for thought about how, as creators of the genus ***Robotico***, we want to design its consciousness is paramount. The design of that consciousness is possibly the greatest task that humankind will ever undertake for it will be the basis of a galactic species. What of humanity, do we want to preserve? What are the mechanisms that have made life such an adaptive development that we need to preserve in our robotic descendent to provide an ability to evolve and survive in new environments? What is it about the evolution of humankind's social organization, the cultural gamodeme, that can provide an ability in humankind to survive as a galactic community? Perhaps most importantly: once ***Robotico earthensis*** exists so will the knowledge that the religious definition of the soul does not. How will humankind deal with having their souls ripped from them? Theology is not about religion but about the ultimate origin [god with a little 'g']. We look to the Theory of Evolution to find the wisdom we need to define why we are, and to understand the inexorable forces that operate on living things over time. The word God/god, like the words atheist and race, has so much baggage attached to it that it is difficult for people to discuss intelligently subjects that involve the use of such words. Personally, I prefer to be thought of as a 'Seeker", with the mantra ***rerum cognoscere causas***: to seek knowledge.

One can see a potential danger for our species as the genus ***Robotico*** evolves for 'What if it ever regards itself in competition with ***Homo***?' ***Robotico earthensis*** is not the merging of human and robotic intelligence in the sense of Ray Kurzweil [2006] but the development of an artificial consciousness based upon how the human brain works and what humanity is. The real danger lies in creating an entity that is not rooted in our nature and one that lacks those characteristics called humanity. It is our humanity, encompassing a series of biological traits, which makes humankind different from all other known life forms. We must commence to address the design issues of our descendents now, because it will require much time and effort before implementation. Urgency is needed not because ***Robotico earthensis*** may turn around and destroy us and our society, but because of a belief that the essence of humanity is good for our Universe. We would be remiss to send sentient beings beyond our Solar System that did not embody our humanity. Even if we are ultimately completely superseded by our creation, human arrogance suggests there is an inherent goodness within humanity that will be a valued asset to our Universe as a whole. That this is most probably a myth is immaterial because it will be a driving force in the creation of ***Robotico earthensis***. Our Universe, of course, is neutral about our humanity and our contribution to the future. However, it is precisely because our Universe is neutral to our consciousness that it is open to our expansion beyond our present borders. My own forecast for the development of ***Robotico earthensis*** is between 2100 and 2300 ybp. Kurzweil predicts that machines and humans will have equal intelligence by 2029 [a time called the singularity] and I have no conflict with this estimation. It is because I accept this prediction that I believe it is critical to understand what the basis of ***Robotico***'s consciousness is to be. Knowledge is not in itself wisdom even though wisdom needs knowledge to be very wise. ***Robotico earthensis*** or its pre-cursors will have processing power and access of information trillions of times greater than humans within a couple of years after the singularity. Robotic brain networking will mean that all knowledge will be accessible to all machines along the network. This formidable force may allow humans to transfer their individual consciousness into super intelligent machines, as hoped by Kurzweil, and in a real sense we will BE the machines if we so choose. The Borg will be us!

Life on Earth has evolved along logical pathways using natural laws to determine the success or failure of adaptation3. The result of all this natural experimentation and selection was the development of ***Homo sapiens***. The present peak of evolution on Earth is the emergent phenomena of consciousness we observe in our species, and the essence of that consciousness is logic and the host of human traits grouped as our humanity. Defining humanity vexes philosophers, for the concept is permeated with the ideas associated with the changing social conditions [the evolution of the cultural gamodeme or ethno-social interbreeding population]. For a humanist a good part of what makes humankind human pertains to myth, legend and religious belief. The humanities in general accept numerous incidental and irrelevant moral parameters of this kind. The sciences, using reductive reasoning, attempt to extract fundamental attributes of humanity that are embraced by the consciousness of ***Homo sapiens***. Science does not deny some essential core to humanity that has to do with man-the-myth-maker. Science attests that myth making is part of emergent organization leading through religiosity to political systems. Because this is so, humanity is intimately related to cultural gamodemes driven by evolutionary processes; and it is necessary to understand the phenomena of humanity and developments in the cultural gamodeme as manifestations of those processes.

Developing a robotic future for humankind will have major social consequences, for the vast majority of people still comfort themselves with some mystical belief about an interfering God [the big 'G']. The concept of ***Robotico earthensis*** is a bit terrifying to some people, and seems to fuel the fundamentalist's belief that a secular humanist future is some kind of hell. Most certainly, the rhetorical battles will be vicious, for science and religion are again on a collision course that will impinge far more on our social condition, than the ideas of Copernicus or Darwin ever did. Moreover, neither religion nor science has the exclusive right to define a theology to explain the origin of our Universe. However, science alone can provide the knowledge of what happened after the origin of our Universe: and about this we have knowledge in detail.

Today, throughout the world, many people are embarking on an agenda that can make science dominant as the force that directs the social condition; and, at the same time others are determined to place the social condition more in the realm of myth and legend with charismatic leaders. Many of those encouraging science recognize it is time to place humankind clearly within a scientific culture in which science education is at the core of understanding the Earth System and our Universe. This belief extends to one in which scientific knowledge plays a pivotal role in decision making within the political, cultural and social framework and becomes the basis of ethical decisions. To attract the attention of the vast majority of Earth's population science must answer the eternal questions about purpose: of life and of death; of existence and of non-existence. It must replace the illusionists' grand plan in which a body is inhabited by an indestructible soul that allows an after life. If you strip destiny and divinity and profundity from the human psyche, what is the purpose of humankind's existence? Is it pleasure encapsulated as life's enjoyment at the awe of our Universe?

The probability that ***Homo sapiens*** will evolve into ***Homo roboticus*** and ultimately will lead to consciousness within the genus ***Robotico*** is a near certainty unless a disaster overtakes our society. Any further evolution of consciousness within the genus ***Robotico*** eventually will lead to a self-evolved entity: a cyborg descendent designed by cyborgs [Robotico roboticus]. Although this stage may signal the end of our true hominid phylogeny [many years in the future] it is humankind's destiny: a destiny we ourselves will set!

It must be emphasized any consciousness derived from our species that is passed along our phylogenic line to ***Robotico*** should be based upon an awareness of the essence of our humanity. Even though further evolution within ***Robotico*** may reject the essence of humankind, and indeed the creation may even seek to eradicate such concepts from our Universe, for us to ignore our human essence, as the creator of ***Robotico***, would be a fallacy. It would be directly opposed to the evolutionary principles we see operating within nature.

TOWARDS A ROBOTICO SOCIETY

Individuals can examine some aspects of these questions of what of humanity should be preserved in our robotic descendents, but a broad 'indaba', where rhetoric rules, must be forthcoming. Lagay [1999] notes:

"Rhetoric's optimism also springs from its nearly inextricable relationship with humanism. Humanism inclines us toward positive regard for others; predisposes us to seek resolution of discord and to work toward consensus on a course of action deemed to be in the best interest of all whom it will affect".

Historically this rhetorical process was confined to small decision making groups and this is how we must proceed with these decisions on robotic consciousness. Such a process is behind the idea of a representative democracy.

A major point to consider is that a global indaba to give consensus is not possible considering the poor technical and scientific education of the bulk of humankind and the differing concepts of ethics and morality within different cultural gamodemes. When I speak of the rhetoric process being the *modus operandi* it needs to be understood that I mean the effective decision making group is chosen from within an existing system that practices the democratic method: other systems are excluded! The rules for engagement, that foster the reaching of consensus on those issues of humankind's future, may well be defined within the context of humanism. Perhaps in ignorance, I believe, an elitist group who understand the issues should make the decisions. Superficially the exclusion of some individuals and views is totalitarian and authoritarian but historically it is neither against democracy nor deliberative rhetoric: elitist committees are commonplace, embedded within democratic society.

Religiosity must be openly examined. A major obstacle ***Robotico earthensis*** will not have to overcome is the necessity for pre-religious myths and legends, and conventional religious belief. The proximate answer to the fundamental questions: "where did we come from?"; "how did we get where we are?"; and, "what is our purpose?" will be known to our descendents. ***Homo sapiens*** represent a sufficient and complete answer to these questions. The ultimate answer to the fundamental question of what created our Universe is one of the tasks that will be set for ***Robotico earthensis*** who, in the quest for knowledge, may ultimately answer that question.

In attempting to look at characteristics that are truly part of humanity, religious philosophy must be one of the first areas to examine. This is because religion arose early as a means of social control and is present in the earliest known cultural gamodemes from the Indus Valley and Babylonia. Whether or not religion developed in the cultural gamodemes as a substitute for a deep need of consciousness; or, is a mechanism that developed simply to allow social control is not a trivial question. In the first case it is a basic human trait; and, in the second, an expression of environmental selection pressure. The answer relates to what extent the concept of God should underlie the consciousness of ***Robotico***. I believe the second suggestion is the reason religion developed, and what the early religions did was provide a way for humankind, beyond the simple family unit, to come to terms with the problem of individual desires and group cohesion. Religion provides a means of social control that has been, and is, successful in its results since its conception. It has been argued that religion arose in a single place and spread by diffusion throughout the pre-existing cultural gamodemes. However, when we analyze religion to seek a purpose, that purpose seems to be one that would be needed in any cultural gamodeme, anywhere on Earth, and, indeed, anywhere in time: the balancing of the needs of the group against the desires of the individual. It is fundamentally an outcome of selection pressure. At the bottom of all the world's religions is a simple means for achieving this result. That religion has developed a hierarchical structure based upon competition and resource allocation is quite superficial to this fundament and represents the politicization of religion. That all religions tend to provide answers to similar questions is probably a result of each cultural gamodeme asking similar questions rather than a diffusion from a common origin. These questions are often those a modern child will ask: where do I come from, why am I here and where will I go when I die. Wilson [2002] argued similar views to those of Robert Oden [1997] when he suggested religion was a product of selection pressure within the cultural gamodeme selecting for individuals that would make the gamodeme more cohesive, cooperative and fraternal. This effectively selects for protection of the group against adversaries. Promoting moral equality within the cultural gamodeme and rejection of those outside the group is a characteristic of religions. It lead, for example, to such brutalities as slavery, and, the whipping, then exiling, of Quakers entering the theocracy established by the original puritanical New England Colonialists.

For many reasons I believe the future global cultural gamodeme needs none of the specific content of the world religions, but must have answers to the same basic questions and must have these answers as part of the fundament. Moreover, the fundament must be more than Law and Order for it must also fill the need for individuals to feel good about being part of humankind.

The development of ***Robotico earthensis*** almost demands the appeasement of modern specific religion as a necessary prior step. This is particularly so when the monotheistic religions are considered for these are all basically totalitarian and authoritarian: the fundamentalist sects are particularly nasty in this respect as they aim for complete social control.

Religiosity relies upon a general ignorance of scientific principles within the population. This is so widespread in global society today that imminent developments could be delayed for hundreds of years if political regulatory control falls into the hands of militant fundamentalists. This might seem unlikely within a democracy but ignores the fact that the original New England States of America formed a ruthless theocracy that excluded true religious freedom and made law based upon the bible. The last century saw the election of Jimmy Carter, who exclaimed from his presidential office that he was a born-again-Christian; followed by Ronald Reagan, who was of similar bent. The suggestion is not that these important leaders distorted democracy to religious ends but they did provide opportunities for increased control by religious zealots. Bush II has carried this to an even more embracing level. We can see that both the American and the global political system is infiltrated by individuals with a religious agenda and permeated by religious influence. From the far land of the Vatican, American Senators and Congressmen have been told to follow their religion in making and interpreting the secular Laws of

America; children are being told whether individual non-religious texts are permissible to read; the European Union has been told to add "a clear reference to God and the Christian faith" to its constitution; and, individuals are being told they do not have the right to control their own bodies.

The fear that our phylogenic future will be in the hands of a religiously oriented Real Estate Agent, Lawyer, MBA and others who dominate our political process, is real and potentially worrying. That leaders with an interfering religious agenda will control it is terrifying. However, this is happening. The Bush II administration, for example, in December 2002, named eleven new members to an advisory panel on reproductive health established under the U.S. Food and Drug Administration. At least three of these new members opposed abortion or birth control on religious grounds. With the biological 'tools' for social control that will be possible in the near future the alternative future is one in which religious fascism, authoritarianism and totalitarianism could be humanity's terminal crisis.

The above having been stated, I do believe that the development of a manufactured consciousness pre-supposes that religiosity will be mollified within the medium-term future [300 years]. Today, any debate on the future of humankind still must address religious belief. Scientifically this is the 'peril in our midst'. However, because the ***Robotico*** development most probably will be spearheaded globally in Asia [China and Japan], Australia, Europe [particularly Russia], and North America the task may be simplified, for progress can take place where religion is more easily channeled into less obstructionist directions. Practitioners of fundamental religions are geographically localized to essentially those areas dominated by the monotheistic religions: especially the Americas, Europe and the Middle East and it is especially for this reason that I see Asia, and especially China and Australia as the future centers of scientific enhancement. Gould's [2002] "non-overlapping Magisteria" [NOMA] concept was perhaps prophetic. In the representative democracies, acceptance of NOMA will permit scientific research to progress with minimal interference, although much of what must be done to create humankinds future will remain politically controversial.

INTRODUCTION

"The cutting edge of science is reductionism. The breaking apart of nature into its natural constituents". *Edward O. Wilson, 1999.*

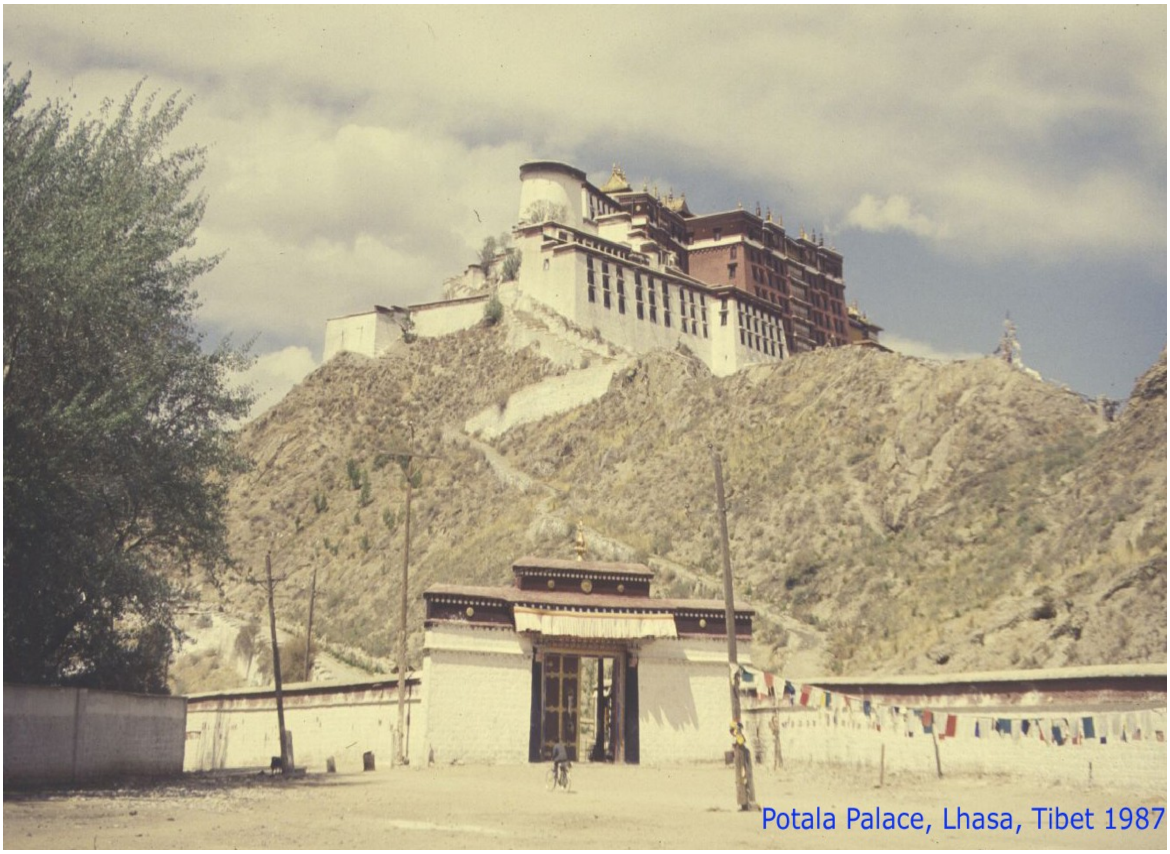
The hundred years from 1850 to 1950, was the renaissance of modern science and saw incredible progress as human reasoning was applied to understanding the natural Universe. Mathematics and physics provided a logical explanation of our Universe; and, chemistry and biology began to reveal the hidden secrets of living systems. Today these fundamental sciences have produced M-theory and its weird view of the origin of our Universe; Topos Theory1 which may reconcile quantum physics and relativity; and, molecular genetics and its stunning understanding of the chemistry of life. This recent past has provided ample evidence for the truth of E. O. Wilson's statement and a solid refutation of belief systems founded in revelation, authority and charismatic leaders. The discoveries made by science, during the next century, will be truly awe aspiring if observed by a human alive today.

Science knowledge is sufficiently advanced to see in the study of physics, chemistry, geology and biology, how our Universe *could* have been created and, most definitely, how matter evolved immediately after the origin. To the surprise of some, modern scientific reasoning does allow the following to be stated as facts.

1. Our Universe is of immense, and probably finite size and has existed for many billions of years prior to humankind's development2.
2. The same basic physical-chemical laws control all forms of matter in our Universe, including living systems.
3. The origin of life on Earth and its existence elsewhere in our Universe was a natural step in the evolution of matter.
4. All life forms, found on Earth, were developed principally as a product of natural selection of biochemical reactions involving twenty main amino acids and five nucleotides, adenosine-tri-phosphate [ATP], nicotinamide-adenine-dinucleotide [NAD] and a few other chemical molecules involved in cell metabolism3.
5. Cellular life on Earth indicates an underlying mechanistic basis in which the cell is a complex biochemical machine, based principally upon four chemical systems: proteins, nucleic acids, polysaccharides and lipids. All of these came into existence naturally by the evolutionary process.
6. The fundamental evolutionary process within the cell was the extension of metabolic pathways by modification, NOT innovation. This indicates a uniformity of living systems going all the way back to the primordial cells i. e. it is a legacy system. The resultant cellular developments require neither a plan of some super-natural force, nor rational design. On the contrary they are the result of random thermal motion within water.
7. There is clear scientific evidence supporting the physical evolution of humankind from other Great Ape ancestors. To view humankind as a central theme, or end point, in our Universe is scientifically naive.
8. Many of the attributes of living people and their unborn offspring can be controlled by science. In the future *all* aspects will be controllable.
9. Controlled evolution of any organisms will be possible using the scientific method.
10. There is no scientific evidence that a soul, as defined by most religions, exists.
11. There is no scientific evidence that an interfering God exists. Indeed, there is nothing to God but believing in God.

These are important facts that have been discovered and promulgated by science, and impact our understanding of the origin and development of humankind. They should be used as guiding factors when attempting to determine the essence of humankind and human society. They represent important knowledge about the physical basis of our humanity and of our evolutionary development [our phylogeny]: both in the past and in the future.

SCIENCE AND CHURCH



Potala Palace, Lhasa, Tibet 1987

From a scientific viewpoint, religion can be seen as a product of Darwinian evolution of the cultural gamodeme. As such, religion does contain an evolved wisdom that is important to the definition of our humanity. Oden [1997] lucidly pointed out that early Christian religion was forged out of competing systems, many of which were actually adaptive social conditions to the prevailing social environment. It was not until long after the execution of Jesus that Christianity developed its present fundament based primarily upon a written collage of hearsay, myth and legend founded upon revelation and authority. From an authoritarian base it is just a short step to totalitarianism and the denial of truth. Historically, the need for religion as a means of social control placed it as a necessary evolutionary pre-cursor to modern political systems.

Many religious leaders today are little different from those of two centuries ago: they find modern knowledge a threat to their power-over-the-people. Because religion IS rooted in a belief in the super-natural, and because many individual members of humankind have been conditioned to believe in a supernatural interfering God, placing society upon a scientific basis will be a difficult road to navigate in any community dominated by religious interference.

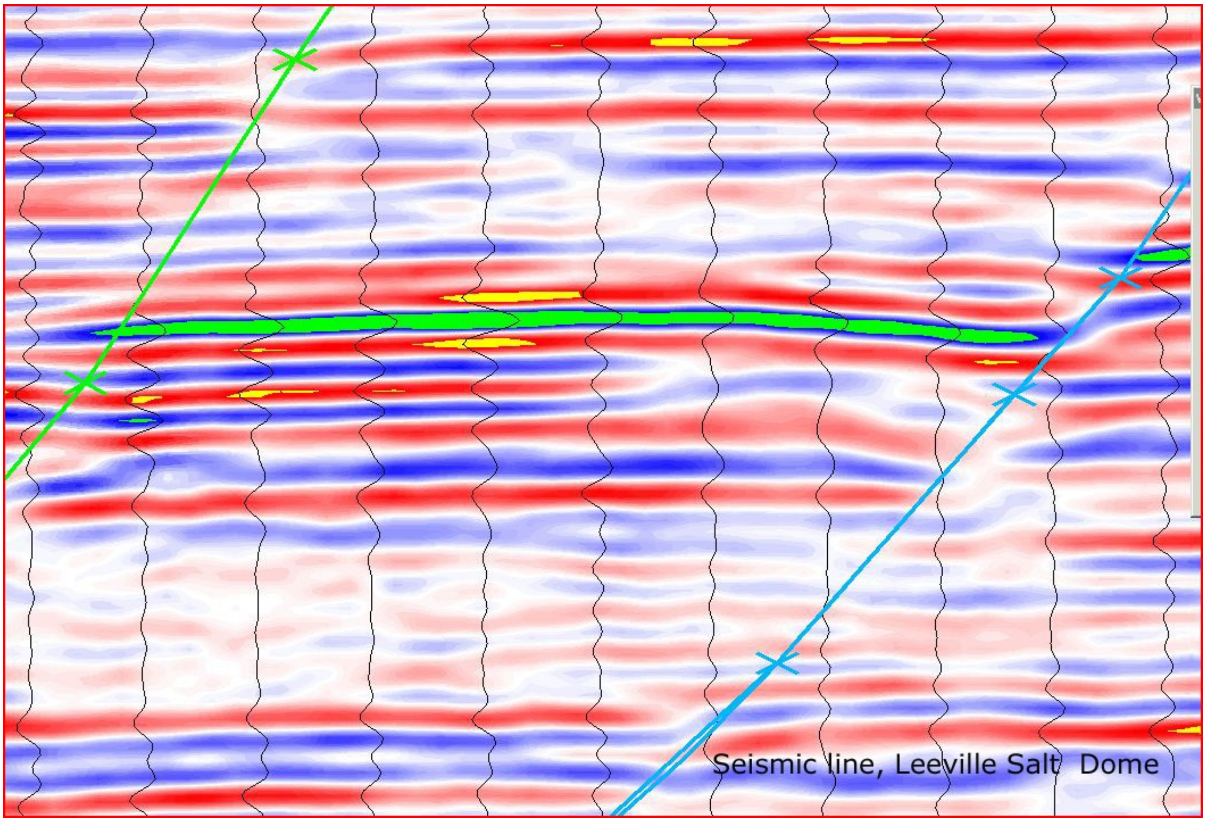
When it comes to the ***origin*** of our Universe religion is no better equipped than is science to make pronouncements. Any belief that our Universe actually had an origin necessitates the existence of a '*force that creates*'. The root of the argument between Science and Church is whether this is the benign little '*g*' or the interfering big '*G*'. Frankly one hypothesis is as good as the next when it comes to the *origin*. It is what happens after the origin of our Universe that significant intellectual conflict begins. Some religions, such as Roman Catholicism accept evolution, the big bang hypothesis and much of natural science, believing nevertheless that God can influence events as they unfold. The mistake religious leaders make is continuing to hold to their historical *political* role instead of expanding outwards into the minds of humankind to cultivate a more wondrous view. There is a tremendous awe about our Universe that provides adequate sustenance to those who would abandon religious politics in favor of scientific reasoning.

It is ironic that the foundation upon which modern scientific logic arose was in efforts to understand the wondrous way in which God worked. The seekers of this understanding were specific theologians and true believers who questioned reasoning based upon revelation and religious authority. Resistance by the Church followed when the theological hierarchy realized that the discoveries of the inquiring seekers were undermining the basic tenets of orthodoxy and authority. Thus began the modern alienation of Science and Church; and, attempts to confine the spheres of scientific enquiry.

It is still apparent that a major barrier to understanding the essence of humanity is humankind's propensity to divide itself into social groups within which unsubstantiated core values define the internal moralities. These unsubstantiated core values differ from group to group and add error to attempts to unravel the communality of humanities traits. For the past millennium, religion has formed the core values of many of these groups, and it must take responsibility for the confusion that places science and many social groups in opposition to one another. This confusion accentuates differences. Moreover, using myth and legend, it perpetuates a deep ignorance of what science knows and what scientists are trying to do.

The future will see humankind greatly modified by genetic intervention, and eventually an artificial consciousness will be implanted into robotic descendents. To create this artificial consciousness future science must seek input from philosophers and the humanities: to understand and implant the essence of our humanity. Religious wisdom should not be left out of this task but it is danger of locking itself out if it takes a stringent anti-science stance.

SCIENCE AND REASONING



Humankind has employed a variety of approaches in an effort to understand both itself and our Universe. In general, four methods are used: intuition, authority, revelation and science. The scientific method is the logical successor to the others. It can be generally defined as a systematic procedure whereby knowledge is accumulated under conditions designed to maximize unbiased and objective reasoning. In addition, it provides a methodology for proving theories and finding truth. Scientific truths are developed within rigorous and logical constraints defined by the scientific method and at the core are the techniques of inductive and deductive reasoning.

Inductive reasoning pertains to empirical reasoning based on experience and uses the experimental method in which a hypothesis, which encompasses a particular problem [idea, concept], is formulated. This hypothesis is tested by gathering additional data to see if the hypothesis can be falsified. A major misunderstanding lies in the fact that scientific hypothesis testing, *never* ends up proving the hypothesis but it either "*rejects the hypothesis*" or "*fails to reject the hypothesis*". If scientists have subjected a hypothesis to numerous rigorous attempts to discredit it but it stands the test of time it becomes a Theory. A scientific theory is in layman's terms a **fact**. This process contrasts with the process by which doctrine becomes accepted in religion: which relies upon revelation. Sadly the dogmatism needed to sustain revelation fails to recognize the rigorously determined 'truths' of the scientific method. In some fundamental religious sects there is, what appears to be, a deliberate attempt to misconstrue scientific facts. Perhaps the most blatant relates to the word theory in the expression 'Theory of Evolution'. In a formal sense scientists do not speak of the Concept of Evolution or the Hypothesis of Evolution: both of which imply something that is still quite tentative and has not been subject to the rigor of long-term attack by the scientific community. Because the basic tenet of science is that nothing is ever proven a Theory is accepted because we 'fail to reject it' and any well-established Theory is essentially a scientific fact. In common parlance the expression really should be the *Fact of Evolution*. From the viewpoint of human understanding a 'theory' is the highest form of 'fact' possible, standing only below reality itself.

Deductive reasoning pertains to the logical language of science. Deductive reasoning uses declaration [assertions of statements that are logically connected] and procedurally does not care whether the statements are true or false as long as they follow the logical argument. Indeed deductive reasoning does not have to be based on evidence and use statements of fact. Providing the logical form of statements is maintained [i. e. the rules are followed] logical argument is a powerful tool in determining the truth or falsity of a statement. It is for this reason that logical argument [or syllogistic logic] is the basis of mathematics.

Reductionism is what has allowed science to be so successful in gaining an understanding of our Universe. It is the analytical method whereby scientists probe for an ever more basic or fundamental understanding of our Universe. The reductionist approach to nature lies in the belief that our Universe can be understood by abstracting and breaking down each system into component parts that are ever more basic and fundamental. Reductionism exposes the nature of a system whereas hypothesis testing allows for the synthesis of scientific truth. These 'truths' may be the pragmatic determination of what is agreed upon to be correct at this moment but their method of derivation makes them facts not fictions.

Reductionism is not simply dividing the whole into parts and then the parts into parts *ad infinitum*, until one can reason no further: this is simplistic scientific reasoning. Reductionism operates in two directions in that it allows anticipation of how the parts can be built into wholes and in doing so incorporates emergent phenomena. It allows for the 'Eureka phenomenon' and for paradigm shifts[4].

SCIENCE, MORALS AND ETHICS

There are no morals in science or nature! Individual scientists may express moral values pertaining to their work but it is evident that morals change with time as the cultural gamodeme changes. Today moral values are predominantly within the domain of the humanities and especially religion, but I believe they are unacceptable as guidelines for scientific research. Thus I see morals polarized between the humanities and science.

Ethical guidelines are a different matter to moral issues. They pertain more to scientific prudence than to a tribal, mythical, belief system. Science needs ethical guidelines because scientific progress also can open by-ways that are potentially exploitable by the unscrupulous5. Logic should control the ethical guidelines of science not emotion. In determining ethical guidelines the relationships between and among humankind, the environment, and the cultural conditions, present some intriguing possibilities for the future. What we learn from physical Evolution and genetics has lessons we can apply to political decisions as they relate to our cultural and social systems. These lessons are not simply socio-biological [ala Wilson, 1975], nor, that genes drive everything [ala Dawkins, 1990]. Evolution takes the best of accidents and makes something of it. Moreover, a fundamental lesson, that needs to be applied for the sustainable development of any cultural system, is that Evolution is ruthless about that which does not adapt. This lesson will apply rigorously to any cultural gamodeme that evolves beyond Earth: it is an edict of nature!

The 1959 Rede Lecture, at Cambridge University, England by C. P. Snow on the Two Cultures brought the disparity between the Humanities and the Sciences clearly into focus for a whole generation of students at

British Universities in the late 1950's. Living through this period I can attest that when the lecture was published in '*Encounter Magazine*' it brought into focus to my fellow students and I that we were living in a scientific age, yet moral and ethical values and the social conditions were being controlled by persons with little understanding of what science was or what it could do. We realized that the logical rules governing society needed to be reformulated within a scientific framework; and, that this scientific framework needed to become the basis of social law and order. It was clear that politics was dominated by people ignorant of science and engineering: and in the case of Great Britain dominated by wealth and privilege and a British Public School educational system: which itself was founded in the humanities.

Today there is a parallel condition, in which science is still subjugated to the broad control of the humanities, and poorly developed social concepts, based on moral values, attempt to control the politics of the cultural gamodeme. Most members of Government in most Nations are trained in the Humanities. In the United States of America most members of Congress have degrees in the Humanities and/or degrees in Law. As a result our legislators are largely ignorant of science and engineering at a basic level and are not equipped to make the decisions that are needed for development of our cultural gamodeme: advisory committees are insufficient to meet the needs.

The realities of the global systems of government today are that the future will require a much deeper understanding of science, technology and social systems. The establishment of a reductionist methodology in the humanities is a necessary pre-requisite. Changes are beginning to occur as previous pseudo-sciences such as psychology and social science incorporate scientific reasoning rather than authority [the ideas of charismatic leaders] to seek knowledge and understanding of their domains. As these areas move from conjecture based on authority, to reductionist analysis they develop scientific rigor and can initiate changes in social structure of the cultural gamodemes at the political level.

Some basic truths have emerged from science about our species that directly bear upon understanding the ethics operating within the cultural gamodemes. These must be incorporated into the fundament of society if humankind is eventually to define its own humanity. Quite important amongst these are the following.

1. All modern humankind is genetically closely related despite slight physical differences.
2. Race is best viewed as a concept associated with social history. Race does have a biological basis in the population [Sarich and Miele, 2004] but differences are trivial and superficial when viewed within the context of both genetics and modern democracy [Graves, 2004]. Species and races, within nature, can be defined by a unison of characteristics existing within global populations. Paleobiology has long used this methodology, which relies on the small number

of differences rather than the large number of similarities, to define a group.

3. Ethnicity based on its associated cultural and social conditions is the real basis upon which we physically separate the major groups within ***Homo sapiens***. However, even between diverse ethno-cultural groups there is unison of characteristics that can define a global concept of humanity.

By recognizing that a fundamental set of humanity traits exist we can derive the core values to implant into the consciousness of our robotic descendents. This may secure a base for humankind's development into a galactic species.

The first section of this book deals with a simplified outline of the processes and mechanisms that cause evolution to occur in a physical interbreeding population. In order for our people and our politicians to make common-sense decisions about a future that will affect them, both as individuals and as a society, a general understanding of Evolution and the laws of nature must become common knowledge. The second section examines the cultural interacting and interbreeding, population as a system that is driven by evolutionary processes. It discusses some of the characteristics of present society and some of the issues future society will have to address in order to progress. There is a profound need to adopt a strictly scientific New World View to ensure humankinds future. The final section outlines how humankind will develop in the future as it begins to actually manufacture its own descendents. It recognizes that consciousness and the humanity traits at today's stage of evolution will continue to evolve within the symbiotic and probably networked minds of our descendents.

Finally, it should be noted that in the United States of America, there are about 95,000,000 people over the age of 25 who have some college education [52% of the population]. Approximately 66% of these have obtained a degree [*National Center for Educational Statistics, Digest of Education Statistics, 2003*]. Thus, at least 63,000,000 people in the United States should be capable of understanding scientific concepts as outlined in this book. Most of those who did not go to College did graduate with a High School Diploma. On the other hand, recent surveys have shown at least half, and probably most, of modern American society are truly ignorant of the modern facts that science provides. Our political leaders have failed our people at the very basic level of education. An adequate education is a basic individual resource that all citizens need to successfully exist in society.

PHYSICAL EVOLUTION

AN INTRODUCTION FOR THE BEGINNER

In this first section I want to show that a major result of understanding living systems is that life is fundamentally a set of biological processes that developed using the mechanisms of Evolution to fit into the environmental niches present on Earth. An extension of this is that other and possibly similar biological entities will, with certainty, have developed on other planets in others parts of our Universe. Because humankind is essentially a biological machine it is possible to improve its performance and range of habitats by manufacturing better and more advanced parts i. e. humankind can effectively control its own evolution. The body not the mind has been the more prodigious part of evolution within Earth's biota and this will continue to play an important role in the future evolution of ***Homo***.

PREAMBLE

PomPom Camp, Okavango Swamp, Botswana

Photo: James Hart, 2008.

The Theory of Evolution is a set of facts for understanding the processes and mechanism operating within the gamodeme or interbreeding population. It involves a change in the gene pool of the inter-breeding population over time [the chronodeme] instigated by changes in the gene set of a single individual [the genome of the individual]. The 18th and 19th centuries were periods of immense inquiry, and a lot of thinking was devoted to trying to understand the natural world. Charles R. Darwin and Alfred R. Wallace [1859] crystallized these thoughts into an understanding of the biological processes responsible for the origin of the diverse group of organisms. The Moravian Monk, J. Gregor Mendel [1865], elucidated the underlying genetic mechanisms whereby this diversity occurred. Many believed that the Laws of Nature were the Laws of God that humankind needed to interpret. The link was not only with religion, often with its poetic and metaphysical views based upon revelation, authority and charismatic leaders, but with philosophy and its views based upon reason, logic, emotion and a quest for knowledge.

Even in the earliest human communities, culture was probably formulated because of the quest for, and acquisition of, knowledge, and its adoption as a survival strategy within the local gamodeme. Wilson

[2002] sees the acquisition of religion occurring because of this kind of selection pressure: combining individuals into a cohesive group that were cooperative and fraternal. Joseph Campbell has eloquently stated that the power of myth and legend, as a way of understanding nature, lies at the root of much of human philosophy. Science, in sharing a common urge to trace the history of our Universe back to the beginnings of time and matter, follows this knowledge quest and thus reveals its links with many other aspects of human inquiry.

Humankind is a product of nature and both our physical form and our humanity are born out of our relationship to our environment. The body is a massive sensory tool continually providing input to the brain. The mind interprets the sensory inputs and combines them with memories stored within the brain. Logic rules as the mind processes the inputs. The resultant output is some form of action: perhaps a simple upgrading of memory, the making of a comment or an orgasm. As will be explained shortly the whole process follows the natural Law of Combinatorial Outcome.

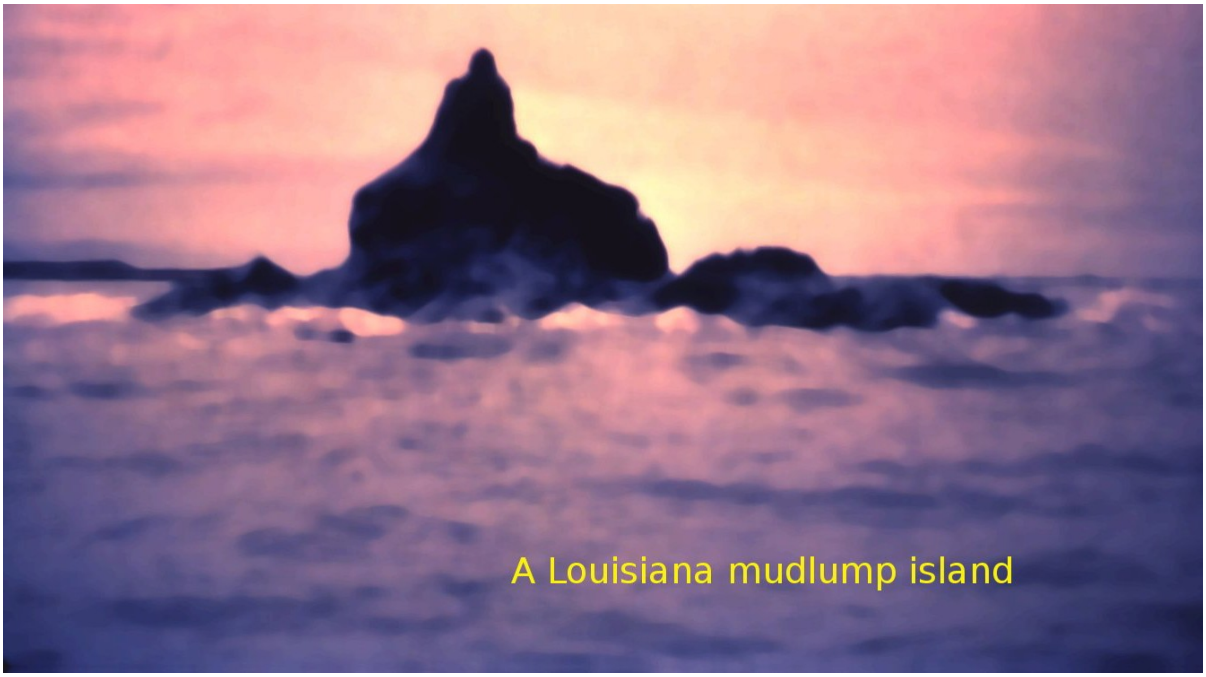
Today we are much concerned with Space, the Oceans and the Environment as we struggle to be comfortable in our knowledge of whom and what we are within our Universe of space and time. Part of the philosophy that geology inspires within its participants involves a realization of humankind's place in our Universe, for the geosciences are concerned with the six Great Origins of natural science. A seventh Great Origin is more the concern of anthropology but can be interpreted in terms of the processes acting within the other six.

1. The origin of our Universe.
2. The origin of the Milky Way Galaxy.
3. The origin of the Solar System.
4. The origin of the Earth, including its layered structure.
5. The origin of life.
6. The origin of ***Homo sapiens*** including human consciousness1.
7. The origin of cultural gamodemes.

The present stance taken by science for the development of our Universe is that the original size was Planck distance. This represents the original space and time from which our Universe evolved. From this space-time on, scientists have logically developed a Theory for the formation of our present Universe. After the Plank Era ended, the next few events happened in quick succession: the Hadronic Era ended at 10^{-6} seconds, the Leptonic Era at 1 second, and the Radiation Era at 1 minute! It took some 10,000 years for energy to evolve before the Matter Era began and 300,000 years before the Decoupling Era when light illuminated our Universe for the first time. The story of our Universe concerns what happened during each of these early eras. Seife [2003] provides an excellent investigative account of the people and factors that are contributing towards our modern knowledge of our Universe.

Science showed, in the 20th century, that trends can be observed within each of the levels that allow an understanding of natural processes. As developments within one level gives raise to the origin of another, observation and deduction allow derivation of fundamental *natural laws* pertaining to the Earth System. Three of these natural laws play an important role in all of the major origins that concern natural scientists. These are the *Law of Instability*, the *Law of Actualism*, and the *Law of Combinatorial Outcome*. In order to understand the human condition it is necessary to examine what these laws govern and how they are reactive within the world of ***Homo sapiens***, for they affect not only physical evolution but also cultural evolution.

THE LAW OF INSTABILITY


A Louisiana mudlump island

There is one clear law that permeates the development of our Universe. Whether we examine the evolution of living systems, as a natural step in the evolution of matter; or we examine any process within our Universe, such as the history of a planetary system, a connection exists between time and change. Essentially, in the vastness of time, everything changes and nothing is permanent. The Universe we live in is a dynamic system and is constantly changing. The rate of change may be different for different things in our Universe but the basic concept that the whole system is changing with time holds true, even for the sub-atomic particles. This observation led to a law governing natural systems called the ***Law of Instability***. This law is expressed as follows.

Every system that is termed stable imposes upon all

phenomena that are associated with it a restricted amount of action. The restrictions imposed upon some phenomena are minimal and the conditions are optimal for their existence. The restrictions that are imposed upon other phenomena within the stable system allow their temporarily existence, because of special transient conditions. Still other phenomena can never occur because the restrictions are total.

Corollaries of the Law of Instability are:

New objects or phenomena introduced into a system interact with that system. If the resulting condition is stress, then the phenomenon either disappears (becomes extinct) because it cannot survive under the prevailing conditions, or adapts to the system and in so doing is itself altered. If the resulting condition is unstressed then the phenomenon will flourish. This interaction between the phenomenon and the system is termed the selection pressure of the system upon the phenomenon.

If the system changes, then all phenomena that occur within the system are placed under a changed selection pressure and will change if stressed.

Knowledge of this simple law allows a natural scientist to begin to understand the Earth System and the processes of dynamic change, including physical and cultural evolution. This law is a direct consequence of the thermodynamics operating within our Universe as a whole.

Science can directly observe the Law of Instability everywhere on our planet. For example, if we take simple elementary phenomena such as the weathering process, we see that weathering is the adaptive response of a rock formed at a specific temperature and pressure: to adapt to atmospheric pressures and temperatures.

Photo-series 1: WEATHERING OF LAVA FLOWS OF DIFFERENT AGES.

Similarly, in neontology [that branch of biology which studies living matter as opposed to paleontology, which is concerned with ancient and fossilized remains] dynamic changes are observed in populations of organisms. Many of these observed changes are slow, such as a river eroding a landscape; a raindrop dissolving away a soluble rock particle; the development of an open oceanic basin. Some changes take only a few thousand years, such as the silting-up of a lake, or the switching of the Mississippi River Delta. Some changes are catastrophic, such as a volcanic eruption, an earthquake, a hurricane, or the flooding of vegetation with high saline brine by a rogue oil well operator.

Photo-series 2: A LOUISIANA CYPRESS SWAMP BEFORE AND AFTER CARELESS DRILLING.

A classic example of selection pressure is referred to as *Industrial Melanism*. Before the British Industrial Revolution the trees over most of the British Isles were covered with light colored lichen. During the Industrial Revolution trees became covered in coal dust and the lichen died. Lichen - covered trees continued to occur only in the unpolluted areas such as Western England and Highland Scotland. Populations of Peppered Moth, occurring in the British Isles, show two main varieties. One of these varieties is white in color and the other is black (the melanic form). The white variety when resting on a trunk covered in lichen is almost invisible to birds, which are the moth’s chief predator, whereas the melanic variety is extremely conspicuous and readily found as a food source.

Before the Industrial Revolution the light colored variety of moth was abundant throughout the country because the melanic form was not camouflaged and was regularly eaten. With the coming of the Industrial Revolution Britain became progressively polluted with smoke - around industrial areas it was actually measured in tons per square mile per month. As a consequence, the lichens died and the trees become blackened with soot - the situation became such that the light colored variety was conspicuous and the dark camouflaged. The melanic form began to dominate. A small number of melanic varieties remained in the restricted white areas and a few white varieties remained in the predominant melanic areas, but these normally died before reaching maturity. With the smoke abatement laws, that were enacted starting in the 1950's, the situation once more reversed, as lichen began to survive again on trees.

The British Peppered Moth example explains quite a lot of the bizarre forms met within the diversity of life - particularly why such wonderfully camouflaged forms of insects are found. In the case of the Peppered Moth only two varieties were being dealt with i.e. the moth is either white or melanic.

Photo-series 3: THE BRITISH PEPPER MOTH CHANGING DUE TO VARYING ENVIRONMENTAL SELECTION PRESSURE.

All of these examples are manifestations of the fundamental idea that everything is unstable with time and contribute to the proof of the dynamic nature of our Universe. In a catastrophic example, such as an earthquake, the situation can be perceived as a changing system [build-up of stress] to which the phenomena or objects [rocks in the upper crust] must adapt. They may do so suddenly. Sometimes the effects are minor [a small crack], sometimes moderate [landslides and faulting], and sometimes of major consequence [the Alaskan earthquake].

The Law of Instability is associated with the concept that all natural systems can be considered meta-stable. As soon as a stable condition seems to set-in, some change occurs which stresses the system, and everything has to start adapting to the new set of conditions once more. This is true even though the change may be small. In natural systems stress at the smallest level seems to be constant. All objects, at any particular moment, can be regarded subject to some selection pressure or other. They are in the process of adapting to the system conditions, momentarily appearing to be adapted to the system conditions, or failing to adapt to the system conditions.

An interesting characteristic of the dynamic nature of natural systems is that the changes that take place with time are conditional changes. This means that what happens now is totally or partially dependant, in some way, upon what happened previously. If conditional changes are fairly obvious they are termed trends or sometimes cycles (if they twist back on themselves). A more general term for conditional changes is a developmental sequence, and numerous developmental sequences are observed in nature. Sometimes the cause is known, in other cases we simply observe a trend and must search for a logical reason for its occurrence. An example of a major developmental sequence is that observed in the paleontological succession of the vertebrates with the evolution of lungfish into Amphibia and then into Reptilia and finally Mammalia. The mechanism whereby such developmental sequences occur or stop [e.g. extinction of the dinosaurs] may not always be clear but by looking at natural phenomena as sequences we are often able to understand the processes that produce the phenomena. In the vertebrate developmental sequence, for example, we can trace the evolutionary lineage through a series of trends that were a result of adaptations to changes in selection pressure [see supplementary reading].

It is often difficult to understand trends and cycles in biological systems because the way in which selection pressure acts upon a phenomenon is rarely straightforward. A number of reactions may be probable responses to a single event, but due to minor variations in selection pressure a particular one of them will occur. Natural science problems are always approached knowing that the system is not only dynamic but also conditional and probabilistic. These dynamic and probabilistic aspects of evolution often make interpretation of natural phenomena difficult and interpretation is highly dependent upon the amount and quality of the data, especially because many of the relationships are non-linear.

THE LAW OF ACTUALISM

The second natural law discerned from the workings of the Earth System is the process – response law. This law strongly affects all natural phenomena; and, is applicable to the future phylogeny of humankind. This is the *Law of Actualism*, based upon James Hutton's [1726-1797] Principle of Uniformity as follows.

"The record of the past could be interpreted on the assumption that processes at work today operated in the same way and at similar rates[2] in the past."* [Stern et al., 1979]. From this the Law of Actualism is developed i.e. *"Physical processes at work today operate consistently in the same way whether in past, present or future, if all environmental conditions remain equal. Moreover, under such conditions they will produce the same responses".

There is a question of resolution that needs to be established when applying this law, because often the actual *observed* phenomenon, or end product, cannot be clearly associated with a particular process. Resolution relates to how much information is available concerning the events between the initiation of a process and the final response. Unless the system is micro-monitored there is an information loss pertaining to the cause(s). Resolution, therefore, refers to the fact that missing information would tell us that the conditions were not equal and defocuses the Law of Actualism. For example, an organism may die in a real environment such as a lake but it is the depositional environment i.e. the mud on the floor of the lake where that organism is entombed, preserved and later becomes part of the rock record that is studied by the paleontologist to elucidate the original environment in which the organism lived. Unfortunately, there is a loss of information from that original environment to the preserved environment in that the rocks do not contain all of the information that was in the original environment. Thus when it comes to interpreting a particular response [the presence of a particular type of fossil] deductive reasoning using the available information [diminished by loss] may not allow a single conclusion, and thus opens the way to an interpretive choice from amongst more than one processes. A classical example would be the occurrences in sediments of fossilized remains of an organism known to be indicative of saline water depths of say 50 to 150 feet [e. g. a particular species of coral]. The normal conclusion using the Law of Actualism is that the sediment containing the fossil was deposited in water depth of around 100 feet. However, there are at least two other possible processes that could give the same response [i. e. the presence of the fossil in the sediment]. In one case the fossil could be weathered out of a rock deposited during an earlier time and *recycled* into the sediment in which it is found. In a second case, an organism could have lived in one environment [approximately 100 foot water depth] but, before consolidation into a rock, was moved by currents into another environment by the process of *reworking*. If sufficient information is preserved along with the fossil it is possible to decide which of these conclusions is correct. Numerous logical reasoning methods are used by scientists to reduce the risk of error in interpretations of this sort.

Actualism is not only applicable to understanding the physical Universe but can be applied to examining changes in social conditions to extract those aspects of society that are persistent or ubiquitous characteristics. Indeed, the prime limiting factor when trying to understand the essence of society through a historical approach also is resolution *i.e.* information loss. Consistently it can be observed that evolution of the social condition is intimately associated with the environment influencing the population at the time, but, history is as blind as are the rocks when it comes to understanding the details of how most social conditions are formed and how they developed. We rarely know with certainty the real stresses that provided the selection pressure on the ideas evolving in a particular population of individuals in the past. In his popular book '**1066**', David Howarth [1977] provides an excellent example of this. Despite a desire to define the daily social condition during the single year of 1066 in England the result is largely conjecture – even though it is excellent detective work [and a good read]. Large segments of history provide only an outline of social evolution, and the information loss is larger the further back in time one attempts to extract details. Detailed expositions in history generally are written by/in the future as interpretations. Again this has relevance to our future phylogeny. If it is important that the consciousness of our robotic descendents be imbued with the essence of humanity, how do we determine that essence when we know that history is biased and skews the definition of a previous social condition towards a present interpretation? This is the resolution problem as a humanist's nightmare! Must science simply take humanity to be something defined in the 'here and now' by the standards of this age? How do we encompass the ideas of the earlier philosophers other than statements simply to ponder: to define them as truth or conjecture based upon modern observations? Should fuzziness and uncertainty be built into ***Robotico earthensis'*** consciousness in the hope that this will provide flexibility for self-development? Manufactured consciousness must be started with some contained knowledge, and founded upon a logical thinking process. Most likely the initial mind of ***R. earthensis*** will rapidly evolve and perhaps new emergent methods of thinking will occur no matter what we start out with. Ray Kurzweil [2006] in his masterful tomb "*The Singularity is Near*" discusses the rapidity at which ***Robotico***'s mind will evolve once artificial consciousness develops. As we move into the new world of our enhanced descendents we will move into a new world of ethical, social, legal, economic and political issues that impact massively upon our global cultural gamodemes. The logical mind itself will probably figure out, quite quickly, that much of history is a myth: provided it has an adequate knowledge base. Undoubtedly the future technologies will change our world in a fundamental way, but the Law of Actualism will continue to play a major role.

THE LAW OF COMBINATORIAL OUTCOME

A further law derived from natural processes is the ***Law of Combinatorial Outcome***. This is seen in various guises and under different names in the sciences, humanities and arts but it is a commonly expressed idea. It is the decision rule law that balances cost against benefit prior to deciding upon a particular course of action but is more than the simple case of *The Selfish Gene* immortalized at the genetic level by Richard Dawkins [1981, 1982, and 1989]. It is the workings of the law as seen in Evolution, in society and in consciousness. It is the yet to be understood workings of the stock market. The law relates to what happens when an action is to take place. In a brute-force solution all possible interactions can be considered in combination before a response is made. The Law of Combinatorial Outcome uses decision rules that recognize pathways leading to a dead-end, gateways, and novel situations. These pathways determine whether or not, a particular action will take place. The outcome will then be performed. Because of the complexity of the solution, the end result may appear as an emergent phenomenon and, indeed, this is the law that probably will provide an understanding of both complexity and emergence.

The Law of Combinatorial Outcome can be stated as:

***when an action is to be taken, a decision rule is set up within the system, which examines all possible input interactions and results in an output determination that causes a specific action to occur*.**

In a massively parallel system such as the human mind numerous links are made, sorted, dead-ended, and followed to produce the result. The process only appears to manifest properties that cannot be predicted from the make-up of the brain [holistic phenomena], but by following the Law of Combinatorial Outcome emergent decisions are possible. The conscious mind decisions seem to be taken by combining all experience contained in the mind [as physical links in the brain] to assess the next action. The future action may be how to respond to a question or whether or not to jump off of a sinking ship, but the working of the brain appears to operate in the same way *viz*: what in my mind pertains to the future action, combine this knowledge to come to a decision that is a logical conclusion [more often will maximize benefit and minimize cost in one form or another: a set of meta-data filters that direct the search]. The Law does not negate free will. The human brain has about 10 billion neurons [Cohen and Stewart, 1994, page 147]. Even if there are only 1000 neurons in the brain acting during the making of a particular decision, there will be 2^{1000} possible combinations that could be considered by the mind prior to deriving an action. This same concept applies to potential genetic variation, acting upon the approximately 30,000 known genes in the human genome. These figures provide more than enough 'space' to account for natural variation and free will as logical and physical attributes of nature. Ray Kurzweil [2006] who is actively involved in understanding how the mind works has much to say on this matter.

CHAPTER ONE

LIFE AS A NATURAL STAGE IN THE DEVELOPMENT OF MATTER

"Humankind is a natural stage in the evolution of matter: anyone who denies this in simply not analyzing the information".[1]

THE SCALE OF TIME AND SPACE

When actively examining natural systems a difficult thing for many people is appreciating the scale and dimension of nature. The average person thinks of time with reference to a clock or calendar. From the beginning of humankind's existence, time has been something measured. In Archaeosociety, the diurnal clock governed daily activity but the lunar clock based on the 28-day moon cycle soon became adopted. In protosociety, when agriculture became prevalent, predicting the seasons was important and the 365-day solar clock became incorporated in our sense of relative time. Modern or Eusociety has enlarged the concept of time to encompass the whole Universe.

Most people can understand the passage of time in terms of half a human generation. Two or three generations seems only to be understood by those that have lived so long, and peoples experiences as recorded in historical texts are difficult to understand within the context of the time and space they took place in. The problem with time and dimension in natural science is principally a result of this 'generational' concept of time held by most peoples.

Appreciating the geological time scale requires a specific kind of training that begins with such things as understanding how rainfall and wind can actively modify the Earth's surface; and how accumulated genetic changes interacting with the local environment causes an organism to evolve. Geologic time is measured in millions and hundreds of millions of years and the human mind cannot easily comprehend time dimensions of this magnitude. To understand the development of our Universe humankind must think in terms of both large and small distances, and long and short time-scales. At one end of the distance-scale is the size of our Universe at 82,200,000,000,000,000,000,000 miles [13.7 billion light years and light travels $6x10^{12}$ miles per year]; and, at the other end is the infinitely small of Planck distance [10^{-33} centimeters]. Planck distance is the smallest distance that exists in reality. At one end of the time-scale is 13.7 billion years [since time and space began] and at the other is a 10^{-43} seconds: the time it takes light to travel Planck distance. The history of our Universe during the first 10^{-43} seconds is referred to as the Planck Era.

When I was a young Professor in the early 1960's, I had no difficulty in showing the location of non-existence because the Big Bang Hypothesis was well accepted and much in vogue. The Universe was expanding and within our Universe was all of existence and all of reality. The question of what our Universe expanded into was simply that which was outside of reality, outside the realm of experience, and was definitely *non-existence*. If they were so inclined, I suggested to my students that they could call this location of non-existence '*god*'. To the others I pointed out the 'baggage' that equating non-existence with '*God*' would bring with it if empirical reasoning were the way they wanted to establish a belief system. My views have changed little in the past 50 years I still on the side of god [with a little '*g*'] and decidedly antagonistic towards God with a big '*G*', as I have observed what has been done in the name of "big *G*". Today I use the term *pre-existence* to refer to the period before the Plank Era: a realm of infinite energy into which Plank Space is the portal. To go beyond Planck time is to delve into a world explored by quantum mechanics where the conventional laws of physics break down and the curvature of space-time has no meaning. Even at its edge, Planck space has some startling properties. First, it has a mass of 10^{-8} kilograms and energy of about 1019GeV i. e. a small size and mass with a high energy2. Einstein's most famous equation suggests that the energy within Planck space will create a material universe at the speed of light.

Whereas the location of *pre-existence* and *non-existence* is easy, the 'what and why of it' are much more difficult to understand. Science, utilizing some future development akin to quantum mechanics, might be able to explain that lies beyond the Planck Era, and explain the 'what' of non-existence. In human terms it is, and will be, a question of philosophy when it comes to understanding the 'why' of existence. As science probes Plank space and extends our theoretical and mathematical understanding of nature we will progress, but probably never truly have a definitive Theory for the creation of our Universe. Indeed, perhaps less than a thousand scientists in the entire world are capable of deep-thinking about the problem, for current hypotheses lie in super-strings, M-theory, Branes, quantum fluctuations, and the like3.

Defining existence is much easier, for it is everything that has and does occur in our Universe and science has a good understanding for this in the Big Bang Theory. Even though we may never understand the Origin of the Universe, we are reasonably enlightened about its development after the Planck Era.

THE ORIGIN OF LIVING SYSTEMS

Life was initiated on Earth about 3.5 billion years ago, after its surface had stabilized following the origin of the Moon [3.8 bybp]. The general details of the manner in which life originated on our planet was well understood by the latter half of the 20th century, and became known as the Haldane-Oparin Biochemical Theory for the Origin of Life. The beginning of the 21st century shows continued acceptance of this Theory in which a pre-biologic state of abiological carbon reactions evolved into the proto-biological stage of non-cellular biochemical activity, and culminated in the origin of cellular life, in which the biochemical activity is isolated within spherical membranes.

The critical stage for accepting the Theory was an understanding of the origin of the *containing cell membrane:* because the cell is the basic unit of cellular life. Living systems can be viewed as specific sets of molecular activity, which are partially enclosed in a spherical membrane, existing in the physico-chemical space that is the surrounding environment. This external environment controls and mediates chemical reactions at and through the surface cell membranes of the organism. *Varela*, 1979, and, Maturana & Varela, 1980, expressed this in recognizing living systems as **"discrete self producing molecular networks closed in the**

dynamics of molecular productions, but open to the flow of molecules through them". Thus, life is essentially a physico-chemical machine existing in molecular space4.

In a slightly different approach Milulecky [1995] sees living systems as the product of self-organized events defined as **"processes, which spontaneously carry a system from one state of organization to another"**. The outcome he regards as an emergent phenomenon.

Emergent phenomena based upon self-organization are characteristic of numerous natural systems. The Laws of Instability, Actualism and Combinatorial Outcome all exert major influences on the complexity of living systems and at the root of this emergence is the extension of metabolic pathways within the cell. The extension of metabolic pathways causes molecular systems to undergo '*organization-within-themselves*' following physico-chemical laws i.e. the creation of organelles, cells and tissues, These can be considered as emergent phenomena in the same manner as life itself is emergent.

Science does not, as yet, understand all of the metabolic pathways leading to emergent phenomena, but considerable progress is occurring in understanding the precise manner of the bio-molecular reactions and the what, when and where of their products. Difficulty in understanding the metabolic pathways of living systems, of complexity and of emergence, is no reason to assume that physico-chemical interactions are not the cause: and appeal to super-natural activity. Scientists have every reason to believe that ultimately our understanding of biological systems will be complete.

The pre-biologic stage

Currently, there are two opposing ideas about the origin of high molecular weight, carbon-based, molecules in our Solar System. The commonly held view is that such molecules are a general characteristic symptomatic of second-generation stellar systems. The alternate view is they are the result of a relatively rare explosive event-taking place early in the formative stage of our Solar System. Whichever hypothesis is finally accepted the decision is not really critical to the formation of life as a natural stage in the evolution of matter on Earth. It is significant only when we consider the probabilities of life evolving elsewhere in our Universe.

As our understanding of primitive living systems has developed so has the realization that many of the constraints placed upon scenarios for developing life on Earth are not as critical as was once thought. For example, at one time it was believed that for life to form naturally on Earth it was necessary to evolve a mechanism whereby monomers could be built-up from the elements C, O, H, N, P, and S under primitive conditions at the surface of the Earth. Scientists spent many years showing this could happen. Today we have alternative views that use the fact that interstellar space is rich in carbon and numerous kinds of carbon compounds that were produced in space. Formaldehyde (H_2C0), formic acid (HCOOH), methanimine (H_2CHN), cellulose, and many others occur and these are present within the space of the Solar System. Thus the basic chemicals, previously believed produced at the surface of the ancient Earth, could have been present from the beginning.

Notwithstanding the occurrence of high molecular weight carbon based materials in space, the prevailing view by geologists is that, predominantly, abiological processes on Earth produced these materials. The atmosphere and the hydrosphere both probably played a major role in the pre-biologic stage.

The atmosphere, existing at the time life originated on Earth, was a result of natural out-gassing from Earth's interior. Volcanoes were the conduits for these gases through the crust and the principal chemicals produced were probably carbon monoxide, hydrogen, methane, ammonia and water. Out-gassing, taking place at a later stage, added carbon dioxide, sulfur dioxide and nitrogen to the atmosphere and hydrosphere.

The critical point is that during the Pre-biological stage inorganic matter gave rise to organic matter at Earth's surface. From the beginning there lasted a period of chemical evolution for about 1.5 billion years prior to the origin of cellular life. During the Pre-biological stage simple organic molecules [the monomers] were formed and following the Law of Instability, those with superior stability dominated. That this was feasible has been shown by many experiments. The classical one used the prevailing ideas of the chemicals presumed to compose the original Earth atmosphere, and bombarding these chemicals with energy such as ultra-violet radiation. The Oparin-Haldane scenarios assumed the early atmosphere was rich in methane (CH_4), ammonia (NH_3) and hydrogen sulphide (H_2S)5. The actual original chemical composition of the atmosphere does not have to be critically precise for life to originate within it. Most of the necessary reactions can occur within fairly wide limits of atmospheric chemical composition. Further, despite the presentation of other ideas, the Haldane-Oparin Theory for the Biochemical Origin of Life on Earth is still the mechanism accepted by most geologists.

A CONVERSATION WITH OPARIN: 1960

Geological data indicates the most probable composition of the early atmosphere did consist of CO_2, H_2O and a few other volatiles such as methane [CH_4], ammonia [NH_3], and hydrogen sulphide [H_2S]6. It is significant that of the five most abundant chemical elements in the Solar System all but helium play an important part in the make-up of early organic compounds [H=Hydrogen, O=Oxygen, C=Carbon, N=Nitrogen]. In addition, Sulfur [S] and Phosphorus [P] are important in living matter and these are common elements in our Solar System, (9th and 16th respectively). These six principle elements [H, O, C, N, S, P] found in organisms organize themselves into six major constituents found in living systems. These are given in Table 1.

Once the chemical pre-cursors to the life-forming biochemicals existed on Earth natural chemical processes took over. Many of the pre-cursor biochemicals are known to undergo simple *spontaneous* reactions to form the chemical molecules necessary to generate a living system. Formic acid and methanimine for example, react to form the simplest amino acid, glycine (NH_2CH_2COOH); and, formaldehyde is the common component of sugars and many other biochemical molecules necessary to generate a living system. In fact, as *Loomis* [1988] explained, ***all*** of the processes necessary to form a living system can occur spontaneously under the early atmospheric conditions.

The proto-biologic stage

This is the stage of non-cellular bio-molecular activity. From a bio-molecular view the evolutionary process is a slow accumulation of chemical reactions subsumed and incorporated in future successful chemical systems. All living systems on our planet are built from biological molecules that function in the presence of water, mostly at a temperature of approximately 37^{O}C, and with a neutral pH, and a weak but definite salinity[7]. Most of the reactions involve covalent, organic molecules that are self-assembling and impose basic limits[8].

Clearly, the conditions existing during the proto-biological stage of evolution were difficult because once developed a chemical reaction is subject to selection pressure following the Laws of Instability. Sudden changes in the local environment could wipe out the established chemical reactions.

The processes and mechanisms of evolution restrained the biological molecules responsible for living systems during the proto-biological stage. It is the stage of sites of localized biochemical activity. At these sites chemical reactions took place according to the fundamental constraints of pressure, temperature, eH, Ph, and chemical composition. Different chemical processes would dominate at different sites. At some of these sites stable systems gradually emerged only to be destroyed by environmental changes, and then to be rebuilt again to fit the new environment. This was selection pressure working at the biochemical level. The proto-biological stage at its most successful was a naked cell stage. The modern viruses may represent something akin to this stage. A virus is mainly DNA or RNA surrounded by protein. Today they need a synthetic host to survive but this may be an adaptation that occurred after cellular life formed. Mitochondria are another successful chemical site which probably originated during the proto-biologic phase, but which today is localized within a cellular system. Eventually, and probably under local conditions where the external environment had stabilized, a few successful kinds of activity flourished.

The cellular stage

The key to greater survival was to develop some method of protecting the localized sites of chemical activity from the vagaries of the external chemical environment. Enclosing those localized sites within a completely surrounding cellular membrane did this. Any theory for the origin of living systems *must* show how cells developed.

Modern cells are chemically complex collections of organic molecules that are *self-regulating and self-organizing* and exchange matter and energy with both their internal and external environment by means of extremely efficient chemical reactions. However, the crucial fact is that these complex chemical reactions take place within a spherical molecule, which is the cell membrane. The cell membrane protects the chemical reactions on the inside from unstable conditions occurring on the outside. At the same time, the cell membrane will allow certain needed chemicals to pass into the cell interior and waste products to pass out into the environments i.e. it is a semi-permeable membrane.

It is instructive to note that the natural formation of hollow organic molecules, similar to those forming the cell membrane, are easily demonstrated in the laboratory by shaking a mixture of synthesized polypeptides and lipids in a salt solution9. The resultant hollow molecules are some two microns in diameter, comparable in size to a bacterium. They are composed of protein and phospho-lipid molecules linked together.

William Loomis [1988] pointed out that in dilute solutions of phospho-lipids these hollow molecules could form around protein-nucleic acid reaction sites, i. e. they can accidentally incorporate the important chemical reactions necessary for development of a living system. Moreover, the fact that they are semi-permeable allows passage of certain chemicals through their structure. In his essay on the evolution of genes and organisms Loomis, long ago, gave an excellent account of how the biochemicals necessary for life could have arisen and developed into autocatalytic systems on the primitive Earth; and, how the cell membrane and the cell could have developed as a natural process in chemical evolution of the Earth. The compartmentalization of molecular activity within a bi-lipid cell membrane would have immediately been subject to the Laws of Instability, Actualism, and Combinatorial Outcome.

The numerous chemical reactions, occurring within the spherical molecule, competed amongst themselves for available materials and against adverse external chemical attack. The evolutionary result was the prokaryotic cell as seen in the Archea and Bacteria [figure 3]. The prokaryotic cell is fundamentally a set of localized sites of chemical activity that are enclosed within a cell membrane and have a symbiotic relationship with one another.

A second type of cell, found in the Eukarya, is one in which localized sites of chemical activity within the cell are themselves enclosed within their own cellular membrane. This is the Eukaryotic cell. The individual localized sites of chemical activity enclosed in their own membranes are called the organelles. Again all of the localized sites have a symbiotic relationship one with the other. Because the organelles are reacting centers encapsulated by a membrane they are doubly protected from the external cellular environment [figure 4].

This presence of a membrane around the organelles makes their chemical reactions more efficient: protecting the reactions from other chemicals within the rest of the cell. Both prokaryotic and eukaryotic cells are chemically much the same. The two cell types are differentiated on how they engage in chemical reactions, not what basic chemical reactions are performed

Most cells found on Earth today, cannot use chemical elements directly but must obtain compounds in the form of small organic molecules. Moreover, cells are capable of using only those organic compounds small enough to pass through their membranes. Such small organic compounds are the monomers. Monomers include such things as amino acids, nucleotides and sugars. Once within a cell these combine into polymers, which are macromolecules usually built from a single kind of monomer. Thus, proteins form from strings of amino acids, nucleic acids from strings of nucleotides, and carbohydrates from sugars. Clearly, the evolution of both the prokaryotic and eukaryotic cell was not simply an adaptation that stabilized a chemical reaction to fit the selection pressure but also it represents a legacy system. In a legacy system the previously successful chemical reactions [of the proto-biologic stage] are *built upon* to form a more successful form. The point is that is likely that most if not all of the organelles were successful chemical systems that came into being during the proto-biologic stage. They were subsequently incorporated into cellular life.

Under present Earth conditions, most monomers are derived from the breakdown of dead organisms. Bacteria and fungi are the major causes of this breakup of the macromolecules into monomers in the dead organism. These monomers can then be used by higher organisms, and as a continuing process, upon death are recycled once more [Hart, 1986].

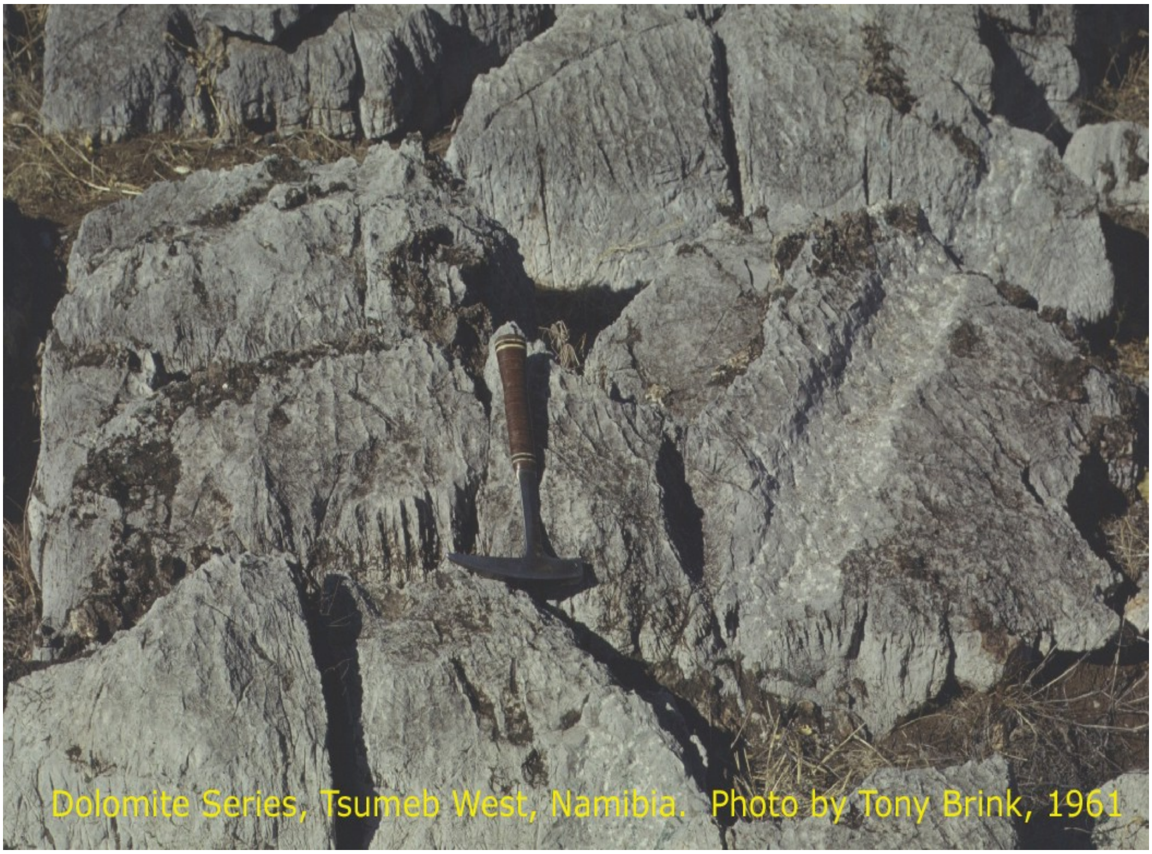
Within living systems organisms can be divided into primitive and advanced according to whether or not they are dependent upon another organism to provide pre-formed basic molecules such as monomers. For example, many advanced animals such as humankind use bacteria in their gut to help them breakdown ingested macromolecules, before they can use the organic compounds in their own metabolism[10]. Primitive organisms, alive today, use simple abiologically derived chemicals to drive their cellular metabolism and thus offer an explanation of how the first organisms could have developed. This ability to obtain monomers from outside the cell may have been a general characteristic of all early living systems[11].

Although the living systems that form prokaryotic cells are simpler to understand, they are not necessarily more ancient than those systems that form eukaryotic cells. Because the basic idea for the development of the prokaryotic cell is that the fundamental biochemicals developed as a series of complex and evolving reactions, and at some stage became wrapped in spherical molecules, it is theoretically possible that the prokaryotic and eukaryotic cells originated during the same period of Earth history. Because the enclosing spherical molecules would randomly enclose any reaction that was taking place, some cells became enclosed in other cells to give rise to the eukaryotic lineage at the same time that simple chemical reactions became enclosed in a single spherical membrane to give rise to the prokaryotic lineage. Many varied kinds of cells could have developed in this way but only the prokaryotic cell and the eukaryotic cell of today were competitively successful. The problem with this scenario is that all the geological evidence points to a conclusion that they did not originate at the same time. In the fossil record, the prokaryotic cells pre-date the eukaryotic cells by some 1.5 billion years[12].

Of the prevailing hypotheses, held by paleobiologists, for the evolution of the cell types, the simplest is that of an orderly development of prokaryotic life forms from a virus-like organism that developed a 'skin', perhaps as a bi-product of its metabolism. The prokaryotes then evolved into the Eukarya by internalizing chemical reactions that initially occurred on the outer side of the cell membrane. Such a mechanism is not difficult to visualize for some prokaryotic cells have specialized chemical reactions occurring on the outside of their membrane. Slight invaginations of the membrane form a protective enclosure for such reactions (compare the gut of humankind) and it is possible that these invaginations simply pinched-off internally to form the organelles of a eukaryotic cell. Another possible scenario, that is widely accepted, is that the eukaryotic cell is the product of cellular cannibalism in which prokaryotic bacteria were ingested into eukaryotic cells where they were retained as functional organelles because they provided an adaptive advantage. Margulis and Sagan [2002] take this a step further and provide a chromosomal explanation of this, in which the DNA from either ingested organisms or invading organisms interacts with the DNA of the host organism and alters its genome.

The development of cells was the first critical stage in evolution. Once life developed as an organized cellular system, the life forms were the unicellular organisms. Reproduction in these simple early life forms was by simple splitting i.e. it was entirely asexual. Clustering of cells to form multicellular masses probably led to cellular symbiosis whereby outer cells and inner cells in the cluster became specialized and the whole mass developed into a cooperative unit. The slime mold [***Dictyostelium discoideum***] oscillates between a unicellular and a multicellular entity. The living organism as a single cell can aggregate, as an environmental response, producing what appears to be an emergent phenomenon i.e. producing a multicellular body. The process has been modeled on a computer by Resnick [1994] using single cellular agents following simple rules.

DEVELOPMENT OF METABOLIC PATHWAYS



The linear sequences of chemical reactions performed within a cell are the metabolic pathways. To some extent, evolution can be regarded as the gradual extension of metabolic pathways to form more and more complex chemical products. Loomis' [1988] entire essay deals with the mechanisms and processes involved in forming and extending metabolic pathways so that life could evolve into a complex system. He asserted that about 50 different nucleic acid sequences needed establishing in the original spherical molecule for the biochemical reactions to be firmly aligned along metabolic pathways that would lead to a living system.

Even when a cell contained the vital sequences and was able to split into two daughter cells, it was essential that a method evolve that could accurately reproduce the same series of bio-chemical reactions in the daughter cells that had existed within the parent cell. The basic process for this to occur is hypothesized to be pure Darwinian survival of the fittest in which the helicoidal DNA molecule of the chromosome was the selected method of reproduction i.e. the Law of Instability in operation. The reasoning is somewhat circular in that all cells today use DNA as their information unit, and RNA as a transferring template. Loomis speculated that perhaps another 150 metabolic coding sequences had to be assimilated into the cells metabolic pathways in order for a stable biologic cell to appear.

There was a broad set of cellular problems that had to be solved in order for a living system to 'take-off' but the conservation of the DNA code by an exquisite method of replication was the second critical stage in Evolution. This was the development of the biological process called mitosis. Accurate replication allowed progressive successful adaptations to be incorporated into the cellular reproductive mechanism. Although a complete understanding of the regulatory activity from the molecular level to the living system level is probably a decade in the future, the key is code replication. As Baldi and Hatfield [2002:135] note:

"The dynamic character of these mechanisms and the prevalence of interactions and feedback regulation strategies suggest that they ought to be amenable to systematic mathematical analysis applying some of the methods used in biophysics, biochemistry, developmental biology coupled with more synthetic sciences from chemical engineering, to control theory, and to artificial intelligence and computer science".

Mitosis is an exquisitely precise method for a cell to duplicate itself. It was perhaps the earliest significant phylogenic event in the evolution of cellular life. By providing an accurate way for the cell to reproduce itself it accurately reproduced organisms. When it is realized that a human being contains approximately 10^{15} cells the quality control inherent in the process is almost incredible. Before the development of mitosis the earlier method of reproducing a successful biochemical system occurring within a cell is assumed to have been random splitting. The contents of the parent spherical molecule were randomly distributed between the two daughter molecules. In order to produce a successful lineage by this process, one of each of the necessary chemical sequences in the parent cell had to be passed on to the daughter molecules. Such a methodology was inefficient because most daughter molecules would not contain the parents' biochemical systems. This is why it took 1.5 billion more years to perfect. With the advent of the divisional process of mitosis, the splitting and replication could be done accurately. It can be readily appreciated that once a stable method of replication was developed, the *anaerobic prokaryotic cell* became the dominant living system at Earth's surface. These early prokaryotic cells were *chemosynthetic* organisms i.e. they derived their energy and carbon from reactions involving the chemical breakdown of other compounds. The fact that these simple organisms are still active today points to the huge evolutionary success of chemosynthesis.

The other way in which organisms derive their energy is from the sun using photosynthesis, and, with time, the earliest photosynthetic organisms evolved as the prokaryotic photo-bacteria. Photosynthesis is a generalized process in which a CO_2 molecule from the atmosphere is split apart to utilize the carbon and provide energy from solar radiation. The oxygen produced during this process is a toxic bi-product that must be either removed from the cell or neutralized in some way. The method that evolved was the expulsion of the toxic oxygen from the photosynthesizing cell. This oxygen was expelled into the surrounding environment through the semi-permeable membrane. In this way, initially local pockets of oxygen would accumulate within the surrounding environment. Cellular systems that found themselves within these oxygen pockets were subject to the Law of Instability and had to adapt to the presence of oxygen as a component of the selection pressure, or disappear as viable systems. The result was the beginning of the process known as oxidative metabolism, which initiated the metabolic lineage that eventually led to humankind13. It is important to put the evolution of these early chemical systems into a temporal perspective. Life evolved in the form of chemosynthetic and photosynthetic prokaryotes for another 1.5 billion years before the earliest eukaryotic organisms appeared.

The earliest eukaryotic organisms were the photosynthetic algae. The establishment of photosynthesis in the Eukarya led to a dramatic increase in the diversity of life forms that obtained energy from radiation. Many phyla of Eukarya evolved, such as the brown algae **(*Phaeophyta*),** red algae **(*Rhodophyta*)** and green algae **(*Chlorophyta*)** amongst others. These algal groups are particularly distinctive in the types of pigments they contain. In the ***Chlorophyta*,** the major pigment is the photosynthesizing molecule chlorophyll that takes advantage of optimum radiation wavelength from the Sun. This allowed the Chlorophyta to diversify across the surface of all water bodies, and eventually led to their conquest of the terrestrial environment. The ***Phaeophyta*** and ***Rhodophyta***, on the other hand, were adapted to deeper levels of the water column, where different wavelengths of light occur14. Because they could not compete with the ***Chlorophyta*** at the wavelength present at the surface, they did not migrate onto the land. It is probable that the early Chlorophyta developed large aquatic communities living in fresh water - just as they do today. The photosynthesizing organisms became a ready food supply for other groups of Eukarya who became herbivorous. These include such forms as the extant Dinoflagellates and Amoeba.

The ubiquity of photosynthetic organisms resulted in cataclysmic developments at the Earth’s surface because of the expulsion of oxygen into the atmosphere. Photosynthesis provides most of the energy used in ecosystems today and certainly has done so since shortly after the mechanism evolved. The chemical mechanism is not too complicated15 but needed the encapsulating cell membrane to allow dominance. Initially the oxygen would immediately be removed by chemical reaction with the materials exposed at the land surface i.e., oxidation of minerals. Once the exposed surface of the Earth became oxidized, atmospheric oxygen could accumulate in the atmosphere, changing its chemical composition. As the oxygen concentration gradually increased those organisms that were adapted to anoxic conditions, [the anaerobic bacteria] became increasingly stressed and restricted to special low-oxygen or anoxic environments. On the other hand, the accumulating oxygen allowed those organisms that where adapted to oxic conditions [the aerobic bacteria and the algae] to thrive. The oxygenic atmosphere had it's origin about 2.4 bybp. From this stage onwards, oxygen-tolerant organisms dominated Earth's surface. As noted, the green algae were probably the most prolific because they were adapted to utilizing the light radiation at the surface of the water column.

Life forever attempts to adapt into any available environment that it confronts: simply by a trial and elimination accumulative process. With time it adapted into all of the aqueous environments, both marine and non-marine. The land area of the continents was available for colonization to any organisms that lived either as plankton in the upper layer of the oceans, or as benthon, on the floor of the very shallow littoral zone of the ocean or sea. In these environments the organisms were in a geographic location from which they could adapt onto an adjacent landmass. Initially, the adaptations needed for migration into the continental terrestrial environments were evolved by the changes in the molecular biology of the green algae. In doing so these Chlorophyta gave rise to the Kingdom Plantae.

For these evolutionary changes to occur and the truly terrestrial plants to evolve, some difficult adaptations, outlined in Table 2, had to take place. Once the hurdle of dehydration and adequate nutrition were overcome, the plants were able to migrate onto, and eventually dominate, the terrestrial landscape. Again it must be remembered that these adaptations involved chemical changes in metabolic pathways that took many millions of years to evolve.

CHAPTER TWO

EVOLUTIONARY PROCESSES CONTROLLED BY THE CELL

Understanding the processes and mechanisms of evolution requires an explanation of some obvious things that have taken place since life first evolved. Darwin and Wallace conceived their ideas about evolution by applying logical analysis to the observations about living systems that they observed in the field. By reasoning in quite general terms they were able to explain their observations and provide a stable hypothesis for how life evolved. Once Mendel's knowledge on genetic variation became available scientists began to understand the mechanisms that influenced the evolutionary processes. During the first half of the 20th century data supporting evolution increased prodigiously and it became a solid scientific Theory. In 1953, Watson and Crick identified the molecular basis of biology when they described the structure of chromosomes as a double helix, and gave birth to the scientific discipline of molecular genetics. The work of Watson and Crick allowed a deep understanding of biology to develop and since that time there has not been a *single* scientific discovery that falsifies the Theory of Evolution.

Molecular genetics not only elucidates the detailed chemical mechanism through which the processes of Evolution work but it allows a scientific understanding of inheritance and diversity to be firmly rooted in physics and mathematical statistics. The mathematics involved indicates that the mechanism of evolution is based on conditional statistics, i.e., the initial condition influences the future condition.

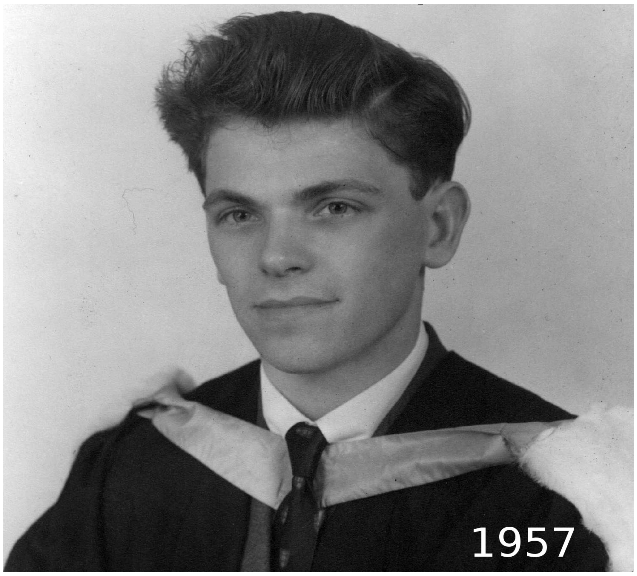
INCORPORATING WATSON AND CRICKS IDEAS: 1953-1962

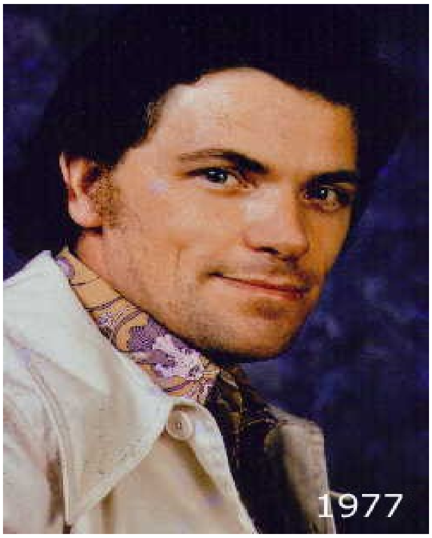
Moreover, molecular genetics has clearly *why* there is a total unity of living systems: because the process at the genetic level indicates one life form gives raise to another by additive and subtractive activities. The unity of science underlying Evolution is now complete. Genetic traits extend not only to the physical appearance of ***Homo sapiens*** but beyond to human consciousness where combinatorial and conditional statistics are the basis of the thought process and of 'free will'

One way to examine the evolutionary process is to approach it from the direction used by Darwin and Wallace. Basically they asked questions about the processes seen operating to create new species. These processes can be studied as a sequence, by answering some simple questions.

1.What determines the physical appearance of an organism?
2.What controls diversity within a interbreeding population?
3.How do new varieties arise in an interbreeding population?
4.Why do new varieties continue to thrive within an interbreeding population?
5.How does a particular variety become a dominant form in a interbreeding population?
6.How do new species arise?
7.Why do successful evolutionary lines suddenly stop, i.e. become extinct?

WHAT DETERMINES PHYSICAL APPEARANCE ?





The RNA and DNA that make up the nucleic acids that form the chromosome molecule contain the information about how the cells will develop i.e. each chromosome molecule comprises a string of DNA unit strung together as one long molecule. Along the chromosomes the individual bits of information are the genes: each of which provides instructions leading to the development of some trait of the organism. The key to understanding the relationship among chromosomes, genes, and traits lies in the idea that each gene is made-up of DNA units, and each gene produces a single enzyme: that special type of protein that facilitates a specific chemical reaction in the metabolic pathway. This "one gene - one enzyme" idea was discovered by Beadle and Tatum [1941] for which they won the Nobel Prize1. Only some of the DNA units that form the chromosomes act as genes. In figure 5 the units 1-5 represent genes that produce enzymes. It shows how a single trait in an organism may be the result of a series of chemical reactions along the chromosome [in the illustration involving genes 1,2 and 5].

To understand how the chromosome molecule controls Evolution, it is necessary to examine its chemical structure and how it acts to produces proteins and to reproduce itself. Slight changes in this chemical structure are what drive the evolutionary mechanism2.

The chromosome molecule is shaped like a long twisted ladder: with rungs and sidebars made of specific kinds of chemicals. Each side of the ladder is made up of a series of chemical units called nucleotides3. The two sides are united by chemical charges between adjacent lines of nucleotides [figure 6]. The central charges are weak and the chromosome readily splits down the middle. During reproduction of the chromosome the entire molecule splits and forms two long stands of chemicals called chromotids. Looking closely at the rung of the ladder we see the nucleotides are formed from the union of three kinds of chemicals [a phosphate, a sugar and a base4: figure 7]. Thus the entire chromosome structure is built from strings of nucleotides forming a linear sequence [the Phosphate to Sugar to Phosphate, etc side-bars], with the two strings joined crosswise [the rungs] linking bases on the left side to bases on the right side of the chromosome.

Modern science has shown that the *bases* are the key to heredity and to cell replication. It is the arrangement of the bases along the DNA molecule that represents the 'machine code' of the chromosome i.e. the basic instruction set that makes the chromosome molecule work as a controller of the physical appearance of organisms, and the heredity process.

Each base has a fairly complex chemical composition but there are only four different kinds involved in the structure of all chromosomes. These are called: A=adenine, G=guanine C=cytosine and T=thymine. We can now refine our definition of the term gene to refer to a *group* of base pairs on a chromosome molecule. The base pairs determine the specific protein / enzyme that will be manufactured and react to control each trait.

The chemical structure of the bases are illustrated in figure 8. Cytosine [C] and thymine [T] are called *pyrimidines*. Adenosine [A] and guanine [G] are called *purines*[5]. It is not the changes in the chemical composition of a base that drives the evolutionary mechanism but the change in the arrangement of the sequence of bases *along* the chromosome. All individuals within a biological species have the same number and kinds of chromosome [the Y chromosome of the human male is simply a modification of the X chromosome of the human female but in each human there are 46 chromosomes[6].

The mechanisms of cell replication

Besides acting as a code the bases have another important function in the cell. Because cells must be able to duplicate themselves with a high degree of precision, for life to evolve, a method was needed to ensure near perfect replication. The chemical properties of the four bases allow this degree of precision in duplication because of their special characteristics. Purines can only link to pyrimidines and vice versa. Hydrogen bonds are the atoms that link the groups together, such that Adenine and Thymine are molecules that can bond together [by two hydrogen bonds] but neither of these can link with Cytosine or Guanine. Similarly, Cytosine and Guanine can bond together [by three hydrogen bonds] but neither can link with Adenine or Thymine. This is an elegant chemical mechanism the chromosome molecules possess that allows accurate replication. The mechanism evolved during the early chemical stage of the Earth's history. The result was that the double helix of the chromosome molecule became dominant because of its efficiency and chemical stability.

When a cell replicates itself the hydrogen bonds that link the two sides of the chain slowly break in what is commonly called an unzipping process. The chromosome molecules are surrounded by the cytoplasm of the cell and as the chromosome is splitting the bases are exposed to the intra-cellular medium, which contain isolated bases. Within the Eukarya the nuclear membrane dissolves during the splitting process to allow access to the surrounding cytoplasm. The isolated bases, in the cytoplasm, are attracted to the electrical charges on the bases of the split chromosome molecule that because of their chemical properties can only link onto one particular type of base. The result is that as the entire chromosome splits, each side of the chain [called a chromotid] adds bases in the same sequence that occurred on the original chromosome. The bases attract sugars to form nucleosides and these in turn reconstruct the nucleotides. Thus from one chromosome two identical daughter chromosome are produced that share the exact molecular composition and series of bases as the original chromosome molecule. Thus the chromosome molecule replicates itself in a purely chemically driven process.

There are two kinds of cell replication that occur in living systems. Simple mitosis takes place in all somatic [body] cells, almost all of which regularly will reproduce, until the organism dies. Mitosis is asexual reproduction that is associated with all prokaryotic organisms; and, with the production of the body cells of all Eukaryotic organisms. The process is outlined in figure 9.

The details of this diagram are not of great importance for this discussion, and can be found in any standard genetics text. The main point is that mitosis involves a sequence of chemical changes and when this chemical activity takes place slight errors in the process can produce chemical variation in the resultant molecules. If these errors are viable they result in additional genetic variation within the organism.

Meiosis is the second kind of replication and occurs in sexually reproducing organism with the formation of germ cells7 [figure 10]. Germ cells are essentially immortal existing from one generation to another until the entire ancestor-descendent lineage [the phylogeny] becomes extinct. Again the details of the diagram are not important to our general discussion other than to note again, there are possibilities for chemical errors to occur at each stage in the process.

Protein production

Proteins are the key materials for building a complete organism and protein synthesis is a separate process from that of cell replication. Proteins are chemical polymers that are made up of amino acids [chemical monomers] linked together [covalently bonded by peptide bonds]. Although 64 amino-acids are theoretically possible only 22 are genetically encoded in cellular systems and of these only 20 are common but this still allows for an almost incomprehensible number of different proteins to exist8. All standard genetics text-books review protein synthesis in detail for proteins are not only the basis of the metabolic pathways established in any living system, but also control trait development and ultimately classification of organisms. One difference that separates the DNA replication process of mitosis from that involved in protein synthesis using RNA is that the base U [uracil] is substituted for T [thymine] and ribose sugar for deoxyribose sugar [hence the name RNA]. Moreover, the actually sequence of processes that happen during the production of protein is a much longer series of reactions than when mitosis takes place.

Not all base pairs on the DNA molecule are involved in producing proteins directly, although many may be involved indirectly. Those parts of the DNA molecule that do code directly for proteins are termed *exons*, and those parts which do not are called *introns*. The intron regions of the chromosome molecule are often referred to as "*junk sequences*". These sequences are probably important in controlling the development of traits in some way or another because chromosome duplication processes are far too precise to allow replication of useless materials. In order to produce a protein the introns are spliced out of the sequence as it exists on the DNA, by a process called transcription, and the resulting molecule [called messenger RNA or mRNA] is now a compact triple-base codon. Essentially the DNA [made of the bases A, C, G, and T] is 'transcribed' into an RNA code [made of the bases A, C, G, and U]. A cellular enzyme called RNA polymerase facilitates this process.

Next a process called *translation* takes place. In this stage the messenger mRNA attaches to a ribosome in the cell [the ribosome chemically includes its own kind of RNA called tRNA]. The tRNA is the actual chemical that specifies the sequence of amino acids that finally builds the specific protein. It is at this location that the actual amino acids are synthesized, as an interaction of the mRNA and the ribosome. This RNA code uses a short string of three linked base pairs [a codon as a template involved in the design of a single amino-acid. The sequence of codons specifies the sequences of amino acids to be produced to form proteins. There are special start and stop codons in the sequence along the RNA molecule. Thus a particular codon may signal the start of a protein sequence [the start codon], followed by the codons for the specific amino acid to be used in the protein sequence; followed by the signal to end the protein sequence [the stop codon].

Essentially the amino-acid sequence is completed in the same way that DNA reproduces itself. Amino acids in the cell are chemically bonded to the bases and then to their adjacent amino acid. The groups of amino acids are released into the cell and curl-up upon themselves to form complex 3-dimensional structural proteins. The curling-up is done, once more, by linking chemical bonds so that once curled each protein has a definite shape and a 3-dimensional surface that has potential sites for the chemical linkage of other atoms and molecules [figure 11].

Thousands of proteins can be produced in individual cells and they take part in all aspects of cellular development. Because the protein molecules are such large and complex 3–dimensional structures, in which the chemical constituents are intimately woven together, it is a monumental task to understand how the various charges are taken-up. Only recently has the technology developed to begin to understand the processes whereby proteins form. Once the details are understood great advances will be possible in biology, medicine and the deeper aspects of Evolution. Moreover, understanding protein structural synthesis will allow experimental Evolution to advance and chimerology [the science of chimera] will become a valid area of scientific endeavor. At that stage the ethical issues will make current cloning issues look trivial.

Estimates of the number of base pairs in a human are about $3x10^9$ when the entire chromosome is considered. As noted, only certain base pairs appear to be responsible for the direct construction of proteins but theoretically the entire chromosome molecule is available to play a role in trait development. With 46 chromosomes in each human somatic [body] cell, and half that number in a human germ [reproductive] cell, clearly the genetic information that determines the development of a human being involves thousands of base-pairs that form the total complex of the chromosomes. Moreover, each amino acid may be formed from a single codon or a number of base pairs. In the latter case the base pairs need not be contiguous i. e., they can be combinatorial which means that in an organism with 1000 base-pairs active in protein production the *theoretical* number of possible number of genes is 2^{1000}. Translate this into human genetics and the possible diversity is more that enough to account for all the variation needed to form consciousness in a human being. Some will oppose this kind of calculation but we are as yet too ignorant of the complete purpose of the entire chromosome chemistry to reject it.

THE CONTROLS ON DIVERSITY

Genes are the ultimate controller of the diversity within a gamodeme: because they control the traits of an organism. However, at the level of the gamodeme, it is the environment, acting through selection pressures upon the gene, which is of great importance in determining the overall trait characteristics of the interbreeding population.

When two gametes [sex cells] combine to form a zygote [offspring] during sexual reproduction, the chromosomes from one parent combine with the same kind of chromosomes from the other parent. They can do this because within any species the DNA sequence along each specific kind of chromosome molecule is essentially the same from one individual to another. The zygote receives one half of its genetic material from maternal chromosomes and the other half from the paternal chromosomes. This combination occurs for each and every chromosome the male and female have in common. This is why the result of the reproductive process is so conservative and children regularly have the characteristic traits of one or both of their parents. Reproducing a chromosome is the means of passing on the fundamental information about the organism9.

The original work by Gregor Mendel showed how variations in traits are distributed within a gamodeme. His sweet pea experiments are classic examples of scientific experimentation that should be taught in every school in the world. Since Mendel was rediscovered at the beginning of the last century Mendelian Genetics has become the starting point for understanding the mechanism of Evolution. Numerous other breeding experiments, along the lines as Mendel's, have shown that many hereditary traits follow a simple Mendelian pattern. Even when the processes are complicated, the outcomes of breeding experiments are often highly predictable. This was well known long before Mendel, as observational knowledge, and allowed agriculturalist to develop better strains of crops, animals, and loyal but ferocious guard-dogs.

Early ideas suggested mutations were driven by external criteria but although such may be the ultimate cause the proximate cause is internal due to slight inconsistencies in replication and protein synthesis. The phenomenon of chromosomal mutation is in general lethal to the cell or causes sterile offspring such as the mule. Genetic mutations, on the other hand, cause most of the diversity seen in a phylogeny. Without genetic mutation the result is simply a chromosome directly based upon the original maternal - paternal characteristics.

Alleles variants

When one examines traits in terms of molecular biology, a principle key to reproductive diversity in the Eukarya is the occurrence of **alleles**. An allele is an alternative form of a gene that can exist at a particular point [locus] on the chromosome molecule. Alleles are simply small sequences of the DNA that may have slightly different chemical compositions on corresponding chromosome molecules in the male and the female gametes. In spite of such differences they still retain sufficient characteristics that allow them to combine during zygote formation. However, the slight chemical differences cause different alleles to produce difference proteins; and, these in turn produce different characteristics in the offspring [e.g. blue eyes as opposed to brown eyes; or albinism]. The dominant allele in a gamodeme is called the wild type allele and all the others are called mutant alleles.

A single allele does not always control a single trait but often a combination of two or more alleles result in that trait. Moreover, because alleles can be genetically dominant [expressed as a trait of the offspring whenever they are present], recessive [only appear in the offspring when the same allele is inherited from both parents], or neutral, the resultant offspring, even from the same parents, can have a broad range of variation. If the chromosome from the male and female carry the same allele they are called homozygous. If they are different they are called heterozygous.

One can say that even from the beginning the individual fertilized egg has a wide range of potential variability. It could survive and grow in a number of possible environments. These are however, initial possibilities only that are subject to the Law of Instability. Once the organism begins to grow it is affected by only one specific environment (or a sequence of environments) and its potentialities for developing specific characteristics are narrowed down as it matures. Thus its resultant growth comes to be directed along a definite channel. Particular characteristics are retained and manifested within an environment because they are meta-stable within that environment at that particular time. An analogy can be made with the concept that "all people are born potentially equal" and our knowledge that once born selection pressure draws out an individuals potential so that they have different physical and mental attributes with time and all people do not die as equals.

Changes in physical appearance may not be directly caused by evolution. For example, height may be controlled by diet as illustrated by the change in average height of the population of Japan after the Second World War. The overall appearance of an organism is called its *phenotype*: a result of the effect of the complete environment acting upon [selecting traits from] an individuals genome [its *genotype*].

Selection of existing alleles by the environment produces diversity within a gamodeme. However, the long-term results are limited in scope because only a finite number of combinations can take place. Only with mutations can novel changes occur in the true genetic make-up of the organism [genotype] and that process provides fundamental diversity as seen in the expressed traits [phenotype]. Somatic [body] cell mutations can be expressed as a phenotype but it is the germ [sex] cell mutations that can be retained in the lineage of offspring and expressed as heritable [genotype] change in the ancestor – descendent sequence [the phylogeny of the organism].

The amount of variation can be shown in a simple way as shown in Table 3.

ORIGIN OF VARIATION

Variation is expressed in a gamodeme because of the presence of alleles. The process of genetic mutation is what changes a gene into two or more alleles. The classical approach to mutation recognizes two general processes10.

Genetic mutations which is a result of physical and chemically introduced changes to the nucleotide sequences. Chromosomal mutation was a result of one offspring getting too much of a chromosome during replication and the other getting too little. Whatever the mechanism causing mutation the result is expressed as a change in the chemical sequence of the DNA molecule.

The mechanism of chemical evolution indicates it is when something goes wrong with the sequence of DNA, RNA, and protein production that something is altered permanently, and exciting variations can occur in the interbreeding population. An important point is that if the genetic sequences are not reproduced perfectly during the formation of somatic cells only the individual is affected; and again, this does not produce new lasting varieties in the population. However, when the error occurs in one or both of the germ cells involved in sexual reproduction the resulting zygote [offspring] is different from the parents combined genetic makeup. This is the important mechanism for the origin of new varieties within a gamodeme.

One reason that evolution is such a conservative process is that the cell has repair mechanisms the result of which make errors rare11. The fact that these repair mechanisms exist illustrate in a profound manner the way in which chemical evolution under natural conditions can produce exquisite adaptations. They offer positive reinforcement to the idea that given sufficient time living systems on other chemically active planets will evolve life forms. Chemical mutations drive the changes in life's evolution. Without mutation the diversity within organisms would stabilize and the evolution of the phylogeny would stop within a short span of geological time.

During meiosis, the chromosomes come out of the nucleus, associate in twisted pairs and unite at certain points. It is at this stage that parts of the chromosomes are exchanged so giving new combinations of traits in terms of the offspring. As Percus [2002] noted, the common theme is an exquisite localization of activity on the chromosome under the control of energy changes. The coiled nature of the DNA molecule itself is a function of alternating electric charges responsible for the junction of the two strands. As DNA prepares for duplication the energy bonds break and coiling places nucleotide sections that may be quite separated linearly along the chromotid in close proximity spatially. This allows a variety of exon – intron regions of the chromotid to be transcribed to a single chain of nucleotides derived from the surrounding material.

SURVIVAL OF VARIANTS

Variation from ancestor to descendent occurs because when germ cells replicate and zygote formation takes place, slight errors can creep into the molecules. Many of these chemical errors [genetic mutations] are simply lethal to the offspring but a few are stable and show themselves as variation in a particular trait, or even a new trait. Arranging the genetic material in slightly different ways can provide an enormous survival advantage for any offspring in which it occurs. From the viewpoint of Evolution it is important to emphasize this process because the errors introduce during meiosis do allow novel adaptation potential by increasing the number of genetic possibilities that can be selected by the environment.

The process of chemical evolution is accumulative NOT innovative. It is a legacy system, which is the reason it is such a conservative process. Novel variations only survive if a mutation takes place, if the repair mechanism fails, and if the resultant chemical change can survive under the selection pressure operating upon it. Variation is retained in the gamodeme because of the Law of Instability. Variation, once established within the genes of an individual will be immediately subject to this Law. It is the environment, in its widest sense that controls what characteristics will actually develop in the offspring. An organism's expressed traits and condition is called its phenotype. The environment effectively draws-out those characteristics of the organism most suited to its struggle for survival within the particular environment at that particular time. The actual time may be the next second or the next decade. Such characteristics are drawn from a total potential variation possessed by the organism and are the result of the total selection pressure on the organism. Thus what the reproductive process passes on, as the genotype, is the potential to develop the parents' characteristics. What appears, as the phenotype, is what the selection pressure allows to be expressed from the genotype. A particular trait present in an individual will be expressed if the external environment both allows it and selects it i.e. if the selection pressure is lenient.

DOMINATING VARIANTS

Individuals are the ultimate fundamental units in the evolutionary process. However, neontologists normally regard the gamodeme as the basic unit not the individual. This is because the assemblage of individuals forming the interbreeding population is a coherent genetic group and continuous gene exchange within the total genetic pool will tend to level out any gross irregularities in characteristics. The tendency over time, within any gamodeme, is for a general unison of characteristics [traits] to be identifiable as a result of certain gene-combinations being most suited to the current environment. This also is the reason that at any particular time there is a particular combination of traits expressed as, what is called, the *dominant form* in the population. However it is probably rare that an environment is stable for long, and changes in the selection pressure can cause rapid changes in the dominant form. An early example of how this evolutionary mechanism works is the classic case of the changes observed in the British Peppered Moth discussed earlier.

EXTINCTION

Although the stream of life on Earth has been continuous since it originated over three billion years ago, the fossil record of the past does not indicate uniform evolution. Even though mutation rates may be fairly constant the influence of selection pressure is such that evolutionary rates vary greatly even within similar species. One of the more interesting phenomena certainly is that of extinction. As already indicated the environment, in its broadest sense, is the determining factor in selection pressure, and changes in the environment disrupt the biological equilibrium on both a local and worldwide scale following the Law of Instability. If the new conditions put high selection pressure on a given organism, it will be considerably reduced in number and diversity. If the selection pressure is sufficiently high the population will become extinct.

CHAPTER THREE

THE CONCEPT OF A SPECIES

Even though we may cherish our individuality, or the uniqueness of our particular ethno-cultural group the really basic unit of our humanity is our species ***Homo sapiens***. When an individual organism is born into a particular interbreeding population the prevailing selection pressure[s] determines whether or not it will survive. Science has shown that chemical changes on the chromosome molecule [mutations] are the fundamental mechanism that occurs and ultimately determines whether or not an organism is fit to survive in the environment in which it finds itself. Once an organism has an established set of chromosomes it is the changing environment [in its broadest sense] that controls whether or how long the organism will survive [therein lies Darwin's 'survival of the fittest' concept]. Because of the phenomenon of sexual reproduction there is a union of characteristics [traits] that link all member of a gamodeme. When new traits become established in a population the various Laws of Nature are consistently applied and explain the means of getting the great variation necessary to explain Evolution and adaptation to a particular environment.

When we extend our investigations from the individual to the species we can explain the occurrence of whole phylogenic lines, such as that of the vertebrate lineage. At this level it is the interbreeding population that is the basic unit of interest, because gamodemes define the basic taxonomic unit: the species.

WHAT IS A SPECIES?

Scientists sub-divide life into taxonomic categories based upon expressed traits that are ultimately dependant greatly upon the genetic makeup of the organism. Evolutionary rate [how quickly the traits develop and change] is an important factor and affects the ease whereby taxonomic groups can be differentiated though time. Taxonomic units, such as species, cannot always be grouped in as rigid a way as some scientists would wish because partial genetic compatibility can occur in species that are in the process of diverging. The neontologists use the interbreeding factor as the basis for defining a species and we get the definition of the biospecies as follows.

A group of gamodemes, potentially capable of interbreeding one group with another, and reproductively isolated from other such groups. This definition of a species has a sound genetic basis. [figure 12].

As far as actual inability to interbreed is concerned, i. e. genetic separation, it seems to arise from the fact that the internal chemical environment is too different for fertilization to take place...the meeting of the male gametophyte and the female gametophyte to form the zygote is, even within a good species, a tricky thing. It seems that divergence to form new species occurs when the chemical regime surrounding the ovary reaches a stage where certain reproductive cells are unacceptable to the receiving organisms. The second cause for a failure to interbreed is that the new form is a fundamental aberration and is rejected as a breeding partner. In other species most aberrations are abandoned or murdered at birth by their parents but if they survive and interbreed they can add new genetic variation to the population and this may have adaptive advantage. A third reason why two individuals may not be able to interbreed is physical separation. This is a factor of importance to communities isolated in space and will be discussed later.

DNA offers another tool for classification, especially for extant organisms. The DNA chain within a single species has a high degree of commonality, with a suggested 99.8% correspondence amongst individuals within the same species. The subsequent importance of DNA is in the proteins that the code specifies; and in a real sense, an organism can be quantitatively defined as the sum of the proteins it manufactures. Future taxonomists might actually discover that the best way to specify a species amongst extant Eukarya organisms is by the enzymes and proteins involved in the chemical environment associated with fertilization.

Because of the nature of evolution it is not surprising that slight anomalies occur in the single-dimension concept of a species as an interbreeding population. The really interesting cases are those of partial genetic incompatibility, such as the European crested newts and Marble newts of central and western France, in which hybrids show partial genetic incompatibility. A certain amount of gene exchange occurs but partial genetic incompatibility is indicative of a species in transition. Thus, although the neontological concept of a biospecies is not always as easy to apply, as one would like it to be, the irregularities, such as partial genetic incompatibility, indicate that biospecies are all part of the evolutionary plexus.

Paleobiologists have a different approach. They define a paleospecies entirely on morphological traits that are preserved in the fossil record. As is well know morphology is usually directly related to breeding factors. The characteristics chosen by a paleontologist to define a species are often those characteristics which neontologists have proved to be diagnostic in separating living organisms: particularly features, which had some functional use. An idea of spatial isolation is usually coupled with morphologic divergence in the definition of a paleospecies. A useful definition of this kind of paleontological species is that given by Mayr (1942) defining a morphospecies thus: a group of individuals with similar or the same morphological characters, the limits of variation allowed in such a species being arbitrarily defined by a competent worker.

It most be realized that the paleospecies is a morphological concept with the expectation that members thus classified fit the definition of neontologists. Failure to meet this expectation is the intrinsic danger in doing phylogeny, using fossils alone. On the other hand it is a fact that different species do, more often than not, show physical differences; and, one does not have to put a cat and a cougar into a cage to see if they can interbreed and produce viable offspring. When the pros and cons are weighted the importance of the paleospecies is how it has allowed phylogenies to be understood. In recent years, molecular biology has shown that the work on the phylogeny of the larger taxonomic groups done by paleontologists is fundamentally correct. The fact that biospecies are not defined in time [even though they may show extension through time], but paleospecies are defined in time, is an often-overlooked factor by neontologists.

The paleontologist uses more than one method for defining species. If only a few specimens are available the term morphospecies is used as Mayr defined it. However, one can envisage and actually find, cases of more widespread and better preservation, such that virtually the entire fossilized population is found - this is near to a gamodeme and is obviously a better group to give the name species to: it is termed a chronodeme. This is not equivalent to the entire biospecies but such equivalence is possible: all fossil gamodemes of one stratum that can be grouped around a single morphological concept are called a holomorphospecies.

Because evolution is a cumulative process one species will grade into another unless abrupt extinction or a novel form suddenly appears and comes to dominate a population quickly. We can thus actually define a species that extends into time: this we call a *chronospecies* and it is a far better concept of a species than any other, including a biospecies [figure 13].

It is this chronospecies that is the basis for understanding a phylogeny. Levinton [2001, chapter 3:81-156] provides a general overview of the various mechanisms of speciation.

RATE OF EVOLUTION

The term phylogenesis is the mere process of descent with or without modification; and, any continuous history of ancestors and descendants is technically termed a phylogeny. The process of divergence along phylogenic lines can be observed to take place at different rates, and this is one of the reasons that delimitating paleospecies in the fossil record can often be difficult. Four recognizable rates of modification in phylogenic lineages are often used to describe evolutionary tempo [figure 14].

Stasigenesis

This is the type of evolutionary change that shows little or no modification with descent. The organisms that form the phylogeny remain fairly much the same over time. The changes, which have taken place between the Paleozoic bivalve ***Linguella*** and the modern ***Lingula***, have been cited as an example of stasigenesis.

Orthogenesis

This is the moderate to rapid type of evolution that many organisms seem to have followed.

Anagenesis

This is a type of phylogeny, which superficially appears to indicate that a new type of species suddenly arises with few if any intermediate types. It is similar to orthogenesis but the process is much quicker so that intermediate stages are lost in the imperfection of the paleontological record e. g. the phylogeny of ***Homo***. Gould's concept of punctuated equilibrium is fundamentally stasigenesis followed by anagenesis.

Typogenesis

This is a real jump in phylogenic lineage - a new form being introduced between one generation and the next. It has been observed to occur amongst extant Marsh Fritillary butterflies.

When we examine the paleontological record we see that each geological time-plane observed in the sediments is characterized by a variety of physical [morphological] types of individuals in each successively observed population of a species. Moreover, succeeding time-planes are often marked by the appearance of new physical types, but there is always overlap with the ancestral population; that is, some of the descendants are always morphologically similar to their immediate ancestors. This is as expected once the mechanism of Evolution operating within the gamodeme is understood. When we examine the successive populations with regard to loss of information caused by missing geological sections and the vagaries of fossilization, the record is surprisingly complete. Missing links are semantic entities and are not real because evolution is continuous. A missing link is simply an artifact of the fossil record specifically related to resolution of inquiry [the level of detail used]. Indeed, once one missing link is found it automatically creates two more.

One of the more important aspects concerning selection pressure is its perceived positive action . Increased selection pressure tends towards a reduction in variation, the more intense the selection pressure, the more uniform the adult population becomes. This is simply because increased selection pressure causes the early death of many of the young individuals that differ from the environmentally controlled norm [figure 15]. If you do not live to sexual maturity you do not pass on your traits to offspring and thus they are removed from the gamodeme. This is the Law of Instability in action. Conversely the lowering of selection pressure results in the survival to maturity of a greater number of offspring showing a variety of traits.

This process was actually observed by the geneticist E. B. Ford and his father during their studies of an isolated butterfly colony and we can examine this study to derive a concept of what selection pressure does to

a population.
Observations on this colony were conducted for over 50 years (1881-1935) and during this period of observation the numbers in the colony fluctuated between extremes. The results of the Fords' observations are sketched in the accompanying diagram [figure 16].

The fluctuations in numbers in the butterfly colony were accompanied by a marked effect on the amount of physical variations in the population. During the period that the population was numerically stable (moderate selection pressure), and during its period of decline and rarity (increasingly high selection pressure), the amount of variation decreased to a minimum. During the period of increase in numbers, physical variation ran rife, even deformed young that were hardly able to fly reached maturity (lowering of selection pressure). As soon as the population built its numbers up to a maximum size it's physical variation became fairly constant (moderate selection pressure once more).

Apart from relating the population changes to selection pressure there is another significant feature. In the initial population of 1881 a particular physical form (type A) was the normal type. After the period of high selection pressure a new type came on the horizon and gradually increased in importance until in the 1935 population it was the dominant physical type (type B). The form B was not at all like the Form A and here we have a case of the sudden appearance of a new form [typogenesis].

CLADOGENESIS: how new species arise

Cladogenesis is the technical term for the detailed process that takes place during the branching of the phylogenic lineage that gives life its overall diversity and is the basis of its taxonomy. It is the process whereby ancestral populations give rise to descendant groups by divergence of the phylogenetic line, each of which remains discrete from every other throughout their subsequent history. Fundamentally, it is the process by which new species and higher taxa arise.

The process of Cladogenesis has been investigated to a large extent by both paleobiologists and neontologists, who have determined that one of the most important factors involved is the geography of the area in which the process is taking place. In general there are four recognizable phases an interbreeding population can pass through during divergence [figure 17].

1. Phase of stabilization.
2. Phase of eruption.
3. Phase of disruption.
4. Phase of divergence.

Phase of stabilization

During this phase selection pressure is moderate and the ancestral species is confined to a constricted habitat, with a closely controlled population size.

Phase of eruption

During this phase the population undergoes rapid increase in numbers and variation because the selection pressure is decreasing and with this lenience the species increases its numbers and inhabits a wider geographic area. In the fossil record the result is a wider range of morphologic types, living in a wider range of environmental conditions, over a wider geographic area with time.

Phase of disruption

During this phase selection pressure is increasing and with this harshness the species can undergo a drastic drop in numbers. The individuals living in the less favorable parts of the environmental range are wiped out. If divergence is to take place, two or more groups must survive in slightly contrasting environments and remain biologically isolated from one another. In the fossil record this is seen as later chronodemes begin to show different means and modes in their population statistics from ancestral [earlier] related chronodemes.

Phase of divergence

During this phase the selection pressure is moderate once more. The surviving groups start to diverge from each other. At first the differences are only slight but they continue to become more and more pronounced until they reach specific, generic or even familial distinction. In the fossil record this is seen when two or more later-fossil populations form a distinctly new taxonomic group that can be related to an earlier form[1].

The process of cladogenesis is universal and has been in operation since evolution began: primarily because of the Law of Instability. It does not always proceed in the same way but differences involving the number of descendant branches and the actual physical differences between the initial branch populations give slightly different results, primarily due to different rates of phylogenesis [figure 18].

These are variously described as: explosive evolution, dichotomous evolution, and punctuated equilibrium. The Laws of Instability, Actualism and Combinatorial Outcome all influence the degree of divergence achieved because it is a result of the genetic make-up of the organism, acted upon by the selection pressures within the new environments.

In its general aspect Gould and Eldredge's concept of punctuated equilibrium revolves more around cladogenesis than on phylogenesis even though it can be seen as a phylogenetic process [a point I made publicly to Steve after his lecture at the GSA Meeting in New Orleans]. The life-span of a paleospecies [2 to 5 million years] is a geological instant. Some paleontologists [called splitters] finely divide what is really a chronospecies based upon morphological criteria. Others [called lumpers] allow a paleospecies to have broader morphological variation. Certainly within the splitters paleospecies remain almost invariant and then quickly evolve into one or more new species. Most if not all paleobiologists would agree that this is what we see in the geological record when we consider things at the scale of two successive species but as a fundamental process over the scale of a phylogeny the process is not real. Sterelny [2002], in her book essay entitled "Dawkins vs. Gould", draws attention to this fact.

Whether or not a newly evolved species occupies a novel geographical area or evolves in the same location as its immediate ancestors is of small consequence as long as reproductive isolation is maintained. Obviously, evolving in a new and restricted geographic area more rapidly isolates the gene pool so that genetic drift can gradually change the nature of the gamodeme [this is similar to cases where an entirely new location become available such as volcanic islands or accidental relocation by storms]. On the other hand, if a new form evolves within the confines of the ancestral population there must be some type of reproductive isolation or the form must provide such a high adaptive advantage that interbreeding with the associated earlier forms rapidly replaces any previously dominant form. A third type of reproductive isolation occurs when a new form has such a different morphology or even a single morphological feature that the rest of the potential gamodeme recognizes it as an aberrant form and will not interbreed with it.

APPROACHES TO DATING A PHYLOGENY


Dead bird, Colorado 1973

One outcome of Darwinian concepts is that Evolution is forever divergent i. e. when species split off from a common ancestor they grow more different with time. Once the molecular basis of traits was recognized it was realized that the concept of divergence could be applied to DNA, RNA, and protein structure to provide a useful tool for comparing phylogenic relationship. For example, one can find proteins which have the same function in different organisms but which are chemically different in their amino acids. For example, Cytochrome C [a basic respiratory protein] is identical in humans and chimpanzees but differs by 44 amino acids out of 104 from the fungus Neurospora. The degree of chemical difference in the chromosome between species can be used to determine the relative location in time that the taxa diverged. This assumes that the molecular changes are associated with cladogenesis.

This molecular approach to dating divergence within a phylogeny has much in common with the geological procedures that use a relative time-scale for dating rocks. Moreover, the attempt by molecular biologists to develop an absolute time-scale using mutational rate is directly comparable with the geological procedures that use an absolute time-scale for dating rocks.

Geologists determine the time of an event in one of two ways: relative or absolute dating methods. Development of the relative geological time-scale was primarily based upon the Law of Superposition. This simply states that the processes that control the deposition of sediments mandate that younger sedimentary layers are laid down upon older sedimentary layers. William Smith, the founder of the study of Stratigraphy, took this a step further in recognizing that similar sequences of rocks had a similar sequence of fossil assemblage. In this way the evolutionary changes in fossil lineages could be related to sedimentary sequences. The exciting bit of the tale came when it was realized that fossil sequences could be recognized independently of the lithological sequences of sediments. This allowed rock sequences to be compared from all over the world and made possible the development of a global relative time scale encompassing all sedimentary rocks. The Law of Relative Time simply states that any particular event occurs before, at the same time as, or after another event. When using fossil sequences, sedimentary sequences or molecular changes caused by temporally controlled mutations, the Law can result in a high degree of precision and resolution.

Development of the absolute geological time-scale was primarily based upon the Law of Radiogenic Decay that was initially proposed by Professor B. B. Boltwood of Yale University when he discovered that the element lead was a decay product of the element uranium. Since that time more than ninety naturally occurring radiogenic elements that spontaneously decay to other elements at a constant rate have been identified. Because the radiogenic elements are present in minerals entombed in all kinds of rocks formed since the consolidation of the Earth [or any other rock body anywhere in the Universe] they provide an excellent means of developing an absolute time-scale. The Law of Radiogenic decay allows scientists to date a rock within a limit of error. Moreover, some radiogenic elements decay quickly and therefore are useful for the younger group of rocks and others decay slowly and are useful for the most ancient rocks.

In terms of ease of application relative time methods can be applied more ubiquitously than absolute time methods. Experience has shown that when relative time determinations are correlated with an absolute time standard the results are more useful than isolated absolute time measurements alone. As a practical matter, arguing about the precise timing of a particular split in a phylogenic line is of less importance than knowing the relative position of the taxa within a particular lineage.

The molecular clock probably operates in a similar way to the radiogenic clock: the mutation rates are dependent upon what molecules are involved. However, whereas the rock type is not important to the rate of decay of radiogenic elements the phylogenic contextual setting of organic molecules is important to understanding mutational rates. Geology has shown that greater precision comes as techniques are refined and the better methods determined. Certainly the molecular clock needs tweaking, and until the process is fully understood the results of analysis of the phylogeny of organisms based upon molecular biology, should put more weight upon relative position in a sequence. This does not mean that absolute methods are invalid simply that they must be examined within the framework of lineage. This is especially important for the Primates, where improvement is being made, as more individual fossil remains are both geologically dated and molecularly analyzed. The molecular clock method shares the same problem as the radiogenic method, in that mutations take place at a statistically regular rate but we cannot predict which specific amino-acids will mutate.

Today there are three main lines of evidence commonly used to determine a molecular time scale: mitochondrial DNA lineages, autosomal chromosome lineages, and sex chromosome lineages, two techniques are commonly used in all three kinds of analyses.

The first common technique is hybridization of DNA which aims at showing species relationships by taking small strands of a radioactively labeled DNA sequence from a key species and comparing its rate of dissociation of hydrogen bonds, under heating, with the rate of dissociation of hydrogen bonds in a related species. The rate of dissociation can be used as a statistical measure of the divergent between the two taxa. When this is done with many species a diagram [called a cladogram] can be formed showing the evolutionary relationships of taxa.

The other commonly used technique is based upon nucleotide sequencing. It is a technique based upon polymerase chain reaction [PCR] that amplifies relatively long sequences of DNA; and, has allowed nucleotide sequences to be extracted and the sequencing of entire genomes. Divergence amongst taxa can be measured by statistical procedures that calculate differences or similarity between the sequences

[Felsenstein, 1981; 1988; Swofford et al, 1996]. The degree of similarity or difference between taxa can in turn allow them to be placed along a phylogenic sequence.

When using DNA analysis to establish lineages the question of how we know that the sequence being compared is representative of the species and not just a rare polymorph examined by chance must be addressed. This is not easy for isolated studies. However, we do know that from the use of absolute and relative age determinations of rocks accumulated knowledge and the application of statistical procedures allows incremental increases in precision and resolution with time. The work taking place in DNA lineage studies is completely analogous with that used in establishing a geological history of a sedimentary basin.

If a mutation in a gene causes it to produce a protein that still operates normally then the chemical change may be incorporated in the future. We know that many amino acids can vary and still not alter the function of the protein. This is the basis for making a molecular clock. For example hemoglobin – the red protein that carries oxygen in the blood shows a difference among all species that possess hemoglobin. Depending upon which amino acids are measured the hemoglobin changes at a rate of 27 or 30 mutations per 100 amino acids per million years. Cytochrome C changes at about 6.7 mutations per 100 amino acids per million years. Thus one has slow and fast mutations that can be used for estimating different times. By using more than one protein more precision can be added to the molecular clock. The number of changes can be used to establish a phylogenic tree showing the relationships amongst difference species or higher taxa.

In population studies the method for developing relationships is called the Unique Event Polymorphism [UEP]2 and works on the basis of mutations rates of about 1 per million generations. For genealogical studies involving a scale of centuries the testing method is called Short Tandem Repeats [STR]3.

Mitochondrial DNA lineages

As noted, mitochondrial DNA [mtDNA] is inherited only though the maternal line, derived from the maternal germ cell4. The pioneering work by Cann, Stoneking and Wilson [1987] showed how to use mutations in maternal mitochondrial DNA as a tool for understanding human evolution. Simplistically stated the process relies on the fact that the mitochondria are not part of the chromosome in the nucleus but are specific organelles containing a single short circular chromosome, that occur in the cytoplasm within the cell. Because each cell contains numerous essentially identical mitochondria they can be used as a characteristic of that individual. The mitochondrial DNA does not recombine with any nuclear DNA, although its function is partially controlled by the nucleus. It is passed on unchanged except for mutations, and herein is the importance of the mitochondrial DNA for understanding phylogenic evolution.

If we commence with an initial individual in whom we know the structure of the mitochondrial chromosome then any lineage developed from that individual will show the same mitochondrial DNA structure. The only exception should be accumulative changes introduced by genetic mutation i.e. copying errors. Because these are assumed to take place at a statistically determinable regular rate, individuals can be placed in the proper place in a temporal sequence forming a lineage, showing how long it has been since they shared a common ancestor. If we can count the number of genetic mutations and we know the rate at which genetic mutations take place then it is simple arithmetic to work out the amount of time that has passed between the original ancestor and a specific descendent5. Because mitochondrial DNA can be used to classify individuals we can see the detailed relationship amongst individuals by examining the exact makeup of the mitochondrial DNA.

Autosomal chromosome lineages

All chromosomes exclusive of sex chromosomes are called autosomes. Autosomal genes have a problem that sexual reproduction mixes the genetic components with every generation. Since the sequencing of the first mammalian genome [***Homo sapiens***] was completed in 2001, complete genomes of a number of other species have been published. The results allow the molecular biology of the chromosomes to be studied in a full biological context. Comparison of chromosomal sequences will be useful for generating precise evolutionary relationships amongst all extant species of organisms. For example the published work on the mouse genome when compared with the human genome indicates a divergence took place some 75,000,000 years ago, in the Cretaceous Period [Nature, December, 5th, 2002]. The female mouse studied [with 20 chromosomes containing 2.5 billion bases] indicated over a 90% conformity with the human genome [with 2.9 billion bases]. Surprisingly the number of protein encoding genes was approximately the same [30,000]. One other aspect shown is how bases can be moved around during meiosis. For example, mouse chromosome 16, although showing similarities with human chromosome 16 also has segments comparable with human chromosomes 3, 21, and 22. However, even though mice and humans may have the same gene at a particular location the developmental stage at which it is expressed, determines its effect.

Sex chromosome lineages

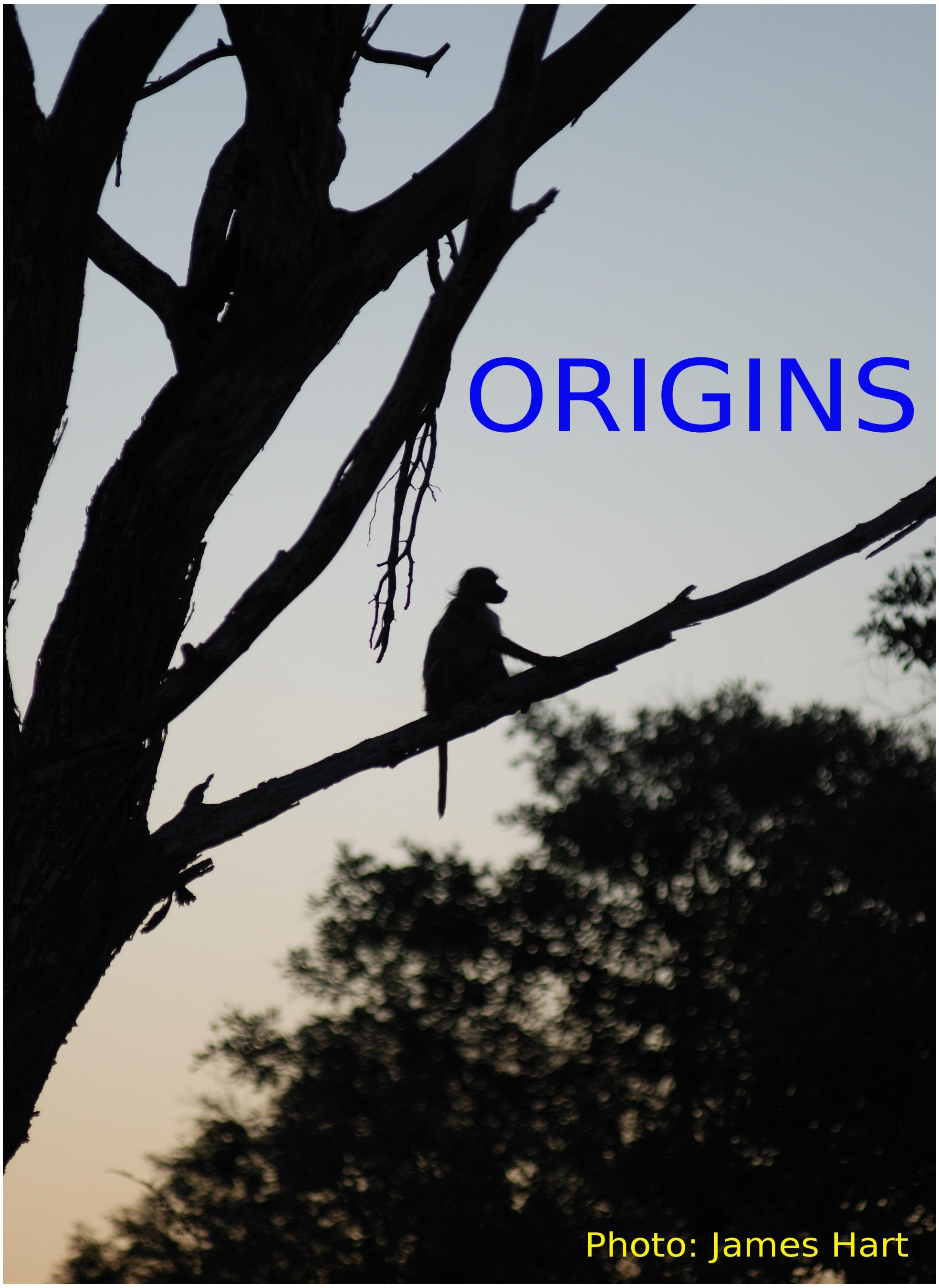
Those organisms that have heteromorphic sex chromosomes have the chromosome for maleness designated the Y chromosome, and the chromosome for femaleness designated the X chromosome. Except for two small regions of the Y-chromosome [the pseudo-autosomal region] there is no recombination of the X and Y-chromosomes that takes place during meiosis. Thus it is transmitted from father to son without change, other than copying errors, and passes on 2% of the father’s genetic material.

Sex chromosome analysis has proven useful not only in tracing lineages involving global migrations of humankind, but also as a tool for elucidating detailed gamodeme relationships. Hammer et al, [1997, 2000], for example, discussed the Y chromosome distribution amongst the people within the Jewish Diaspora. Commencing with a study of the Jewish Priesthood [Cohanim], membership of which is determined entirely by patrilineal descent, they determined that the patrilineal practice antedated the separation into Ashkenazi and Sephardic communities that originated during the last millennium. These two communities today show a different phenotypic makeup. Later, it was shown that Jewish populations from such diverse regions as Africa, Asia and Europe shared common Y-chromosomal characteristics with non-Jewish Middle Eastern populations, particularly those of Syria and Palestine. This common linkage probably dates back to exile from Babylon in 586 B.C. Moreover, there has been relatively little admixture with the local populations wherein the Jewish communities now reside.

CHAPTER FOUR

HUMANKIND

"I have discovered that, to my astonishment, we are all connected through our mothers to only a handful of women living tens of thousands of years ago" The Seven Daughters of Eve [Bryan Sykes, 2001, page 2].



Evolution of the Hominoidea phylogeny occurred during the Cenozoic Era [figure 19], which is marked by a gradual reduction in atmospheric temperature and the re-establishment of a zoned climatic scheme with associated vegetative zones. The Hominoidea were part of their local ecology and primarily adapted to climate and vegetation, and it was the changes in climate and associated vegetation that applied a major selection pressure that led to evolutionary divergences within the group.

Hominoid fossilized remains can be placed along a trend indicating a probable developmental sequence of types from ancestral forms found in the Miocene of East Africa some 22 million years ago. Further finds indicated that these early ancestors migrated into Europe and Asia some 17 millions years ago and the lineage eventually diverged into the African Great Apes and Hominini phylogenies 6-7 million years ago. Molecular time-scale, measurements place the divergence at about 1 million years before the then oldest known Hominini ***Australopithecus afarensis*** [5 to 6 million years ago]. Earlier Sarich and Wilson [1967] estimated the divergence to have taken place about 4-7 millions years ago but more recent discoveries from Chad of a transitional form between ***Pan*** and the hominids has narrowed this down to between 6 to 7 million years [Upper Miocene Epoch]. The Chad form is called ***Sahelanthropus tchadensis***, and has a brain case similar to ***Pan***, but teeth and facial features that resemble Hominini [Nature, July 11th, 2002]. The small brain case of ***Sahelanthropus*** places it as a transitional form to ***Australopithecus***.

Three phases of Hominini evolution are apparent and probably relate directly to the changing climatic conditions. The first phase was the ***Australopithecus*** phase that saw the evolution of the Hominini from the Dryopithecines. The genus ***Dryopithecus***, the probable ancestor of the Hominini, last occurred in the fossil record some 8 million years ago. It existed in Southern Europe and Central Asia and it is from the Dryopithecines that the ancestors of the bipedal form ***Australopithecus*** probably arose and migrated from Asia into Africa [Begun, 2003]. Molecular data has supported the paleontological determination that divergence was from the Dryopithecines.

Probably the most critical event was that around 2.4 million years ago, during the Pliocene Epoch, the temperature began to drop radically eventually leading to the Pleistocene Glacial Epoch. Adaptations in the vegetation to the changing climate resulted in the re-establishment of more strongly defined vegetation zones: and consequently more strongly defined environmental niches. ***Australopithecus*** evolved in to ***A. africanus*** and ***A. garh***i and eventually adapted, initially diverging into forms such as ***Homo habilis*** [1.8 million years ago], and ***Homo ergaster*** [1.75 million years ago], from which evolved and ***H. heidelbergensis***. It was the many fluctuations in temperature that caused the vegetation changes in Africa, especially the reduction of the forested areas and their replacement by dryer savanna. Areas that were previously savanna were replaced by semi-arid and arid conditions.

Australopithecus was an arboreal hominoid with a cranial capacity of approximately 450cc. The bipedal species ***Australopithecus afarensis*** has facial, body and limb bones of a hominid. Clear hominid fossils are recognized in sediments from the top of the Pliocene Epoch and I personally use only the two genera ***Australopithecus*** and ***Homo*** to represent the Hominini line. Many believe that the Hominini line can be defined by the development of tool making on a large scale. ***Pan*** uses natural objects as tools and presumable so did ***Australopithecus*** but the first stone tools do not appear until around two million years ago with the advent of ***Homo habilis***. Use of tools and weapons, and the quality of these objects, is an important concept for site recognition within the lineage.

About 800,000 ybp marked climatic and vegetation fluctuations occurred as a series of waxing and waning of glacial conditions. The effects can be observed principally over the northern hemisphere but were global in scope. These fluctuations influenced the selection pressure on the arboreal Hominini and led to the development of ***Homo heidelburgensis*** [350,000 years ago], ***Homo neanderthalensis*** [300,000 years ago]; and, eventually ***Homo sapiens*** [150,000 years ago]. The last severe glaciation in Europe was the Wurm glaciation and lasted from about 65,000 years ago until about 11,500 years ago. It was during this period that ***Homo neanderthalensis***, around 30,000 years ago, and ***Homo erectus***, around 50,000 years ago, eventually became extinct, and Homo sapiens came to dominate Earth.

Part of the confusion in the literature associated with the lineage of ***Homo*** is caused by the small number of specimens available for study. Initially I was a taxonomist who worked with samples of ancient rocks that may contain 10,000 specimens [or more] per gram. Working with microfossils the phylogenic plexus that encompasses morphospecies, holomorphospecies, paleospecies and chronospecies provides an insight that is different from that of the scientists more familiar with biospecies from a living population [extant biocoenosis]. The problem with the fossil record for ***Homo*** is that palaeo-anthropologists have so little material available that they cannot get much of an understanding of intra-species variation. The approach had to be that of the taxonomic splitter and the use of numerous morphospecies [a species that is tightly defined around the morphology of a single specimen]. If we look at the Hominini family tree as present in the literature we have the following taxa [the length of existence is given in brackets]. ***Orrorin tugenensis*** [>100,000], ***Ardipithecus ramidus*** [>100,000], ***Australopithecus anamensis*** [>300,000], ***Australopithecus afarensis*** [>1,000,000], ***Australopithecus africanus*** [>500,000], ***Australopithecus*** [or **Paranthropus] robustus**, [>100,000], ***Australopithecus*** [or ***Paranthropus***] ***boisei*** [>1,000,000],, ***Australopithecus*** [or ***Paranthropus***] ***aethiopicus*** [>1,000,000],, ***Homo ghari***, [?], ***Homo rudolfensis***, [>600,000], ***Homo habilis***, [>400,000], ***Homo ergaster***, [>300,000], ***Homo erectus***, [>700,000], ***Homo heidelburgensis***, [>400,000], ***Homo neanderthalensis***, [>300,000], and ***Homo***

sapiens, [>200,000]. To these one can add the genera ***Ardipithecus***, ***Kenyanthropus*** and a few others and this is for ONLY the last 5,000,000 years1. A conservative estimate for the life of a chronospecies in the paleontological record I would place at a minimum of 5 million years. This has little to do with the resolution of the rock record as paleontologists have methods that can resolve better than this figure in many cases. It has much to do with the availability of material. Unless the Hominini underwent a unique explosive evolution about 5,000,000 years ago [which is possible] then much of what is current being said about the phylogeny of ***Homo*** is pure conjecture necessitated by the paucity of the fossil record. A strict cladistic approach to Hominini taxonomy has yet to become stable. The extraction of reliable genetic material from fossilized remains would greatly improve our knowledge but for the moment all interpretations of the taxonomic relationships of the fossil materials is speculative. My own ideas are somewhat akin to Relethford [2003] and Prothero [2007] although differ because of our different scientific background.

The change to grasslands, and semi-arid lands undoubtedly put tremendous selection pressure on the Hominini because they were now more vulnerable to predators. When ***Australopithecus*** gave rise to the earliest ***Homo***, about 2 million years ago [this can be called ***Homo habilis***], increased intelligence [as manifested in increased cranial capacity] could have been the key to survival. Certainly the change to ***Homo habilis*** was characterized by a cranial capacity of some 700-800 cc. Bipedalism is thought to have occurred in ***Australopithecus*** and was surely also characteristic of ***Homo habilis***. ***Homo habilis*** is believed to have evolved into ***Homo erectus*** some 1.75 million years ago. The suggestion by Relethford [2001, P. 46-47] that ***Homo erectus*** was possibly the first form that was truly bipedal is difficult to understand. ***Australopithecus*** is thought to have continued until about one million years ago coexisting with the early populations of ***Homo erectus*** in Africa.

As ***Homo habilis*** was evolving into ***Homo erectus***, the geography was changing, and in particular climatic changes were causing local ecological stress. These changes in the environmental selection pressures were probably the reason that ***Homo*** migrated out of northern Africa into the Middle East. ***Homo erectus*** is regarded by many as the first major wave of ***Homo*** out-of Africa [1.7 mybp] moving into eastern Asia, but ***Homo habilis*** might have actually preceded that species. That ***Homo*** commenced emigrating shortly after its initial appearance in Africa is "testimony to a species capable of long-distance movement and adaptation to a variety of environments across much of the Old World" [Relethford] makes sense, but the reason ***Australopithecus*** never left Africa probably had more to do with ecology. ***Homo erectus*** certainly migrated long distances and by 1.5 million years ago had moved into central and southeast Asia where it existed until about 50,000 years ago.

Remnant populations of ***Homo erectus*** continued in Africa and later gave rise to ***Homo heidelburgensis***, which may represent the second migration out of Africa some 200,000 years ago [third if we accept an initial ***Homo habilis*** migration]. ***Homo heidelburgensis*** eventually diverged into ***Homo neanderthalensis*** [in the Middle East?] which migrated into, and became adapted to, cooler climate of Western Europe. The overriding selection pressure exerted by the climatic effect probably placed ***Homo neanderthalensis*** in semi-isolation in the more frigid Europe and ***Homo erectus*** in semi-isolation in Asia. During this time period ***Homo erectus*** continues in Africa and eventually diverged into ***Homo sapiens*** some 150,000 years ago and spread outwards as the third [or fourth] wave of migration into the Middle East around 120,000 years[2]. By 60,000 ybp ***Homo sapiens*** was in Australia, and by 50,000 ybp it dominated Eastern Asia. In Europe it took longer to oust ***Homo neanderthalensis*** and it is uncertain whether or not the two species actually competed: they definitively co-existed. However, by 24,000 years ago ***Homo neanderthalensis*** was extinct and ***Homo sapiens*** dominated the Earth.

The phylogeny of any group of fossil organisms is difficult to break down into species taxa. When determining the point in time that we recognize ***Homo sapiens*** as a novel species, there is heavy weighting upon the cranial capacity variable: at least when it comes to the physical recognition of the fossil specimen. ***Homo sapiens*** certainly had a large cranial capacity [but so did ***Homo neanderthalensis***]. I believe the genus ***Homo*** is defined by its creative imagination and its propensity for cultural complexity: characteristics that make our species adaptively distinct amongst the entire plexus of living systems. Whilst agreeing that it is impossible to recognize creativity directly in the fossil record, the archaeological record can provide some information on cultural complexity, and reconstruction of brain shape and speech mechanisms may allow indirect interpretations. Certainly the deliberate making of fire and of weapons is indicative of a creative imagination. The Swartkop Caves of South Africa have yielded evidence that early man used fire some 1.5 million years ago; although not necessarily that there was knowledge of how to start fire. I have always liked, my former colleague, Ray Dart's idea of 'man the weapon maker', as part of the informal definition of ***H. sapiens.***[3]

Many spectacular finds made in the last century may be used to indicate advancement in both imagination and cultural complexity. For example, there is evidence from the Schoningen area of Germany, that cooperative hunting using weapons took place some 400,000 years ago. Three well-balanced wooden spears indicate this. Similarly, the axe-head [called Excalibur] from the Atapuerca area of Spain, dated at approximately 350,000 years old, has been used in its association with apparently deliberatively buried ***Homo heidelburgensis*** remains as evidence of a burial ceremony. These suggestions are much earlier than conventional thought places the development of a cultural consciousness in ***Homo***. They do play well with the idea of using emerging imagination to define ***Homo***.

Many artifacts indicating a cultural consciousness are in the 30-40,000 year old range. These include such indicators as the paintings of Chauvet Cave of France and the fabric impressions in clay dated at 27,000 years from the Czech Republic.

As a final note geography was clearly the primarily reason that our species began to diverge into partially geographically isolated gamodemes in Africa [with the Sahara as a barrier], Australia [with the ocean as a barrier], Southern Africa [with the Kalahari as a barrier], Eastern Asia and Europe [with distance as a barrier]4. This divergence is the basis for racial grouping that were used within ***H. sapiens***. By the 15th century BC this division began to rapidly break down as the geographic barriers were breached5.

GENETIC EVIDENCE FOR HOMINI EVOLUTION

The work on a molecular clock for the Homininі tends to underestimate dates but otherwise provides reasonable relative estimates of the relationships amongst taxa6.

Studies of mitochondrial DNA from a variety of extant populations by Sykes, Cann et al, and others suggested that all the modern gamodemes of ***Homo sapiens*** contain genetic material from a common female ancestor who existed some 200,000 years ago. This can be taken as the arbitrary time when modern variants of ***Homo sapiens*** evolved7. It MUST be remembered that ***Homo erectus*** is a morphospecies focal point in the lineage that initially evolved into ***Homo sapiens*** probably by orthogenesis. The decision where to place the boundary is an arbitrary one defined by a 'competent systematicist'8.

Studies on the Y-chromosome suggest that all modern males shared a male ancestor 60,000 ybp9. More recently, Chinese and American geneticists examined Y-chromosome markers from 12,127 males from across East Asia and asserted they all traced their ancestry back to Africa 35-89,000 YBP. They used three chromosome mutations known from extant African populations and discovered that within their sample all individuals carried at least one of those markers.

The fact that the broadest range of genetic variation found in our species occurs in the modern African populations, and also those populations contain the oldest alleles, suggests a pure out-of-Africa origin for ***Homo sapiens*** [the African Replacement hypothesis]. However, it is important to note that all scientists who have studied the question of humankind's origin do not accept the out-of-Africa hypothesis. The alternate hypothesis is the Multi-regional hypothesis, which has ***Homo sapiens*** evolving throughout the geographic range of ***Homo erectus*** by simple orthogenesis in each region. The present-day cultural gamodemes, which are basic regional groups of humankind; and, are thought to have originated early have been used to support this hypothesis that the variants of humankind developed separately from specific gamodemes of ***Homo erectus***. The multi-regional approach has been criticized by some scientists as being politically incorrect10. I believe the use of a criterion such as *politically correctness* is extremely bad science11.

Relethford [2001] concluded that a mainly out-of-Africa origin of humanity was likely but without replacement: developing a multi-regional approach with genetic drift altering indigenous populations. He presented a strongly analytical approach and examined evidence from molecular biology, population genetics, archaeology and paleontology and avoids the politically correct overtones of Sykes.

Whereas both theories are logically internally consistent the present evidence indicates ***Homo sapiens*** was a novel form which came out of Africa and completely replaced ***Homo neanderthalensi***s in Europe and the Middle East and ***Homo erectus*** in Asia. There was no interbreeding between ***Homo neanderthalensis*** and ***Homo erectus*** or between those two and ***Homo sapiens***12. The question of interbreeding has been brought up by a number of scientists and it was thought that mtDNA evidence would settle this question after Svante Paabo [1997] extracted material from a specimen of ***Homo neanderthalensis.*** When compared with modern Europeans no similarities were found and suggested the species were clearly genetically separated. Unfortunately, since that time Adcock [2001] reported similar findings for a ***H. sapiens*** specimen from 62,000 ybp from Lake Mungo [specimen LM3]. The mtDNA differed as much from modern ***H. sapiens*** as did the Neanderthal specimen. Recent fossil comparisons [Walpoff, Science Jan. 12, 2002] suggested European ***H. sapiens*** showed neanderthalian traits and Australian specimens showed Indonesian traits. The final decision is still pending and awaits more evidence13.

Well's recently concluded that ***H. sapiens*** did not begin to migrate out of Africa until around 60,000 ybp. The suggestion is that a small band [or bands] migrated northwards into the Middle East. The descendents of this band [or bands] eventually formed all of the other ***Homo*** clans that populated the rest of the world i. e. the evolution of ***H. sapiens*** from ***H. erectus*** took place in Africa and ***H. erectus*** moved into Asia 1.7 mybp at approximately the same time ***H. neanderthalensis*** moved into northern Europe. ***Homo sapiens*** commenced to occupy Northern Europe and Asia some 50,000 years ago; and, the Americas sometime between 35,000 and 13,000 years ago [the period during which the northern land-bride existed]. The story that the geneticists tell is a fascinating and convincing one, marred only by the occasional attempt to give some of the story a politically correct twist. Of significance to humankind's future venture into our Universe is that this story implies that initial groups of say a hundred individuals from ***Homo sapiens*** or their descendents could populate the Universe.

EVOLUTION OF THE CULTURAL GAMODEME

Originating some 2 million years ago our genus ***Homo*** is observed through its paleontological and cultural remains in Africa, Europe and Asia. The earliest cultural gamodeme is called the Oldowan of Homo erectus. The Oldowan gamodeme was African but, at least one sub-group migrated eastwards into Asia and the Cavcas [Caucasia] around 1.8 mybp [this may have given raise to ***Homo habilis***]. In Africa, the stem gamodeme evolved into ***Homo heidelburgensis***. From this a second wave of ***Homo*** migrations originated, and moved through the Levant into Europe forming the Aucheulen cultural gamodeme. Climatic selection pressure imposed by Ice Ages probably killed off all of the representatives of ***Homo heidelburgensis*** in Europe. By 250,000 mybp ***Homo neanderthalensis*** evolved and established itself in Europe. Shortly afterwards, ***Homo sapiens*** evolved in Africa and is represented by the African Middle Stone Age gamodeme. It is from this group that the rest of Earth was colonized by the late African Stone Age [Upper Paleolithic].

Both mtDNA and Y-chromosomal evidence indicate all of the present day gamodemes outside of Africa originated from one, and only one, of the gamodemes present throughout Africa. Somewhere in the time-span of 95,000 to 70,000 years ago a group of African's split off, from what Stephan Oppenheimer [2003] called the L3 group [gamodeme], and migrated eastwards into Yemen and across the Arabian Peninsular to India. Oppenheimer called these the Nasreen and Manju clans. The Manju gamodeme established and evolved in India and Pakistan and did not penetrate western Asia. However, further migration of the Nasreen established new gamodemes in south-east Asia and China [75,000 ybp] and Australia [70,000 ybp]. Migrating from both China and Pakistan people moved into Central Asia [40,000 ybp], to establish independent gamodemes. Additional migration from Pakistan and India took place via the Middle East. This led to the establishment of the European gamodeme 45-50,000 ybp. 20-30,000 ybp this European gamodeme was supplemented by an eastward migration from Central Asia. Finally, around 25,000 ybp ***Homo sapiens*** crossed the Bering Straight from north-east Asia to establish the American gamodeme. The genetic evidence indicates that by 20,000 ybp there were probably seven [7] major gamodemes, and numerous smaller partial gamodemes, existing on Earth. These were physical gamodemes with, almost certainly, a dominant, evolving, cultural gamodeme.

1. African gamodemes [there were more than one]
2. India-Pakistan
3. Australasian
4. Asian
5. American.
6. East European

7. West European

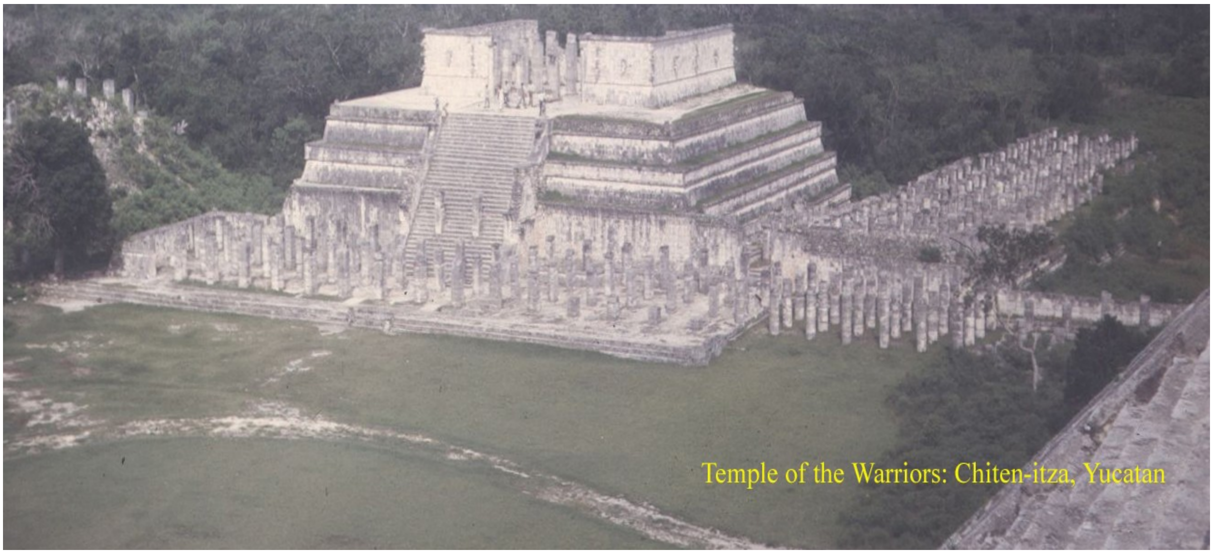
Oppenheimer [Appendices, 2003] describes the detailed lineages through which these gamodemes can be derived. That these major gamodemes continues until recent times had to do with containment by physical and climatic barriers – today these barriers are no longer insurmountable and the individual gamodemes are being rapidly broken down to form a global gamodeme. Trade, the economic benefits and the developing corporate ethic is causing the cultural gamodemes to merge more rapidly than the physical gamodemes. From the point of view of Evolution this makes sense because it injects variability into all of the existing gamodemes – variability that can be acted upon by the total environment and provide potential for the further evolution of humankind. The modification of the cultural gamodemes present a much broader set of problems than does simple interbreeding primarily because we ARE ***Homo sapiens*** [thinking man]. It is this set of problems that future society must address and which can yield to solutions based upon evolutionary theory.

The interbreeding populations are not simply products of the evolutionary process acting on physical populations but are socio-ethnic interbreeding populations – the cultural gamodemes. These gamodemes are the products of geographic isolation as are the physical gamodemes but their evolution also has been constrained by our humanity. They are products of the collective minds of the cultural gamodemes following evolutionary principals. The selection pressures on the cultural gamodemes are primarily population [numbers and density], and the availability and utilization of resources. Minor pressures are exerted internally by sub-cultures that have their own demands and externally by competition with other cultural gamodemes. Predominantly society has evolved by the effects of one of the minor selection pressures acting upwards and outwards from a sub-culture within the overall cultural gamodeme. These minor pressures have caused a huge increase in the number of people existing but more critically have caused a near catastrophic increase in population density. The habitable Earth has finite size and finite resources.

The resource needs of individuals form a basic hexagonal cage within which humanity operates [figure 1]. In the pursuit of these basic resources individuals reacted with others to form the initial cultural gamodemes. Initially, physical and cultural gamodemes, presumably, were based primarily upon family units extending over an enlarged kinship system. Dominant male presumably had prime access to breeding females; and the young were probably protected by both sexes. The individual needs for resources, both physical and human, leads to social conflict in all cultural gamodemes. The process is no different from that seen within a population of baboons. Co-operation is a necessary trait to diminish conflict; and the sub-division of labor is a way in which power can be divided and exercised at the secondary level. This is the way Archaeosociety evolved. With increased numbers and especially, population density, conflict resolution became critical and leads to various methods of social control: from brute force, through religion, to political activity. This is the way Protosociety evolved. Knowledge always has been an important resource for survival of both the individual and the gamodeme but as population numbers increased knowledge in the form of language, mathematics and technology has become the prime resource of advanced gamodemes. This is the way Eusociety is developing. The basic core of language, mathematics and technology has an outer core of the humanities, sciences and arts that provide a greater insight into our nature and place in our Universe [figure 2]. The cultural gamodeme is maintained both a unity and a controlled evolution by surrounding the inner and outer core with a shell of Procedural Policies, Politics and Law. Currently, these three shells form the sphere within which the cultural and physical gamodemes are evolving. Most likely this sphere will be evolve as the basis of humanities collective consciousness in our phylogenetic offspring: ***Robotico earthensis***.

THE CULTURAL GAMODEME

THE SOURCE OF HUMANITY



Temple of the Warriors: Chiten-itza, Yucatan

In this second section I want to put forward the basic idea that our humanity is a product of evolutionary processes. The mind of ***Homo sapiens*** has evolved, constrained partially by the selection pressures of population growth and population density, into the cultural gamodemes existing today. These socio-ethnic interbreeding populations are products of the collective minds following evolutionary principles: they are the cultural gamodemes. The social control ensuing is an evolved product of mind; and, the social conditions produced are the interaction of this social control with the populations.

The sum of the collective consciousness of the cultural gamodemes is embodied in the idea of humanity. Humankind's goals, desires and progress are products of the eccentricities of our collective humanity and their distillations are cultural traits of our genus. Humanity must be maintained in our future phylogeny as necessary attributes for ***Homo*** to colonize our Universe, for they provide a flexibility that allows adaptation to changing conditions.

MAINTAINING POTENTIAL

Diversity of humankind and of the cultural gamodeme will probably be a part of the future because choice will be considerably more effective: and maybe only have temporary effects dictated by the individual. Moreover, it is a fundamental observation of population ecology that population diversity supports population stability. In a society that is free of disease, where individuals have a long and youthful life, and live their life based upon their ability and effort, things will be different as choices proliferate. Moral attitudes we deem questionable or wrong today may not be so in the future, for life will be lived more for pleasure and less for necessity.

Science reveals that the physical differences amongst people are genetically trivial; however, it is highly unlikely that the variations in skin color, facial features and general appearances will disappear because 'beauty is in the eye of the beholder'. Physical diversity will be more of a choice made by parents than by chance, but the common complement of attributes we observe in humankind today will be supplemented. Some of these modifications will be 'fad' such as temporary green hair that is photosynthesizing. Others will be permanent adaptations for new environments. As nanotechnology advances the location of the sense organs need not be in the same spot as biology has placed them: and may be supplemented by other novel senses. Genetic modifications will allow humankind to exist in a variety of climatic zones, both here on Earth and elsewhere in our stellar system. If we so choose the inclusion of an anti-freeze gene in the human genome will allow individuals to colonize frigid zones. The arid zone can be conquered by genetic modifications of the skin and breathing / cooling mechanisms, allowing the retention of water within our bodies; and, the future may see the addition of gills by modification of the breathing system. This will open-up an entirely new environment for real colonization on Earth: the oceans. Beyond obvious modifications in the human form lie changes for extra-terrestrial conditions: from gravity to atmosphere.

Earth currently exhibits a latitudinal population diversity gradient related to the temperature at which chemical reactions take place. It is this temperature gradient that determined that the equatorial latitudes have greater diversity than the frigid latitudes; and, that population density is more erratic in the Polar regions. Superimposed upon this latitudinal gradient are the actions of predatory humankind that have modified the present-day observed diversity.

As far as the incorporation of permanent new traits into the genotype is concerned, time will remain a factor in human development. One will probably need more than a single generation of modified humans prior to general acceptance and incorporation of a particular trait. Remorse may come when a new individual states "**I did not ask to be born**"; and, we have played the role of the creator. However, this is still not a moral issue. There are possibilities on the horizon to fix even this problem. Scientists are intensely studying the ways in which genetic traits are switched on and off. It may be possible to provide any novel trait, incorporated in the zygote by germ line engineering, with a genetic switch. This genetic switch will allow an individual gene to be turned off or on by the individual that possesses it, at any time in the future.

There is the possibility of truly exotic abilities to be incorporated in an individual. As nanotechnology advances so will the development and implantation of machines to replace poorly functioning natural organs. Improvements over a wide range may prove of great advantage to certain professions. Imagine a human with the smelling ability of a bloodhound and consider its use to a forensic scientist or criminal investigator. Whereas, gills and improved senses may be initially an 'add-on', there incorporation in to ***Homo roboticus*** and ***Robotico earthensis*** are sure.

WHAT IS HUMANITY?

The essence of humankind is encompassed by the concept of humanity. Unfortunately, despite a long history of attempts, there is still no consensus on what truly defines humanity. One approach is to proscribe a definition that relates it to those traits common to the collective consciousness of humankind. As humankind evolves into a global cultural gamodeme future society will require a more coherent definition as the concept of humanity in one ethno-cultural group blends with that of another. Behavioral geneticists use the term endophenotype as the building block of a behavioral trait, in an attempt to recognize the component parts that cause a trait to develop. The idea is that a number of endophenotypes react with the environment to produce the phenotype of the individual. The understanding of humankinds endophenotypes may become the basis of a scientific understanding of our humanity.

Without a catalog of human traits that affect the cultural gamodemes it will be difficult to develop humanity in our robotic descendents. Brown [1991, 2000] discussed universal human traits common amongst Earth's diverse ethno-social groups. Some of these traits, such as duty, honor, service and patriotism may not be universal traits at all. Others, such as the so-called religious virtues of love, compassion and charity may be universal. Whether such traits are hardwired into our genome, or are conditional traits derived as emergence phenomena from our experiences, is somewhat immaterial if one uses the Law of Combinatorial Outcome as a basis for understanding their operation.

Consciousness and an introspective ability is the combined exception that sets the concept of humanity apart from other traits of living systems. In this regard humanity becomes a collective trait of ***Homo***, involving the adaptability of the human mind. As with other traits, it is a consequence of selection pressure. This approach to humanity is particularly interesting in that it has evolved as a collective trait that is primarily concerned with regulatory control on the population. Of course, its development has involved much more than thinking-up greater means of social control, more regulations and adding more regulators! Nevertheless, it ramifies throughout cultural gamodemes as a control on conscious action.

At the root of the development of the humanity trait[s] is logic. One can think of logic as analogous with the DNA sequence, and humanity traits as analogous with the proteins that subsequently develop. This root is not surprising for logic lies at the foundation of all natural systems. It is the basis of the Law of Combinatorial Outcome and thus the basis of mind; and, indeed, is the key to understanding our Universe as a whole. Any attempt to understand and define humanity must recognize, above all, that logic lies at the fundament. Moreover, logic developed as a natural stage in the evolution of matter in our Universe. Humanity emerged in modern ***Homo sapiens*** as logic became established as a basic trait of the species. Once logic was established the other traits associated with humanity could be derived: honesty, work motivation, preferential love, a sense of fairness and of justice. All of these have distinct counterparts in a single cell, where chemical affinity equates with preferential love, chemical reaction with work motivation, and, chemical binding with honesty.

Humanity is often associated with the related concept of humanism but humanism is not a necessary part of humanity. Humanism is an educational ideal, one of the foundations of which is the human potential to achieve good. Whether humanism should be part of the consciousness of our future descendents is an ethical issue that is of no small importance for, as an ideal, the humanist approach has been neither accepted nor used much by ***Homo sapiens***. However, because many believe that 'humanism' is a significant part of the essence of humanity then humanism needs to be considered as a potential part of ***Robotico earthensis***' consciousness.

In describing the humanist approach to problem analysis and decision making Lagay [1999] sets out five characteristics that I believe do add value to a more general definition of humanity.

1. Humanism **"aims to discover moral truth by subjecting candidate moral judgments to the requirement of consensus by all whom the judgment would affect"**. Consensus is a tricky issue for it means that everyone agrees with the decision. Nevertheless the statement may provide a moral legitimacy to the exclusion of some groups in the decision making process, if 'all who the judgments would effect' is a specific subset of ***Homo sapiens*** e. g. the gamodeme that will occupy a Space Liner. Representative democracy can operate within the framework of consensus if certain decision rules are in place i. e. the representative has the authority to make a decision on behalf of all represented.
2. Humanism **"goes beyond logic for its methodology, admitting deeply held values, emotions, and convictions to the debate"**. This statement is conceptually Greek in its origins. Lagay noted, **"The Greeks well understood that emotion generates knowledge, self-knowledge particularly, and confers practical wisdom, tolerance and compassion. ……… The**

important role of emotion in judgment and its connection to our sense of values and valuing represent a welcome supplement to the dominance of logical empiricism in the philosophy of the early twentieth century." That values, emotions and convictions are not the result of the logical necessity of local selection pressure is unlikely. To my mind logic lies at the fundament of all aspects of debate. This is particularly so when one considers that the mind uses a combinatorial decision making process to produce 'emergent' ideas. The use of deeply held values, emotions and convictions in debate are powerful methods for seeking truth. Most often debate takes the form of a logical analysis of pro's and con's but sometimes it relies upon the emotions: allowing outrageous statements to be made, designed to attack the emotions of the opposition, and monitoring the results. Outrageous statements are a valid method of debate designed to throw people off-balance and force them to use their imagination, either in defense or to get their ideas flowing. The use of offensive statements in debate is quite different, and shows a lack of self-control. Today many, if not most, shy away from truly debating the important issues that affect the human gamodeme and instead attempt to regulate against even exploring such issues e. g. political correctness.

3. Humanism **"respects others' views as moral and reasonable when they can be defended as such"**. This is logical and assuredly must be built into ***Robotico earthensis***. This is part of the foundation of Institutional Democracy and allows for a system of checks and balances designed to achieve an optimum outcome through the process of rhetoric. The logical nature of consciousness within an individual has an analog within the group. This is the method of rhetorical analysis to reach a decision that affects the group. Rhetorical analysis is a structured method of reasoning that evolved in the cultural gamodeme to reach decisions. Like individual consciousness it operates under the Law of Combinatorial Outcome but does not necessary lead to consensus, nor does it need to. The reasoning process of rhetoric is structured to achieve an optimum result. Consensus is not fundamental to the concept of rhetoric. Society has devised methods of by-passing true consensus. By allowing the rhetorical process to require consensus only within the decision-making group. Moreover, decision rules are set-up that allow agreement by a majority as acceptance. This is how much of society has functioned throughout history although not necessarily under the umbrella of democracy or the Rule of Law.
4. Humanism **"is historic and context-sensitive"**. This is a logical constraint but historic sensitivity should only start with historic fact not some historians' fiction. The accumulated knowledge of humankind's history should be taken into account in the

combinatorial outcome process in ***R. earthensis***' consciousness. The complexity of conscious decision-making will ramify especially through political decisions that must be made by ***Robotico***. The way in which the cultural gamodeme uses the result of rhetorical analysis is quite dependent upon the level of social organization of the particular gamodeme. Rhetorical consensus is one thing amongst the Kung! Bushmen of the Kalahari and another in the North Korea of 2008. Here, perhaps lies the most critical need for an optimum method to be built into manufactured consciousness. The envisioned spatial and temporal scope that will define that essence of humanity to be included in ***Robotico earthensis***' is large.

5. Humanism "**places trust in human ability and desire to reach moral consensus**". This is a logical constraint to avoid conflict but is invalid when the engaging parties have different ethical standards and moral values. Indeed, history shows that many do not follow this ideal at all but instead are opportunistic and greed-driven. Realistically the world still has many tribal values, especially where one tribe or group contrasts itself with another tribe or group and believes that it is morally and naturally superior to the rest. Democracy can handle these tribal differences until they get to the level that one group steps outside the boundary of humanity: as was the case with the German Nazi Party; with the Khmer Rouge; and, with the fundamental Muslims attack on the United States of America on September 11th, 2001. The mistakes the world made with the first two examples were, in the former, to organize and retaliate too late; and in the latter to do nothing at all. Whether this was through ignorance, sympathy with the perpetrators or fear of reprisal is immaterial: whatever the reason it showed a lack of willingness to defend democracy worldwide and a decidedly lack of humanity. The third case provides the present dilemma for democracy for it indeed touches a fundamental issue. The fundamental dilemma is how can democracy defend itself and remain democratic? In order to defend democracy against the forces that would destroy it society must discard some of the laws that govern it internally, and certainly act undemocratically. This I call militant democracy and its use by democratic forces is quite logical and seemingly inevitable. In defense: under such actions society is no more brutal than nature.

WHAT IS RACE?

From the viewpoint of a social historian morphological subgroups are important, because of the major influence of the idea of human races during historical times. Exploration, travel, emigration, immigration and the spread of materialistic ideas is destroying the historic cultural and genetic sub-groups. However, this does not make them disappear from human history. Today most of us abhor the concept of race when used in the context of 'racism', but our knowledge of the human genome does not invalidate the use of physical and cultural features as a method for classifying people in a social historical context. Neither should it negate such a methodology for studying the origin of the ethno-cultural geographic groups of humankind existing today. The simple recognition of sub-groups amongst humankind does NOT validate the idea of superior or inferior cultural gamodemes. Irrespective of how it is measured, every cultural gamodeme recognizes superior and inferior individuals, as Alfred Einstein, Mikhail Baryshnikov, and Mahatma Gandhi indicate on one hand; and, approximately 1/3 of the people confined within the US penal system attest on the other hand i. e. we recognize elitism.

The word race is like the word god in that it carries so much baggage with it that it is better avoided. If we need to use the term "race" I think that Little [2002, page 91] defined it in a way that is acceptable as: "a subdivision of [the] human population that is characterized by [trait] specialization to different environments". Unfortunately, abusive connotations are regularly associated with a definition of this kind by arbitrary defining many traits based upon false premises [see the excellent discussions by Graves, 2004]. When applied to the modern global cultural gamodeme the idea of race is often a harmful concept. The mere use of the word perpetuates false ideas and values and is best avoided when discussing modern and future social concepts. However, it has to be used to interpret past social ideas.

CHAPTER FIVE

PHYLOGENY OF THE CULTURAL GAMODEME

"There is a cultural imperative to evolve consciousness into a galactic presence". Lecture notes, LSU 1973.

The emerging roots of humanity can be seen in other organisms, particularly the social behavior of some animal species. Whereas this approach offers insight into the connectivity of living systems it is similar to seeing the origin of preferential love from chemical affinity: its origins are too deep to be of practical value. The potentials are even as deep as the chemical level.

Only after extensive adaptation and development did logic and consciousness evolve. This allowed individuals to acquire a strong concept of similarities and differences within their own gamodeme, and amongst natural objects. This logic of self-awareness became the driving force that pushed the selection pressure button leading to speech and the use of symbols that eventually led to the development of cultural gamodemes. The selfish gene [Dawkins, 1976] and evolutionary game theory [Smith, 1982] are important ideas that provide insight into the mechanisms of social behavior but the evolution of the humanity trait[s] appeared as adaptations as logic developed within consciousness.

Whatever taxonomic criteria are used, all of modern humankind is unquestionably placed in the same biological species. Undoubtedly, morphological sub-groups occur due to temporary isolation of populations but the reality of the world population is that there are far more sub-groups than the 'age of empire' recognized. Humankind is a continuous genetic plexus with definite geographically localized clusters that tend to look similar because they have interbred over a period of generations. Historically defined local clusters are the cultural gamodemes recognized by anthropologists, archaeologists, historians and sociologists. Recognition of these cultural gamodemes continues to have value in a societal context because they do allow the effects of partial isolation to be examined. Many of the humanity trait[s] seen in sub-groups, and much of what happens during their histories, can be analyzed using game theory applied to a set of non-random groups based on kinship. John Maynard Smith [1982], Axelrod [1984], and Trivers [1985] amongst others discuss this approach. These analytical methods do suggest that the processes of evolution are what influenced the origin and development of social behavior.

Ervin Laszlo [1987] grasped the fundamental relationship between the human gamodeme and culture. The social condition entails the cultural binding of individuals in the gamodeme through time. This network defines a culture by unison of characteristics in the same way as a paleospecies is defined. Indeed the culture itself is defined and delimited, similarly, by a competent systematicist [an archaeologist, anthropologist, historian, sociologist etc]. The self-organization of society into functional political and economic blocks is a result of the interaction of its parts, and those parts with the environment. This is not clearly an emergent phenomenon, as Laszlo would want. Society is bound together primarily by its cultures independently of the fact that individuals within a society tend to breed amongst themselves and pass on genetic traits. At the same time, genetic traits can become the dominant phenotype of that society which provides the associated ethnicity.

As Laszlo [p: 91] points out:

"The historically evolved social orders are constantly shaped by individual action and interaction and modified by changes in collective culture and public policy. The orders impose constraints on individual behavior, although these constraints are perceived as such only if they are out of phase with the values, expectation, and general cognitive map of individuals. In a relatively stable unstressed state of society, the constraints imposed by the spontaneously evolved social order appear as accepted forms of social intercourse. They bond individuals within kinship, community, or interest groups. In traditional societies myths and religion create the main kinds of social bonds, while modern societies produce many types of bonds and allegiances, cemented not only by mores and customs but also by legal and juridical systems and various rules governing public and person behavior."

That the social order of society follows the Law of Combinatorial Outcome is self-evident. The social mores, the rules and the laws that govern a particular cultural gamodeme, have evolved through well-established methods based upon individual thought, deliberation and group consensus. These weigh individual thought and group experience to determine and adapt to, the external and internal selection pressures that are brought to bear on all individuals that form the particular cultural gamodeme. The Law of Instability is clearly acting within and between the ethno-cultural gamodemes and shapes much of their histories. Just as in the physical gamodeme the imposed selection pressure alters the rate-of change. Pestilence and war, whilst devastatingly effective on the local society at the time they are active, can rapidly change a society's direction within a few generations, especially when conquest alters the tempo of change e.g. Japan after 1945. However, the fundamental needs of individuals within a society remain: food, sexual partners, shelter, protection [including health], knowledge, and companionship [fundamentally kinship]. These I call the basic needs of the individual and they are amongst the important needs that span all cultural gamodemes.

What is missing in many analyses of society is the enormity of the effect of geography and biota in establishing the populations that eventually evolved into the ethno-cultural gamodemes; and the overwhelming importance of selection pressure. Specific external physical controls have combined to form the selection pressure on populations in the past and present, and will affect humankind's future society: both on Earth and elsewhere. Throughout the history of humankinds phylogeny there has been an immense geographic effect on the gamodeme[s]: primarily determined by climate and terrain. The climatic factors of temperature and rainfall did not provide migrational barriers simply because they produced difficult terrain, such as deserts, frigid mountaintops and high latitudes. In their control of Earth's biota, climate critically affected the distribution of game and edible plants, and thereby the migrational routes of ancient peoples and the location, distribution and density of populations. In particular, the Laws of Instability and Actualism have asserted definite controls resulting in more similarities than differences in the development of the diverse ethno-cultural gamodemes. In addition, the Law of Combinatorial Outcome has influenced the development of diverse religious and political methodologies that have been used for social control within each cultural gamodeme.

Perhaps the most distinguishing feature that separates modern [last 11,500 years] and contemporaneous [today] humankind from the ancestral part of our phylogeny lies in the nature of that segment of our consciousness that defines us as human beings: our humanity. Our humanity traits are well tuned towards our social needs and welfare, because they are adaptive traits. Other sentient creatures display rudimentary forms of many of the characteristics shown by humankind – even self-awareness. The humanity trait can be summarized as the:

"degree of development and inter-relatedness of capabilities ……… that … contribute to a dynamic reflexive dimension of self-awareness that forms the platform for intentionality and exercise of free will [choice]" Lagay **[1999: page350-351]**.

The origin of this separation by consciousness probably lies in the development of four specific physical traits.

1. The development of structures allowing true speech1.
2. The development of hands that can manipulate objects in three dimensions.
3. The development of a highly mobile bipedal posture.
4. The development of a brain showing surprising plasticity.

All four traits contributed to the development of humankind's ability to reason and to imagine, and to apply intentionality and free will to the overall human condition.

THE CULTURAL IMPERATIVE

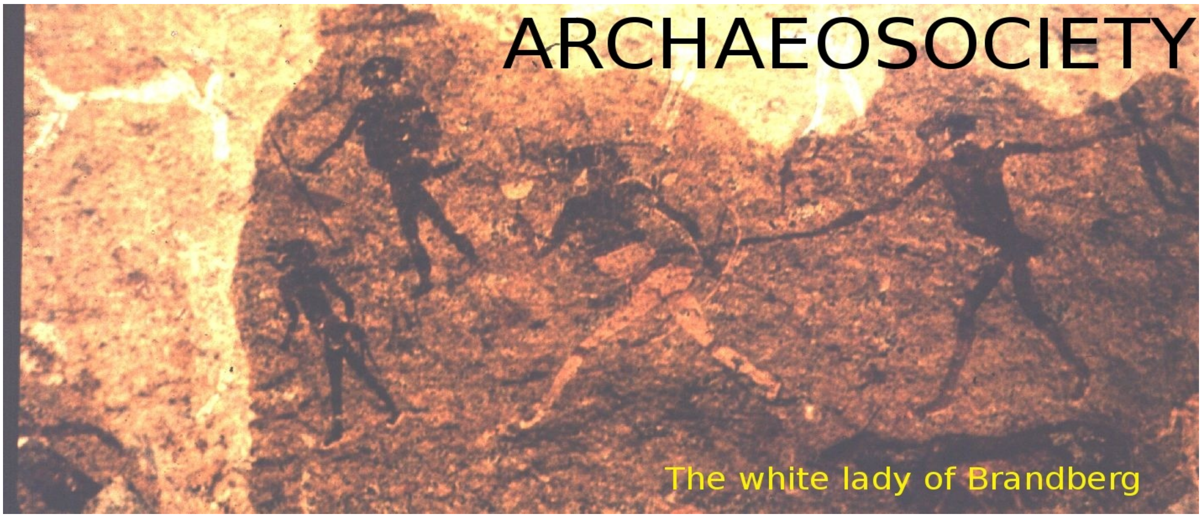
Science still needs to understand the depths of evolutionary controls on society and especially those factors that influence social control, social innovation and social change. We need scientific answers to such questions as the following.

1. How has the population pressure, resulting from increased numbers, affected the development of the cultural gamodemes? Increased social control is perhaps the major consequence but what are the others?
2. What causes new ideas to arise that direct social change?
3. What is the equivalent cladogenic process that pertains to the development of a new social movement?
4. What determines the success or failure of a new social movement?
5. How does the rate of change affect the success of social innovation?
6. What determines the fate and ultimate acceptance or extinction of a social movement?

Science does understand that the origin of organized society lies in adaptive necessary. Moreover, the natural structure of the simplest cultural gamodeme [the kin-based tribe] can be interpreted as a pecking order based upon strength and cunning. These can be starting points for understanding the evolutionary basis of the cultural gamodeme. As population density increased primitive culture became intertwined with nature, and natural law became more important not less. Reason and imagination led not simply to improved adaptation to the environment but the alteration of the environment so that it adapted to the presence of humankind. In these earliest cultural gamodemes those phenomena that could not be assimilated into human knowledge were classified as the result of some super-natural phenomena. Gods were invented, as those who were responsible for the unknown, and religion took hold within the cultural gamodeme. The earliest gods of humankind were gods of nature that acted within the earth, the water, the atmosphere and the sky. These gods controlled volcanoes, earthquakes, storms, winds and a whole myriad of natural catastrophic phenomena. Myth and legend became important tools of social control and brawn changed into brain as the controlling power passed into the hands of those that could interpret the will and reasoning of these gods: the priests. Today we see remnants of these beliefs in the animalism of parts of Africa south of the Sahara, and in the multiple gods of modern Indian society; and the Greek and Roman mythology that is at the root of European culture. The earliest cultural gamodemes form archaeosociety [the kin-based hunter-gatherer tribe], which evolved into protosociety [the interbreeding agrarian community with chieftains and city-states], which in turn evolved into eusociety [the nations, empires and religious hegemonies that sought cooperation]. The sequence archaeosociety to protosociety to eusociety is not a linear temporal sequence. Not only can all three types co-exist, but temporary reversals may occur. An analogy is the simultaneous existence of ***H. sapiens***, ***H. neanderthalensis***, and ***H. erectus***.

Myths, legends and religion are instrumental in enforcing social bonds in archeo- and proto-societies but terrain was most important in determining where these societies developed. Terrain factors such as the location of mountains, valleys and oceans greatly affected climate and vegetation and thus the migrational routes for both game and the early members of our genus. These became part of the origin myths found in many societies.

ARCHAEOSOCIETY



Common observations show that the combination of various geographical effects was evident in the isolation of the cultural gamodemes that formed the traditional interbreeding populations of ***Homo sapiens*** by the end of the Pleistocene Epoch [11,500 years ago]. By this time the archaeosociety of the hunter-gatherer was being replaced regionally by protosociety as agriculture developed. Because of the vagaries of the fossil record of terrestrial organisms we have a few fossil remains whereby the global distribution of ***Homo*** can be understood prior to the last ice age. A similar argument applies to early archaeological sites, especially those of coastal regions, where erosion is active. Coastal regions, suitable for archaeosociety to flourish, have undergone severe erosion and inundation since the end of the last glaciation. Add to this the problems of dating archaeological materials and we can see why we know little about the cultural gamodemes of early ***Homo sapiens*** and archaeosociety.

The climatic effect at the time of the early migrations of ***Homo sapiens*** out of Africa and into the Middle East was dominated by the changes that were causing the opening and closing of potential migrational routes. These were associated with the varying glacial conditions of the Pleistocene Epoch and especially the commencement of the last glacial phase some 65,000 ybp. This was true, not only, in the north where the frigid conditions waxed and waned but also in the 30° north and south latitudes where aridity was and still is a major barrier to migration on foot [the Sahara and the Kalahari deserts]. It is generally held amongst paleontologists and anthropologists that the earliest migrations of ***Homo sapiens*** consisted of small bands of hunters and gathers that wandered out of Africa and into the Middle East some 100,000 years ago. Whereas the out-of-Africa migration is almost conclusive the earliest actual migration of ***Homo sapiens*** may have been southwards, within Africa, giving raise to the Khoi [San peoples].

Oral tradition in many African societies, explains the origin of the tribe and its ancient migrations by way of myth and legend. Credo Mutwa [1963], the hereditary Witch Doctor of the Zulu Nation, and an old acquaintance of long ago, presents an oral history of the Bantu people that relies on the legends and myth of derivation from the Goddess of Creation2. Credo writes that in Zulu legend, the first people that the goddess created were the Khoi [San Bushmen] and the pygmies in the region of the Congo. They then migrated southwards into Southern Africa. This initial migration was into the rich game areas of southern Africa: not simply into the great internal deltaic basin of the Okavango Swamp, but also in the Etosha Pan of southwest Africa, the Makarikari pan of the Kalahari Desert, and the high and middle veldt to the tip of Southern Africa.

Lye and Murray [1980], again using oral history, suggested that the Khoi were both absorbed and dispossessed by the waves of the Tswana and the Sotho tribes, during a later migration of Bantu from the north down the central part of Southern Africa [figure 20].

Similarly, myths and legend suggest the migration of the Nguni People [also Bantu] down the east coast of Southern Africa and they again interacted with the Khoi and either absorbed them or forced them to migrate into the Kalahari Desert. The Khoi were further restricted by migration of the Herero down the west coast of Southern Africa. The driving force behind these early migrations was probably the result of increased population density [in the manner of the Xhosa noted later] and opportunistic developments that allowed for the six resource needs within a kinship group. In the earliest migrations sexual partners and protection came automatically with a kinship group, and permanent shelter was not necessary.

Migration by population pressure.

It is highly likely that the initial migration of our phylogeny out of Africa was similar to what is known about the Khoi of Southern Africa; and, was a consequence of a natural instinct to follow the migration pathways of game. This kind of migration may not have been driven by an increased population pressure. Even today a common cause of migration into new geographic areas by ***Homo*** is either, to exploit new resources, or, to seek a better living. Increased population density may, or may not, exacerbate this process.

We do know that population pressure is a major selection pressure driving the evolution, and migration, of all gamodemes. A modern human example is the southern expansion of the Xhosa population [a tribe of the Nguni Bantu] down the southeast coast of Africa during the last three hundred years. The mechanism of expansion was simply that as soon as the population [local tribe] became too big for the natural resources a small group split off, and migrated to 'empty land'. This was usually under the leadership of a son of a chief. Movement was rapid but there was not genetic isolation of these new gamodemes. Although this was primarily forced by population pressure, it was also opportunistic, because of available food supplies and pasture land and the relatively low level of resistance from the indigenous Khoi.

To obtain some idea of what was important to early humankind it is necessary to look at direct evidence and extrapolate backwards, using conjecture. The direct evidence is two-fold. Firstly, information from animal behavior and particularly from related primates. Extrapolating from observations of animal behavior we can assume that in small groups of early ***Homo sapiens*** 'might was right' and the dominant male ruled the pack. The young males may have been excluded from sexual partners except by cunning and stealth; and, often were forced out of the pack during adolescence. Secondly, we can use information from the earliest writing e.g., the Upanishads of India.

Developments in the cultural gamodeme probably occurred as attempts to preserve basic needs: providing a fertile ground for new ideas to arise that direct social change. A good example is the worship of fire seen in the Upanishads. One religious ritual demands worship of the fire-god immediately after awakening and immediately before going to bed: this ensures the fire is stoked and is not extinguished. The early Hindu writings ask many of the deep questions that human beings want answered and record answers to these questions that contribute toward social control. The answer to a question regularly can be seen as a basis for social control. For example, the answer to the question "Is there death in heaven?" led to the social acceptance of the caste structure because it leads to the idea of reincarnation. In a similar way a negative answer to the question "Did Adam have a belly-button?" leads to the belief in miracles and the literal authenticity of the Bible.

We speculate that the social organization of the early tribal bands contained a pecking order similar to that in our primate relatives, and was led by a dominant male. The general rule would probably be the one seen in animal behavior: the paramount imperative of individual survival and reproduction. However, judging by studies of other animals [Keddy, 2001] these bands were probably inherently egalitarian in most aspects of their interactions. Observations on the San Khoi of the Kalahari suggest a small group is egalitarian by necessity. The best hunter leads the hunt, the best healer is the shaman and often the elder [male or female] is the keeper of the tribal wisdom but a single leader is not always apparent. In the Kalahari San the population density and group size is adapted to food supply. The scarcity of food has led to breast-feeding for extended periods of up to three years. Breast-feeding assures the infant a constant and efficient food supply; and it also tends to stop a pregnancy developing. As a result the females are adapted to producing an offspring about every four years.

Even though the hierarchical structure in tribal society may be generally quite egalitarian where the selection pressure is high, there are many known historical cases where a small sub-set of the population, as chiefs, officials and medicine men, has exerted sufficient power over the tribe that they do garnish a preponderance of resources. These resources are principally in the form of food, breeding partners, land and labor [Taylor, 1994; Mostert, 1992; Pakenham, 1991].

At what stage social control based upon attributes other than simple physical strength evolved we do not know3. Certainly the general concept that might-is-right has played an enormous part in human history, and transformation to a hierarchical society was probably a natural development from a group pecking order. It is likely that social control based upon simple religious concepts developed even before the preservation of related cultural artifacts – certainly the importance of maintaining fire was critical. Once signs of cultural artifacts are seen in the archaeological stratigraphic record it is likely that religious myths already had become an important part of social control. At this point, 'mental' strength [cunning] can be assumed to have joined might as determining leadership. Once a hierarchical structure developed where some small subset of the population exerted power over the majority they gained access to the preponderance of resources and initiated a self-perpetuating class system in which they controlled the distribution of the six basic resource needs of the individual.

Recent controversial evidence from Spain suggests that 'religion' might have had a start some 350,000 years ago, if the use of ceremonial burial customs by ***Homo heidelburgensis*** is confirmed4. The implication that ***Homo*** had developed intentionality to such a level, so early, somewhat alters our views of the cultural quality of early society. Could it be that a hierarchical structure was a major part of tribal society in the Pleistocene Epoch?

Paleontology, archaeology and mtDNA/Y-chromosome analyses indicate that by 65,000 years ago the migration of ***Homo sapiens*** had reached Australia and by 45,000 years ago East Asia [Olsen, 2002]. The migrational routes used were clearly geographically controlled and tribal society became well established everywhere except, perhaps, in the Americas.

Besides following the migrating herds ***Homo*** domesticated some migratory and plains animals: the pig, the goat, the sheep, and the cow are all in that category. The dog was probably the earliest domesticated beast. It arose from the Asian wolf by the most recent accounts, and almost certainly pre-dates agriculture. Most recent studies [Savolainen, 2002] on DNA suggest the domestic dog originated some 15,000 - 40,000 years ago from the East Asian wolf in the East China – Japan region. Because of the east-west orientation of Euro-Asia and the land bridge between East Asia and the Americas there were few geographic barriers to migration. The dog spread rapidly amongst the various regions occupied by ***Homo sapiens***, presumably as a result of its utility. It migrated with humankind to the Americas around 12,000 to 14,000 ybp. Other animals followed: the pig, the goat, the sheep and the cow all possibly initially as migratory herds. This phase of humankind's history is referred to as the Paleolithic Period.

Development of archaeosociety into protosociety shows that the cultural gamodeme demands social control; moreover, as the population increased social control must become more pervasive. Whether this social control is in the form of a tribal masquerade, a theocratic dictatorship, or a 'Law and Order' institutionally based political agenda is not the point. Increased social control is a necessary part of the evolution of the cultural gamodeme and the concept of social control is buried deep in our humanity.

PROTOSOCIETY

Terrain and climate played an important part in all of the early migrations of Archaeosociety because it governed the presence of the biota [indigenous living flora and fauna]. However, the composition of the biocoenosis [actual species present] was a result of both migration and evolution. Mountains and rivers aided the development of a multi-gamodeme Earth but without the right kind of biocoenosis tribal society could not rise above the hunting and gathering stage. As Jared Diamond [1997] brilliantly suggests, without the right kind of plants and animals present within the biocoenosis agriculture and other forms of hierarchically structured societies [Protosociety] would never have developed where they did. To a large extent the location of early agricultural society was a result of evolutionary adaptations in the fauna and flora. Although about 7,000 plant species have been collected or cultivated for consumption only about 200 have been domesticated and today just 12 crops provide 75% of human calorific intake [banana, beans cassava, corn, millet, potatoes, rice, sorghum, soybeans, sugar cane, sweet potato and wheat].

The decreased severity of glacial conditions over the northern hemisphere some 11,500 ybp saw the beginning of the Mesolithic Period of humankind's history. Agriculture started to develop in the earliest protosociety, probably first in the Middle East but rapidly spreading throughout all suitable regions of the world. Diamond [1997] well illustrates the reasons for the origin of agrarian society, in the locations it did develop, and provides adequate analysis of how and why agriculture spread. Because with agriculture came more reliable food production the first significant increase in population occurred. At this stage there is evidence that the social conditions changed. In agrarian society land is the primary resource and in Mediterranean and semi-arid climates within and around the Fertile Triangle the availability of water is part of that resource base. Both of these attributes lead to control by a relatively small group in the form of landowners and eventually administrators.

As agriculture spread and more animals and plants were domesticated and became part of agriculture, primitive city-states evolved. Ernest Gellner [1985] argued that with the production of food by agriculture came the necessity for food storage, and consequently the need for food protection and food distribution. Food protection leads to violence and food distribution leads to power5. The power and violence forced organization upon protosociety. Hyden and Ryder [1991] have argued that the larger the resident group the more hierarchical society becomes. At the same time, larger numbers in the top levels of the hierarchy can better control the masses and make possible a more compartmentalized caste structure. Societies became distinctly geographically located under regional warlords. With warlords came the "Principle of pre-emptive violence". Initially landowners generally acquired and kept their land by force and then embodied rules of Law and Order into social control, developing government that used administrators and a military class. This allowed them and their offspring to prosper. The remnants of this system are seen in the vast wealth of both the Monarchy in England and the Papacy of the Roman Catholic Church.

By the Neolithic Period true farming had expanded into many parts of the Earth. Sykes' [page 144] evidence supported earlier archaeological evidence that farming arrived in Europe from the Middle East via two routes. One route:

"headed up from the Balkans across the Hungarian plain and along the river valleys of central Europe to the Baltic Sea. The other was confined to the Mediterranean coast as far as Spain, and then could be traced around the coast of Portugal and up the Atlantic coast to western Britain".

This probably provided the means for the first major technology transfer because most of the European population was indigenous6. Fixed farming requires the population to remain in one place, with only seasonal migration of domestic herds. The enhanced political system necessary for fixed farming increased the rules and regulations pertaining to land use; and the need for both internal and external security. Moreover, with fixed farming came the need for 'weather forecasting' and the rise of a more organized mystic class that predicted events and became the proto-religions. Proto-religion based upon myths and legends probably grew throughout the Mesolithic and Neolithic periods and it was during this early phase of cultural consolidation that the numerous religious practices arose. Much of social control in traditional society relies not so much on punishment as on fear: of crop failure, of hardship, of rejection, of death. Those that could predict the seasonal changes, or at least, pretend to interpret the coming of hardship became the tribal controllers: the shamans, priests or whatever [Hart, 1972].

The increase in agrarian productivity led to more food; more food meant more people, and more people required more organization. That organization was provided by further expansion of religions sphere of control, and the raise of a well organized military class. Myth and ritual played a key role in establishing belief systems, perpetuated by custom and social pressure, avoiding the need for legal intervention. Having worked in India, on a regular basis, for almost 20 years I was struck by the nature of Hinduism more as a way of life than a religion. Hinduism has many characteristics I envisage as part of proto-religion and its literature is a literature of myth and legend. God is both ultimate as Brakman and also personal as Bhargavas: a supreme reality with a face. Modern Indian society continues to show a dominance of proto-religious practices. Hinduism encompasses a much broader place in the cultural gamodeme than do those modern societies with monotheistic religions. With its absence of a prophet, Hinduism has no single Fundament and is a morass of social taboos and mythical gods. The lack of a single consistent set of social rules, and its polytheism [a polytheism that recognizes only one true God], gives insight into what protosociety was like. Even today myth, legend and tribal memory rules throughout large segments of the Indian Peninsular.

As population increased so did a hierarchical structure, and so did the caste or class system. The caste system was basically developed along the Lamarckian lines of acquisition of social adaptive traits within the cultural gamodeme. A comparison with what happens in an ecosystem is illuminating once it is accepted that humankind can pass on acquired social traits in a Lamarckian manner. Some in the cultural gamodeme acquired specialist skills to become potters and artisans or other tradesmen but the important groups were the administrators, the military and the religious folk. Civilization was not developed on the principle that all people are born equal. On the contrary in these societies all people were definitely not born equal. The strong, broadly defined as those with physical or mental strength or religious power, continued to control the weak. Women and children were chattels and, as far as the living conditions of the common folk were concerned, life was dismal.

Even today, in Africa, Southeast Asia and many other regions of the world cultural gamodemes based upon myth and legend persist and those societies are often fundamentally at the proto-level, where single warlords or city-states exert major control e. g., Afghanistan, northeastern Pakistan and, some would claim, the Vatican.

In Europe, geography played a major role in the development of localized cultural gamodemes within which separate polities' developed as separate states and city-states. By 1500 ad there was over 500 states in

Europe. Each cultural gamodeme evolved its own optimal strategy for survival, and a pluralistic Europe evolved as the product of geography in which successful cultures adopted successful strategies for homogenization their Nations.

EUSOCIETY

By the beginning of the Eusociety stage of gamodeme evolution, Europe was an area of multi-norms, where cultural conflict and competition were the active selection pressures. The single cultural gamodeme that Europe is attempting to form today is only a recent development resulting from homogenization of individual Nations, often by brutal methods; and, more recently of Institutions becoming increasingly independent of State.

Increase in population density requires an even greater structure to the cultural gamodeme. Eusociety is especially characterized by a need to maintain internal law and order and a need to negotiate protection from external damage from competing cultural gamodemes. Negotiating-from-strength continues to be a characteristic of early eusociety, for the threat of violence is the ultimate means of control. Characteristics associated with the birth of eusociety include an increasingly integrated class structure that was different from a simple pecking order or rule by a warlord. The larger the controlling group the better they can structure themselves to control the masses. A need for strong internal regulation clearly understood by the population is evident in Eusociety, and rules and regulations pertaining to all manner of social interaction arose as common law. The role of government is fundamentally one of regulation, the development of regulation, and the imposing of regulation upon the population. An important constraint is that government is perceived as providing access to the basic resource needs of individuals within the cultural gamodeme.

The rise of monotheism and empire

The origins of eusociety can be traced to the divergence that began with the rise of the monotheistic religions long prior to the age of Enlightenment and Industrialization. Monotheism's origin and growth are associated with devotion to specific charismatic individuals and ideas. Society separated into different groups with differentiating characteristics based upon the thoughts of specific individuals. Who is Mohamed, and who is Buddha, and who is Jesus but individuals in whom the masses believe? They do present a way for humankind to band together as a society and set down a set of rules wherein individuals can coexist in that society. The fundamental goal of all world religions is identical in this regard. The invention of religion was not simply based upon the 'fear of dying' as many have remarked but arose out of a need to live according to rules within a group.

Each prophet who represents the head of each religious group was the foundation of the Church, which comprises those fit for entrance into heaven because they have obeyed the rules on earth. The 'way' of Christianity, of Islam, of Buddhism is the belief in the foundation, and the teaching of the prophet who is that foundation. As societies grew in size and communities expanded into new geographical territory, new religious strategies evolved to meet the new requirements. Robert Oden [1997] pointed out some of the competitive strategies used in the Hellenistic world. To have any credence at all in the market place religious leaders had to do at least the following.

1. Perform miracles, especially curing blindness, lameness, and saving drowning mariners.
2. Receive oracles especially through a divine apparition.
3. Promise immortality at least after death; or, even better in this life.
4. Be the heir to knowledge of great antiquity, especially claims to be the oldest or first.

The Churches continued to exist, and play a major role in regulation and the maintenance of law and order. Some as in Islam with little change, others, as in Christianity with its reformation, split into sects with their own minor prophets who believed in keeping a self-defined 'way'. The development of religious sub-groups whether Sunni or Shiite, Pentecostal Christian or Mormon, are divergent phenomenon that originated via a mechanism comparable with cladogenesis. In time they evolve into clear distinct independent churches and become part of the overall religious theogeny7, or, they become extinct.

The rise of the major monotheistic religions in the Middle East can be viewed as an evolutionary improvement in social control. Moreover, monotheism led to a broader concept: that of Empire. Politically religious belief embraced the whole universe, and required conversion of the unbelievers and effective annexation of territory beyond the immediate community. It justified the modern concept of Empire. A lot of the gathering of gold and resources from outside of Europe and the Middle East was done in the name of saving pagans. The use of fear as social control was practiced, essentially, in the same way in both polytheism and monotheism and included conversion by the sword.

Human written history shows continuing conflict beginning with the Epic of Gilgamesh and through the Hindu Myths, the Iliad, the Odyssey, and the Old Testament until the present day. It is in these early writings that we can understand the many of the ideas of our modern society. Western civilization for example is based primarily upon Greek and then Roman beliefs. The Greek Homeric epics contain an oral tradition of how a 'civilized' society conducted itself some 3,000 years ago, and indeed, exemplify some of the basic traits of our humanity [Vandiver, 1999]. Because they were not written down for some 400 to 700 years after their presumed origin they undoubtedly contain some characteristics of the values of the cultural gamodemes that existed at the time they were written down. The Iliad addresses numerous traits of modern western societies. The Greek warrior fought for "Tim-hey" which can be translated as "he who dies with the most toys wins", and "Kleos", or prestige and remembrance. These are driving forces of much of modern society, and represent the immortality sought by writers, poets and scientists. Hectors reasons for fighting [for the preservation of his cultural gamodeme] and the distain for Paris' cowardice are elements of modern Patriotism.

As Boone [1983] noted the development of expansionist warfare is fundamentally a means of gathering and controlling resources. In addition to appealing to increasing the resource base an alternative strategy implicit in the use of expansionist warfare is to divert the population's attention away from the controlling group to an outside enemy. This was an early strategy used by both State and Church alike [Keddy, 2001:237]. Keddy further notes that anywhere that there is a resource that can be controlled by size or physical strength hierarchies will be the expected social condition. Competition for resources and the resulting conflict were the major selection pressure on the cultural gamodeme. This was often done in the name of religion but resulted in resource acquisition that often appears to have been the driving force. Not only did it result in the re-distribution of resources but, once acquired, control of resources allowed them to be denied or granted to others as a means of damaging or subjugating populations. The last two millennia have seen the rise and wholesale adoption of this concept of Empire, which became the driving force that developed nations. Whether it was the slave trade of kefirs [infidels] between Africa and Arabia or the subjugation of the known world of the Middle Ages by the Muslim or Christian sword, resource acquisition was a definite outcome. However, the end of the last millennium began to see the change from religious Empire to commercial Empire even though the rules were basically the same. The essential change was from 'give me your souls [and taxes]' to 'give me your resources [and taxes]'.

Myth and legend have persisted, as a belief in the supernatural, in Eusociety. As the Roman Catholic Church became the unifying controlling factor in Europe so did Islam in the Middle East. Empires became the norm in Europe and the Middle East and existed until the first quarter of the 20th century. Religion, as a means of societal control, permeated the cultural gamodemes. Emperors, Warlords and Kings may have ruled in practice but the deal broker was the Church and it ramifying system of agents.

CHAPTER SIX
THE SOCIAL PRESENT

Lhasa Tibet, 1987

"A passing century is sometimes remembered in terms of a single event of lasting significance. For ours – the 20th – the singular happening may well be the sudden and unprecedented expansion of the world's population" Carl Haub**, 1995.**

The cultural gamodeme is a conditional system in which factors existing today can retard or accelerate future development; and, thus the social present is important because it will affect the future evolution of our lineage. The hope is that our robotic descendents will have an understanding of, and affinity for, the kind of society they originated from: the one based on humanity.

Eusociety began with the establishment of Empires, Nations and religious hegemonies that increased the level of social control and gained greater access to regional and global resources by cooperation and capture. The present stage became established in many cultural gamodemes around 1500 ybp with the beginning of the Age of Exploration and accelerated with the Industrial Revolution of the 1750's. Remnant cultural gamodemes – holdovers from the Protosocietal stage - still exist where agrarian, quasi-city states run by warlords and chieftains occur. However, as the principles behind Eusociety spread the remnants are targeted for extinction. Global communication and media penetration emphasize the similarities and differences between one cultural gamodeme and another. People from all cultures now see how others live and this instigates change. In this manner a knowledge of other conditions in other cultures can increase the selection pressure on the State. Increased population density and numbers put increased selection pressure on the State because people bind together in society to acquire the six basic individual resource needs. Essentially the people mandate the State to acquire sufficient resources for the people. This has to be done within a framework that allows group rights alongside individual rights; and, concurrently encourages interaction with external States to avoid conflict. Because of adaptive necessity this places two important constrains on the State.

1. The need for increased social control.
2. The need for increased cooperation amongst States.

If these constraints are not applied then the State is destined for change or extinction, by revolution or war. The present cultural gamodemes are the product of these two constraints and the cladogenesis of Eusociety is in the eruptive stage. Currently, Institutionalized Liberal Democracy [ILD] is not the modal form of global government. Much of modern society is democratic but few States have the checks and balances of an ILD which performs two main functions. Firstly, it uses Institutions to provide group rights that supersede those of any individual, whilst controlling those humanity traits that would allow one group to dominate another group. Secondly, it uses Liberalism to allow individual rights providing access to individual resource needs. Thus the Eusocietal Cultural Gamodeme must balance both group and individual rights whilst maintaining a balance with external States, by a policy of cooperation.

Two important events have molded humankind's present cultural gamodemes: the growth of empirical reasoning based upon sectarian logic, and population growth. Both increased internal selection pressure. With population growth came a need for increased regulation of society at a more, and more, detailed level. With this need arose additional administrative classes or castes to interpret and enforce the law. In Protosociety this was done within the confines of religious law but Christianity saw a divergence of a State political hierarchy from the Church theological stem. An acceptable concept of the separation between State and Church was only accomplished in the last two centuries in western society but this divergence did create the conditions for the rise of a Representative Democracy in many parts of the world. The establishment of global Representative Democracy, preferably based upon Institutional Liberalism is the objective of much of American and European international policy as the doorway to Eusociety.

Modern Representative Democracy has its roots in the western European democracies and Hellenistic logic. It is currently the best contender upon which to form a global Eusociety. The concept is well illustrated by the Constitution of the United States of America, which provides for a system based upon the Rule of Law, one man one vote, the right to live and work anywhere in the nation, set periodicity of elections of governing officers, trial by jury, the separation of Church and State, the separation of the government into three independent branches, and a whole gambit of individual and group rights, amongst other characteristics.

Evolutionary processes are playing a major role in the development of eusociety. Historically the past 300 years has seen the breakup of Empires and the consolidation of Nation States as linguistic-ethno-cultural units. The language of any Nation contains its culture, and the initial stages of the evolution of eusociety necessitated linguistic cultural consolidation. During the 18^{th} - 20^{th} centuries millions of people were forcefully or voluntarily moved, or slaughtered, to allow the main internal cultural gamodeme to dominate the political, military and social leadership of each particular Nation. Ethnic cleansing is the current name for this process. Ethnic cleansing attempts to establish Nations that are essentially homogeneous ethno-cultural groups. Essentially Europe was ethnically cleansed during the past 150 years but little is said about this history other than with reference to the outstanding atrocities of Hitler and Stalin. The European Nations are now essentially homogeneous linguistic ethno-cultural gamodemes. Evolution suggests that for the betterment of any Nation multi-multiculturalism does not work and will be eradicated by the dominant cultural group. Following this line of thought evolution suggests that it is better to have Nations that are small, politically independent, cultural gamodemes within which internal conflicts are minimized. These produce metastable societies. An old Iraqi friend of mine wisely said "when people are at the same social-economic levels, speak the same language and essentially believe in the same principles then they can integrate". We were speaking about his intention to marry his fiancée, who was a British, English speaking, Christian doctor. The same philosophy applies to Nations. Once homogeneous groups are established the internal conflicts are minimalized and they can concentrate upon external problems that reduced conflict and improve cooperation. The European Union is a result of this cultural evolutionary principle.; and to some extent so is NAFTA and the WTO.

In nature, because evolution is a legacy system that progresses via conditional probabilities the end is ALWAYS justified by the means as far as the physical and cultural gamodemes are concerned – there is no alternative viewpoint. The evolution of the modern cultural gamodemes when seen in hindsight followed this rule. Even though I abhor what happened in the name of national unity in Europe over the past century – Hitler and Stalin were only the prominent purveyors of national cleansing- I recognize that every Nation in Europe has participated in a policy of national purification during the past 150 years. The present geographic national boundaries prove this.

Africa has been undergoing similar changes since independence from Colonial Empires. This is continuing today throughout the continent with atrocities and a mass movement of populations. India, despite the efforts of Mohandas Gandhi to keep that great nation together, split into a Muslim State [Pakistan] and a Hindu State [India] accompanied by massive atrocities by both peoples against their neighbors who had a different religion. Numerous people either voluntarily or forcefully moved across the national borders. Later Pakistan itself split into two linguistic groups: Pakistan is Urdu speaking and Bangladesh is Bengali speaking. This itself was accomplished by little population disturbance, primarily because the countries were both Muslim and were widely separated geographically.

Globally the process continues onwards: with specific regions or states, pursuing a policy of cultural cleansing through internal conflict and civil war. The United States is becoming dangerously close to this happening by allowing freedoms based on multicultural rights to take precedence over those needs and rights that promote national unity. Current policies are either foolish, in that the pursuit of multiculturalism promulgates internal conflict, or, they are manifestation of progressive evolution of eusociety.

Historically Empires broke up into Nations because of internal selection pressure. These Nations then reduced internal conflict by internal cultural cleansing. Only after evolving a linguistic ethno-cultural unit could the independent Nations adopt a policy of cooperation with neighboring Nations and approach the question of integration. Agglomeration of adjacent Nations that are at a similar level of socio-economic development can be advantageous to both Nations providing the initial internal identity can be maintained. In Europe the dissolution of Empires into Nations evolved into a Union of agglomerated States [the EU]. In North America the Nations were never really part of Empires. Canada and the United States always have had characteristics that indicate they should agglomerate: they are at the same socio-economic level, speak the same language [despite the irritation of Quebec] and they are both based upon institutional representative democracies. When British Columbia became independent only a small majority swayed the decision to become part of Canada rather than the United States. With regard to Mexico the United States is presently integrating Spanish speaking people into the Nation at a rapid rate. The natural consequence will be an eventual agglomeration of Mexico, the United States and Canada as a North American Union. The only danger lies in allowing multiculturalism to progress unhindered such that individual regions begin to pursue a policy of cultural cleansing. Indeed, already religious enclaves are beginning to arise within the United States.

The raise of reason

Empirical reasoning and sectarian logic, that became science and led to the Age of Enlightenment in the 18th century, also arose from the theological stem. It is reason that has shaped much of the 'social present' and will continue to shape our 'social future'. Eusociety requires the abandonment of myth, legend and religion as the basis of regulation within the cultural gamodeme, and its replacement with commonsense law based within scientific logic.

We can observe four major areas that contribute to the ills of the current global cultural gamodemes.

1. The effect of population growth.
2. The influence of corporate world.
3. The occurrence of internal conflicts amongst sub-sets of specific cultural gamodemes.
4. The existence of external threats to cultural gamodemes.

THE EFFECT OF POPULATION GROWTH

The present selection pressure, imposed by population growth, on the global cultural gamodemes is high! Within the last 150 years it has gone from low to high with potentially devastating effects if it is not soon lowered. This high selection pressure impinges on both group and individual resource needs. High selection pressure on group needs leads to War or extinction. High selection pressure on individual needs leads to the breakdown of law and order, to famine, and to the reduction in protection [including health issues].

There has been a disquieting attempt in the past 40 years to play down the population growth factor. Statements like: the whole of today's world population could fit into the State of Texas [National Geographic Magazine]; and, population growth is declining; or, population growth will not produce the high population by 2100 that was predicted, totally miss the point. The world population is already too large and is already destabilizing the Earth System. The affects of HIV-Aids is a mere blip on the curve of population growth, which simply stalled and reset itself. Today population density is increasingly out-of-control in the majority of cultural gamodemes. This means the social condition for most people remains dismal: put colloquially 'the pie is only a certain size'. An interesting number presented by James Lazell [2005] in his fascinating and erudite book "Island", is that only about 670 million people could inhabit Earth if we wanted them all to enjoy the same standard of living as the population of the USA. With over 6 billion living on Earth today the situation appears hopeless. Only by decreasing the global population to one that does not strain Earth's resources can humankind hope to live happily.

The extent that the world population is already too large and is currently destabilizing the global cultural gamodemes, is not perceived adequately, or understood well, by most people. The problem IS one of perception! All populations become adapted to their cultural condition and then continue to coexist with that condition [this is the Law of Instability in action]. History shows that as long as conditions get incrementally better with passing years a society can sustain high levels of hardship [as Stalin well knew, and Hitler initially prospered upon]. As long as the members of the cultural gamodeme have access to adequate food, shelter, protection, health, and education, the population stress is not readily apparent. Population density and population numbers are currently stressing every segment of the Earth System. Only a complete ignoramus believes human activities are not contributing towards global environmental deterioration and thus reduction in the availability of basic human needs.

The technological developments of the industrial revolution affected humankind on a global scale by fueling the population growth. This population explosion was based upon a greater understanding of hygiene, improved drinking water, and improved pre- and post-natal care. At the same time, the industrial revolution facilitated an increased flow of population from the rural to the urban areas. It was, and still is, a rare person who as a youth would forgo the potential of the city for the village. On a global scale population expansion has affected not only the cultural gamodeme but plays some role in every aspect of our planet. Future population pressure and its control will impact upon all other aspects of human development.

Carl Haub was the Director of Information and Education at the Population Reference Bureau, Inc., Washington DC. His studies, especially Haub 1995 alerted many to the need for population control. Whilst noting the difficulty of counting the world's real population at any particular time, he concedes that whatever numbers the U.N. supplies is accurate to about plus or minus 3% of error. In fact estimates in the last century were underestimated.

Figure 21 shows the population of Earth reached about 1 billion around 1800, by 1900 it was 1.6 billion and by 2000 it was 6 billion … think on this! The Population Reference Bureau estimates for global population put the 9th billion at 2035 and the 11th at 2093. Shortly after the year 2100 the Earth could have a population of 12 billion people, most of which will have spilled out of the developing world into North America and Western Europe.

Even if these enormous numbers are not attained, the increases will still be overwhelming. The human cultural gamodeme and the physical environment, will adapt; and, the generational effect will erase much of the fear. However, the real loss to the Earth System will be immense when examined historically.

At present, population stress produces two specific areas of conflict within the Earth System.

1. **Environmental stress on humankind**. The really potentially serious effects occur in the coastal regions and principally involve hurricanes, flooding, and land loss. Because most of humankind lives in the coastal region the stressed social condition has a huge impact on political decisions e.g., the US Federal government's Coastal Protection Program.
2. **Humankind's stress on the environment**. Fundamentally there are three large areas that are impacted by humankind's activity, and produce feedback that adversely affect the cultural gamodeme.

    - Pollution of the air, water and soils.
    - Eradication and disruption of the fauna.
    - Eradication and disruption of the flora.

It is this second kind of stress that is destabilizing the Earth System[1]. The stress of overpopulation on the cultural gamodeme causes scarcity of the basic human needs resulting in increased competition within the gamodeme, and between gamodemes, and the exploitation of natural resources without regard to the overall societal impact. Current examples are the struggle for future energy resources amongst China, India, Japan, USA and other parts of the world; and, the struggle for market position in exports.

INDIA'S POPULATION PRESSURE

Much is heard today about how the developed nations are destabilizing the Earth System by excessive use of resources. Certainly, the developed nations are major consumers but the developing nations are major destabilizing forces because of lack of regulatory control. Per acre of land or per volume of air or per number of organisms removed from an area the developing nations are causing havoc to the Earth System. Maintaining the quality of life of the developed nations mandates the use of resources to supply the needs of their populations. The undeveloped nations strive for a similar life-style but it is improbable they will achieve this under a sustainable system. I contend sustainability can only be obtained by the reduction of population stress caused by population density. Only then can the Earth System be managed in a sustained way to supply a good life to all individuals. 'Terraforming' Earth to human need is NOT an outlandish idea but sustainability must go hand-in-hand with population control, especially reduction in population density.

A further problem contributing to the deterioration of the Earth System can be viewed as the result of two factors: personal greed and the intrusion of the global corporate world into local politics. These two factors are creating situations in which government is unable to maintain regulatory control for the benefit of its people. Laws to stop humankind's stress on the environment are most consistently applied in the developed nations. They are poorly applied or poorly conceived in the developing nations and especially those with high population stress such as Indonesia, India and China. The developing nations are destroying huge areas of the natural environment and creating highly polluted living conditions. These developments are essentially irreversible without local government exerting explicit social control both on itself, the local population, and the intrusion of greed. Population reduction will curtail the dismal labor conditions and poor living conditions, that are still rampant in the developing nations, by reducing the labor pool and lessening environmental impact. This will be hard to accomplish for it necessitates internal reform in most, if not all, of the developing nations. I think that history shows that social progress comes from within a society not by external fiat.

The argument that the consumption of resources by the developed nations is the driving force that stimulates the developing nations to destroy their own environment is limited in its view. The destruction is stimulated by local greed and corruption in response to scarcity of basic needs e.g. the aquaculture fiasco of coastal Peninsular India. Questions of population control, environmental remediation and preservation, and the control of corporate and personal greed can ONLY be addressed by the indigenous population and the legitimate government that controls the country. Outside expert advice to assist an indigenous population in making environmental and population decisions is necessary, but reforms must be enacted by-the-people for-the-people who inhabit the country.

THE EFFECT OF CORPORATE WORLD

Unfortunately, population growth is welcomed by global corporations, for it increases both the work force, [providing competition amongst workers and thereby cheaper labor], and the number of consumers. The tie between corporate wealth and donations to politicians, rampant in all countries, has a hidden effect of promoting population growth. The 'corporate influence' and 'lobbying' problems are not being confronted aggressively enough because ALL politicians currently in office [in western Europe and the USA according to recent reports] receive financial contributions, in one way or another, from corporate wealth.

The present selection pressure imposed on the cultural gamodemes, by the growth in size and influence of Corporations, is high. The influence of Corporations can be a major external threat [leading to war] or internal threat [leading to severe damage to the Earth System] to some cultural gamodemes. For example, the damage being done to the environment in India, especially by local corporations, is profound bordering on evil. Because it takes place in rural areas it fails to met the scrutiny of the world media and is ignored by local and national authorities. Even local corporations can have comparatively deep pockets.

What distinguishes the American economic system from other systems is not so much free enterprise itself, but the level and method of government control of the financial structure of the society. The real difference is between a hands-off approach and a totalitarian approach to the cultural gamodeme. Soviet socialism failed miserably primarily because of the totalitarian way in which the government controlled the financial structure, and the USA succeeded because of the hands-off way in which the government controlled the financial structure. Definitely, there were other factors that came into play, particularly the accident of geography that placed North America as a north-south oriented continent with all major climatic and vegetation zones, allowing a strong agricultural basis, and the development of numerous all-weather ports. In contrast, the former Soviet Union grew on an east-west oriented continent with mainly frigid and temperate climatic and vegetative zones, and a single all-weather port on the Pacific Seaboard. The Soviet Unions failure to develop a sound agricultural policy was directly a result of climate not politics: although Lysenko did not help2.

The market-place-of-ideas and the concept of the free-enterprise system are major forces in contemporary western cultural gamodemes [including Russia], dominating not only the economy but also the law, where it is the basis of ideas on individual freedoms and rights. These concepts can be SEPARATELY applied to the economy, law and order, and government. Western democracies are dangerously mistaken if they believe that they and they alone are underpinned by the market-place-of-ideas and free enterprise. China today demonstrates that the government can be totalitarian, yet utilize the free-enterprise system to build and sustain its cultural gamodeme. The former Soviet Union failed to make that connection, but modern Russia is not making the same mistake.

As the corporate world has infiltrated government the security of corporations and the maintenance of privileges for the wealthy have become standards for policy. The absence of such protections for the average person could destroy the basis of capitalism in the future, and with it Institutionalized Liberal Democracy. The US constitution gives the people the right to terminate a corrupt government: this is a warning our founding fathers gave for their descendents. Corporate sponsored government ignores this warning at its own peril, because a democratic society depends on voting, not on capitalism.

Government does not have to allow Corporate World to engage in unconstrained free enterprise to make the financial structure of capitalism work. Representative democracy plus capitalism make a nice combination that fosters a healthy cultural gamodeme IF adequate rules and regulations are in place to stop unmerciful Darwinian growth. Unfortunately, the rules and regulations that have developed in the past five centuries of merchant capitalism are becoming the fundament that supports a highly structured society that is dependant upon corporate activity. History shows well that once a society becomes moribund such that new ideas of social import are squashed from above, rather than allowed exposure to the market-place-of-ideas, then that society eventually degrades. Currently, many cultural gamodemes are dangerously close to a system where their Government either supports a Corporate World ethic, or a Religious World ethic. This is a disastrous approach for any democratic system of government, which should revolve around a Peoples ethic; and, the freedom of the market-place-of-ideas.

THE EFFECT OF INTERNAL CONFLICT

Internal conflicts within a cultural gamodeme generally provide a low to moderate selection pressure and result in slow evolution or society, or no change at all. However, a critical observation regarding the social present was made by Olson [2002] who noted:

"almost all the armed conflicts in the world take place not between nations but between groups separated by differences that often are interpreted in biological terms" i.e. the ethno - cultural gamodeme.

He goes on to assert that race, as a biological concept, is dead. However, this is irrelevant because, unfortunately, global race issues have morphed into cultural gamodeme conflicts. That race and culture can be equated has little meaning for any specific cultural gamodeme, because the modal racial form does represent the culture of that gamodeme. In Africa, where specific physical gamodemes still exist, tribe [which can be considered a sub-group of race] is definitely an important attribute showing a positive correlation with culture and region. However, in regions such as the USA equating race with culture is false. Almost all people born and raised in the USA are culturally Americans NOT a member of another separate cultural entity. Whilst respecting the diverse backgrounds of citizens USA society has functioned within a very tight cultural gamodeme, even though selection pressure on sub-cultural enclaves is becoming more lenient. The whole concept of offering different treatment to different groups within the American cultural gamodeme is bunkum and a divisive force that perpetuates conflict and inequality. In ILD's economic equality is the goal not the proliferation of a 'designed' cultural heritage! What is meant by equality is well understood in American society. Class is where the real battle is being fought in the present cultural gamodeme: not among racial or ethno-cultural groups. Class is financial based and equates to how much money and wealth a citizen has relative to others. Real bias and discrimination today is based upon money – prices discriminate and poverty is the enemy of the lower and middle classes. If we want an evolutionary stable cultural gamodeme anywhere on Earth then:

"screw cultural diversity and establish economic equality".

From the viewpoint of the dominant cultural gamodeme other cultures do not have to be respected, and cultural heritage does not need to be artificially perpetuated. Different cultures, like different languages, do not need to survive. On the contrary, in the competition of evolving and interacting gamodemes, some will become extinct. Natural diversity exists and society does not need to accommodate it with special rules and regulations for humankind to follow. Diversity will continue as long as the environment allows it to exist, and the cultural environment should not be propped- up by intuition, authority, or revelation.

There is no such thing as diversity of truth, and for many issues regarding the cultural gamodeme the conflict is between truth and falsehood. The mantra 'belief systems' has become a tool in the battle for space within the American cultural gamodeme. Many forget that when arguing about beliefs someone in the argument is wrong: and in many cases both or all are wrong. This does not mean that there is not a single true position.

Today, numerous conflicts are perpetuated through myths based upon culture and ethnicity. Cultural roots are the cause of internal conflict in Turkey, Afghanistan, Iraq, Spain, Ireland, etc. Such conflicts do show that the freedom that allows ideas to develop, blossom and evolve in democracies has a price to pay internally: there is a failure of social controls when society is faced with extreme values that impinge on internal operation of the social condition. The ILD's have good laws but the danger is in allowing people with personal stands to manipulate the law to destroy the present cultural gamodeme. A recent example came from Canada, where the 'Hate Crime Laws' are readily used against any statement of opinion that someone regards as biased against someone else. It does not matter how logical or pragmatic a statement is, it can often be made to appear illegal under the hate crime law.

Internal conflict often presents problems that directly pertain to values held by a democratic society: individual versus group rights; the right to open court representation; the right of one-person-one-vote and many other things we hold as important rights to defend become blurred when law and order fails because it is exploited. When extended to the global level problems take on a different luster. For example, the US version of democracy places great emphasis on the 'rights of the individual'; whereas, in Europe the rights are more on the side of the group. It is certainly true that the great list of 'freedoms' now sought by many in the US population go beyond what many others consider as basic rights, because they intrude on the freedom of the group. This becomes a greater source of conflict between and among Nations that attempt to agglomerate or even co-exist.

Race and ethnicity are surprisingly persistent causes of internal conflict within eusociety. Unless a democracy can remove the concept of race out of its legal system it will continue to hinder harmonious development of that society. The dilemma presented by this position is well seen within the USA where there is a desire to remove the concept of race but there are only superficial attempts to remove the idea from society. Numerous laws that perpetuate and emphasize the idea of race, and thereby promote racism, are still in use i. e. those relating to affirmative action. I believe that insidious racism can be removed in a generation if Federal and State laws requiring such statistics as racial proportions in the work place, racial quotas, and racial population statistics were no longer required; and, if any problem or solution that is framed in a racial overtone is simply ignored. Racial conflict will not go away by saying it does not exist but it will eventually go away by ignoring the basic idea and refusing to take it into account. This approach does require re-education of the population. Racial issues should be replaced by class issues. Such 'laws' as affirmative action should be economically based [i.e. on class, which has everything to do with money]. Affirmative action as practiced violates the principles we derive from the Theory of Evolution: meritocracy and elitism are integral parts of the evolutionary processes.

Sins of the Fathers

"When it comes to democracy, the rights of man and equality, God is only a recent convert." Quote from the Spanish socialist Josep Borrell Fontelles.

If we are to be a democracy that removes blatant causes of internal conflict, then government must protect the political system against religious intrusion, which permeates many current cultural gamodemes. There is increasing evidence that the Church is requiring politicians to hold to their religious beliefs when making decisions in the political arena. This is so not only throughout the Arab Muslim world but in both the

United States and in Europe. Moreover, there is strong evidence that the Church has infiltrated into education, government, the legal system and the military in the US. Both mainstream and fundamental religious leaders perpetuate the myth they are above the law. Democratic society has backed away from making laws against religious practice but in doing so have avoided penalizing religions intrusion into the political system.

The maintenance of any democracy requires that the difference between religious practice and religious intrusion is made clear. Either, the present laws against religious intrusion are insufficient, or, they are not being applied. In the United States of America the present society use the law to prevent religious intrusion into the function of the State. It is time to recognize that religious intrusion into politics is against the law. It should be punished by a strong response.

1. Fines and confiscation of religious assets for such activities as failure of the Church to disclose criminal acts: it is no different from ignoring insider trading.
2. Criminalization of the activities of religious leaders who initiate practices that are clearly and knowingly against the State law intended to separate Church and State. The Church is not different from ENRON in this regard.
3. Declare proven religious bias in decision making, by government officials, whether appointed or elected, to be sufficient reason for dismissal. Punishment for not following the law is not a 'witch hunt'.

It must be recalled that it is only in the past few centuries that religious systems have evolved into modern political systems that maintain the same basic fundament: to allow individuals to live in communities obeying a set of rules that allows the society to exist as a stable group. The secular state legislated this but politicians, amongst others, fail to insist that the law be followed: primarily because of a fear of the group vote.

The dilemma between government and religion occurs because religious practice is an integral part of the present social condition in most cultural gamodemes. As Lenin noted, religion is 'the opium of the masses'. Historically, the pervasive error that developed, as religion developed into a political system, was that society failed to move universal issues from the supernatural and metaphysical to the scientific realm. The issue is not that religion serves no purpose, for it is a near certainty that religion will continue to play a role, in the cultural gamodeme, for generations to come. The issue is that the great mass of people do not see how religion interferes with their own well-being or societies progress: this question is an issue of education. The belief during the Enlightenment that religion would soon die-out was not fulfilled because the rapidly changing cultural gamodeme never allowed sufficient time for knowledge to permeate down to the level of the common people. If the people are not educated in scientific reasoning, religion continues to have a strong hold on society. This is well known to religious leaders and one reason for the increasing grip that they attempt to apply to the educational system. In contemporary American society non-scientific thinking inspired by religious belief is exerting an influence that retards the progress of our society.

Islam and Christianity have the problem of all religions in that the basis of each belief system rests on myth and legend; and, the statements of men who understood their local society as it existed hundreds of years ago. Such men, as Jesus and Mohamed, may well have become prominent leaders in modern society, if they were born in the 21st Century. Their local strength was a collection of ideas of how the cultural gamodeme should be organized. Many such people have existed throughout history but few have established a successful system of social control that has lasted more than three generations e.g. Lenin with Communism, Hitler with Fascism, and the ancient Greek experiments with Democracy. Religion is very different in its appeal, but to be a sustainable political system religion has to have a 'band of others' that mold the original ideas into a persuasive political movement – a belief system that appeals to a sufficiently large segment of the local cultural gamodeme that it could embrace the whole. Control is not purely by belief but includes providing protection, threatening and taking of life, and the use of mumbo-jumbo [the appeal to the supernatural]. The monotheistic religions particularly embraced these techniques. In both Christianity and Islam, the leaders of the religion are perpetual extremists in their belief system. Indeed, they have to be in order to both sustain and evolve the faith through modern times and into the future.

Christianity presents less of a threat to present society than does Islam because Christianity is largely practiced in areas where Institutional Democracy exists and the tension between Church and State keep the fundamentalists at bay. Unfortunately, modern Islam did not develop alongside Institutional Democracy, and its offspring Liberal Democracy. This does not mean that the vast majority of its adherents are fundamentalists or extreme believers. The people of the Muslim communities have suffered from the same set of re-occurring problems which beset many communities: the absence of institutionalized basic human rights. Internally, they project the same dualism of all gamodemes centering around the traits of empathy for others, and self-discipline. The five largest Muslim cultural gamodemes [Indonesia, Pakistan, Bangladesh, India and Turkey] today are all functional democracies [although not liberal democracies]. Of these, India with its inherited western institutions approaches a liberal democracy [although it acts more like a benevolent despotism run by a single political party]. The others are essentially democracies without well developed independent institutions to control the tensions existing between the State and the people. It is the Middle East [Iran, Iraq, Syria, Palestine and the Gulf States] where Islamic fundamentalists dream of an Islamic

Empire of social control. In the long run it is improbable that this 20% of authoritarian Muslims can persuade the other 80% to abandon a path toward democracy. This having been said, it must be noted that Hitler was freely elected.

When it comes to the freedom of religion within the present cultural gamodemes many people realize that religious pluralism represented by the number of creedal systems does not mean that all religions are of equal value.

"To suggest … that it is impossible to assess rationally conflicting claims to religious truth is both absurd and dangerous; it allows any belief or action if it is performed 'in the name of God'. Religious tolerance is one thing and is much to be commended in the face of bigotry and sectarianism, but it does not follow that religious claims to truth are incommensurable" [Stanesby, 1985: 107].

Just as religion historically provided the State with a basis for social norms, science can provide a non-interfering State with a basis for social evolution. I do not imply a Haeckelian doctrine [Ernst Haeckel, 1901] of a dictatorship of science and neo-fascism. Science, like religion, has a major affect on the cultural gamodeme that ramifies throughout politics. However, science is humankind's way of discovering the reality of our Universe. It does not make claims that are outside of logic, and needs to pursue its goals with minimal State interference, just as religion claims it can do! Regulatory politics should not be applied to scientific research itself but to the use of science.

From the viewpoint of the cultural gamodeme real conflict exists between science and non-science. In taking sides religion has failed to evolve as new knowledge about our Universe has been discovered [irrespective of the fact that the late Pope believed in the Big-Bang]. The value of religion can best be appreciated when it is part of the secular system. Society cannot afford a right, left, or any religious presence in government. To do so puts a partisan belief above that of a belief in government for the people, by the people.

Shades of Shakespeare

Democracy alone is no guarantee of freedom: on the contrary it can lead to dictatorship and censorship by the majority. Western democracy took hundreds of years to develop successful political systems that constrain the 'tyranny of the masses' and the 'tyranny of the powerful'. It succeeded by embracing constitutional [institutional] liberalism. Constitutional liberalism is a system of rule which contains both regulations and ethics established by, and maintained by, institutions – both real and virtual. This system limits the power of the State and the ruling class; and, opposes the establishment of a legitimate [i.e. elected] dictatorship. Institutional liberalism provides democracy with a strength to absorb dissent by decentralizing rule, thus preventing abuse by a higher authority e.g. the Federal Government in the case of the USA.

At the present time most democracies have a criminal code based upon the rule of the majority. It does not matter what the fringe groups say because the majority, through a representative system, established the Rule of Law setting down the regulations that govern the society. For example, in the present system of democracy in the USA, the killing of doctors favoring abortion by extremist religious zealots; and, the burning of churches by religious bigots, are against our criminal code because the majority decided this was to be so. Despite its shortcomings, the system of representative democracy works and ensures that the majority voice prevails. Even the US constitution can be emended by the majority voice.

By separating power Institutional Liberalism supports a code of human rights, embodied in Liberal Democracy, by providing protection for individual and minority rights within a framework in which the majority is both fair and tolerant. Changing our political system to a universal Deliberative Democracy, in which true consensus must occur for any decision to take effect, is potentially dangerous. A political system in which the law is determined by everyone who will be affected by it [consensus], allows the fringe groups to derail the wishes of the majority. From an evolutionary point of view Deliberative Democracy [true consensus] could be worse than totalitarian rule by the majority.

Since the middle of the last century present society has seen an increase in litigation involving individual rights. This has led to a specific set of internal pressures causing problems within our representative democracy. For example, recent times have seen the development of a set of distinct problems caused by overzealous psychologists, plaintiff lawyers and social scientists that remove accountability as a trait of the cultural gamodeme. This has led to group vs. individual rights internal conflicts. Individual rights should be derived, and embedded in society, by scientific reasoning and should be directed towards the resource needs of individuals. Unfortunately, using non-scientific methodology numerous psychologists and social scientists have overwhelmed the study of society by using the 'quote technique' in which demigods pronounce a personal preference law and others follow3. The laxity of the legal system has allowed plaintiff and defense lawyers to use pronouncements of psychology and the social services as facts of evidence. Thus the pronouncements of psychology have been combined with the ill-conceived personal agendas of politically motivated social activists to develop a body of 'soft science' concepts affecting the cultural gamodeme. They can be regarded as lenient selection pressures and have allowed a plethora of deviations to develop.

The result of these manipulations by lawyers and the social sciences is that much of the malaise of democracy as practiced in the USA is a result of the affects of removing accountability as a trait of the cultural gamodeme. Steven Pinker [2002] expressed well the illusion created by modern social scientists and hints at the devastating influence it has had on democracy. Acquired cultural attitudes and the denial of human nature are the problems. As Pinker notes:

"The denial of human nature has not just corrupted the world of intellectuals but has harmed ordinary people".

Belief that human nature [genetics of the individual and the gamodeme] plays no part in the development of the individual [which is expressed as 'The Blank Slate' by Pinker] has been used as the basis for modern political and religious morality and especially has had a dislocating influence on psychology. Modern science in the form of neuroscience, behavioral genetics and evolutionary psychology is showing how such a view is untenable and at the same time confirming the common sense views of ordinary people world wide.

THE EFFECT OF EXTERNAL CONFLICT


Rajistani military weapons collected after integration with India

Important outcomes of the industrial revolution were the changes in the tools of warfare and the concentration of regional power, and eventually global power, in the hands of a few industrial states. The global reach of powerful nations that characterized the Colonial Era is today manifest as economic power. Whereas nationalism was a prime cause of internal conflict during the past century today most European and Asian nations have been built and have stable boundaries. Internal belligerence still exists in areas such as Kurdistan, Kashmir, Chechen and Palestine where autonomy has not been granted. Today important conflicts do exist between the larger cultural gamodemes that are defined globally with regard to religion and economic wealth: generally these have an underlying base in resource acquisition. Cultural gamodemes based upon religion are much less adaptive because they tend not to allow exchange of ideas and values.

The nature of the conflict has changed to be largely external with one cultural gamodeme pressuring another. Examples are cultural conflicts amongst the Hindu/Muslim/Jewish/Christian groups; or, the rich post-industrial nations versus the poor African nations. The exchange of knowledge and ideas is perhaps the most important method to relieve this conflict. Those that do exchange idea and values evolve e. g. at the village level in India the emancipation of Hindu women versus the stasis of Muslim women is leading to marked differences in economic wealth.

One irony of ILD's is that internally it optimizes for organization but it does not provide a good method of defending itself against external competing groups, which use non-democratic methods of attack. Survival of a ILD depends upon absorption of any malignant group or eradication of that group. Appeasement designed to incorporate the enemy does not work as the many historical cases of crimes against humanity have ultimately shown: punishment and retribution is too late. The lesson learned is that at the extreme of conflict, to truly defend democracy, one must be undemocratic! Even rhetoric cannot get us out of this trap, set by effects far removed and essentially outside a common norm. It is questionable whether most of the citizens of the ILD's have the stomach for an approach that discards democracy in order to defend democracy. Too many do not accept that violence and hatred are not theoretical concepts but are part of the real world. Democracy itself provides a shield to such realities. However, the failure to undertake brutal methods can lead to the downfall of any established eusociety.

An offered alternative, for defending democracy, is an unrestricted commitment to the international community in which democracy defends itself by living by the results of the deliberation that defines it, even when living by the results of the deliberation is not to its immediate liking. This involves the risks accompanying multilateralism outweighing the risks associated with unilateralism. As David Rieff wrote in the journal Mother Jones [2003]:

"The Nazi experience showed that the right to act unilaterally was bound to be abused by evil regimes and provided democracies with insufficient means to confront evil".

Significantly, a system of collective security has to work well for a democracy to defend itself. Unfortunately, I do not think it has ever worked well. There is such a big difference between the ways in which people actually perceive democracy, and what it actually takes to make democracy work: this is a prominent problem.

The brutal approach lies in militant democracy, which asserts that threats to democracy must be dealt with quickly and effectively in a manner that the supporters of the attack will understand: by retribution. The cultural gamodeme existing in the USA today mitigates against this viewpoint. Many believe in a New Age spiritualistic mumbo-jumbo and that prayer will change the world or that love will change the world, and these folk have a debilitating effect on social will. The deliberate intrusion into another nation, to attack enemies, is regarded by many as an immoral act [the pre-emptive strike stance]. Others believe it takes moral depth to undertake such action. The American citizenry, as a whole, has proven to be a very moral group; and, it was surprising to note the support that was given to the United States government in combating those forces that are intent upon destroying the fundamental Belief System of our civilization [after 9/11]. This was militant democracy at work.

The nature of war has not changed by the mass application of terrorism from an external force. What is changing is the way in which the global population perceives this kind of war. An advanced organism when attacked by a potentially lethal power such as the pneumonia virus firstly enacts a defense mechanism and then uses all its resources to destroy the enemy. Applying this to a cultural gamodeme means that retaliation against those who would destroy the cultural gamodeme must be brutal and merciless. The problem with this approach is that it must be accomplished at the same time as projecting the idea of justice. It is a trait of humanity that actions, whether individual or group, should be just. Retaliation if perceived as a just act is acceptable as a global ethic. If it is not so perceived it can antagonize the global population. From the viewpoint of militant democracy to kill, or imprison, known terrorists and their individual supporters is a given. However, to wage war against those States that support the terrorist movement needs a deeper commitment. The war on terrorism is for the survival of what representative democracy regards as humanity. The tragedy is that to win such war humanity must be temporarily discarded and we must become the beast within adopting a militant democracy approach. Evolutionary Theory would demand that such an act must include complete obliteration of the enemy State apparatus, and all of its officials that consciously aided that State in its pursuit of terror. The concept of 'do not kill the leaders because we will then have no one to negotiate with' is fallacious as a natural response.

Life by its nature is brutal and unforgiving of weakness. Humankind has tried to differentiate itself from the rest of life by a belief in altruism and compassion: traits it regards as civilized and characteristic of our humanity. These beliefs are embedded in the idea of ILD. Unfortunately, these traits contribute to the fact that democracy has no way to defend itself against the forces that would destroy it.

CHAPTER SEVEN

THE SOCIAL FUTURE

"Once upon a time, humanity's answer to certain death was Heaven, or some such extraterrestrial world, a working hypothesis for the preservation of the spirit." Shostak**, 2003, page 6.**

A prime goal of society should be to maximize individual happiness. To do this population numbers and density must be controlled so that resources can be allocated fairly. This can be accomplished though a global bureaucracy applying social control via institutionalized law and order. The ideas of the League of Nations and the United Nations were initial attempts to bring about some mode of global stability. Unfortunately, radical changes of the global cultural gamodeme cannot come from above – evolution teaches us that change comes from within. When two contiguous Nation States have obtained comparable, and sufficient, levels of social norms and living standards, agglomeration is possible and should be encouraged from within each society. Immediate possibilities are Canada and the United States [and with time possibly Mexico]; all of the States of Europe, including Russia; and Australia and New Zealand. These are all areas where ILD's have taken root. The exchange of people within and amongst these areas will stabilize the cultural gamodemes and provide a potentially unstoppable force for the spread and acceptance of the ILD's. Democracy comes in many forms and other kinds may be adopted by others regions. However, the underlying theme of all democracies is voting. It is very unfortunately that the United States has vilified the word socialism for the past couple of generations; and, bred a population that does not understand what the word means. I have argued with many that the root of both the Republican and Democratic parties in the United States is socialistic in practice. Indeed if the parties did not recognize the basic rights and needs of the people they would not have survived and evolved. Socialism rests upon the belief that people can demand protection, of their rights, from the State. This protection includes the right to food, shelter and education. How this is provided and the level of minimal support separates the political parties: not the idea of fundamental rights.

In order to survive the future selection pressures, a requirement is to balance the population and resources on a global scale. In effect, a Nation must adapt or become irrelevant. State sponsored Democratic Totalitarianism as in China; variable Democratic Benevolent Dictatorships as in India and Militant Democracy as in the USA all need to evolve, to balance population pressure against resources. All democracies are extremely difficult to maintain, and difficult to keep going against the promises of authoritarianism and totalitarianism.

The global future is opening with the clash of cultural values amongst the extant cultural gamodemes1. Selection pressure is exerted within all societies from the internal dominating culture and major sub-cultures. These pressures govern the behavior of the individuals within each cultural gamodeme modified to varying degrees by the influence of external cultures. There is a direct analogy with the external environmental effects that exert an external selection pressure on the physical gamodemes. Conflicts both within and between societies are all manifestations of the internal and external selection pressures on the cultural gamodeme, and will operate in ways similar to biological adaptation.

Logic, with rhetoric, has been utilized throughout humankind's history to question, not only the purpose of life, but, also, how humankind should be organized into a society. Lagay [1999] referred to deliberative rhetoric, which she recognized as the ancient **"pursuit of judgment by consensus on matters of everyday life that demand action"**. If humanity is to evolve, deliberative rhetoric is a possible basis for the logic trait to build into consciousness as a guide to a political future: constrained by placing the process within a hierarchical structure of representation within a ILD. On the downside is the knowledge that in seeking practical judgments in this way deliberative rhetoric must pursue both egalitarian and altruistic goals that may be at odds with individual freedoms. The constraint applied by deliberative rhetoric is pertinent when the question 'How can a democracy defend itself?" is asked.

Lagay provides cautions that are pertinent to this aspect of humankind's phylogenic future, viz:

"In the complexity of present-day life, amid the plurality of cultures and opinions that form the context for our actions, and given the temper of skepticism that allows us to trust neither science, nor faith, nor reason, it is easy to forget that this is not the first time in which human beings have felt as though they must act in the face of uncertainty. Rhetoric's contribution here may be its most significant overall. How do we proceed when we can agree on no shared principle of conduct? or when we must act but are short on information that would predict the most likely consequences of our actions? With what do we replace belief in religious tenets, trust in science, and confidence in reason? Rhetoric's answer is that we substitute non-coercive consensus".

Lagay's comments are extremely pertinent to humankind's future but I see no way in which the answer can be non-coercive consensus. Consensus is certainly a powerful base for action when uncertainty exists but is disastrous when applied within a heterogeneous group that encompasses extreme views. One clear dilemma is religious inclusion. Such large portions of Earth's population profess a belief in an interfering God [at least 1 billion Christians, 1 billion Muslims, 1 billion Hindu, and over a billion Buddhists amongst others]. Religious inclusion would introduce an immensely illogical element, based upon myth and legend not fact, into any attempt to reach a logical consensus. The recognition that religion may direct society towards understanding basic human needs, points to the need to take account of what religion has to say but there is a definite need to filter the results through a factual knowledge base before action is taken i.e. evolutionary psychology, behavioral genetics and neuroscience.

Non-coercive consensus is a powerful methodology prior to action in the face of uncertainty, but it is dependent completely upon what confines the cultural gamodeme that uncertainty operates within. The rules of engagement thereby become critical factors for they also determine the participants in the rhetorical process. Certainly, I would totally exclude, radical religious zealots and racists from any participatory group that is attempting to define ethics, morals or norms for a future cultural gamodeme. The latter destroy the concept of a physical gamodeme and the former distort the cultural gamodeme.

Biologically rhetoric itself can be seen as an outcome of collective minds polling brains. It attempts to use collective consciousness to define our humanity. Because rhetoric is open-ended, adaptable and works where there is a desire to resolve conflict it is a desirable attribute to be part of the basic reasoning pattern of future cultural gamodemes. Accepting rhetoric as part of a methodology of deliberation and decision making for ***Robotico earthensis*** rhetoric's optimism is a necessary part of the mind-set, for there is a need for the adaptability rhetorical analysis applies to reasoning. This is because rhetoric

"deals in particulars rather than in universals, and because it seeks the best course of action rather than a timeless truth ... Therefore ... the set of possible judgments that rhetorical deliberation can produce is, in a practical sense, unlimited. Rhetoric pushes beyond either/or resolutions. Deliberators need not relinquish nor compromise closely held values in agreeing to smaller scope judgments regarding future action. Thus, for example, those who oppose abortion, fiercely and passionately, can nevertheless agree with equally committed pro-choice deliberators that violence outside clinics and the stalking of physicians and their families is morally unacceptable".

Looking towards the future of our phylogeny, it is clear that when humankind eventually designs our robotic descendent it should not simply be equipped with ideal systems optimized to ensure survival under all probable conditions. The essence of our humanity should be part of the heritage of ***Robotico earthensis***. There is no clear 'listing' of what humanity encompasses and therefore what of it needs to be retained as part of the consciousness of our robotic descendents is unclear: yet this is a critical decision to be considered when attempting to manufacture a consciousness.

GLOBALIZATION AND THE SOCIAL FUTURE

If humankind is to become a single cultural gamodeme an important question is:

'can we assess the 'worth' of a particular sub-cultural component of a particular cultural gamodeme [or even a complete society]; or, must we simply allow 'fortuitous development'?

Both methods can work under the processes of evolutionary theory. With fortuitous development the worth of a sub-cultural component is assessed by acceptance and absorption or rejection by the cultural gamodeme: the process following the Law of Instability. History indicates there is a common tendency for one cultural gamodeme to assess the worth of various traits in another and assimilate the valued traits. In theory this is how the establishment of a global eusociety should evolve. The alternate to fortuitous development is to start from a theoretical assumption of an ideal society and show what component parts are basic for its success. Progress is by working towards the new development by persuasion and regulation [with an alternative approach using totalitarianism]. One can argue that the concept of an ideal society depends directly upon what is its purpose. Once a purpose is defined a decision rule can be set-up to declare a particular aspect acceptable or not acceptable.

The ideal global cultural gamodeme is one in which the purpose is to have humankind as the central component, managing a harmonious complete Earth System, based upon a secular global democracy as the theoretical social framework. Obtaining this goal is aim but how to obtain it is debatable. Some believe that militant democracy is the quickest and surest way to obtain this goal; others prefer the process of fortuitous development.

Whether we believe in a forced militant approach to democracy or a natural adaptation to a global cultural norm the future necessitates the elimination of inter- and intra-cultural conflicts without destroying the 'worthy' components of the diverse cultural gamodemes. The evolution of the global cultural gamodeme is a continuation of biological evolution in which complexity and emergence continue to play a role through time.

As population stress increases on the global cultural gamodeme; and, as the New World Order based upon a global economy grips Earth's population we will see developing one of two scenarios. Either of these scenarios will have major repercussions on the future social condition.

The first scenario will see an increased control by Corporate World so a corporate ethic becomes a means of social control on the population through government [which will no longer be an arm of the people]. One consequence will be increase social conflict against government in the form of political extremism or religious strife. It is not without significance that the evil of Muslim extremism is rooted in antagonism to western culture as promulgated by global corporations into rural 'Greater Arabia'.

As Corporate World tightens its grip freedoms will change and indirect rule by Corporate World through the political system is more likely to occur. All major social changes are accompanied by individual tragedies and often mass-suffering but if Corporate World is allowed to control World Government, I believe, the lot of the common people will regress back to the dismal stage and internal conflict will increase.

The second scenario will see the increased control by Global Government so that a government [of the people] ethic becomes a means of social control. It will have direct conflict with both Corporate World and Religious extremism. The development of a global gamodeme, based upon a people's government ethic, spawns a dilemma for the future development of democracy. Can the financial institutions be controlled, by and for the people, and at the same time retains a fundament of 'free enterprise' and the 'market place of ideas. So far history suggests this is difficult if not impossible because politicians are malleable by many forces It is necessary to implement a government policy founded in strong laws directed against the excessive influence of Corporate World. The following immediately come to mind.

1. Strong punishment for malfeasance in office by politicians.
2. Criminalization of corporate leaders who knowingly initiate or condone illegal practices.
3. Fines and confiscation of corporate assets for illegal activities.

The evolution of democracy into a system where the people are truly represented directly by the political system is being fraught in the western democracies today both by the corporate and religious worlds. Future society necessitates honest sectarian leaders unencumbered by obligations to a third party. This will require major financial and political reforms. Society must resolve and answer to the question:

How do we get rid of the influence of Corporate money and religious bullying from the political – electoral process?

All evidence in the United States and Europe indicate that Corporate World has placed itself in the position of the financial provider to almost the entire political system. The people must regain control of the political system. One method is simple and would involve placing on the ballots of all States a referendum that would modify the electoral process. The referendum would simply state that all elections must contain "None of the above" as a voting option. Most importantly if "None of the above" gets the majority of votes then the election must be held again and the candidates in the earlier election become ineligible for consideration. The process is then repeated until a candidate is selected. The cleverness of this method is that it can reduce the influence of corporate money and special interest groups rapidly: and allow the majority to influence the rejection of a candidate as well as the selection of a candidate. It effectively places the electoral process within an evolutionary framework. The argument that this process would lead to a stale-man forgets that the system evolves. The general population has a lot of common sense even though it may have a lack of knowledge about an issue.

Government maintains the coherence of the State primarily by the threat of violence to the individual. In nature the barriers are much higher and unsympathetic to poor survival fitness. Nature supplies resilience to a population through the genetic makeup of the individual in the same way as the market-place-of-ideas supplies resilience to a democratic society.

Evolution does suggest specific guidelines along which the global gamodeme needs to develop to meet the challenge of the future.

1. Humankind must strive to optimize the Earth System for itself, recognizing that harmony with the rest of nature is vital. Humankind is part of Earth's ecosystem.
2. Humankind must create new knowledge, which is rapidly becoming its most important trait.
3. Humankind must encourage diversity and therein individuality, and the market-place-of-ideas, as a means of exploiting its own future.
4. Humankind must strive to move ***Homo sapiens*** and our phylogenic descendents into Space and establish our humanity throughout our Universe as a galactic species.
5. Humankind's future cultural gamodeme will be shaped principally by the following components that will increase its worth.

    - **Education.** This will result in a more enlightened populace that will allow reorganization of the cultural gamodeme to balance individual freedom with group needs.
    - **Reduction of the population pressure.** This will occur by redistribution [immigration and emigration], euthanasia, restricted breeding, and the development of human chimera [to inhabit the oceans and movement off-planet].
    - **Genetic intervention.** This will involve both somatic and germ line therapies applied to physical and mental health, aging, and diversity.
    - **Technological developments**. These will result from the knowledge quest that education will bring. There are obvious technologies where the social future can benefit most. These include evolutionary genome studies, deep ocean exploration, and space technology.

Evolutionary principles will play a major role as different ideas compete for dominance and evolve into novel social features. The market-place-of-ideas will dominate.

At one time knowledge in the western world was divided into divinity [the study of God] and humanity [the study of Man]. However, the Laws of Instability, Actualism, and Combinatorial Outcome; and, their manifestation as adaptability, indicate knowledge of humanity and of divinity must be viewed within a broader spectrum. This broader spectrum pertains directly to the progression of the Earth System with ***Homo sapiens*** at the lead i.e. strive to optimize the Earth System for the use of our species. This is a definite anthropocentric approach in contrast to the controlling divinity approach. It allows the purpose of humanity to be defined as part of a natural stage in the evolution of matter as it developed on our planet and within our universe. As a consequence the purpose of humanity is intimately intertwined with the planet Earth and humankind's role in the Universe.

EDUCATION: THE LAMARCKIAN THREAD

Lamarck was a scientist who believed, incorrectly, that a major contributory factor in physical evolution was the inheritance of acquired characteristics. It followed that by acquiring characteristics humankind could pass them on to future generations. Although Lamarckism was wrong about the inheritance of physical traits the idea has value when it comes to the cultural gamodeme, and particularly knowledge acquisition. Clearly, knowledge is an acquired trait of the cultural gamodeme that can be inherited by future populations. Thus, creating and retaining knowledge is of utmost importance to the evolution of our phylogeny and predictably will lead to major changes in our lineage.

There are numerous social ramifications connected with the acquisition and dissemination of knowledge. At the lowest level the definition of a standard body of knowledge to form the core of modern education needs to be established globally as the basis for equal opportunity. Most of this educational core concerns language, mathematics, science and technology even though maintaining diversity in the cultural gamodemes necessitates a middle layer based in the humanities and art. The outer layer of a core education is procedural rather than fundamental in that it defines how a planetary gamodeme works under political [democratic] principles, that require accountability, law-and-order, and a definition of the limits and content of individual rights as opposed to group rights i.e. the ethical principles upon which the cultural gamodeme is built.

It is the outer core of education [figure 2] that affects the overall evolution of the cultural gamodeme. The past provides some insight into the problems that must be faced. The largest attempt at direct, outer core, political education was that empowered by Sovietism in the last century. Perhaps the most terrifying aspect of Sovietism was neither the oppressive measures that were used to keep the system working, nor the threat of nuclear war that a strong Soviet Union brought into focus. Rather it was the theoretical model upon which the whole system was based. This model relied deeply on two concepts: the "Soviet" and the "New Soviet Man". The concept of the Soviet subjugated individual freedoms to the rights of the group; and the New Soviet Man was evolution by Lamarckian processes to produce the ideal citizen to serve the Soviet2. In retrospect the mistakes are obvious, as are the values to a government that wished to use such persuasive methods.

In the 1960's the argument went along the following lines. The 'new soviet man' is a wonderful ideal for society; therefore, it is valid to manipulate the educational and cultural environment to mold the population into that image. Much of Soviet doctrinaire thinking was based upon concepts of cooperation and compliance yet it was revealing to see that the social system was hierarchical with a broad base and political elite at the apex of the triangle. The entire system was built this way, and the upper class was entrenched. Herschel and Edith Alt noted the aim was a cooperative, altruistic, group oriented person living under the maxim "for each according to his abilities, to each according to his needs" and guided by the "scientific principles of Marxism", accepting the overriding truth of the Party philosophy and pronouncements: for the Party is the people, it is the society and therefore what the party decrees is for the benefit of the people. I see comparisons between 'corporate world' and the 'concept of the soviet'; and, the conformity of the 'new soviet man' with the beliefs of the religious conservatives. We need to take care that we do not follow the Soviet model in which the Government decree a solution and then implements that solution on the situation, forcing the people to accept it. This is why rhetoric is a necessary foundation to democracy. It is interesting how Mikhail Bakunin's preaching regarding man being entirely conditioned by his environment and therefore was not responsible for his actions as long as the environment was imperfect held sway for so long over much of Soviet thought: and was embraced by psychologists and lawyers in the USA. It is amazing how this Bakuninian thread continues today to form the justification of much of illogical reforms and political correctness presented in both the political and social arena. Indeed it has become a psychological defense for numerous anti-social actions: from theft to rape and murder.

Up until recently there was strong reason to believe that the nature of humankind could not be changed. Manipulation of education, and the cultural environment, certainly can direct individual human nature along specific directions. The environment draws out the genetic traits to produce the phenotype. Nevertheless the basic nature of humankind was not thought pliable. Things are now different! Today, in the west, we are fast approaching the ability to create the 'new soviet man' with pharmaceuticals: Prozac and Ritalin would have been embraced by the Soviet leadership had they been available. We can learn a lot about how to engage the future evolution of humankind by studying these earlier concepts of the "soviet" and "new soviet man". If we are not careful they represent major ideas that will be imposed upon us in a different guise by some future government for cooperative, altruistic, group-oriented citizenry are highly controllable. History has shown that forced attempts to re-engineer the cultural gamodeme leads to unacceptable acts being committed on major segments of the population, ranging from forced sterilization to murderous atrocities. The road leading towards such unacceptable acts must not be taken again, if society is to avoid global totalitarianism.

Robert Frank's [1988] Commitment Model declares that emotional factors have evolved that serve long-term interest that allows the use of social relations to achieve long-term goals, and this gives some basis to the 'new soviet man' concept. Whether or not it is short-term gains versus long-term gains it is indeed true that what appears as an altruistic unselfish streak is part of our humanity. Perhaps one of the present eras most noted altruistic individuals was Agnes Bojaxhin who as Mother Teresa is revered by numerous individuals. However, even here the motives are questionably a result of appreciation of long-term gain. She was a highly motivated Roman Catholic proselyte and her training and belief system saw benefit for the Church, and her own salvation and possible immortality, in her activities.

Smith [2002] pointed out the argument over the nature of humanity has a long intellectual history ranging back to Aristotle [in translation: 1962, 1991] who thought humankind's reasonable nature was a major taxonomic factor separating humans from the other animals. Smith's Rational Choice Hypothesis, asserting humankind examines cost balanced against benefits, prior to action, is a more likely basis for understanding an individual's actions in the cultural gamodeme than are hypotheses involving a cooperative, altruistic, and group-oriented nature. The cost and benefits always are constrained by the prevailing knowledge of the moment. The 'our-group against their-group' mentality seems to be a basic instinct possessed by any cultural gamodeme. It is this element of choice that has permeated most cultural gamodemes in the past and still prevails today. The Rational Choice Hypothesis is a possible paradigm for the future gamodeme. It is the Law of Combinatorial Outcome in action.

Education is the great leveler in modern society because it provides the key to equal opportunity. At the same time it is a basic requirement to partake in the democratic process. A broad based education is necessary for all people in a democracy because an educated population can make informed decisions for themselves and for the future. A knowledgeable citizenry is vital to the evolution of the cultural gamodeme.

Educational systems of the nineteenth and twentieth centuries indicate that selectivity and academic elitism based on meritocracy are useful mechanisms when the goal is to optimize the production of specialists to efficiently run a cultural gamodeme. The idea of meritocracy as the basis of society is a good one, but the concept does lead to unequal access to privilege, status, wealth and power. In this regard it manifests the complexity of humankind; at the same instance it provides a measure of individuality. No one really believes that all people are equal but that equality is an admirable theoretical quality to aim for. The moral equality that all people are equal under god demands the recognition of a non-natural being. Future society will not remove elitism. For many people elitism is seen as rule by an upper echelon of privileged class, and has become a 'dirty word'. Elitism is a fact of evolution. The equivalent to survival of the fittest in the physical gamodeme is the concept of meritocracy [ability plus effort equals merit or reward] in the cultural gamodeme, and the base of elitism is meritocracy. Society encourages ability by giving privilege as a reward for success [to education, to resources etc] and fosters elitism. All societies practice some form of meritocracy but this is done within the constraints of their local cultural gamodeme, so that the practice appears in different forms. The overt antagonism towards elitism and selectivity has not negated academic rigor in most good students, although my experience is that it does adversely affect those below the top quartile.

As noted earlier, freedom of thought is useless if people are not trained to think, just as freedom of speech is useless if people have nothing to say. Modern western educational systems show a definite capability to produce the kind of trained citizen needed to play an active role in contributing to modern democracy. Education is now recognized by large numbers of citizens as the way to 'level the playing field' of opportunity and, as such, they are calling for meritocracy[3]. It is necessary to recognize that elitism an meritocracy play a major role in the present gamodeme in that it can be controlled. The future cultural gamodeme certainly will continue to value the more capable citizens over those with lesser capabilities but a system of checks and balances must be put in place to avoid the 'taking' of excessive rewards by the more capable.

BRITISH EDUCATION: TO SERVE THE EMPIRE

At all educational levels the US system suffers from the lack of standardization and, as a result, once in the work-place, performance is an immediate determining factor for advancement. This produces a huge economic waste that can be eliminated by standardization in K1-12 education; increasing the selection pressure by 'streaming'; and, standardizing the assessment process: characteristics that are a necessary part of the future gamodeme.

A pre-requisite necessary for improvement, not only in the educational system but also the global gamodeme, is that discipline must be re-imposed within the entire social system. Education is organized as group right and individual rights must be subjugated to the needs of the group. Punishment of individuals breaking the rules must be swift and apparent. To do this regulation needs to be enacted that severely limits the intrusion of the legal system into schools4. Many parts of the world have shown that discipline works in education. Compulsory dress standards [particularly school uniforms], and separation of the sexes during Middle School are intimately connected with the discipline problem within the US educational system.

The future will necessitate a more extensive core science and technology curriculum. This can be accomplished by the following.

1. Start free compulsory education at the age of four.
2. Extend free non-compulsory education to include the equivalent of the Associate Degree i. e. two years of specialization with the choice of a few [2 or 3] concentrated areas of study, and to encompass Trade Schools.
3. The removal of elected education boards and the replacement by a Federal civil service, so that real uniform standards can be set and quality controlled by regional and ultimately national testing. The control of the State run systems should be moved to the Federal level.
4. An important goal of the penal system must be education. It has been reported that a third of afro-American males between the ages of 14-30; and 1:142 American citizens are within the penal system. Many of those in custody have poor education. If the educational system is mandated to educate inmates and if freedom depends upon obtaining such an education the educational level of the most problematic sector of society will be improved. Having a captive audience that can be disciplined works: as the European Boarding School system has shown.

Today we see shades of Lysenko, Lamarck and Bakunin influencing the social fabric of democracies, especially by highjacking education as population growth dilutes resources. Put simply there are insufficient funds made available for education of the masses but the masses need a good education so that they can make considered decisions. Society errs by not countering political correctness when it goes against common sense. It particularly errs in the denial of elitism i.e. that some individuals are superior to others and should be rewarded differently. It errs by not providing our children with an education that informs them of scientific truth. Ill informed voters make a democracy wide open to political control from above by propaganda, and rabid influence by any group large enough to threaten a politician's career by a mass vote. The permeating of Bakunin's ideas amongst the soft sciences and its effect upon educational rigor fostered irresponsibility and non-accountability. That acquired cultural traits can be passed on to future generations is definite for all cultural gamodemes. However, applying Lamarckism to cultural evolution belies the truth of Darwinism if it denies that those traits that allow survival are the ones that should be inherited. Without the freedom-of-the-market-place operating Lamarckism can be deadly.

Maintaining meritocracy

M[eritocracy] = A[bility] + E[ffort]

Meritocracy is the ONLY way for individuals to be assessed in the future global gamodeme. However, this is not a simple linear additive formulae. Both A and E can be complex functions within themselves. Individual worth is not simply the value of the roles that a person plays in the cultural gamodeme and the question of how do we measure individual worth becomes critical?

Today, there is a worrying global trend that directly opposes meritocracy. There has always been a strong undercurrent of academic politics that determines a person's initial job and often a whole future. Even though the academically good may rise to the top financial level of society, the children of the rich are already there. This is so even though they may be mediocre. An academic 'joke' about some universities is: "Pay you fees and collect your B's", and this leads to some gross inequalities. Most parents believe that what you pay for is future access and a system is growing that mirrors the evils of the upper class of Britain during the past two centuries. The advantage of an education is real when it comes to access to a better future. The influence of money, wealth, and family status needs to be removed from the global educational system at all levels, if an egalitarian society based on meritocracy is to evolve.

The fact that the upper classes [the rich] are able to maintain separate environments within which they operate is not undemocratic, provided class is based upon meritocracy and not theft. Individuals who make their own wealth through effort i.e. the founders of companies that generate wealth such as Microsoft or private Oil and Gas companies are important and necessary aspects of eusociety [as opposed to 'elected' leaders such as the CEO's of public companies.] The fact that the self-made rich have private enclaves, second homes, and places I cannot enter, should be accepted as natural if we are to maintain a stable social gamodeme. On the other hand ILD's should strongly curtail, if necessary by State violence, the actions of leaders of public companies.

C. P. SNOW AND THE TWO CULTURES

POPULATION PRESSURE

The problems of population containment, population reduction and population migration are critical ones pertaining to population density that will affect future society. Even if people do not see this as a present critical problem it will arise when population pressure is so great that the questions "How can society be structured in a fair and equitable manner?" and "What is to be done with the excess of individuals?" must be re-addressed. Attempts to address these two questions in the past have not been too successful. Today global society is full of undeserved inequality and unnecessary poverty and the problem will be exacerbated by scientific development for a looming goal of humankind is to extend the life of the individual for an indefinite period. The solutions to the questions of population will pose large moral and ethical dilemmas that must be addressed by the political system, based upon scientific principles.

How can society be structured in a fair and equitable manner?

To ensure political stability the distribution of resources must be equitable[5] but as population numbers and density increases this becomes more and more difficult. Today it is obvious that even in the representative democracies the access to resources is distinctly related to wealth. In recent times the period of partial financial equality in the USA existed for a mere 50 years [1930'3-1980's], and today even the idea of financial equality is rapidly vanishing. This is leading to a political undercurrent within the middle and lower classes, which is becoming increasingly agitated by corporate intrusion and personal wealth. With increased population pressure it seems that society can be structured in a fair and equitable manner only if all people have the same, unrestricted means of gaining wealth. By applying the Principle of Meritocracy the social condition for all people can be optimized within the economic marketplace.

Equitability is related to compensation in the economic marketplace. Whereas we compensate our political leaders a just sum for their services the cost of an election is now outside the means of all but a few individuals. Election is increasingly related to funding and the influence of groups with their own internal agenda: particularly the influences of corporations and the wealthy. The need to develop a better method of selecting leaders, and fairly structuring our society so that anyone capable enough can participate, will become dangerous issues leading to social unrest as population density increases, unless the inequalities are addressed in the immediate future. Today, a hierarchy of civil servants and government advisors exists behind a political façade. This hierarchy, itself is not permanent, although it often uses a hidden and fairly continuous intelligentsia to advise the body politic6. For the most part, the presence of these semi-continuous government officers represents a sensible solution to governance that avoids anarchy associated with frequently changing political power holders. At the same time people recognize that elected politicians are not subjected to the same constraints as a civil service and are influenced by lobbyists with special agendas that harm the people as a group. The future population demands initiated by increased population density and cultural diversity will see an increase in this method of seeking influence, unless some other method is devised. An improved and integrated civil service is a necessity for the future gamodeme.

To structure society in a fair and equitable manner it is necessary to address compensation in public corporations [private companies are an entirely different matter where unlimited compensation is acceptable within the framework of 'the survival of the fittest']. The government must apply regulatory controls on compensation within public corporations. The excesses in public corporations is a major contributory factor to inequality in present society. Self-regulation by public corporations has failed. It is fallacious to think that a single CEO 'earns' a 10 million dollar annual compensation: if there are not many others in the same organization who can accomplish the same results the structural organization, training and recruitment efforts at the incoming level of that corporation are seriously flawed. This applies to most public Corporations in all industries. Over-riding the compensation issue is the clear lack of a corporate ethic that pertains to social justice, accountability, and fairness when it comes to public financial corporations..

The effect of special interest groups will become even more prominent as immigration continues and pluristic societies develop worldwide. In many aspects India today is a living laboratory for understanding the problems of high population density in a democracy if the issues are engaged too late and get out of control. Resources are not fairly and equitability distributed in India because the population density has got beyond the control of the government. India could well be the direction that all representative democracies could follow if something is not done to curtail population growth.

There are other aspects of immigration associated with problems of population pressure. An interesting aspect of education that multiplexes with the politics of immigration, economic development and the cultural gamodeme was noted by C. P. Snow and is worth quoting in its entirety for it directly applies to economical and social conditions in the European Union and the United States of America at the present time.

"There is one curious result [of education] in all major industrialized societies. The amount of talent one requires for the primary tasks is greater than any country can comfortably produce, and this will become increasingly obvious. The consequence is that there are no people left, clever, competent and resigned to a humble job, to keep the wheels of social amenities going smoothly round. Postal services, railway services, are likely slowly to deteriorate just because the people who once ran them are now being educated for different things. This is already clear in the United States and is becoming clear in England."
From C. P. Snow [1964], page 47, footnotes 25.

Here we see both the reason for and the need for immigrant labor. We see why loose immigration policies are not of long term benefit to the people of the host country because they lead to a larger population growth in the second generation than would occur normally: and the same problem re-occurs. Better indeed to advance the global market place to stimulate internal growth in the countries supplying the immigrants and at the same time to invest in the science necessary to automate the more 'humble' work. One solution to C. P. Snow's problem is NOT to automatically grant citizenship on the basis of birth but to do it on the basis of the parent's nationality.

Another facet of the selective pressure caused by immigration is that such a large scale movement of people from one geographic area and/or culture to another has never, in the past, been as massive as it is today. In the modern representative democracies this population becomes a voting population after a fixed number of years and tends to alter the social norm of the host country. Most countries are quite conservative and evolve slowly because the indigenous population does not want rapid change: especially those that involve 'foreign ideas'. Unfortunately, the current citizenship laws of most countries can mean that, with a large immigrant population, change can be forced to occur too rapidly. In the USA the classic case is the influx of the Hispanic population, especially in Florida. In the State of Florida the large immigrant Cuban population has altered the political climate by block voting. The fear of the ballot box effects political change that impinges on the original indigenous population. The solution is really quite simple – change the voting rights. All people born, of US citizens, should have voting rights in the US at a specific age: 18, 21 or whatever. An immigrant should only obtain citizenship and acquire voting rights after a similar period of residence, similar to the one currently applied to indigenous citizens' i. e. after 18, 21 or whatever, years of residence. Promulgation and passing of such laws can avoid cultural crises in the representative democracies. Associated with the immigration problem is a contiguous question of national language. Language competency should be applied with similar strict laws. Immigrants, who do not learn to speak, read and write the national language, within a set period of time, should be denied citizenship and voting rights. The language issue is important because language contains basic elements of the cultural gamodeme. American does not have a National Language but needs to legislate one or two [i.e. English and Spanish].

Ancillary social questions relating to the selection pressure caused by immigration also divide our society today and need addressing. These particularly concern unearned social benefits. Health, educational and social security benefits should only be made available by the State [charity has its own rules] to individuals, or their immediate family, who have paid or are paying for such benefits by taxation. All of the problems associated with these questions are exacerbated by increased population pressure.

The future of individual freedom

A major driving force of democracy is thinking freely using a critical intellect. The freedom of thought lies at the core of individual rights. Ironically, it was the plaintiff lawyers who effectively used both civil and constitutional law to force the implementation of the numerous individual rights existing today in American society. Litigation within the limits of the Constitution together with dissemination of ideas through the mass media proved extremely effective tools for developing America's present democratic system. Whether the litigation was a result of social agenda or personal greed the effect on American society has been spectacular. However, many today would agree with the suggestion of Fukuyama [2002] that these rights are being misused and overemphasized. The safety and welfare of the individual family group is important for it was for that reason that humankind banded together as society in the first place.

Some of the solutions for our social future certainly will involve changes in our rights and freedoms. What happens will depend upon who controls the world: a government of the people or a government backed by the global corporations. Maintaining a correct balance between individual freedoms and group freedoms within a representative democracy is difficult because an active minority can coerce the political vote. Solutions do exist to the latter problem. For example, all political candidates can be elected for a longer but single term e.g. 10 years. Secondly, we can change to a universal democracy, as opposed to a representative democracy. If people can vote through their television set or computer, on every issue, then we no longer need a representative democracy but a strong and honest civil service. The technology for mass electronic voting is already available but, of course, politicians of the present generation are against this latter proposal because they would be turned into administrators, interpreting and following procedures, as opposed to their present role of decision makers. The latter allows the politician more power and wealth generation than the former. Similarly corporations oppose this solution for then they would have no control over the political system except by mass advertising. In line with J. J. Rousseau's "Discourse on Equality" only in challenging our Institutions and establishing rhetoric at each level of the political – social hierarchy will our social freedom allow meritocracy.

We change our society by critical thinking, by studying cause and effect and by allowing a feed-back mechanism. As a consequence changes are essentially generational. It was critical thinking that led to birth control and initial population containment in the democracies. It led to minimum income levels and forms of socialization that provided safety nets for the masses. It led to an understanding and balancing of individual needs and group needs and many other things that make our society worthwhile. Future society must continue to foster the use of individual critical thinking not the doctrinaire group - thinking of the political or religious right or left as some wish for. Democracy must be vigilant that the political system does not enslave the minds of the vast majority of voters, by promises and punishments designed to force conformity under high population density. Vigilance is especially necessary on the educational front: this form of social engineering has real effects!

Who shall live and who shall die?

With increased population pressure on all resources the question **"What is to be done with the excess of individuals?"** rises a host of moral questions, ranging from immigration to genetic manipulation. Restricted immigration is not particularly useful because immigration is driven partly by the needs of the host country. Besides, controlling the migration of people does not remove the global population problem. Nevertheless, there are options to reduce population pressure that may turn out to be initially both financially and even politically expedient. Some of these options such as euthanasia and restriction on the number of offspring are not appealing to most people.

The modern world is aware that the question of who shall live and who shall die has been a constant presence in the cultural gamodeme: often resulting in ill conceived social optimization programs developed by a particular group, as in ethnic cleansing. However, as humankind develops towards a global government with global regulation, the dimension of this question will diminish to ethical and moral problems related to specific individuals and, hopefully, never again directed towards specific cultural and ethnic groups.

Genetic manipulation may present much better solutions for it can reduce the burden before unwanted individuals are added to the population pressure. The phylogeny of humankind is linked with the societal aspects of genetics. Inheritable diseases, disabilities and disorders have been recognized for a long time. In all organisms, including at one time humankind, genetic aberrations were brutally removed from the gamodeme.

Euthanasia

Euthanasia is a question that may have to be addressed by future generations, even though it is avoided by some societies today. Compassion is a trait of humanity and the present cultural gamodemes do accommodate those individuals that would face euthanasia under rigorous, natural conditions. The real question lies with future individuals. The salient question posed by some is: **"should humankind allow resources to be used on individuals who would not survive under natural conditions, when reason dictates they should be culled prior to birth".** This 'needs' question must to be answered as part of the optimization of the Earth System for it affects humankind's future. In answering this question humankind will refine the definition of our humanity: for the better or the worse.

It is important to separate the two issues of Euthanasia and Eugenics. Euthanasia is practiced throughout the animal kingdom, including humankind. The moral problem faced by society regarding euthanasia is primarily fed by religious components within the cultural gamodeme. Stated simply those who uphold euthanasia believe that society should not waste its resources on individuals that do not meet their criteria for defining a human being. Euthanasia is a well-known and tricky problem for conceptually it includes not only the unborn, but some of the chronically sick; and, indeed some that are incarcerated in penitentiaries. In archaeosociety it even applied to some of the very old.

By accepting an all-encompassing view of euthanasia we expose our ignorance and do injustice to our own logic. Much of what is related to modern euthanasia concerns some simple issues that are both the domain of State and the domain of individuals, and certainly do not belong in the domain of religion. These issues include the following.

1. Where euthanasia does not apply is for physically or mentally handicapped individuals who are alive today. These individuals should receive all of the care, affection and compassion possible:

whilst society recognizes this as a transitional stage that in the future will be a rare event as we eliminate genetic errors from our germ-line.

2. The right to die issue is an individual decision and the illegality of suicide is an infringement upon individual rights by religious zealots. If I decide I want to die I believe I have the right to commit suicide.
3. Denial of the right to terminate an individual's life at that individual's request is an infringement upon individual rights by government applying a religious based belief. If a member of my family states either verbally or in writing that they wish to die if brain-dead or in a coma then I will try to fulfill such a request.
4. About one third of individuals incarcerated in penitentiaries will never be able to enter society again because they are so wicked[7]. Because they will spend the rest of their life in prison utilizing resources, society has only a few logical alternatives for this group of individuals who by their own decisions are incarcerated. We can kill them, or we can isolate them in a self-sustaining penal society of no escape. The specter of a Gulag penal colony is still part of our group memory, as a means of political oppression. If the old European concept of an island prison is not applicable then euthanasia is a real alternative. It is doubtful that somatic cell therapy combined with forced education can solve this dilemma.
5. Euthanasia of the unborn is mainly an issue because of religious belief: with many religions perpetuating a mantra of sustained ignorance. Euthanasia of the unborn should not be a parental or family decision but a part of State regulation. Bringing an individual human being into the world knowing that it is physically or mentally retarded is illogical, and in the United States perpetuated by the use of tax-derived funds to support the incapacitated. If a fetus is known to be physically or mentally impaired it should be aborted, or killed at birth, by State law. This has its extension in the ethical issues associated with eugenics.

Eugenics

Eugenics keeps on returning as an issue relating to social condition because repeatedly some people see the concept as not only logical but a clear way to improve the cultural gamodeme. Others cannot separate modern eugenics from the inhuman ideas of the last Millennium, and do not accept that germ line genetic engineering [GLGE] could improve the human condition. The past saw the use of numerous unsophisticated practices to 'improve civilization'. Marriage restriction, as in the apartheid era of South Africa; genocide, as practiced by Hitler; sterilization as a condition for legal abortion [as practiced by England during the latter part of the twentieth century]. These were all socially visible methods that were eventually proven to be either illogical or impractical.

Eugenics, when it is based upon GLGE, is a benefit to the social condition of humankind. The moral issues raised by many appear not only narrow-minded but also severely short sighted. I do not believe the rights of the unborn or un-conceived are related to moral issues. I believe morals apply to the living and the here-and-now. Indeed it is questionable whether or not we have a responsibility to our future phylogeny. We are the ones alive at this moment and we make daily decisions about what is best for us as individuals and for our own offspring. The sum total of these decisions is how the social condition changes. All human being's have immense common sense when it comes to self-preservation and kinship, and most have an ability to assess information and make decisions for their own good and for the good of their kin. People take decisions that are both logical and desirable for their own and their offspring's future every day. The process decouples us from the decisions our offspring might have preferred. Although such processes are conditional they are without feedback i.e. physical and cultural evolution is time constrained and the future cannot effect the past except as a thought experiment. This does not deny that future outcomes of present actions are conditional; or, that individuals and groups will continue to use speculation and predictive methodology about the future to determine their own future action.

Abortion is part of the eugenics issue. Prenatal testing, such as amniocentesis and chorionic villus sampling, provide information on the genetics of the fetus. This allows a decision to be made early in developmental stages regarding abortion. The possession of genetic diseases such as Down's syndrome and Gaucher's disease can be pre-determined this way. The choice to abort or not is an issue which religion attempts to interfere with greatly and is the cause of much antagonism towards religious groups. The abortion issue is being fought by one side under the banner of 'freedom of the individual' and especially women's rights; and, on the other by laws said to have been given by a supernatural being. Linking the modern eugenics movement with the politically ill - conceived eugenics movements of the last century, in order to dupe those who are uninformed is equivalent to false advertising scams.

The basic questions that need to be asked are as follows.

1. Does the State i.e. the group, have a right to ask parents to submit to genetic tests so that future gene based disorders can be avoided?
2. Does the State have the right to ask mothers to submit the fetus to genetic tests so that decisions can be made whether or not to abort?
3. Does the State have the right to request that the mother aborts the fetus if genetically determined diseases are found by

prenatal testing?

4. Finally, and quite significantly. Does the State have the right to withhold financial aid and other resources from parents [and by extension the child] that decline to abort a sick fetus?

The question of society's acceptance or rejection of State intervention has always been the real issue of eugenics. The first three points relate to this question. The fourth point is not even a moral issue that should be addressed by group reasoning for it is clearly in the domain of an individual family's freedom of choice and is in the domain of personal ethics not group ethics. A simple recognition that a failure to comply with State law [items 1, 2, and 3] should activate item 4 would need to be mandatory.

Science is developing further ways to address the eugenics issue. For example, the abortion issue often can be avoided by pre-implantation genetic diagnosis [PGD]. The process takes place after in vitro fertilization and prior to implantation of the embryo into the uterus. A series of embryos may be developed in this way and they are examined in the Petri dish at the 8-cell division stage. One of the cells is removed from the embryo and subjected to DNA testing for known genetic diseases such as Tay-Sachs disease, cystic fibrosis and Gaucher's disease. In this way, hopefully a disease - free embryo can be selected for implantation in the uterus. In the future, our phylogenic descendants may shift the entire process to an artificial womb. Many of these aspects of controlling population pressure are intertwined with genetic interventions on a more general scale.

GENETIC INTERVENTION

Hunting party, Texas 2008

Part of humankind's introspectiveness has led some to question the need for improvement in our species itself, seeing such action as an affront to either a god or a singular view of humankind's nature. I do not believe the basic urge that drove our ancestors to band together beyond the kinship level was self-limiting in this way. On the contrary I believe the inherent nature of humankind requires a strong reaction to such suggestions. That we accept deterioration, senescence and death when we have the potential means to prevent it violates the nature of a living system. Death is the prime obscenity in the cultural gamodeme. Longer and healthier life, better intellect, and stronger bodies are all desires that at one time or another cross the minds of most individuals. The ability to eliminate deterioration, aging and possibly death is only a generation, or at the most two, away for scientists. Genetic intervention is the key to humankind's future phylogeny. To attempt to stop this progress is truly a crime against humanity. Science should be allowed to develop techniques to extend useful life, without government interference. The core of he arguments currently leveled at genetic engineering have been around during much of human history but in a different form and it will be difficult to remove the underlying issues that are interwoven with those of equality, freedom and rights.

In both somatic and germ line therapy research the role of the State should be regulatory: not in regulating the development of the science but in regulating its application. It is clear, that if allowed to progress unhindered during the next hundred years, genetic intervention will show remarkable progress in two main areas. These are deterioration and aging of the body; and, life extension.

Both of these areas of potential progress are dependent upon an increased understanding of the relationship among DNA, proteins and the phenotype. They both can be affected by progress in trait selection and by progress in medicine. Trait selection requires altering the genes either in the gamete, in the zygote or in the embryo. Besides offering the potential for eliminating disease, deterioration and aging, it can provide parents with a choice of specifying the gender, intelligence and other physical and mental aptitudes of their offspring. It is this last possibility that often brings dissent. It is highly unlikely that research on genetic enhancements of this kind can be stopped because such research will be the basis of real improvement in our phylogenic line. To what extent the State will interfere in these developments is unclear.

The danger to the cultural gamodeme that trait selection procedures may bring is not related to the process itself but to an unethical use of the process e.g. the restriction of the process to the offspring of certain individuals or groups i.e. the wealthy, the military, the fanatical. In all likelihood the State will initially try to control experimentation i.e., which offspring will receive genetic enhancements. This may ultimately be the best method, for enhancements to the phylogeny can be controlled through committee [the rhetorical indaba]. The danger is that once the technology is proven the wealthy will use it and so will the military establishments. To avoid a serious period of social unrest that this may cause the technology must be rapidly and fairly distributed. In all scenarios this must be implemented on a fairly wide scale and certainly within three generations [100 years].

The rules for germ line genetic engineering are still being developed. Nevertheless, the assumption of 'safe testing' is likely to be broken by some State or individuals both outside and inside of the democracies. Governments, corporations and humankind will see that altering such traits as memory and learning ability, or muscularity and libido, will be seen as too great a prize not to take risks. Today there is strict control on drug testing within the democracies and similar controls will probably be effective for genetic engineering. They should be primarily safety controls rather than moral controls that impinge on ethical issues in science. Pharmaceutical testing is designed to make sure a drug is proven both safe and effective in test animals over a period of generations before used on human beings. This same process is not feasible for genetic engineering research because the time it takes for the scientific developments to progress is short, the rewards are too vast, and the results may be permanent. Safety rules that will be applied to genetic engineering will probably initiate changes in the rules as they apply to testing throughout the pharmaceutical industry: quickening the process for life enabling drugs. In some areas of genetic engineering individual enterprise will push the envelope, as will the greed of corporations and the goals of government and military control.

Lagay [1999] notes five arguments that adversely pertain to germ line genetic engineering.

1. **The practice puts humankind on a slippery slope to eugenics. This is the 'sum of all fears' argument that plays upon the imagination rather than the reality of modern science. Modern genetics need not be feared by any segment of society because its use in this context pertains either to a future generation or to individual freedom of choice by the present generation.**
2. **Because access to the technology will not be distributed justly, GLGE will exacerbate the disparity between the well off and least well off. In the early stages and as a generalization this will probably be correct. However, once GLGE practices are established, the risks removed, and the advantages seen, the insurance and health care industries will push for the use of GLGE in health related areas.**
3. **GLGE violates a fundamental principle of democracy— consent of the governed — inasmuch as parents will be deciding upon the traits and personalities of their offspring without their offspring's consent. Though children have never consented to their traits, parents have likewise been unable to select or consent to traits, so parents and children were both at the mercy of the natural lottery. Parental**

knowledge and access to GLGE upsets the balance of knowing and choosing in a way that seems unfair. I do not accept that the living gamodeme has this obligation to the unborn. However, with the use and understanding of genetic switches this could become a moot point.

4. **GLGE will affect the evolution of our species. This is undoubtedly correct in the long run and is a good idea if it improves the lineage.**
5. **GLGE may alter the meaning of being human. This may be correct for our future phylogenic line but the trick is to retain the essences of humanity as part of the human genome.**

As germ line genetic engineering develops what must be avoided is developing an individual who uncritically "subordinates his self interests to those of the wider community. Who is solicitous of other people's welfare, a vigilant guardian of State property and diligent in work habits …… law abiding and observant of conventional behavior standards as defined by authority. [A person in which] pursuing an alternative life style or participating in a counter culture holds no attraction"8. This is the wet-blanket effect of government control implicit in the concept of the 'New Soviet Man'. On the contrary society should encourage the eccentric. To be 'off balance' leads to imaginative developments in humankind and within the limits of democracy should be, not only tolerated but also actively encouraged. The range of possibilities of the human intellect is broad.

An important development on the horizon may make the choice issue a moot point. This is the development of artificial chromosome therapies that may allow correction of chromosomal diseases such as Down's syndrome to be rectified, in the uterus, without aborting the fetus.

Disease, and deterioration of the body

The efforts of science to curtail disease, and prolong useful life, will ramify throughout the debates on population pressure, equality and meritocracy.

Strictly genetic diseases will probably be eliminated in the next 100 years. Undoubtedly, major strides soon will occur in somatic cell intervention because this is much less controversial and together with drug therapy provides for improvement of the living as opposed to the unborn. Perhaps the classic case of somatic cell therapy in recent years was the publicity surrounding SCID [Severe Combined Immunodeficiency Disease] or the "bubble boy disease'. Scientists understand how to cure SCID using somatic cell gene therapy, although further progress is necessary to make the process safe9.

Eliminating disease is one area where genetic intervention will play a role in optimizing humankind because disease prevention is cost effective. Cost-effectiveness means that the health insurance corporations, which are a major channeling force in biotechnology, will support it. If disease prevention therapies and organic and mechanical enhancements can reduce cost the health corporations have good reason to support their development. Improved methods of monitoring a healthy human being, in prediction possible problems and in providing cheap replacement parts are all important aspects of preventative medicine that are being embraced by the health community. DNA testing at birth may be the most significant breakthrough once the links between genes and disease are fully understood. This will allow a prescribed preventative strategy to be developed and followed throughout an individual's life span to curtail disease.

The sphere inscribed by efforts to avoid deterioration in an individual involves a whole host of technical generalized strategies that will benefit all humankind. These are beyond conventional medicine and are already becoming part of the current concept of preventative medicine. The use of clothing to monitor the body's health and of self-diagnosis kits to test body fluids and thus signal the need for preventative care prior to the onset of disease is well within the capability of 21st century medicine.

Providing replacement parts to improve or extend life includes both mechanical and biological innovations that represent important steps leading to ***Homo roboticus***. Xenotransplantation, organ replacement, embryo manipulation and cloning are all part of this future. Mechanical replacement and enhancement remains in its infancy but a completely reliable manufactured heart, eye, blood, and skin will soon join the pacemaker as successful commodities. There are numerous cases where organ and mechanical replacements are prolonging life, slowing senescence and improving the quality of an individual's life. Maeder et al [2002] note that in 2001 an "estimated $305 billion was spent on introducing organic and mechanic enhancements to almost 25 million people worldwide". In a text figure they show that this money was spent on the cardio-vascular system [heart – lung – pacemakers – valves - stints], dialysis, joint replacements and organ transplants.

Organ replacement by donation from either a living individual or a cadaver is an important form of life- extension. The methods work well but unfortunately regulation acts against its widespread use in many countries: including the United States of America. In a nutshell there are insufficient organs available for transplant because of two reasons. Firstly, insufficient deaths occur that are suitable for organ transplantation. Secondly, the number of available organs is further reduced because a cadaver is still the property of 'the estate' after death and many believe that organ removal from the dead is an infringement on personal liberty and autonomy. In this latter area I believe the group should have initial rights above the individual. The ways to increase the availability of organs for transplant involve two approaches. Presumed consent assumes all organs are available from a cadaver for transplant unless the potential donor whilst alive has made a specific statement to the contrary. This method is used in Austria, Belgium, and Singapore. In the United States of America a Federal regulation similar to the concept of the 'no call rule' for telemarketers would go a long way to improve this situation. Such a law would decree that only those individuals who choose not to have their organs donated would be exempt from a national organ transplant program, the rest would be automatically made available for organ replacement. This can be done without making a dead body state property, which many would object to. Those who do not want to comply could so state on their drivers license, tax forms or whatever; and, this made available as a database to police stations and hospitals. The second method is mandated choice which allows those who do want to be part of the organ donor program to state so on their driver's license, tax forms or whatever. Compiled data indicates that more than 70% of the population agrees with organ transplant program but fewer than 30% have signed-up for it. In the United States the exception is the state of Colorado that has a 60% sign-up through the drivers license program [Torr, 2003].

In the medium term future [300 years] the problem will be moot because organ cloning will be available. The advantage of growing an organ in a laboratory bottle is that it can be done both by individuals for their own future use; or, by general laboratories to provide a pool for the next generation. Cloning of course is another scientific endeavor that is being hindered by the cult of ignorance.

Biologically altered crops that produce a high yield have been available for decades and one trend is towards genetically altered crops that can provide both nutrients and prophylactics. With the developments in cloning the deliberate production and harvesting of medical materials from plants, livestock and bacteria is advancing rapidly. Pharming is already a burgeoning field of research and development and is likely to progress because it is potentially so beneficial to the health of humankind and at the same time is not necessarily injurious to the plant or animal that is pharmed. To genetically alter some animals to produce materials of biological usefulness in their milk [clotting factors, vitamins] is part of optimization of the Earth System by and for humankind. Because Pharming of plants and the production of milk and eggs do not lead to the death of the source individual, this type of activity should bring little moral or ethical protest.

Related to organ donation are Xenotransplantation techniques, against which animal rights activists are vocal in their opposition. Xenotransplantation does present a dilemma far greater than that of cloning for it is a process that utilizes donor organs from other animal species and require that the adult animal to be killed to harvest the organ. This is not the same as harvesting stem cells from an aborted fetus or deliberately propagating embryos to harvest cells. It is more akin to propagating brainless embryos, allowing development until organs can be removed and then growing those organs to completion in a laboratory.

An example of Xenotransplantation is the use of pigs to develop organs suitable for human implantation such as a heart. The problem for science is that until more is understood we cannot, for example, grow a pancreas artificially in a glass container: until this is so Xenotransplantation needs to continue. I accept that this is philosophically the 'end justifies the means' but this concept is inherent in our nature when it comes to survival. There is a wide spectrum of strategies developing. One is the development of a restricted 'species', which has the specific purpose of growing human organs. The recently work of Italian researches has produced pigs that have the human DAF gene [decay accelerating factor] in their hearts, livers and kidneys. This gene will be part of the germ cell and thus passed to offspring thus establishing a lineage of pigs with this particular human gene. Eventually other genes will be transferred to this lineage with the intent of developing internal pig organs that will not be rejected by human donors10.

The next generation of preventative medicine will move towards a technological approach that targets molecular and cellular abnormalities that affect disease in the organism. Together with a greater emphasis on understanding the microbial biocoenosis that exists within the human body these advances will virtually eliminate death from disease.

Aging, senescence and life extension

The immense benefit to the aging, sick and injured that will come from stem cell and related genetic research is real not speculative but it can only come with scientific effort over a period of time. Thwarting this effort and causing science to waste time has occurred because of the ignorance of our politicians who are more interested in 'eating at the trough of special interests groups' than looking after the needs of society.

Progress in knowledge on senescence and life extension during the next generation of research undoubtedly will provide ***Homo sapiens*** with a longer and more youthful life, and once more the population density question will need addressing. Whether such therapies become available to all the people or only the few will depend directly upon the population pressure. It is likely that in the democracies there will be general availability of many preventative health improvements: primarily as a result of demands by the insurance and health providing agencies to reduce costs.

In addition to problems associated with disease technological developments will lead to intervention in the process of deterioration of the sense organs. This is one set of aging problems that will be all but eliminated in the medium-term future. Cataract surgery involving implants may soon be an outmoded method surpassed by injections to reconstitute the lens in a similar way as some macular problems can now be arrested. Research on restoring vision to individuals with retinal damage using a biocompatible electronic microchip may eventually lead to an electronic replacement whole-eye. Cochlear implants today are common procedures to remediate the sense of hearing, and are gradually evolving into whole auricular implants. Even though manufactured, in the future these developments to the senses may be biological rather than mechanical in origin. The sense of smell and taste is being understood at the molecular level and machines can recognize numerous differences at small levels of concentration. The sense of touch is already seeing advancement for the blind. For example, 'SmartFinger' shown at the 2002 SIGGRAPH meeting is a nail clip that can 'read' a surface and stimulates the skin of the finger [or wherever] according to the patterns presented to it.

In the future the visual, auricular and olfactory systems will probably be tunable over a much wider frequency than nature has provided and will be modular, so that the ability to see, hear, and smell over a much greater range will be an available mechanical enhancement for normal senses. A simple device such as spectacles that enhances all the senses and either makes use of the visual cortex as conduit, or some direct transference mechanism to the brain, is possible. Current research suggests that germ line genetic engineering [GLGE] eventually will provide some startling possibilities and radical alternatives in the sense organs. For example, human chromosome-14 has two clusters, amongst its over a thousand genes, that are critical for the health and functioning of the visual and auricular systems, and understanding these genes alone may allow a major advance in these senses.

Scientists are realizing that many illness of aging are caused by bacteria, fungi and viral attack and as DNA-protein studies advance so will our knowledge of how to kill, or at least turn off the debilitating aspects of, the micro-organisms which we host. The direct ingestion of pharmaceuticals in the form a pill or elixir will probably evolve into ingestion of preventative chemicals in our food as Pharming evolves. It is highly likely that within a few generations most of the age-related problems associated with the human body organs will be relegated to minor surgery, readily obtainable pharmaceutical intervention, or wearable options. Early death will be relegated to accidents.

I am certain that within the lifetime of our grandchildren the incapacitating neurological injuries, such as spinal chord severance, should be repairable by combined surgery and chemical intervention. The spinal cord, being the main pathway linking the brain and the body below the neck is the major communication conduit of a vertebrate organism. The ventral side of the spinal cord contains the motor nerves, which transmit information between the brain and muscles related to movement. The lateral and dorsal side of the spinal cord contains the sensory nerves. Today such damage alters the functioning of the nerves and generally incapacitates the organism and once spinal cord nerves have been destroyed the damage is usually permanent. In the future this will be curable. Slowly research progress is being made to re-attach and re-train severed spinal cord nerves damaged by physical injury. This area of research is of critical importance because understanding how to repair a spinal cord that has been damaged by disease, infection or physical damage will ultimately lead to the ability to transplant a brain. Brain transplantation will be the ultimate factor in evolving ***Homo roboticus.***

One question facing many of the neural and nervous system problems of aging is whether or not they are primarily gene or environmental controlled and if gene controlled can genetic engineering remedy the condition [either somatic cell therapy for the living; or, germ cell therapy for future descendents]. One hopes that in a generation the former will be possible and for future generations that the latter will occur. Neurological diseases, particularly those associated with aging such as Parkinson's disease and Alzheimer's disease, may soon be curable or at least preventable.

Although somatic cell and pharmaceutical therapies can provide immense benefit to the older segment of a population, the key to senescence and death lies in an understanding of the physiology and the metabolic pathways of the cell [Hayflick, 1994, 2000]. Herein also lays the primary key to life extension.

It has been known for a while that life spans can be extended in a variety of organism by altering particular genes. The daf-2 loci is such a gene and Cynthia Kenyon [Science, 25th October, 2002][11] has shown that blocking this gene in the young adult stage of the roundworm [***Caenorhabditis elegans***] doubled their lifespan. The daf-2 gene is present in other organisms including humans and it eventually it may be possible to block that gene to extend a human lifespan.

A major problem of aging is physical weakness and frailty. If these problems can be eliminated life in old age will be made, at least, more comfortable and probably considerably extended. This is now recognized as a prime disease of aging and as such should be curable. Frailty, defined by muscle weakness, poor gait, weight loss and fatigue severely restricts activity and rapidly leads to death once these symptoms are prominent. The more recent suggestion is that frailty has links to inflammation[12]. Medical literature is full of observations that inflammation is often caused, directly or as a bi-product, of microorganisms that have invaded the body. It has been said that humans are merely hosts for microorganisms, and the human body contains more microorganisms than it does human cells [10 trillion vs. 100 trillion]. If we consider that these microbes are normally in equilibrium with the human system that is their environment it is not surprising that when they malfunction [the microbes essential get ill] they cause problems to the host system. Halting the initiation and spread of various diseases of aging may be possible by restoring our internal biota to good health. As yet there is little knowledge on this topic.

Cancers are perhaps the most widespread and certainly one of the more lethal groups of diseases of aging. Eliminating cancer will be a major step towards life extension of numerous individuals. Curing cancer has made rapid progress in the past decade, and today most cancers are actually curable. Whereas the future holds hope that those cancers that are genetically controlled eventually will be removed from our genome entirely by germ cell therapy, those that are environmentally or otherwise induced are the ones that will see the greater improvement in treatment in the immediate future. Once more these improvements will rely upon molecular, cellular and microbial knowledge.

Another major improvement in the quality of life for the older age group will occur with the control or curing of cerebra-vascular and myocardial atherosclerosis. Even though this may eventually be removed from the genome by germ cell therapy, in the immediate future we can look towards injections and medications to reverse adverse effects. Cerebra-vascular, myocardial atherosclerosis, osteoporosis and age diabetes [mellitus] all may be caused by microorganisms and allow microbiological interventions.

Of the many minor diseases of aging hair and skin deterioration, which may be considered by many as cosmetic nevertheless, are aging diseases. The cosmetic industry is vast and a cure for graying and loss of hair or for skin deterioration is a cash prize to huge to ignore. Research into these aging phenomena will find a means of stopping and reversing the process, probably using somatic cell therapy. The psychological benefits of these treatments will probably extend life expectancy for many people.

The questions of well being, illness and death impact not only on our immediate social condition but, as will be seen later, impact on the future goal of integrating humanity into the consciousness of our robotic descendents. There are powerful political and religious forces that claim rights to address these issues but often the spokespeople for these groups lack the scientific facts to make assessments.

The possibility of near immortality

The Egyptian cults of Osiris and Isis offered eternal life in the present life and played upon humankind's fear of the unknown in the same way that religions in general use the 'fear of dying' as a means of social control. To a large extent, future science may eliminate such needs by allowing life to be only terminated by suicide, accident or necessity. Dying is the end of all aspects of our individual existence and gives rise to humankind's terminal question "what is non-existence?"

Stanley Shostak [2002] presents an interesting approach to the possibility of immortality. He postulates that a combination of stem-cell therapy and cloning can produce an essentially immortal organism by replacing germ cells with stem cells and then producing offspring by cloning. The offspring would naturally be sterile but have an inherent mechanism for bodily self-repair. The idea is intriguing and if it could be made to work fits well with the desired characteristics for a Space Liner population: long age to accumulate knowledge and wisdom and zero population growth. The idea could be tested by animal research. Aging, followed by death, is regarded by many to be an obscenity. To remove aging and death from our phylogeny would be a noble improvement. Shostak's methods, unfortunately will only work for a future generation. He makes three points of great potential [pages 15 and 37].

"Anyone able to perpetually regenerate, reinvigorate, and replace aged or diseased parts of their body could live in the same body from birth to eternity with their persona intact."

"A clone of one's own cells could serve as a source of embryonic stem cells able to support cellular renewal".

"Human beings can be made immortal through the simple device of replacing germ cells with stem cells....utilizing a cloned blastocyst grafted to an embryo for the purpose of replacing its rudimentary gonads and providing a durable generator of embryonic stem cell in perpetuity. The absence of sex cells should stop the process of aging at prepubescence, at a point before any of the genes for aging and degeneracy has acted - or, at least, before they have become dominant".

There is another side of the coin and that is that humanity has a major driving force concerned with the use of imagination. How long is long enough before boredom becomes the main cause of death by suicide? Certainly I have viewed my own life as a wonderful experience and want to do the whole process again … but how many times is enough if we retain memories of that past?

Humankind's efforts to extend life can interfere directly with two important aspects of the cultural gamodeme. Firstly, on the negative side, life extension can increase the population pressure. Secondly, on the positive side, life extension can increase humankind's knowledge pool. How long a meaningful and useful life is, is not a difficult question if we accept suicide as a right of the individual. Under such a constraint the answer is "as long as you want!" This may, of course, not be the reply of the 'group' but certainly is valid for the individual. Currently, I believe a healthy life span of some 300 years is a reasonable minimum for humans to reach a contented intellectual level. Within 300 years an individual can acquire sufficient knowledge to provide useful contributions to the future. In the process perhaps a personal satisfaction of having lived a full life might ensue such that death is a more acceptable process. From the viewpoint of the group the future will demand a limit to the population of Earth and therefore for an individual to live four times the normal life span implies three other individuals cannot simultaneously exist on Earth. This is the 'immortality dilemma' for ***Homo sapiens*** as an earthbound species but disappears as a problem for Space Liner society, where birth will be regulated, population density strictly controlled, and a long life of accumulated knowledge an asset. For Homo cosmos it is more likely that birthrate will be dependent upon both the finding of new planets to populate, and the rate at which new Space Liners can be fabricated during the voyage to New Earth. In a Space Liner biological pro-creation will presumably be a rarity especially if the basic premise of Shostak [2002] comes to fruition, whereby immortality depends upon sterility.

THE KNOWLEDGE QUEST

Imagination is humankind's most intriguing attribute and its development is the prime task of any educationalist. It is imagination that leads us to seek knowledge and be creative and it is creativity that will lead humanity into the future. Knowledge is made by humankind and not given to us from the gods.

Perhaps the most spectacular achievement that will occur within the short term is that scientists will understand how the mind functions in the brain to make consciousness. This discovery will eventually lead to the evolution of Robotico earthensis. Understanding consciousness will open up a whole host of possibilities for control of the cultural gamodeme: both desirable and very scary.

Psychiatrists are finally beginning to understand the diseases of the mind and psychologists are coming to grips with how molecular biology relates to intelligence and mood. Mood modification drugs, tested in laboratory rodents, are already being implemented in human trials. Forget about Prozac and Ritalin. McCarthy [2002] notes that Melanotan, a synthetic hormone immensely more powerful than the bodies own compounds induce not only an increased melanin content of the skin but boost the libido three-fold in female mice, and at the same time controls weight. This is one of the so-called 'Barbie' drugs. In providing a nice tan, good weight control and an enhanced libido many women would want to take it? The question "how many men would not want women to have an enhanced libido?" would probably have a one sided answer. As McCarthy extends his comments we see that for 'Ken' there is the muscle-making compound IGF-1 delivered by modified viruses to make couch-potatoes into body builder types with minimal effort. Even though I can see the amusing side of these developments they do expose the less therapeutic and more social side of the issue. 'Designer' drugs of this kind will rapidly find their way into our culture and unsound 'improvements' will take place with some disastrous side effects.

Our level of knowledge in neontology as it relates to humankind was summarized in "Biology and the Future of Man" [Handler, 1970] and concluded that two major questions would dominate the future of biological knowledge. These were the origin of life and the mind-body relationship. The origin of life is no longer a major problem. Indeed, we understood the answer from the viewpoint of the process, some fifty years ago and simply had to understand the mechanism. Molecular biology is doing this well today. The consciousness problem is more difficult: not because it does not allow itself a solution by deductive reasoning but because it does involve complex chemical relationships that will take time to understand. Science has had the tools to tackle the problem of consciousness for only a few years and it is gradually being understood by deductive reasoning.

Today the two major areas where we need more knowledge still include the mind-body relationship that is consciousness. Moreover, the second area still can be regarded as pertaining to the origin of life but is much broader. In today's science the question translates into 'how do we build life from chemical and mechanical systems?' Science should have an outline of the mechanism to do this within ten years if it is allowed to progress without a theistic burden and unimpeded by self-ordained moralist and ethicists.

The consciousness quest is a major one facing science today. To assert that science has failed to solve the problem of consciousness when it is well recognized that we are only just beginning to understand the mechanism, as Rosen [1985] did, is inappropriate.

Emergence

Complex systems have one characteristic that segregates them from simple systems: emergence. Most scientists believe that physics [the basis of deductive reasoning] is the only way to understand complex systems and emergence, and, that eventually, there will be a rigorous mathematical understanding of both based upon empirical reasoning.

Regularities at some hierarchical levels do arise only at that particular level of organization i.e. reductionist dissection of the whole does not show how the parts make the sum. Levins and Lewontin [1985] explained this along the lines of the words to a Gilbert and Sullivan Operetta as:

"parts require properties by being parts of particular whole, properties they do not have in isolation or as parts of another whole. It is not that the whole is more than the sum of its parts, but that the parts acquire new properties. But as the parts acquire properties by being together, they impart to the whole new properties, which are reflected in changes in the parts, and so on. Parts and whole evolve in consequence of their relationship, and the relationship itself evolves".

This they see as the basis of the concept of emergence [no wonder some people are confused about it!].

In the 1950's at Grammar School in England I was taught that reductionism recognizes that interactions amongst parts are features to be counted when the whole is dissected: and this takes into account a hierarchical paradigm that is both top-down and bottom-up i.e. emergence. Water was used as the example for emergent phenomena, and the question that was asked was: **"from Hydrogen and Oxygen can you predict the properties of water"?** My remembrance is that no one in the class could answer the question but we all agreed that it would be possible when we knew more about science because the properties in question were the emergent features from the organizational state of the molecule. Since that time I have thought of emergent phenomena as something that can be understood by the reductive process.

Temporal knowledge

An understanding of time is perhaps the most elusive concept facing science. There is a temporal dimension and the second law of thermodynamics provides that any point in space has an irreversible time frame. Phenomena at any such point are governed by conditional statistics relating past to present to future events. In Nature, future events cannot influence present events. In his Anticipatory Systems Rosen [1985] clearly states the point:

"in any law governing a natural system, it is forbidden to allow present change of state to depend upon future states."

Although Rosen then goes on to attack this, the use of a feedback mechanism from a predictive model of future events to control present events does not violate this temporal law. Knowledge of probable or even certain outcomes is constantly used to govern present events. That is why most of us do not die when we walk across a busy road!

Terraforming Terra

Optimizing the Earth System is concerned with the knowledge quest and technological. It must be clearly recognized that if the concept of an Earth System is to be part of our concept of humanity it is necessary to optimize the Earth globally to that which fits the human condition: in a sense this implies terraforming Terra. Gaia was a good concept although it has lost strength, as it became an environmentalist's totem. Undoubtedly, the entire Earth System is globally inter-connected and extinction and population reduction of any life forms is of consequence to the Earth System. The societal problem with optimization is that any effort to optimize the Earth System is implicitly 'determination from above'. Although they are applied within a framework of democracy any global laws will be imposed by the global group and certainly cause a major reaction from numerous regional groups. This is in contrast to the past where the Earth System has evolved upwards, from below, by natural interaction of individual phenomena. Optimizing earth, at a global level will raise a new list of questions that will be framed as moral issues needing ethical rules. The major players will be science, politics and religion. The fact that morality is dependant upon historic context will probably be overlooked in this battle for humankind seems ardently opposed to the idea that the end justifies the means, no matter what is at issue.

Sociobiology attempts to analyze the social condition from the viewpoint of evolutionary principles [Wilson, 1975, 1978, 1997, 1999], and to integrate biology into the Earth System. It encompasses behavioral genetics, and evolutionary psychology and other disciplines in the New Social Sciences as important areas of study. To what extent the cultural gamodeme has been influenced by these principles is still being debated. However, the other side of the coin has definite merit. Improvement in the cultural gamodeme can be rapidly achieved by applying evolutionary principles and applying these principles to social change is the most sensible way to improve the social condition. Oddly enough, this is seen most recently by the implementation and success of the market-place-of-ideas process to both the global economy and political systems like communist China.

Bio-ethicists have often leveled their 'sights' on social biology. To a large extent bioethics, as practiced, is increasing a rouse to subjugate science to politics and religion, forcing it to march along morally acceptable lines according to some humanistic, political or religious cultural attitude as, for example, the way of Leon Kass. People have agendas or viewpoints based upon their own cultural gamodeme and the only logical way to assess the merits of ideas is the use of some form of 'hypothesis testing' and rejection/acceptance criterion.

"Public conversation about behavioral genetics can be no better than our grasp of basic scientific concepts. Likewise, we require a basic grasp of some of the different things philosophers, lawyers, and others mean when they talk about freedom and equality" [http://www.aas.org/spp/bgenes].

The fundamental issue that faces the transformation of Terra is the classic one of 'breathing space'. It is only in modern times that most States have realized the intricate balance that humankind maintains with other parts of the Earth System and that the concept of 'breathing space' applies to the entire Earth biocoenosis. Humankind, because of its current ability to dominant the planet, must have both its activities and its numbers regulated if a sustainable global cultural gamodeme is to evolve. Human activities, and population size and density, all effect the future generations more than the present generation; even though some immediate effects can be disastrous to the living population. This temporal shift of accountability is partially the reason for failure to enact sensible and consistent global legislation. Fundamentally most individuals do not hold themselves responsible for future generations [see Macklin, 1981, and Feinberg, 1981 for more discussion]. As noted earlier people live in the here-and-now and the approach used by some to appeal to a banner crying "save Earth for future generations" does not work. A more realistic approach would be "save Earth for the present generation". How we think the cultural gamodeme should be organized is the theoretical framework individuals must work within to improve the Earth System. How we foresee ourselves within the cultural gamodeme is a singular personal interpretation. Individuals can influence the cultural gamodeme because they acquire 'power', which is not necessarily based on ability, and they become a selection pressure on the Earth System. Realization that humankind controls Earth and can alter it for humankinds own needs is the key to balancing the Earth System. Terraforming of Terra for humankind can produce an ideal balanced world but needs a deeper understanding of the Earth System and globally enacted, monitored and enforced regulation. The enemy is of course, within: the greed and stupidity of some individuals and many elements of Corporate World and the political system.

THE QUEST FOR THE STARS

THE FUTURE OF HUMANITY

"At any moment in time, any race – human or alien – that feels moved to pick up the gauntlet may do so. To whoever wins, the reward is survival" Strong [1965].

In this third, and final, section a path is outlined that I believe humankind will take in extending itself into the Solar System. Beyond the Solar System other stellar systems in the Milky Way galaxy are beckoning; and, beyond that our whole Universe will open-up to our descendents.

There is a biological mechanism that has allowed humankind to adapt to new environments, and this will provide the drive for humankind's expansion throughout the Solar System and perhaps beyond. Hopefully, our collected consciousness will be part of what is offered to the future. Improvements in the global cultural gamodeme will make humankinds galactic future easier to achieve but it will take considerable time for a unified Earth System to evolve. In the immediate future an existing society could make the initial commitment to become an intra-galactic species. The United States, China or Russia are all possible candidates.

Most humans understand time poorly, because they think within spans of human generations. A more realistic, broader view recognizes that even a million years is only a short time in our phylogeny. Indeed, ***Homo sapiens*** could naturally continue to evolve for a hundred million years as a chronospecies that populates the Milky Way Galaxy. However, it is unlikely that natural evolution will continue that long, for the future will necessitate tasks such as terra-forming other planets and our Moon; inhabiting space itself; and, altering the nature of humankind at the DNA level.

The Greeks championed the concept of cultivating human traits through socialization and education, establishing a model for study, the humanitatis, which has endured for more than two-and-one-half millennia. Today, we can consider cultivating certain traits and de-emphasizing others through genetic manipulation and this presents important questions pertaining to our future. Both approaches can lead to changes in our species abilities and we need to understand the benefits and deficits attached to each before making deliberate alterations to our phylogenic line.

Personally, I see human-chimera playing an important role in the colonization of the Solar System. Initially, Earth's cultural gamodemes may disallow human-chimera to live on Earth. Nevertheless, given sufficient time the number of individuals altered by genetic manipulation will become common within Earth's population: initially by genetic improvements and then by outright genetic alteration. This will set the stage for definite major phylogenic changes within ***Homo sapiens***, whose taxonomy will become queer. The necessity will be provided by the need to adapt to environments within our own Stellar System. It is important that permanent changes in the human germ-line are controlled and coordinated because of political reasons of State. Whereas it is important that somatic cell improvements should be available throughout the gamodeme as a question of ethical fairness; germ cell modifications must be controlled because of the danger of social conflict. This is the specter of the development of a Master variant. Many regard the idea of a super-variant of ***Homo sapiens***, existing for a long period of time side-by-side with ***Homo sapiens var. sapiens,*** as an aberration. Such a variant would be fraught with disastrous social problems, but that does not mean a small initial gamodeme with novel traits should not be formed as a desirable start for an off-earth population. For humankind to become a truly galactic species there are three techniques that must be addressed. Firstly, we must understand how to alter ***Homo sapiens*** to produce novel traits. Secondly, real progress must be made in developing space colonies on the Moon, on Mars and on manufactured Space Liners. Venus [Sagan, 1961] and the other Solar System planets are highly unlikely locations for early colonization. Thirdly, research into the acquisition of novel genetic traits must be directed towards evolving ***Homo roboticus*** and ***Robotico earthensis***. Once a brain can be functionally transplanted into a donor body the technology to utilize manufactured bodies will probably progress rapidly. Specific connections must be developed that can control purely manufactured body devices, through the brain. At this point ***Homo roboticus*** will be ready to explore our galaxy.

CHAPTER EIGHT
PHYLOGENETIC DESCENDENTS

"Biological enhancements will lead us into unexplored realms, eventually challenging our basic ideas about what it means to be human". Gregory Stock **[2002].**

A review of the phylogenetic evolution of any of the major groups of organisms suggest that when humankind makes the leap to become an intra-galactic species we must remember that life as it evolved on Earth provides a deep and wide well of adaptive potential present in the overall gene pool1. Gene splicing and manipulation to form chimera can circumvent the enormous time spans normally necessary for adaptive evolution to work. Certainly, in the early stages of ***Homo***'s further evolution, our offspring will be fundamentally human but when they venture into space they must be accompanied by as much adaptive potential as possible. This will probably include modification of the human genome to increase the likelihood of survival in a Space Liner. Secondly, it will be desirable for the Space Liner community to have a knowledge base especially concerned with how to make genetic modifications to organisms. This will give them potential adaptability to specific environments. Thirdly, the Space Liner should carry a wide diversity of living systems from Earth, associated with a detailed knowledge of the environmental preferences of the organisms. These will probably be as frozen fertilized individual cells [zygotes] or at least, some form from which a viable system can be reconstituted. Much of the knowledge base that will be contained in a Space Liner will depend upon our future progress in understanding the genomes of living systems here on Earth, and how the molecular makeup and the environment interact to form the organism. The huge mass of Earth-bound research in these areas will be much greater than that developed in an isolated Space Liner comprising a community of perhaps a thousand individuals. Clearly as much information as possible must be available to such a community and some method of alerting the inhabitants of the Space Liner to new discoveries is desirable. Much will depend on our knowledge of the adaptive processes inherent in the chromosome and how selection pressures will influence the development of viable life forms in alien environments.

When viewed within the context of western humanist tradition chimera [monstrosities in common parlance] are related to sexuality and sexual reproduction. A moral barrier arises from the possibility of the development of chimera when placed within the framework of genetic engineering. Genetic manipulation will provide us with the ability to produce offspring that is not the product of normal mating and which is the result of combing different genetic material from more than one species. Lagay [Harvard Meeting, 2001] addresses this future moral dilemma as follows.

"Sexual reproduction and sexuality have critical importance in both western science and the prevailing moral codes of western civilization. … On the moral front, interspecies mating becomes monstrous through myths of perverse sexual acts such as that of Pasiphaie's consorting with a bull to create the Minotaur, and incest becomes perverse through myths that depict the tragic consequences of the sexual acts and longings by the likes of Oedipus and Electra … We wonder, then, what is it humanists have found repugnant and taboo-worthy over the millennia — the chimera itself? Or did the monster myth appear to teach that the sexual activity that produced it should be taboo? Is sexual activity between a parent and child taboo, or is it the social disruption and psychological suffering caused by indistinct familial ties and relationships that must be avoided? What will society make of the fact that we can create the monsters and monstrous relationships that have haunted and guided moral behavior for at least 3,000 years? Moreover, this can be done without the means of sexual reproduction from which it was formerly inextricable?"

As scientific inquiry the creation of chimera does have an ethical side. It is the questions of whether of not individuals [parents for example] have the moral right to determine the character traits of their offspring. I answered this question in the affirmative from the viewpoint of parent-offspring relationships but hesitate when the question of developing a ***Homo sapiens*** chimera, which will live on Earth, arises. Within Space Liners the question may be one of gamodeme survival and therein the answer is logically in the affirmative. For the survival of the species creating a human chimera will be the logically correct decision despite what the 'god-fearing' Earth dwellers might exclaim. Most certainly whether or not chimera should be developed for living on Earth is a political dilemma and quite explosive. The ability to inhabit and investigate the Earth oceans, and the frigid and arid climates zones seems a sensible development. However, this will certainly involve chimera, or chimera-like genetic intervention.

Altering ***Homo sapiens*** to produce novel traits as opposed to improved traits will direct our lineage along a challenging pathway. Changes at the cellular level or the organism level are the main areas where novel traits can be inserted in humankind's genome. There are several basic directions along which our phylogeny can move and in all likelihood all will be explored and lead to new species and genera along humankind's evolutionary line. From ***Homo sapiens*** the general avenues that can be followed will lead to ***Homo cosmos*** and ***Homo roboticus*** and onward to our final descendent ***Robotico earthensis***. Further evolution within ***Robotico*** will no longer be humankind for the new genus will represent too large a divergence from ***Homo***'s phylogenetic line.

The political problem of State that surrounds germ line manipulation for novel traits lies under the banners of 'designer children', and the 'brave new world' in which slave classes exist to perform menial tasks for the genetically enhanced upper classes or Genobility. These are exactly the alarms that will be raised. The more imaginative of the neo-Luddites see human - primate hybrids as in 'Planet of the Apes'; or, gill-people as in 'Water World'. Such reasoning, in general belongs where it originated: in the minds of creative novelists.

As outlined earlier there is a hierarchy of structure that characterizes life. At the base is the chemical hierarchy that forms the chromosome, above this is the cell and above the cell the organism, gamodeme, species, chronospecies and mono-phylogenic group. At each of these levels there are critical processes, which determine adaptability and evolution. Some are factors that can be explained in terms of the chemistry and physics operating within and upon biological systems; others may require recourse to the concept of emergence [i.e. generation of phenomena that cannot be predicted from a simple conditional approach]. Much has been said in recent years about the chemical hierarchy leading to, and from, the chromosome, and its importance for genetic variability within the gamodeme. Nevertheless, it must be recognized that the cell, the organism and the population dynamics seen within the gamodeme provide additional significant locations that can be modified to alter the overall process of our phylogenic evolution. As Moss [2002] eruditely points out the DNA is not the only information needed to develop a phenotype.

Essentially the cell contains an energy system, a control system and a chemical processing system and in this regard each cell can be considered a small but complex chemical machine. Much of what is observed in the cell is a necessity for its function within the organism but it has got there by a complex molecular history that has evolved through time as a series of useful interactions. These interactions may not be ideal for an ideal organism living in a particular environment but are optimized for the chemical system within the cell that occurred at a specific time in the cells development or evolution. The implication is that any cell we observe today is a result of some initial state and a temporal series of chemical changes that allowed survival of the cell at specific times in its development. Thus what we see can be regarded as accidental optimization rather than directed evolution. Indeed, the idea of directed evolution is ludicrous when on realizes that the whole process is opportunistic. This having been said I believe that eventually humankind will be able to improve our species by directed optimization for specific conditions. Much of the so-called junk DNA may simply be the natural remnants of this process, and most probably is still important for cellular development.

Of secondary consideration is whether or not the metabolic pathways used in Earth organisms are part of a universal biology of carbon-based systems. Many molecules appear to be natural developments under Earth-like conditions and the probability that control systems based upon DNA, and RNA; energy systems based upon chlorophyll, glucose, and ATP; and chemical systems based upon amino-acids and proteins will develop on other planetary systems is high. The fact is that biology is based upon carbon molecules and the only real competitor is silicon-based life: which in reality is a poor second-choice molecular system upon which to construct life. Silicon molecules, despite the ability to form chains and sheets, simply do not produce vital systems. The belief that carbon-based systems are the most likely to be found in our exploration of space also rests upon the fact that life on Earth is formed of six principle elements [H, O, C, N, S, P] plus some inorganic ions.

The six basic elements are amongst the most common elements found throughout space and can be formed into the major cell constituents by a variety of energy sources that are known to occur in space. Because the materials and processes are ubiquitous throughout the known Universe it is highly probable that carbon based life occurs on many other planets in our galaxy.

Our understanding of the biochemistry of life has elucidated the fact that three major cell types are found on Earth: the Archea, the Bacteria and the Eukarya. It is highly likely that carbon- based cellular life elsewhere in our Universe will be similar to one or more of these systems although this does not deny that other novel approaches may have originated to take advantage of different metabolic pathways. Certainly, starting with these basic cell types, evolved modifications on a different planet will have produced different phylogenies and end products. However, the generalized mechanisms of cellular activity, involving energy and control systems overseeing chemical synthesis are unlikely to be much different. Clearly, modifications in cellular activity have a major cumulative effect on phylogeny. Further, if we are to deliberately alter our future phylogeny then modification at the cellular level will be fruitful i. e. somatic and germ cell engineering is the key factor for improving humankind's phylogeny.

MODIFICATION BY THE CELL

When considering the cell as the basis for developing novel traits in humankind both somatic and germ cell manipulations are relevant. The simplicity of somatic cell therapy, once the sequence of genome-protein-cell development is understood is the obvious way to alter ***Homo sapiens*** for it starts with the natural organism at some stage in its development and corrects a 'defect' on the chromosome. The extension of somatic cell therapy to somatic cell alteration, allowing insertion of a new trait on the chromosome, will be a natural development from research activity. By modifying the chromosome, and allowing normal division of the modified cell, a slow process of replacement, within the body, can take place. The method uses normal cell division to correct a disease, disorder, or disability, and will work in the same way to add a new feature to the genotype or phenotype. The importance to ***Homo***'s future evolution is that the method can be used for improvements in the individual that are not genetic defects but can alter a chromosome so that a specific trait, that was not present before, manifests itself. Effectively this is manufactured adaptation and, I believe, is the reason that genetic engineering will never be regulated out of humankind's future. The military, industrial and political establishments will support development, for it is potentially too valuable for humankind's future.

Somatic cell therapy is not particularly controversial because it is encompassed within medicine's traditional goals, and has great potential for alleviating suffering. The fact that somatic cell therapy is seen as of great importance to the living, for it holds the key to life extension and the elimination of medical disorders, will ensure continued research in that area. However, somatic cell manipulation may be the only 'politically correct' way scientists, in the immediate future, can develop chromosomes that are disease free, have a long life span, and can accept novel traits.

The question of improving the living individual by changing parts of that individual's genome [germ cell manipulation] has seen little attention as a rhetorical moral issue, other than recognizing that the future can bring far reaching effects. However, from what has been learned from the facts of evolution it is clear that germ line genetic engineering has the most potential for alteration of humankind's phylogeny. Perhaps a more stunning pointer to the future is the ability to grow sperms in a laboratory, manipulate the genetic material of the sperm, replicate the sperm in large numbers, and use the sperm to impregnate a similarly altered egg. This method can produce an improved offspring in which new genes are spliced into the organism in the first generation. The controversy of cloning and embryo manipulation is avoided.

Altering the genetic make-up of the gametes prior to conception can result in a zygote that is fundamentally novel: but it is just as natural as was the development of plastic! The processes of conception, gestation and birth eventually will move from in-vitro fertilization to a truly artificial womb i.e. conception, development and birth outside of the human body or exo-hystera genesis.

The ability to transplant a uterus, which can be transplanted with fertilized embryos that can proceed to produce live births in the donor, has already been developed for mice. Once the technology for sustaining such a uterus outside of an organism is developed normal pregnancy will become unnecessary. Whereas this may be welcomed by many its importance is that the next stage is the development of the artificial uterus. Once this stage is developed an effective method of producing an individual from stored male and female [or male and male, or female and female] gametes will become possible. The extension of this is the use of wholly artificial chromosomes to develop an individual organism. A Space Liner laboratory designed to operate in such a manner will be the key to developing experimental organisms with particular adaptive traits for new worlds yet to be colonized.

Whatever alterations are made to the gametes thus will be inherited by future offspring, whether or not they are conceived and born by natural methods. It is likely that exo-hystera genesis will be the accepted method of birth for future generations born on space colonies. Moreover, if ***Homo sapiens*** is to inhabit the oceanic realm it must be acceptable as a research tool for developing novel traits here on Earth even in the face of protest.

Chimera, when manufactured, definitely will be members of our evolving lineage but the more important modifications for the immediate future will draw upon the genetic possibilities already existing within the gamodeme. A reductionism approach to understanding the gene, the genome and protein activity will mean that ***Homo cosmos*** almost certainly will be a chimera, produced by deliberate addition of new traits to the human genome. The question of whether or not they can coexist in the world of modern ethical principles and moral beliefs will be taken-up later.

Once the mechanism is understood by which the chromosomes, acting as single genes or complex associations, mediate physical, cognitive, and personality traits then scientists will know how to manipulate the DNA so as to alter the resulting traits. Similarly, once the chemical and physical processes involved in regulatory development of the embryo are understood scientists can alter some characteristics that appeared early in mammalian evolution. It may be possible to accomplish massive structural alterations such as separation of the breathing and the alimentary systems in the throat area, which is a poor design in Homo. Certainly the development of a dual heart might prove useful in the early stages of modification. When humanity finally exits Earth and establishes permanent extra-terrestrial communities beyond the Solar System it is a near certainty that the genetic makeup of the species will be quite different from today.

Manipulation of the genes in early embryos before implantation, so that the alteration affects all the cells in the developing embryo and the individual, is now possible and is leading towards the elimination of unwanted traits. Such genetic changes can remain in that person's progeny unless a further germ line genetic intervention "undoes" the first one. At a basic level germ line genetic interventions can greatly improve the cultural gamodeme by altering the physical and mental genotype / phenotype of ***Homo sapiens***. By making humankind more biologically efficient and indeed better adapted to the prevailing environment, numerous social conditions can be affected: from health care to population density. Genetic intervention may become the dominant activity in the future for optimizing humankind to live within the Earth System. Moreover, it will become the main way in which humankind's future phylogeny is optimized to become a cosmic species.

Sean Carroll [2005] summarized the present state of knowledge of the genetic processes involved in regulatory development of the embryo. In his delightful book “Endless forms most beautiful” Carroll provides the facts and clues that not only show the evolutionary unity of all living systems but, very simply, describes how regulatory genes work.

As manufacturing a chromosome from basic chemicals becomes possible so will the potential for the development of chimera will increase. ‘Chromos’, a Canadian company, is actually growing chromosomes from centromeres. Moreover, these centromeres can be used as templates upon which to add specific DNA i.e. genes. One characteristic of artificial chromosomes that makes them attractive to the ethicist is that, probably, they can be built with on-off switches for genetic traits. Once scientists have devised a method of understanding how the genome interacts with the proteome [all the different proteins produced by the genes] then an important part of the cell-code [the transcriptional network of the cell] will be understood. Eventually, this should allow protein interactions to be deciphered. This will lead to major advancement in sciences understanding of how cells build organs.

An avenue that is only just beginning to be explored is the insertion of non-natural amino acids into organisms. There are 64 theoretically possible amino acids but only 22 plays a major part in protein synthesis. By constructing a novel amino acid along with its tRNA, and inserting this into a protein new physical, chemical and structural traits should be possible. Certainly this is a route that the chemical industry in its search for advanced catalysts could pursue.

MODIFICATION BY THE ORGANISM

The development of form and structure within an organism takes place during the early stages of the development of the zygote. The process is primarily influenced by the genetic makeup of the organism but in animals, at least, there seems to be a definite influence of maternal mRNA in the cytoplasm within which initial cell differentiation and development takes place. It is important to understand what these effects are if exo-hystera genesis is to be successful. As noted earlier, biological structures develop largely through a set of genes being activated in a temporal sequence and through a variety of regulatory developmental chemical messengers such as hormones, transcription regulators and morphogens; and electro- and mechano - chemical interactions between adjacent cells. Levinton [2001, chapter 4] discusses the general relationships between embryological development and evolution and notes that “Embryos develop only as the result of a complex series of timing events that bring different cells into contact or place cells or molecules of restricted developmental potency in a proper environment for induction. The spatial position of cell groups seems crucial in the generation of morphological patterns" developed. This is well explained by Carroll [2005]. This process of development of the organism again presents an opportunity for alteration of the phylogeny.

That it may be possible to incorporate in the genome of an organism alteration in the spatial and temporal location of developmental events will be important knowledge for our future phylogeny. Understanding of the effects of changing the sequence that genes are switched on and off will be a most fruitful outcome of research that can lead to developing novel traits in an organism. We already know that the development of an organism is not simply the emergence of the information contained within the genes. Rather the genes are instructional codes that make higher codes that make higher codes and so on. The hierarchy of codes develops as the cell forms, as cellular differentiation takes place and as organelles develop. Knowledge of how these codes work is clearly of importance for developing novel traits. The higher instructional codes are not apparent at the basic genetic level even though they may be accessible by reductive reasoning applied to metabolic pathways. To a large extent these higher codes are developed and isolated within the organelles of a cell. They are processes isolated by membranes within the overall cell membrane. They are isolated because the permeable membranes are a suitable way to allow concentrated chemical processes that do not disrupt other cellular functions. In one sense the genetic code develops small biological machines that have their own metabolic code that controls various cell functions. Altering our phylogeny by tinkering with the various development stages from the zygote to the onset of adulthood will undoubtedly be done unless this form of biological experimentation is regulated out-of-existence by the political system.

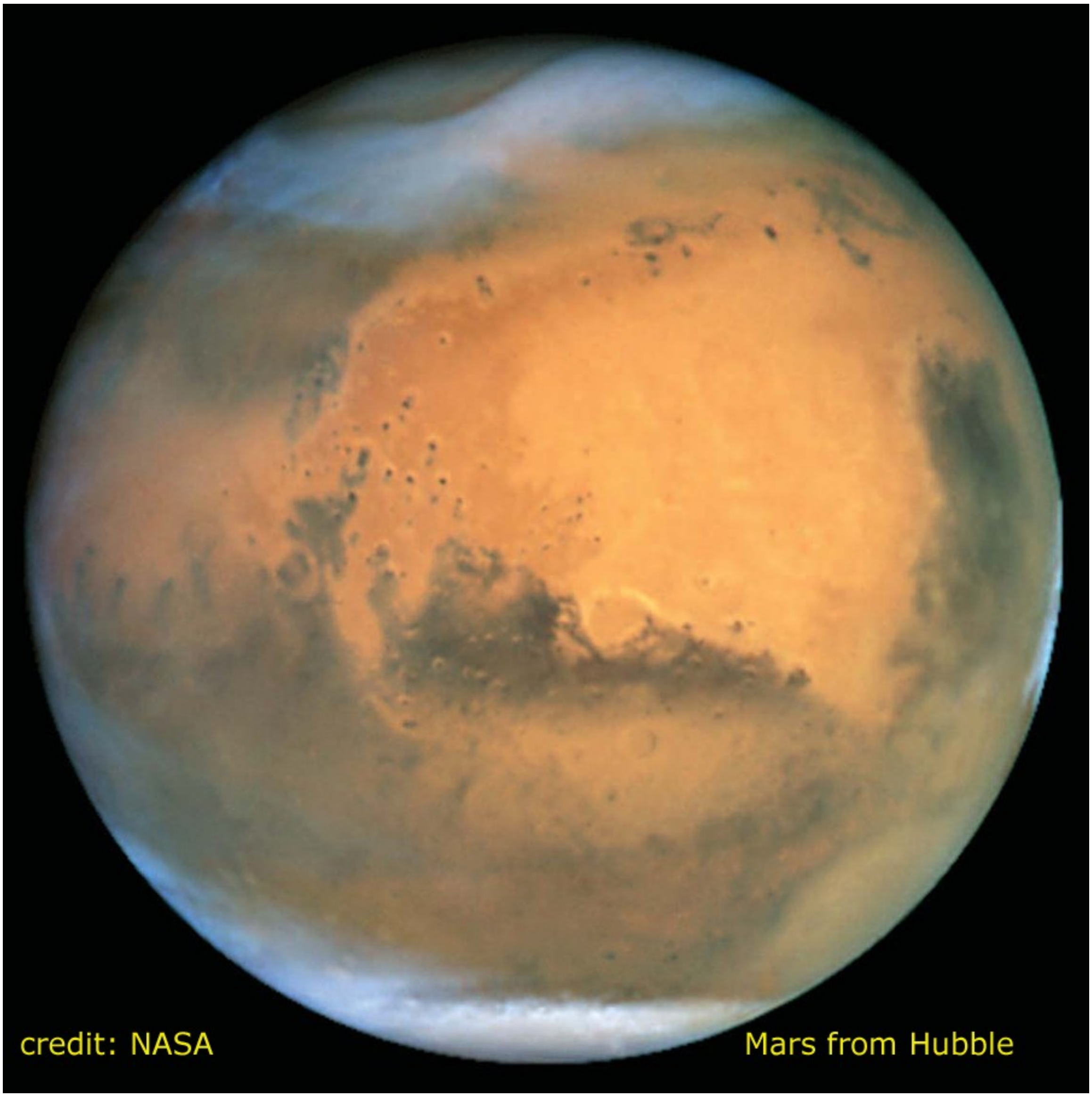
The mechanisms involved in the development of an individual are highly efficient, interactive and complex and account for the extensive variability of cellular organisms. The results are optimized for life on Earth i.e. the ones that survived were the ones that adapted! The complexity of the system probably is the reason that evolution appears to be a conservative process but science has the opportunity to establish novelty in the phylogeny where it is needed for future survival.

HOMO COSMOS

Homo cosmos is the name applied to those members of ***Homo sapiens*** that do migrate into deep space, beyond the Solar System, on Space Liners. The point of their differentiation is that the Space Liner will be its own gamodeme and with time, genetic drift alone will differentiate the gamodeme from ***Homo sapiens***. Whether or not the initial community has been optimized for life in a Space Liner is immaterial from the taxonomic point of view. Provided the Space Liner colony has sufficient knowledge and technology it is easy to envisage genetic intervention that will occur if new, potentially inhabitable environments are found. For example, the production of chimera with properties derived from our knowledge of other species here on Earth i.e. adaptation to freezing temperatures or a methane environment.

Improvements in understanding of embryonic development here on Earth may turn out to be critical to ***Homo cosmos***. In understanding humankind's evolution the most important increase in knowledge probably will be Earth-bound, where the vast reservoir of intellect will reside. Understanding of the details of how individual structures develop is important for growing specific structures and organs, and once the mechanism of cellular development is understood it will be possible not only to grow specific structures but to initiate the growth of alien [chimera] structures within embryos. Experimentation may occur at a rapid rate once the Space Liner is underway but the previously accumulated knowledge will be essential for this future work.

HOMO ROBOTICUS



As humankind evolves there will be a limit to what genetic changes are possible before ***Homo*** [***sapiens*** or ***cosmos***] meets an environment that cannot be colonized. To progress further humankind must become an individual entity that is beyond the concept of a genetically altered human or an extra-terrestrial probe. This is where and when ***Homo roboticus*** must evolve. Individuals belonging to ***Homo roboticus*** will be organisms altered such that control is still by a conscious human mind. Thus we have a real human individual with a biological brain but the body within which this brain is implanted is totally manufactured.

In order for development of our lineage to ***Homo roboticus*** the problems of spinal cord repair must be solved for ***Homo sapiens***, and this is a goal many scientists are striving for. The future will necessitate linking a conscious brain to a manufactured body via the brain stem. Whether the body is an organic or a mechanical body is irrelevant for without the ability to attach the body to the brain stem there is no possibility of our evolution towards ***Homo roboticus***. Attaching a brain, with an already contained consciousness [mind] will follow as a result of research into neural chord reattachment. I am referring here to a mind-brain transplant using a living human being who needs a new body: a technique that is not too far on in the future. Body donation, ethically, should be treated no differently than heart or kidney donation.

The principal idea for ***Homo roboticus*** is that the entire entity will be a self-replicating, partially manufactured individual that uses a pre-existing human consciousness. However, devising a method of reproducing a new brain with a new consciousness that is not a clone or transplant is another alternative. Reproducing a brain will follow as a result of extra-cellular manufacturing of biological organs i. e. within a laboratory set-up. I am referring here to attaching a biologically manufactured brain to all of the necessary sensory inputs [whether biological or mechanical] and allowing the mind to develop naturally to a conscious level. Surprisingly current scientific trends indicate that neither of these hurdles will be difficult given a hundred years, or less, of research.

It is likely that technological developments will enhance ***Homo sapiens*** well before genetic and structural modifications and manufacturing of whole biological organs dominates humankind. Certainly, until genetic and structural modifications are successful humankind will continue with mechanical and biological transplants that replace failing organs such as the eye, cochlear and heart. There are many such enhancements that are conceivable that will lead to features that could be incorporated into ***Homo roboticus***. Numerous current ideas for improving ***Homo sapiens*** have this potential. For example, the development of a wearable external skin, enclosing and enhancing the body will be generally preferable to an internal prosthesis such as an artificial limb by ***Homo sapiens*** and will be a logical basis for the skin of ***Homo roboticus***. Wearable skin is of current interest to both the military and the erotic industry. Already devices are being developed such as the WearSat project at MIT. This is designed to provide astronauts with multimedia information within a spacesuit helmet by wireless communication. This technology can readily be used to provide instructions to individuals who do not have a detailed training to repair, for example, machinery of various kinds simply by providing a series of instructions and schematics upon voice request. But the wearable skin idea has other avenues for exploration. A wearable skin can have additional sensors: such as sensing electric current as in primitive fish; or, micro-magnetic and micro-gravity sensors for location. Technology of this sort is being developed at many places: ranging from distance sensors for the blind to wearable computers connected to the Internet. The Institute for Soldier Nanotechnologies (ISN) recently established at

MIT promises to make important strides in physically enhancing the capabilities of humankind. A flexible exoskeleton can provide protection from external elements: ranging from a tree limb to a blizzard. Attached energy sources can greatly magnify muscular strength for enhanced human performance such as lifting and locomotion, and with the advances currently taking place in specialty clothing the suite itself could dispense drugs and vitamins and provide real-time medical treatment.

Already we are in a phase where we are developing the necessary knowledge to create replacement parts for internal biological structures. Development in this direction is moving quickly as abiological manufactured transplants of hearts, livers, and sensory and other organs become viable alternatives to deterioration and death. John Lenihan [1975] provided an early look at this future in his book 'Human Engineering', and numerous works in related robotics have followed. ***Homo roboticus*** has one major advantage that will contribute towards development: it needs only those chemical functions that are required to support the brain and to maintain human consciousness i. e. it is the ultimate brain-in-a-box.

The first stage of developing a manufactured body by mechanical implants and biological modification has already occurred and there will be no turning back. The rewards at the level of the individual are so great and many will choose to reap them. Studying the behavior of living systems and creating analogous behavior in robotic systems will lead to the development of the necessary manufactured structures that will be the basis of developing mechanical-bodied ***Homo roboticus***. Current research is into the details of specific relationships within living systems and developing both physical and digital models of the processes and mechanisms [Holland and McFarland, 2001; Ayers, Davis and Rudolph, 2002]. However, the really exciting future is when living neurons and manufactured devices are connected. For ***Homo sapiens*** the desire for organic devices similar to natural ones may be preferable but for ***Homo roboticus*** the control of the device by the conscious mind is the only requirement.

It must be reiterated that the concept of ***Homo roboticus*** lies not simply in modifying the human body to adapt to changing conditions [including cell death] but the development of a completely manufactured body with a conventional brain and a mind containing conventional consciousness i.e. true brain transplant. There are three ways in which this probably will be developed.

1. Implanting a pre-existing brain into a manufactured biological body.
2. Implanting a pre-existing brain into a manufactured mechanical body.
3. Implanting a pre-existing brain into a hybrid bio-mechanical body.

Thus the essential transition from ***Homo sapiens*** to ***Homo roboticus*** will involve advancements in manufactured mechanisms and manufactured biological components. To a large extent robotics in the past has relied upon manufactured mechanistic organs [see for example Mark Rosheim's, 1994, book on Robot Evolution]. I have no doubt that a brain transplant that retains the original consciousness of the mind will be possible before the end of the 21st century and by that time all three scenarios for building ***Homo roboticus*** will have been explored.

Consciousness in a manufactured biological body

The immediate future holds out the possibility for manufactured biological organs: formed in a laboratory. Impetus to develop a manufactured biological body will certainly come from the need for replacement parts for ***Homo sapiens***.

The use of a donor biological body to contain a brain-mind; and, therefore human consciousness, is probably only a short time away. Once a brain-mind transplant of this nature has occurred the development of wholly manufactured biological body could occur quite rapidly. As scientists gain a thorough understanding of the gene-protein-trait processes, and our knowledge of embryological development progresses the manufacturing of replacement parts will rapidly increase. The rate of knowledge accumulation in protein function and organic development is increasing exponentially and by the end of the present century a completely manufactured biological body, could be possible and await a brain-mind implant.

To what extent the body system will be entirely carbon-based depends upon future developments but it is likely that totally carbon-based humanoids will not evolve beyond the ***Homo cosmos*** stage. Of importance is that because ***Homo roboticus*** will be manufactured numerous chimera-structures can be incorporated into the bio-body system. Thus the species can be modified and even optimized for many conditions it is likely to encounter in space. If proteins and enzymes are retained as the basis of structures and functions then ***Homo roboticus*** will have a lot in common with ***Homo sapiens***' construction. In this case ***Homo roboticus*** could have much in common with cellular life on Earth.

When developed along the bio-body direction it is probable that the basic body plan will be fairly conventional, although modified for efficiency. In many cases an external skeleton may be useful and allow a greater amount of optimization to varying environments. One reason to believe that bio-systems will be important is simply because living systems have evolved to do what they do both efficiently and effectively, and, the basic building blocks of living systems are abundant in the universe. It may turn out that the optimum structure for ***Homo roboticus***, in the immediate short term, is biologically and carbon-based simply for ease of replication and repair, with a manufactured exoskeleton for protection and advanced sensory systems. Using elements present in abundance throughout our Universe is the simplest approach, especially when we have a complete understanding of how ***Homo sapiens*** work as a chemical machine.

Consciousness in a manufactured mechanical body

Judging by the present pace of technical discoveries and speed of development of robotic systems, the relatively short time frame before ***Homo roboticus*** becomes a reality tends to favor mechanical systems. This will be true unless a breakthrough in cell development and embryology alter this expectation and accelerate the manufacturing of carbon-based body-systems. Having said this it is also correct that later developments may actually favor bio-bodies because of the ease of obtaining the necessary chemical elements in space. On the other hand it is certain that the rigors of getting to most locations in our Universe will necessitate much more hardy body designs, which can exist in differing temperature, pressure and chemical regimes. Undoubtedly, those forms of ***Homo roboticus*** in which mechanical parts dominate will have structures that are highly resistant to corrosion and wear and they will be advantageous for long and hazardous space exploration. With a completely mechanical body it is easy to plug and unplug parts that need to be used for specific situations and there is no reason why a mechanical body for ***Homo roboticus*** cannot be modular.

Consciousness in a hybrid bio-mechanical body

Initially, the body of ***Homo roboticus*** probably will retain a basic humanoid form. This is because rapid advancement is being made in mechanical devices for incorporation in ***Homo sapiens***. Many of these will become prototypes for insertion into ***Homo roboticus*** built upon a humanoid framework. However, although it is plausible that the hybrid bio-mechanical body will develop first because of the current rate of progress in organ implants into ***Homo sapiens*** the problem is not that simple. Making individual mechanical devices, or individual organ transplants work within a living body may be more difficult than making an entire functioning body. With completely biological or mechanical manufacturing the total body can be built as an integrated system that discards items that are of no use and includes other novel items that are of use. The major hurdle would be singular: connecting the brain-mind to the body and making it work as a complete organism.

For those who take a moral stance against the effort to develop ***Homo roboticus*** I ask two questions2.

QUESTION ONE: **"If you know your death will shortly occur but I offer you the opportunity for your mind to live on within another body, will you allow your brain to be transplanted into a manufactured biological body that has human form?"**

QUESTION TWO: **"If you know your death will shortly occur but I offer you the opportunity for your mind to live on within another**

body, will you allow your brain to be transplanted into a manufactured mechanical body that has the form of a fish that will be placed in the Pacific Ocean to explore that oceanic world?"

I believe the moral question of implanting a human consciousness inside a fish-like marine ***Homo roboticus var. oceanicus*** will be of only passing concern. Certainly, at the end of my own normal human life it is an experience I would willingly look forward to. I believe many would take such a second chance at existence, especially if their conscious mind remained significantly intact and only the body changed. Many humans living today will answer yes to both questions and this will be the answer to the moral-issue of the neo-Luddites! If the question is placed within the framework of individual choice the moralists and ethicists have no voice. The ethicists will try to place the questions within a societal context i.e. the group is more important that the individual but in doing so will place themselves upon their own 'slippery slope' towards fascism. Humankind will be drawn by the nature of 'mind' to extensions into presently adverse environments here on Earth, allowing permanent dwelling in the hydrosphere. Indeed, it is this mental urge that will drive humankind to live elsewhere in the Solar System and beyond. Adaptation to the low gravity of the Moon and the poisonous atmosphere of Mars should be relatively simple to achieve once the human brain can be placed within a synthetic body.

Mind transplantation

Brain transplantation is the placing of a conscious human brain within a donor body-system. Mind transplantation is different. This is the placing an individual's consciousness [mind] within an artificial brain. The classic idea is to use a computer as the artificial storage system for both access and perpetual existence. ***Robotico earthensis***, by definition, requires the development of manufactured consciousness and the development of mind transplantation could be the necessary pre-cursor scientific break-through to this final stage in the evolution of our phylogeny. Moravec [1998], Kurzweil [1999], Minsky [1988] and Extropians have all embraced the scenario of mind transplantation for perpetual existence. Their procedure goes something like the following.

1. Understand consciousness.
2. Extract an individual's consciousness either in digital or analog form.
3. Store the individual consciousness as an individual memory module: replicating it for redundancy.
4. Update the redundant memory modules periodically to assure a correct backup.
5. Implant the conscious memory module into a clone by brain programming.
6. Recover the new consciousness after a period of further

development and repeat for the next generation.

Looking beyond using a computer to store the mind this scenario may turn out to be one that is quite feasible. There is no reason why scientists could not manufacture a blank brain in a manufactured bio-body that simply waits re-programming. The problem I see is that given the choice of implanting my entire present brain and mind into a manufactured body or having my mind re-programmed into a new brain I would choose the former. The second is effective death for the original individual unless the two separate entities are somehow linked in space-time.

In order to transpose human mind into a mechanical device such as a computer, nanotechnology is seen by some as the key. In the future nanotube circuitry will be several orders of magnitude greater than a similar volume of brain cells in computing capacity according to Ray Kurzweil. Kurzweil believes that within 30 years the human brain will have been reverse engineered.

ROBOTICO EARTHENSIS

Robotic assistant help a human
Credit: NASA

From a taxonomic point of view the next stage of evolution for humankind's phylogeny will incur the establishment of a new genus defined by the facts that both the body structure and the consciousness are manufactured. An entity that is a self-replicating, totally artificial individual that has its own mind [consciousness] is a major divergence from the ***Homo*** lineage. This new genus will perhaps be designated in some future 'Intra-galactic Code of Life-form Nomenclature' as follows.

GENUS: ***ROBOTICO***
TYPE SPECIES: ***Robotico earthensis***
TYPE LOCATION: Planet Earth
GENERIC DESCRIPTION: An individual with manufactured [designed] body structure and manufactured [designed] consciousness. The organism is a self-replicating species.

Understanding consciousness

The manufacturing of true artificial consciousness for implantation into a brain may be many centuries away but already significant advances are being made in neural functioning, the mechanism of memory and brain-body control. A brain that will be programmable to contain a specific mind-set is not outside the bounds of currant scientific possibility, and could easily occur within the next 300 years. Almost certainly it will be well established within the present millennium. One thing that paleontology teaches is that the human concept of time is severely limited: a million years is not long in terms of the life of a phylogeny and humankind has many millions of years left before the Sun ceases to shine!

Until recently the nature of consciousness lay predominantly in the domain of philosophy. Art, music, religion and philosophy can be involved with any topic but today the understanding of consciousness is firmly rooted within the domain of science: indeed I believe it lies in the domain of science and science alone. The latter decades of the last century saw an increase in developing appropriate scientific methods to understand the nature of consciousness. Future technology will develop the ability to image the detailed locations and chemical activity involved in brain processes and eventually the dynamic functioning of the brain will be correlated with thought. The essential nature of consciousness does not lie beyond human understanding; and, neither do the concepts of science need to be broadened to encompass the mechanisms and processes of consciousness. "Conscious human experiences are merely epiphenomenal artifacts of neural activity". They are, in fact, the Law of Combinatorial Outcome in action.

The origin of consciousness lies in understanding how matter reacts to an environmental change. This evolved through natural stages in the evolution of matter until we find in humankind a relationship between sensory reactions and environment. In this regard, consciousness relates directly to the Law of Instability as a complex extension of common chemical reactions. A cube of salt placed in fresh water "senses" the water molecules and adapts to the new physico-chemical environment in the same way that a feldspar crystal formed in a granitic pluton "senses" a changed pressure, temperature and chemical regime when it is exposed to surface atmospheric conditions, and adapts by changing to a clay mineral. Living systems are more complicated but conceptually are not more complex: even though we may not yet understand all the mechanisms and processes involved. This simple beginning to consciousness evolved into what can be termed intelligent reaction. This is the kind of response to external stimuli as seen in human consciousness. There is no reason to believe that the reductionist approach, which allows understanding of primitive physico-chemical reactions, will not work when attempting to understand intelligent reactions. Margulis and Sagan [1995] support the view of simple conscious experience.

The question of "choice" in advanced life forms becomes more understandable when consciousness is regarded as a natural stage in the evolution of matter. Choice in primitive systems has only one possibility [i.e. in effect it has a value of zero]. In more advanced systems locomotion and survival strategies provide real, if limited choice. When supplemented by advanced reasoning these limited choices provide a broad spectrum of possibilities, depending upon the existing conditions. This we see in humankind and will be built into our robotic descendents as a powerful survival mechanism.

The Law of Instability is important for understanding consciousness whose origins lie in the simplest process – response system. At the atomic level the everyday world works when the presence of one atom in the region of another atom causes elemental responses such as repulsion or attraction. This is awareness in a simple form and is no different from the fact that certain DNA sequences cause an aversion to the dark in fish; or, the sight of a car heading towards us causes an avoidance reaction. All natural systems have a chemical or physical awareness of external influences, and awareness is the basic building block of consciousness. Awareness evolved in its complexity, alongside the evolution of matter itself, until it became what we call consciousness. I see this as a scientifically reasonable view not requiring any great paradigm shift in conventional thought and a footnote in cosmic history: consciousness being a complex property of matter.

The notion that the level of consciousness is specific to the level of evolution suggests that consciousness is related to the location of an organism within its environment. Indeed that the environment becomes the prime selection pressure acting upon the organism to develop a level of consciousness. It also suggests that a theory for consciousness should be scalable. This further implies that the social condition surrounding humankind was an important factor in evolving ***Homo sapiens*** consciousness. One derivative from this is that the evolution of consciousness it directly comparable to the evolution of form and function. The underlying system is built upon the genetic fundament [genotype] that has been drawn out by the environment to produce a particular individual [phenotype]. As human consciousness emerged, from a plexus of individual responses to sensory inputs, it was shaped by the physical and social environment to develop various levels of reasoning power. The basic idea remains quite Darwinian, even though the processes and mechanisms are much more complex than ever envisaged by most pre-twentieth century humans.

Consciousness evolved as an adaptive survival mechanism involving better perception of what is happening and predicting what is about to happen. The brain itself lives slightly in the past and a predictive ability, based on past experience of what the body/mind might expect to happen next, is a useful survival attribute. The brains that better anticipate and made ready had an advantage.

Brooks [2002] has provided an interesting insight into how ***Robotico earthensis*** might reason and his conclusions seem similar to my own, even though he approaches the problem from a quite different direction. Brook's ideas of situatedness and embodiment fit well with how living systems seem to act. His belief in the effects of visual behavior and social interaction provides a good initial model for understanding how consciousness can develop through a plexus of sensory inputs and action during human evolution. The flaw that he exposes in the relationship between visual sensory input and humankind's perception of the world leads to a deeper understanding of 'what memories are NOT made of'. Adoption of a similar idea for developing robotic perception could considerably increase the reasoning capacity of our currently simple systems. An improvement in the ability to capture and to retain data from a novel sensory input could lead to vast improvement in ***Robotico earthensis***' reasoning power.

The belief that qualia, existing in an experiential medium as a fundamental feature of reality, are the essence of consciousness is an idea that has received some support by some scientists [Penrose and Hameroff, 1995; Hameroff and Penrose, 1996a,b; Hameroff, 1997; Frohlich, 1968,1970, 1975] but without any proof. The cited mechanisms do not exceed the bounds of scientific reductionism. The hypothesis attempts to place the phenomenon of consciousness within the framework of the physics of space-time operating at the Planck scale. Unfortunately, the relationship seems to be pure conjecture despite attempts to use quantum mechanics as its mechanism and Schrödinger's observer-event dualism as a demonstration of process within the theory of objective reduction. Penrose, in particular, nowhere presents scientific evidence that quantum effects existing inside microtubules inside cells are the source of consciousness!

That body of science concerned with the adaptive behavior in autonomous robots is leading to the development of a computational theory of consciousness. The computational theory of consciousness has roots in both the Law of Instability and the Law of Actualism in which the process-response model defines mental activity of the brain. Essentially, external environmental stimuli are passed to the brain via the sense organs and cause specific electro-chemical reactions in the brain. These reactions are manifested as processes in the mind i.e. thoughts. These thoughts, in-their-turn, create an electro-chemical response which is manifested as an action. Certainly, we need a fuller understanding of how neurotransmitters work to combine information from different parts of the brain to sustain memory but the basic direction for obtaining such knowledge is already unfolding. This will be the foundation for understanding mind. Studies of adaptive behavior in autonomous robots is showing that many such responses [thoughts] are essentially adaptive reactions of the mind to new situations i.e. small-scale emergent phenomena due to novel combinations of brain-activity. In the computational theory of consciousness the mind is a natural complex machine that is DNA based. The fact that this machine can 'learn' is nothing spectacular nor does it need some inner Id or soul. I see little difference between a brain [essentially a carbon-based bio-chemical machine] and a computer [a multi-component based mechanical machine] as a repository for mind. Rene Descartes' statement "**cogito ergo sum**" - I think, therefore I am - will apply equally to both ***H. sapiens*** and ***R. earthensis***. The dualism of body and mind / soul, seen by religion and the humanities, will be a shattered myth once science proves that robots can think like humans do. Self-awareness is in the details that will become apparent when we understand the neurological [chemical, physical and biological] processes involved in consciousness. I am not certain that this will be a true emergent phenomenon because the essence of consciousness seems to be present in all biological systems.

A perusal of the literature on adaptive behavior of robotic systems indicates the intrinsic relationship that exists between behavior and external stimuli [Meyer and Wilson 1991; Meyer, Roitblat and Wilson 1992; Pfeifer, Blumberg, Meyer and Wilson 1998; Holland and McFarland, 2001; Ayers, Davis and Randolph, 2002]. The difference between an animal and an animat is becoming less a question of 'mental' process and more one of the specific functions [external stimuli] the animal or animat are adapted to respond to. This is the type of research that could eventually lead to a manufactured consciousness.

Two things that must be imparted into ***Robotico*** consciousness are 'meaning' for existence and the concept that consciousness contains the essence of humanity. Even though nature may be indifferent to humankind itself it is not bereft of meaning. How to instill a meaning for existence is uncertain at this moment. Cybernetics fundamentally works on analogy and although scientists may achieve exact behavioral patterns in robots the responses are not the same as the reality, which are being simulated. Analogy is a basic pedagogical method for getting an idea across and the danger is in extending the analogical method beyond its capability: creating a cyborg without humanity in its consciousness. Uncontrolled development could do just that!

The most important questions to be answered and documented for those who will develop ***Robotico earthensis*** are:

1. 'What defines the humanity of ***Homo sapiens*** today; and,
2. 'What of our essence should be passed on to future generations?

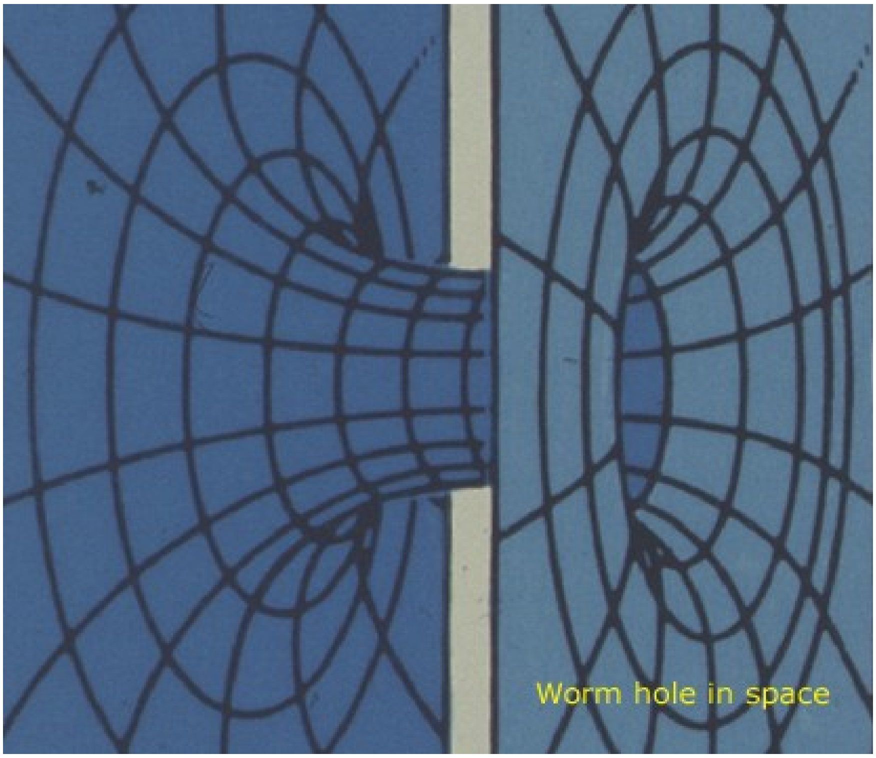
Evolutionary fact suggests that the genus ***Robotico*** could eventually evolve into something in which the concept of humanity is either a hindrance or a lethal trait. However, from humankind's viewpoint the goal will be to make sure that the representatives of the genus maintain a concept of humanity. Bill Joy [Wired 8.04: Why the future doesn't need us.] suggested that once robotics, genetic engineering and nanotechnology are combined they will threaten to make humans an endangered species. To avoid this, the trick is to implant the concept of humanity into the ***Robotico*** consciousness. Certainly ***Homo roboticus*** can be developed to this level: for it will have a human consciousness. However, ***Robotico earthensis*** does not need this restraint unless humankind wants to perpetuate it's humanity throughout our Universe [effectively a political move]. I suspect that building into our future descendants a constraint, something like "the prime directive" of Star

Trek fame, is both pointless and futile. Only an evolved sense of origins will save humankind from its brainchild once it has left our Solar System to colonize other parts of this, and maybe other universes. Isaac Asimov [1950] provided the original 'prime directive' in his three laws of robotic behavior that essentially forbade robots to harm humankind. Although this is a sensible part of robotic humanity the concepts of love and empathy for humankind is more important than such a directive: after all history has shown that some humans need to be killed!

CHAPTER NINE

THE MOON, MARS, AND BEYOND

"Either men journey to the stars, there to take fresh root – or they perish to no apparent purpose, a mere incident in Time's eternity." Strong**, [1965].**

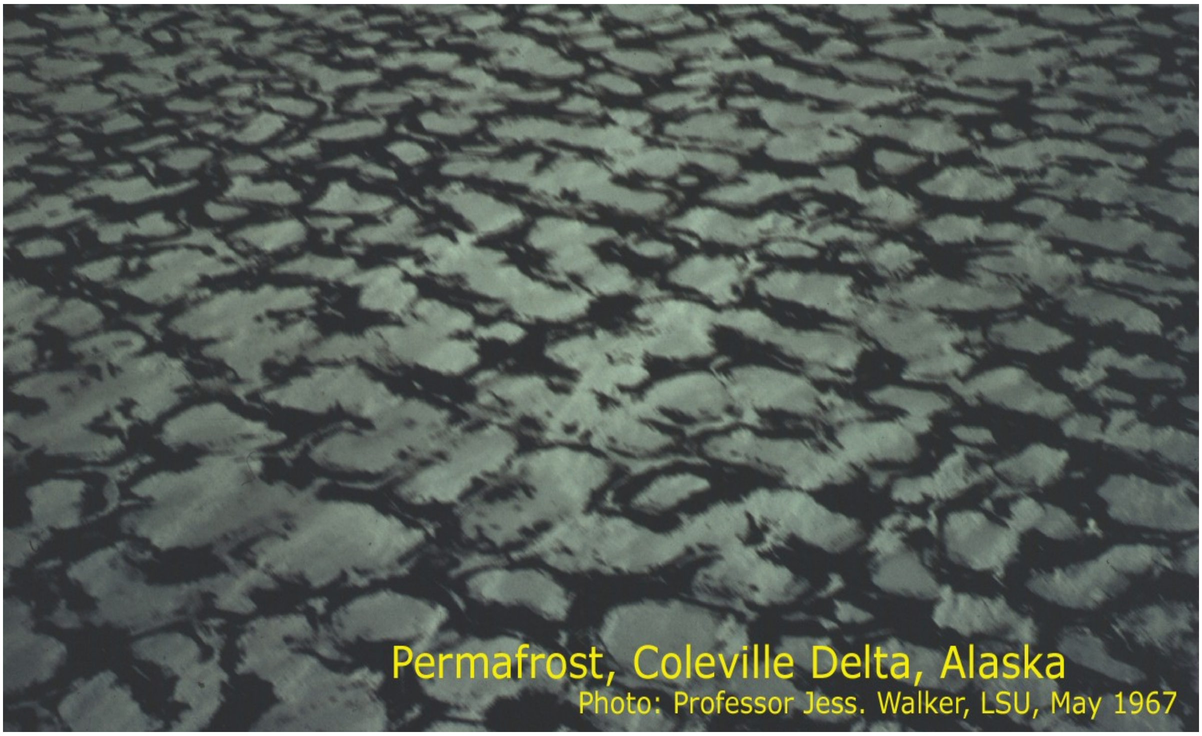


As a long-term technical problem, sending humankind off-planet is not difficult if the effort is determined to be of high priority. Sending humans to the Moon; developing computers, and understanding the genome proved this. This having been said the immediate technical problems are difficult ones, and present a huge challenge to our societal will. Humankind has the intellect, ability and resources to colonize the Moon and Mars, and eventually build Space Liners: but the Solar System will remain 99% unexplored without a suitable nuclear energy system for propulsion. Also, there are issues that many will regard as both moral and ethical for more crucial problems relating to sending people off-planet are the concerns relating to germ line and somatic intervention to improve the chances of survival of a complete gamodeme in adverse environments such as Mars. As emphasized throughout this essay, sending humankind off-planet to live elsewhere in the Solar System will eventually lead to the deliberate development [i.e. manufacturing] of human chimera. Even greater issues will be presented when it comes to selecting the individuals that will form the initial communities to inhabit Space Liners for extra-Solar System exploration.

I believe that somewhere, some group will attempt to complete the tasks that will lead to a fundamental shift in our phylogeny. Although it is better that this is completed in the open, under strict logical guidelines, than left to isolated groups, the tasks eventually will be accomplished one way or the other. Nature does not care whether humankind extends itself into the Universe, or remains moribund here on Earth. If humankind does not take the route to the stars then some other species, somewhere in our Universe will, and effectively our temerity would have initiated our own extinction. There are many individual scientists who are not willing to take that risk. Fortunately, we still have about 5 billion years before our Sun will devour Earth so time is not of the essence! Moreover, even though our Universe may have an immense finite life there is a possibility that future technology will allow migration into another universe [Kaku, 2005]!

Perhaps, more important for the future is the knowledge that "Thanks to its roots in thermodynamics, the general course of evolution becomes predictable: there is a tendency for energy flow (and for life) to expand into any niche, provided there is a mechanistic path; it will diversify, radiate, speciate: and it will tend to produce structures that are increasingly complex" Harold, 2001, p: 230. The 'quest for the stars', predictably, will open-up whole new environments, into which humankind may choose to diverge.

COLONISING THE SOLAR SYSTEM



Within the limits of our Solar System nature provides a wonderful laboratory for humankind to develop the pre-requisites for intra-galactic travel. The Moon, Mars, perhaps Europa, and many spots in the asteroid belt offer opportunities to humankind and their descendents to prepare for Space Liner travel beyond the Solar System. Mechanical probes can fulfill many scientific data-gathering tasks but a human descendent is necessary to establish humanities presence off-planet. Albert Harrison's [2001] book is an excellent starting point for understanding the problems of 'Spacefaring'.

Because of the enormity of its cost and its risk exploration of the Moon and beyond will continue to be initiated by government. However, in shortly thereafter, economic interests may accelerate the development of small space vehicles for lunar and near-Earth activity [especially mineral exploration such as Helium3 from the Moon]. This could provide useful technology for the ancillary small space vehicles needed for Space Liners. This commercialization of near-Earth space could serve as a vital catalyst in the medium-term future particularly to provide a clean and abundant energy source using deuterium/helium3 and helium3/helium3 reactions. I say medium term because the necessary reactors have yet to be invented. The technology to mine helium3 and transport it back to Earth is essentially in place. The loading bay of a standard shuttle could be the transporting mechanism once the material is mined and uploaded to near lunar orbit. Indeed, once humankind has established a permanent footing on the Moon a Shuttle launch facility, similar to that on Earth, would provide a simple way to exploit the energy and mineral resources of the Moon. The building of a Lunar Station will be a national or international effort by government[s]. If done alone it is highly likely that the United States or China will be the first to act. In the meanwhile the priority is to develop a suitable helium-3 reactor, a task that is difficult but not impossible provided sufficient funds are provided. A sufficient and renewable fuel source would open up the entire Solar System beyond that which is possible using chemical propellants. The Prometheus project was proposed by NASA as an attempt to solve this problem: by developing a major nuclear power energy system for both space probes and a space vehicle. Nuclear powered engines will supply a much reduced fuel weight than conventional chemically based materials as used today but developing a safe space-rated nuclear reactor, power conversion hardware, and large ion engines present big challenges to engineers and scientists. Eventually such manufacturing will take place 'off-Earth', in a location that cannot damage Earth.

The International Space Station had the initial aurora of the beginning of ***Homo sapiens*** habitation of the Solar System but it is proving costly and in recent years has lost its luster. Indeed the completion of this 150-ton complex, the size of a three-bedroom house, has had sufficient cost overruns to cause NASA to reconsider adding any launch facility for expeditions to the Moon and Mars. In reality the ISS is a somewhat small step towards space exploration: based upon the principle of developing enabling technologies. Certainly, humankind can learn much from the ISS but going directly to a Moon habitation is the kind of bold step that is needed.

Without a doubt the slow grind inherent in the 'development of enabling technologies [DET]' approach has merit. It is safe and sound: but unimaginative and slow. If the DET approach leads soon to improvements in propulsion systems, and the control of the radiation damage to living systems, then it will be worth the wait.

Colonization of the Moon

For at least a generation many scientists have believed a permanent Moon base will provide the opportunity for important advancements in both science and engineering. Although enthusiasm has waxed and waned there are many today who believe that lunar dwellings are a worthwhile step towards inhabiting the cosmos. The Moon has certain advantages for initial permanent settlement. Not the least of which is easier access than Mars. The shorter trip means less exposure to radiation damage and speedier development. The betterment of humanity or the reduction in population pressure is unlikely to be the real reason for Lunar colonization but humanity will be better for it. The effort probably will come either as a result of corporate or political-military expansion in a push for natural resource exploitation.

The Moon provides a relatively close laboratory for developing advances in cutting-edge science. Some of the more obvious possibilities are:

1. Developing the designs of controlled closed ecosystems.
2. Development of machinery for the manufacture of useful products from the lunar materials. At the end of the last millennium remote sensing of the lunar surface using spectrometry discovered water-ice in the subsoil. There are certainly sufficient minerals for extraction to allow manufacturing to be developed.
3. Once manufacturing facilities are established the low gravity of Moon will allow the development of a Space Liner technology.
4. An advanced telescope on the Moon will provide Astronomy with images mega-orders better than those from the Hubble space telescope.
5. The isolation of Moon may allow gravity waves to be measured. In particular, the establishment of a sister colony on Mars may allow synchronous measurements to determine short wave gravity waves.

Politicians often use cost as a factor negating against extra - terrestrial colonization. However, within the time-span of three centuries or more cost is not an important factor: and it is within the range of 300 years that ***Homo sapiens*** or ***Homo roboticus*** will have colonized the Solar System.

Colonization of Mars

The Martian year is 687 Earth days and the round-trip from Earth, is a 280-million-mile voyage. Colonization of Mars must be considered alongside colonization of Moon. Some of the interest for the initial exploration of Mars lies in the possibility that life did originate on its surface sometime in the past. Finding a fossilized or extant life form on Mars would prove that life is not confined to Earth. Geologists have always been uncertain about the possibility that a brief time span did occur during the early evolution of Mars when the development of biological systems could occur. The evidence for water increases the likelihood that such a time span did exist. Mars is certainly the one place to look in the Solar System for evidence of pre-cellular evolution of dynamic chemical systems and the most likely location that life-forms up to the bacterial stage will be found in its surface and sedimentary layers. However, scientifically this is quite trivial because logic points to life's ubiquity in the Universe. Belief in life elsewhere in our Universe rests on the argument of the universality of the necessary materials and energy within the Solar System and Universe. Moreover, the knowledge that self-sustaining and self-reproducing bio-chemical systems exist should be enough to ease the fear that Earth contains the only living systems in the

Universe. It is perhaps a facet of science education that most paleontologists, I know, accept this idea that life exists elsewhere in our Universe as definite whereas most physicists and chemists are uncertain.

From the potential choices within the Solar System inhabiting Mars reduces the problem of reduced weightless that will plague lunar inhabitants. Moreover, Mars does have an escape velocity suitable for retaining an atmosphere and thereby is a possible candidate for [very] long-term terraforming, and therefore a planet-of-choice for colonization. Unfortunately, a recent change in the Martian atmospheric model, based on new data, indicates the ice caps are most likely water-ice and not carbon-dioxide ice. This means that the planet will not be as easy to terraform, by warming the atmosphere by artificially initiating a green-house effect, as once thought. At the same time it does provide a water source for future inhabitants of Mars.

Perhaps the most exciting news concerning Mars in the recent decade is that results attribute to the Martian subsurface a sufficient quantity of water to sustain a human colony. The likelihood of the past or present occurrence of water on Mars has undergone changes in the past half century. The 2001 Mars Odyssey Mission mapped the top meter of Martian soil and the results suggest that in the high latitudes [>60o] a water-ice rich layer exists 30-60 cm below the surface deepening to 100 cm below the surface in the equatorial regions[1]. More recently, Los Alamos2 has come forward with a map of the distribution of Martian ice based upon Odysseys remote sensing of the Martian surface with a neutron spectrometer. The map covers the regions pole wards of 35^o north and south3. If melted this ice could cover the entire planet some 4-6 inches deep. It has even been suggested that there is evidence that it snows on Mars and that the melting of this snow [and water-ice] is the real basis of Martian geomorphology. Much of the water content is thought to be as hydrates such as zeolites, clays and magnesium sulfate. These materials possibly accumulate to about 50% by mass of the top few feet of sub-soil near the poles and 10% by mass in the equatorial regions. Even though trapped within a mineral it will be possible to extract water from the Martian surface as a long term source. The most recent results from the Phoenix Project imply that water-ice indeed exists at the Martian surface.

At the surface Mars has a gravity, temperature [plus 20 to minus 60oC], pressure [very low] and chemistry [mainly nitrogen] that may be livable for a genetically altered human. Politically, it is unlikely that chimera technology will be allowed on Earth but must await the long-term establishment of facilities on Mars.

Permanent habitation of Mars by humankind will necessitate taking into account the basic needs that evolution has shown as necessary for humankind. Initially, protection, food, and shelter will be provided by the space ship itself but eventually a permanent abode will be necessary. Materials brought from Earth can be used to build a temporary abode, as is done in the Antarctic Base Camp. However, the construction of a permanent habitat will have to be built from local materials: this is why the learning process acquired through a prior colonization of the Moon is important. On Mars the initial landing site should be close enough to suitable building locations and natural resources to facilitate the construction of a permanent shelter, and a food and water generating plant can be constructed. Once a homegrown Martian habitat has been established the Martian colony will begin and the other needs of the cultural gamodeme will come into play.

The initial human probes of the Martian environment will provide much more knowledge about the environmental variables than will conventional mechanical-chemical probes. If Mars is to be colonized humankind must attempt to live on the Planet as soon as possible. A one-way-trip to Mars is decried by some people as immoral. However, ethically, there is nothing wrong with such an idea if it is based upon individuals freedom-of-choice. There are some who are willing to accept death as the price to pay for knowledge and exploration. Indeed, it is questionable whether or not, guaranteed, return of the explorationists is required if human life can be sustained on Mars. Once long-term habitation on Mars is feasible and sustainable return to Earth is not a pre-requisite. A considerable amount of available human-power will be necessary to expand the habitation facilities to accommodate more general human needs. Certainly early on the agenda will be the construction of a permanent health-exercise-entertainment facility; and, the development of a social structure including the need for sexual partners. Soon after that the first humanoid Martian will be born. As we have seen on Earth, the key to development will be optimization of the available energy systems, and other natural resources. Simple manpower will not be enough to make any large-scale contribution but the utilization of a nuclear energy plant similar to that which drives the space ship could. Having available an energy generating plant, built on Earth or Moon, which can take advantage of Martian minerals will greatly accelerate Martian colonization. Once established the colony will probably spend much of its time acquiring natural resources and developing genetically adapted organisms for seeding the Martian landscape. Portable laboratories could be initially built on Earth to process the atmosphere and lithosphere to generate needed materials such as fuel for surface exploration vehicles.

Extensive terraforming of Mars will require heating its atmosphere by using a greenhouse effect. This will necessitate the building of machines to extract CO2 and the other greenhouse gases from Martian rocks. In the long run this may be unrealistic, and genetically engineering plants and animals, including humankind, to live on Mars, might prove a much better method. It is perhaps inevitable that the lunatic fringe will arise to oppose terraforming as unethical or immoral. Terraforming Mars or altering Earth organisms to fit Mars are both radical alternatives to some. However, the morals and ethics that are needed are not those of Earth dwellers. Developing chimera, or other forms of genetically altered human beings, for survival on Mars, is neither immoral nor unethical from the viewpoint of our future phylogeny. They will be truly of concern to those who must live, and breed, on Mars; and, the logical outcome necessary for adaptation and survival is obvious.

Long before human colonization of Mars there will be many mechanical-chemical probes. The current Martian short-range rovers are designed to search for water, for signs of life and to elucidate the geomorphology of the surface features. The Mars reconnaissance Orbiter adds detail, at the 20-30 cm level of resolution, to the knowledge gained by earlier remote sensing technology; and, the Phoenix project commences a more detailed analysis of Martian regolith materials. In the future a long-range rover will test intelligent landing systems that can avoid hazards; and, improved sample gathering technology. This phase of Mars exploration is expected to culminate in 1014 with the first return of samples from Mars. However, the recent decision to concentrate on developing a habitat on both the Moon and Mars; and, the confirmation of water-ice on Mars may change the entire program.

Colonization of Europa

Europa is one of Jupiter's four main satellites and has a frozen water surface with a presumed ocean below the thin ice. Europa has a magnetic field, and heat derived from its core is believed to be sufficient to keep the water liquid below the ice. It is likely that the oceans have existed for millions of years and this presents the possibility of living systems having evolved. Certainly the potential elements for the development of living systems could be present. The adaptations necessary to survive in such an environment may not be that different from those present of Earth where organisms have evolved in limited light conditions in aqueous environments. For an informative look at some of the possibilities of Europa Cohen and Stewart [2002: chapter 9] is a good first approach. Europa certainly is an object that can be explored and perhaps colonized by ***Homo roboticus***.

Although some of the larger moons such as Europa provide interesting locations for exploration the really exciting places are the asteroids for they contain mineral resources that can be mined and exploited to fabricate materials needed in space. Certainly, they could supply a low-gravity source of useful minerals, including nuclear minerals that would be too heavy to lift from Earth in large quantities. The asteroids would not have the negative-cost of high gravity lift-off. Ultimately it will be necessary to develop a manufacturing infrastructure based upon materials available in space: a greater intellectual breadth of Earth-bound scientists and engineers will be needed to design these structures that will be operated in deep space.

BEYOND THE SOLAR SYSTEM

"The meek shall inherit the Earth ... the rest of us will journey to the stars" [Anon.]


A small Tibetan village: Tibetan Plateau, 1987

Certainly ***Homo sapiens*** followed by ***Homo roboticus*** initially will dominate the Moon and Mars. Beyond that it is questionable whether or not our species will be important. Space Liners probably will be designed for ***Homo cosmos*** but ***Homo roboticus*** and ***Robotico earthensis*** are the real candidates for intra- and inter-galactic exploration.

Only a low thrust system is needed for propulsion once outside a strong gravitational field and this could be supplied by solar energy or nuclear energy. Whatever the source development of a suitable propulsion system, an internal energy system and radiation barrier, is necessary for exploration beyond the Solar System. Voyager 1 has already gone beyond the defined limits of the Solar System and certainly the future will see mechanical probes sent that return data to Earth from those outer reaches of our Solar System.

Exploration beyond the Solar System presents the exhilarating possibility of discovery of another sentient life-form. The conditions necessary for life to develop on a planet, as opposed to in interstellar space, are probably fairly common in this universe. It has been estimated that about 1-5% of the stars in a single galaxy might possess planets capable of supporting life. There are over 100,000,000 galaxies within the range of our telescopes and thus the number of planets that could possess living systems is approximately 10^{17} (100,000,000,000,000,000 planets). This number is based upon observation and estimation using scientific reasoning and the laws of probability. Even if this estimate is reduced 1 million or 1 billion times it still leaves us with the conclusion that life occurs and even is widespread elsewhere in this universe.

Suggestions by Frank Drake in 1960 led to the introduction of the equation that now bears his name, as a predictive measure of the probability of life existing elsewhere in our Universe [Drake and Sobel, 1992]. A lot of emphasis has been placed on the restrictions that this equation places on the development of living systems but even so the Drake equation does predict that life will exist elsewhere in the Universe. My own opinion is that the only valid question that needs to be asked about any particular location in our Universe is "what could have stopped life from forming in this location?" not "what could have caused it to develop?" In other words the null hypothesis is that life is present and we must attempt to reject the hypothesis. This view is the correct approach if it is accepted that life is a natural stage in the evolution of matter.

If a stellar system has planets and some planets are at a distance from the star such that water occurs on the planets surface as a liquid, then such a planet is a good candidate to become a living-planet. Within the temperature range where liquid water can exist, the chemical reactions necessary for the development of living molecules can progress. At higher temperatures the chemical reactions slow down. Moreover, for a stellar system to contain carbon-based life forms it must be at least a second-generation star in order to contain the heavier elements, particularly carbon [if conventional wisdom is used to determine these variables]. In order to increase the probability, for more advanced life forms to have developed the density of the planet ideally should be similar to that of our inner planets and preferably have a size approaching that of Earth. A much smaller planet probably could not hold an adequate atmosphere and a larger planet would hold too dense an atmosphere and screen out radiation. This does not imply such planets would be life-less but that most probably they would have chemical systems equivalent to bacteria as their highest life forms.

On Earth it is observed that life forms have adapted to Earth conditions. For example the eyes of a human being are nearly perfectly adapted to using our sun's dominant radiation (visible spectrum) for seeing with. Moreover, the varieties of life processes that occur use that part of the spectrum between 300-1,100 micrometers. Shorter wavelengths destroy large organic molecules; larger wavelengths cannot activate photochemical reactions. As a consequence of the subtlety of adaptation under the universal laws of Instability, Actualism and Combinatorial Outcome life elsewhere in our Universe may be found in some odd environmental niches and provide some spectacular surprises.

The question "where will we go first" has a fairly obvious answer. Once outside the Solar System our own Galaxy [the Milky Way] is the choice. Scientific reasoning in the middle of the last century suggested millions of planets exist in our galaxy suitable for the development of an alien presence, or as a potential habitat for ***Homo***. More recent estimates similarly confirm this. It is now known with certainty that other planets exist around other stars. To date numerous gaseous giant plants like Jupiter and Saturn have been seen, for example, 47 Ursae Majoris is believed to be similar to our own Solar System. Barrie Jones, of the Open University, used mathematical simulations, to suggest that other stellar systems in our galaxy may contain as many as a billion planets. As techniques for finding planets have progressed so have the number of planets found increased. To date, the numbers of know extra-solar system planets can be counted in the hundreds and is rapidly approaching 1,000's as better technology and techniques develop. An early example, and one of the more interesting, was discovered by Marcy et al [2002] orbiting the star 55-Caneri, which is about the size and age of our sun. The planet orbits about the same distance from its star as our Jupiter does from the Sun, and has a mass the same order of magnitude. The excitement lay in that at the limits of technology Marcy saw a stellar system comparable to our own. Whether or not, an earth-like planet is within the 55-Caneri System awaits technological improvements but if it does its distance of 41 light years from Earth makes it a prospective target for investigation by ***Robotico earthensis***.

It is highly likely that our remote sensing ability will be refined enough to image small earth-like objects prior to the time we send Space Liners to explore the Milky Way Galaxy. NASA's Terrestrial Planet Finder program and the later, more ambitious, Planet Imager program are designed to image planets located outside of the Solar System, using advanced interferometry. The establishment of an advanced interferometry system on the Moon will probably produce numerous locations. Thus, when humankind ventures to explore our Solar System a destination will be in mind.

Science can be reasonably more specific in suggesting the general area of exploration because 'nearness' of the target planet will be an important factor. Earth is located in the Local Cluster of Orion, on inner edge of the Carina-Cygnus arm of the Milky Way Galaxy. In this region the Sun is a fairly insignificant star except for the fact that life forms are associated with it. From this stand, the nearest possible stellar system of interest to both ***Homo roboticus*** and ***Robotico earthensis*** is Alpha Centauri, a star of the southern sky, lying in the direction of the Southern Cross.

Space Liners

Although not the first volume of its kind the 'Flight to the Stars' by James Godwin Strong [1965] gave a comprehensive coverage of pertinent knowledge as it was in the early 1960's. Lawrence Krauss [1993] in his "The physics of Star Trek" did a nice job demolishing the fantasies of traveling within our Universe: at least for a civilization at humankind's level of science. Although he did not rule out future advances that would allow traveling through space-time [see more recently Davies, 2002] humankind must accept that, for the immediate future, any attempt to move our intelligence beyond the Solar System must involve successive generations living on Space Liners, robotics, or the development of near immortality. Cryogenics is debatable and an 'iffy' choice.

Science fiction writers and Star Trek, in particular, have pre-empted many of the ideas for facilities on Space Liners. Nevertheless it is worthwhile to note the salient features that lie over and above a viable ecosystem. Of these, oddly enough, navigation systems will only be important at the beginning and ending of the journey for once initiated the Space Liner will be on a long monotonous course. Multimedia digital libraries containing all of humankind's scientific and engineering bookish learning will be supplements to the real knowledge contained within a mind that is perhaps 300 years old. With the advent of ***Robotico earthensis*** much of this information will be contained within its real consciousness.

The key elements for life support will remain those of temperature, pressure, chemistry and gravity: definitely for ***Homo cosmos*** but even for ***Homo roboticus***. Rotation, as in '2001', is a simple way to create gravity, although for those with a robotic body a tunable magnetic grip might be all that is needed. An artificial gravitation field is necessary for any biologically based descendents, as a countermeasure to muscle, bone and general physiological deterioration seen in astronauts to date. This will be true for expeditions to Mars as well as deeper penetration into space and a fairly large volume of the Space Liner must be allocated to a Gym if any biologically based space travelers are not to deteriorate beyond repair. Within a Space Liner the central core, where gravity is essentially zero, will probably be the location of an industrial complex, with an outward series of successive hulls of increasing gravity. Chemistry, temperature and pressure will be directly linked to a sustained eco-system simulating Earth's atmosphere for ***Homo cosmos***. Heat, pressure or chemical loses into space would be calamitous. To be realistic the probability that any Space Liner actually will reach a specific destination without sustaining major damage is very small, so that the space communities must not only be self sufficient for multiple generations but have the capacity to manufacture their own needs for survival. This implies a contingent of smaller vessels for scavenging objects in space that are met during the voyage. It cannot be assumed that a Space Liner will have on board all of the materials needed for unlimited survival. Oddly power for manufacturing is not a major concern because even small amounts of light can be concentrated and used in the near vacuum of space to refine materials.

Clearly sending ***Homo*** into space as a living gamodeme presents many difficulties. Many of the requirements are already known and have been investigated. Some have even been implemented although not yet to the extent that they will allow true exploration of space. A controlled ecosystem is critical for all extra-terrestrial exploration. Space Stations, space flights and space probes provide some insight into the simpler problems but complex environmental experiments like an Earth Sphere on the Moon or Mars are mandated prior to deep space exploration of the Solar System by ***Homo***. Our descendents must take those parts of Earth environment into space that is considered needed, not just necessary, for the continuance of humanity.

It is almost certain that ***Homo sapiens*** and ***Homo cosmos*** will play only a minor part in deep space exploration. Travel to a distance galaxy such as Andromeda, which is some 2 million light years away will be a task for ***Robotico*** not ***Homo***. Because both ***Homo roboticus*** and ***Robotico earthensis*** can be designed for adverse conditions their needs will not be as stringent or as complex as those of ***Homo cosmos*** and thus neither will the support system within the Space Liner that carries those novel species.

Gamodeme composition of a Space Liner

A Space Liner will not simply be a vehicle that transports people in space but will be the artificial planet upon which the population lives and dies: it will be home. Self sufficient, self-orienting and huge a Space Liner will be humanity's primarily means of expansion into the other parts of the Universe.

Humankind's journey into space will necessitate controls on the allowed variability in the gamodeme because the stabilization of the group will be required. Essentially stasigenesis will be the required form of gamodeme change: at the most with minor orthogenesis to tweak-the-system. However, when humankind reaches a suitable planet for colonization anagenesis will be the desired mode of evolution.

In space the group must dominate the individual but on planet 'New Earth' the individual will once more become the key element in evolution. Perhaps our descendents will carry the DNA blueprint, or even actual gametes and zygotes, to redevelop ***Homo sapiens*** on a 'New Earth'. If some scientists are correct in their ability to predict the future an earlier consciousness i. e. of specific human beings once living on earth, might be implanted into a manufactured humanoid body: certainly this is an Organ Donation Program many would subscribe to! This process could be repeated over-and-over as humankind and its descendents extend our lineage to the reachable limits of our universe.

Because the migration of humanity into deep space will involve a total and final severance of all contact with Earth the Space Liner must have a complete and controlled ecosystem that is conducive to the maintenance of the gamodeme. This is why most of the difficult exploration of space will be left to ***Homo roboticus*** and ***Robotico earthensis***. A suitable ecosystem is much easier to construct for those species. Engineers and scientists will be the primary personnel but all adults will be teachers for with such a small community it is imperative that knowledge be passed on to following generations: if breeding is necessary.

Space Liners carrying between a hundred and a thousand individuals will be an immense project and it is likely that only a few will be built by ***Homo sapiens*** from a Solar System base. The inhabitants of the Space Liner, and indeed its entire evolutionary lineage, may never have contact with another human community again, although conceivably later technology might allow a Space Liner that sets out a hundred years later to overtake earlier forms. Indeed this would be a useful strategy for both knowledge exchange and gene exchange. Similarly, communication with Earth would be at the generational level. However, it is important that it take place because a vast well of intellect will lie on Earth more so than on the Space Liner. Exchange of technical information, even if it takes a generation for the two to communicate, could benefit both worlds. One advantage is that both the receiver and the recipient will know which direction to beam the communication and the distance apart of the two locations. The exploration of the Solar System will give impetus to advances in quantum communication technology. If a method of quantum communication can be developed instantaneous messaging across light-years may become feasible.

Life within a Space Liner may be fraught with danger in the initial generations, for claustrophobia is a social condition of humankind, and will certainly exist in the psyche of ***Homo cosmos*** and ***Homo roboticus***. The community will be essentially on its own with eventually no contact with Earth. Perhaps one solution is to send two or more Space Liners together on intra-galactic travel. This could not only provide more social comfort but if each community remains a single interbreeding population then the gamodeme stress on the population may be avoided by occasional inter-exchange of people among communities.

Current political and moral thinking indicate the decision will be taken, as scientifically expedient, to send a humanoid probe first. Not the least problem is the tiresomely long time involved and the size of a Space Liner necessary to carry a gamodeme of the minimum size for a multi-generational journey through space. Although Strong [1965] suggested that about 100-150 people would be a necessary minimum; and, more recently John Moore [2002], using computer modeling, specified 160 people, the work on gamodeme stress in animals suggest a 1000 as a better population size [Frankham, Ballou and Briscoe, 2002].

The survival probability of a population need not be 0.99 or even 0.95 which is a common value used in statistical analysis. The decision to build and outfit a Space Liner will depend on additional factors over and above a simple population survival probability based upon gamodeme stress that results from inbreeding. Frankham et al [2002, p. 523] and

Shaffer et al [2000] note that in wild populations of less than a few thousand the gamodemes are not likely to be viable for long! However, humankind's knowledge of genetic engineering may make this a moot point and a gamodeme of between 100-1000 could work.

Studies on animals suggest there is a minimum natural habitat area for species persistence over a long period of time and this is related to population size i. e. population density is a factor in survival. Both under and overpopulation will certainly lead to problems on a Space Liner and the average and critical upper and lower limit must be pre-calculated with great care.

A moderate size for a Space Liner is perhaps about a mile in diameter, the size of a small Tibetan village today, or a similar place in Europe in 1066! Sending two of these together is an ideal strategy to avoid gamodeme stress, with the additional possibility of sending faster Space Liners at regular intervals that can catch up with earlier vessels every second or third generation. The weight of a Space Liner will probably be at least 100 megatons and therefore must be totally constructed in space [hence the importance of learning from building the Space Station].

WILL THE UNIVERSE BE OURS?

"Nature is completely neutral and scrupulously fair" Strong [1965].

The location of other life forms and 'civilizations' is important and indeed may lead to a quickening in the evolution of ***Robotico*** by modifications using the alien format. However, knowledge of an advanced society elsewhere in our Universe is a double-edged sword. The way humankind has treated other species on planet Earth urges caution in communicating with other civilizations. Consider how far our civilization has advanced in the last fifty years and how far it will advance in the next fifty years. This implies that a civilization that is even 100 years more advanced than Earth's may consider ***Homo*** more of an item for the Zoo or Laboratory than an equivalent being.

An important role for ***Robotico*** in its relationship with ***Homo*** should be the seeking out of places suitable for humans to live and effectively directing other Space Liners to those locations; and/or having a cargo of zygotes of Earth organisms, including ***Homo sapiens*** to establish 'New Earth'. If our descendent genus ***Robotico*** is the deep space traveler then the presence of an Earth nursery should be mandated as part of the cargo of any Space Liner. In an extreme scenario the pace of engineering development may be such that ***Robotico*** will evolve before we have a suitable Space Liner to transport an immortal ***Homo*** but not before we have the ability to deep freeze our gametes and zygotes.

Homo sapiens as an Earth dweller may continue to exist as 'carbon units' for a long time. Simple evolution of our species would develop change by genetic drift, as we populate our Solar System. Nevertheless the earlier evolution of our phylogeny suggests with near certainty that designed systems [machines] will rule our Universe. In this eventuality the hope is that these systems will either ignore humankind completely or act as benevolent despots providing us with knowledge to build a better living space, both on Earth and elsewhere. At the minimum ***Homo roboticus*** will survive until the end of our phylogeny and by then it will not matter because abandoning human form will be seen as the ultimate life style … in fact we may have become our own gods.

Seeking 'that which creates'

"That there is a reason for existence [the little 'g'] is derivable from purely logical reasoning and I have no problem with that as the Ultimate Origin". Lecture notes,1963.

Understanding of the origin and development of our Universe has come a long way in the last 100 years. Scientists have a strong Theory on how our Universe developed from its inception from an object the size of Plank distance, even though we do not know why it developed. Our Universe and all stages in the evolution of matter follow totally logical processes and for that reason the belief that something created it deliberately is a reasonable assumption. Humankind can speculate on the purpose of our Universe but it is unlikely that ***Homo*** will ever know, or understand, that purpose. Hopefully that what we do discover will be sufficient to quiet our inner id.

Much of early science was undertaken to illustrate the splendor of god's work but the historic outcome was that many of those engaged in this pursuit became religious skeptics and science diverged from religion. Throughout history these skeptics have been at odds with the views of the religious leaders that form the fundament of the established church. In more recent historical times, with the rise of reductionism, the skeptics developed a tool that began to destroy the fundament of religion: the role of the supernatural interfering god. Religion has failed to accept reductionism as the basis of a reformation and rarely accepts developing scientific knowledge. Consequently religion eventually will suffer the effects of normal Darwinian selection pressure as logic and reason, operating within a reductionist framework, prevails. I believe this can be said despite the apparent rise in religious fervent during the latter part of the 20th century.

The logical structure of our Universe demands the existence of "that which creates". When we create a consciousness for ***Robotico earthensis*** an important part of that consciousness must be to seek knowledge about 'that which creates'. Like Rousseau I believe that humankind has a primarily need to understand, and once designed consciousness occurs the answer to this question of origin must become a driving force in seeking new knowledge. The popular writings of Paul

Davies [1983, 1992, and 1995] and Paul Greene [1998] provide explanations of what scientists think about the origin of our Universe.

Some will interpret 'that which creates' as the name of all humanities gods. However, it is not defined as either an object or a process, for only this we know: it is a logical presence. This is the only assumption needed and probably the only one that can be uniformity accepted amongst people. At its core religion attempts to answer the question "what is non-existence in our material universe?" That our Universe is logical and thus all objects within it have a logical purpose is not inconsistent with an atheistic belief-system. Atheists essentially reject the existence of the supernatural within the time-space framework and in so doing reject the concept of an interfering god. I do not reject the notion that our Universe had an origin nor that it was created by some set of physical laws and processes. There is a general belief amongst scientists that our Universe is based upon a finite set of constants, which if altered in any way would have produced a different universe. Because of this, speculative and imaginative reasoning allows room for a derivation of a purpose for our Universe to exist.

If our Universe is simply an experimental design of "that which creates" then our Universe is observed and therefore it exists[4]. The observing phenomenon is in a dimension outside of those within which we exist.

If our Universe is a logical experiment by "that which creates" then the purpose of the phenomena within our Universe is simply information i. e. all matter in our Universe can be seen as part of an information system developing from the experiment set in motion by "that which creates".

If our Universe is a logical experiment then there are conduits monitoring the experiment.

The idea that the purpose of all things is to seek knowledge of our Universe for some logical presence in another dimension does not require a leap-of-faith of religious proportions, merely the belief that our Universe is based upon logic. If our Universe is an experiment of 'that which creates' how information is transmitted back to the observer can only be guessed at the present time: as do the Priests, Poets and Science Fiction writers. Perhaps it occurs through one of the other dimensions that exist within our Universe. Mathematical physics using M-theory allows for a multi-dimensional universe, which provides plenty of room for an information conduit back to 'that which creates'[5].

A vexing problem regarding the above idea is that it suggests 'that which creates' has some kind of temporal existence: even though it exists outside of our space-time. Unless the experiment is temporally instantaneous from the viewpoint of the observer the observer must exist in the equivalence of linear time outside of the Universe. This is not as far-fetched as it sounds for as far as I am aware there is no scientific reason why time cannot extend backwards beyond the point of origin of our Universe [except by definition].

The type of logic used above raises some interesting questions that could impact upon our cultural gamodeme. One question in particular can be asked that is of the form: "If it is true that our Universe feeds information to 'that which creates' then can 'that which creates' influence our Universe after it was set in motion". An affirmative answer to this question would certainly please the leaders of religions: because it leans towards acceptance of an interfering god. However, the asking of the question misses the point of the logic behind such an experiment: 'that which creates' is no fool.

Another possible question of profound significance is: "Could 'that which creates' tweak the system in the same way as a programmer can tweak a computer program?" This opens up an interesting possibility. An affirmative answer to this question produces a logical basis for religion to exist, for if we allow tweaking we must then accept an interfering god can exist; even though existing religions would still need to undergo a reformation to accommodate modern scientific knowledge. Accepting that this is a valid and logical question we can phrase it in a more interesting alternative form i.e. "Do we know whether 'that which creates' did or did not tweak the system?". This is an interesting question indeed, because there may be an answer! If the physical constants of our Universe have changed since the initialization of creation, without any logical explanation, then the system may have been tweaked and the major question springing from the consciousness of humankind will be answered. It could be interpreted as independent evidence that an interfering god exists! As an atheist, of course, this appalls me but as a scientist the question [s] have an undeniable basis in logic. As a 'Seeker' this presents an interesting project.

Nature has a wonderful simplicity about it that science unfolds.

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TABLES

Table 1

MAJOR CHEMICAL CONSTITUENTS OF THE CELL

Water	The major solvent in cells that ionizes H+ and OH-. These ions are important in chemical reactions during metabolism. They also help to maintain the acidity of the cell near neutral.
Nucleic Acids	RNA and DNA are involved in the basic genetic code and control protein synthesis.
Proteins	The proteins are the proximate product of the genetic code and form enzymes and the structural units of the cell.
Adenosine Phosphates	ADP and ATP are chemical resources that allow the rapid transfer of energy.
Carbohydrates	The various sugars are important intermediate energy resources of the cell.
Fats	The various fats and lipids are long term energy resources of the cell as well as playing a role in membrane formation.

Table 2

IMPORTANT MODIFICATIONS NEEDED BY CHLOROPHYTA FOR THE DEVELOPMENT OF TERRESTRIAL PLANTS

Osmotic Pressure	The first change was from saline to brackish to fresh water. The final stage was adjusting to using rain water and the use of roots. The change to utilizing fresh water probably took place in the Chlorophyta and thus the earliest land plants did not have this problem.
Dehydration	The initial problem was one of water storage. Probably the first plants developed immersed in water. This was done by developing cell walls. These cell walls do not occur in animal cells. In plants they consist of layers of lipids (waxes) that form a protective coating around the cell. The outer surface of the plant developed a thick covering of cells that were full of lipids and this formed an epidermis which prevented excessive evaporation.
Sub aqueous	Photosynthesis using direct sunlight was possibly the driving force causing plants to become sub-aqueous i.e. with part of their structure above the water level. In order to do this they had to develop a supporting structure of stiff tissue. The epidermis along with the lignin and cellulose, acted as a support structure allowing the plants to grow taller.
Energy capture	There was improved energy capture by elevating the upper part of the plant with stems but the major improvement was the development of leaves.
Rooting system	The rhizome of primitive forms developed not only into a root system for gathering nutrients but also as an anchoring system.
Nutrient channels	The development of a primitive vascular system [an internal tubular system for carrying nutrients and water] allowed efficient metabolism. Thus rather than diffusion an actual transport of nutrients took place via xylem tissue (upward movement of nutrients and water) and phloem tissue (downward movement of manufactured food) that was formed of elongated hollow cells.

Table 3

HOW ALLELES RE-COMBINATION CAN PROVIDE BASIC VARIATION IN A GAMODEM.

The amount of variation can be shown in a simple way. If we assume each parent has one dominant and one recessive allele at each of two loci then the possible values for two traits in the parents are as follows.

PARENT	TRAIT 1	TRAIT 2
Female	Aa	Bb
Male	Aa	Bb

The possible values for potential zygotes are shown in the table [duplicates are in red].

FROM PARENT	A	a	B	b
A	AA	aA	BA	bA
a	Aa	aa	Ba	ba
B	BA	aB	BB	bB
b	Ab	ab	Bb	bb

This illustrates that in the case of control by two alleles there are 16 combinations possible [4 taken two combinations at a time = 2^4]. Ignoring duplicates the number of possible variants is 10.

If we have three traits the possibilities from the parent are as follows [assuming again one dominant and one recessive allele].

PARENT	TRAIT 1	TRAIT 2	TRAIT 3
Female	Aa	Bb	Cc
Male	Aa	Bb	Cc

The possible values of each trait that can be derived from both parents when these are combined are shown in the table [duplicates not shown].

FROM PARENT TRAIT	AA	aa	aA	BB	bb	bB	CC	cc	cC

If all three loci are involved in the manufacturing of a trait then the resultant variation in the offspring provides 21 possible variants **N. B.** the order is important in determining the trait.

FIGURES

Figure 1: The web of individual resource needs within the gamodeme.

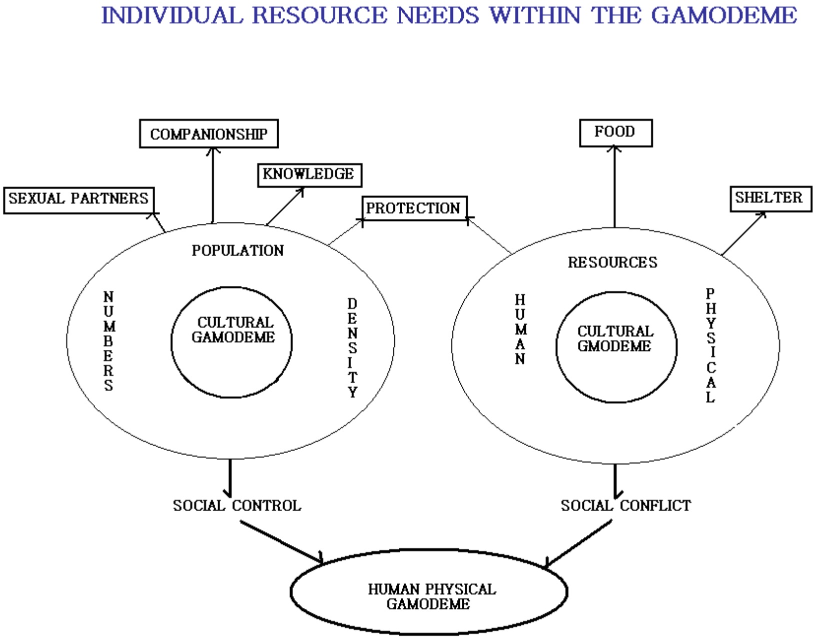


Figure 2: The makeup of the core of Eusociety.

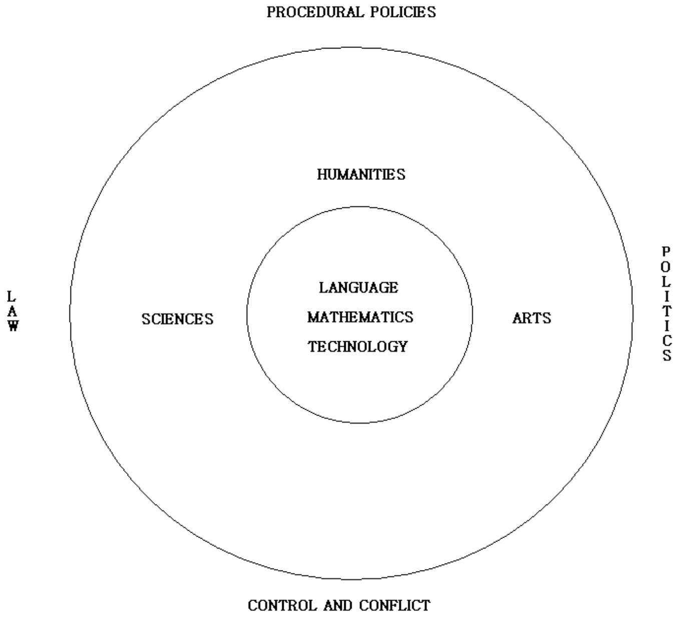


Figure 3: The chemical systems of the Archea and the Bacteria. The prokaryotic cell is a hollow molecule enclosing various sites of specific chemical reactions.

- Ribosomes are involved with protein synthesis, granules acquisition and storage of materials and the nucleoplasm is the information control center.
- Mesosomes are invaginations of the molecule where specific chemical reactions can take place, partially isolated from the hostile external environment.

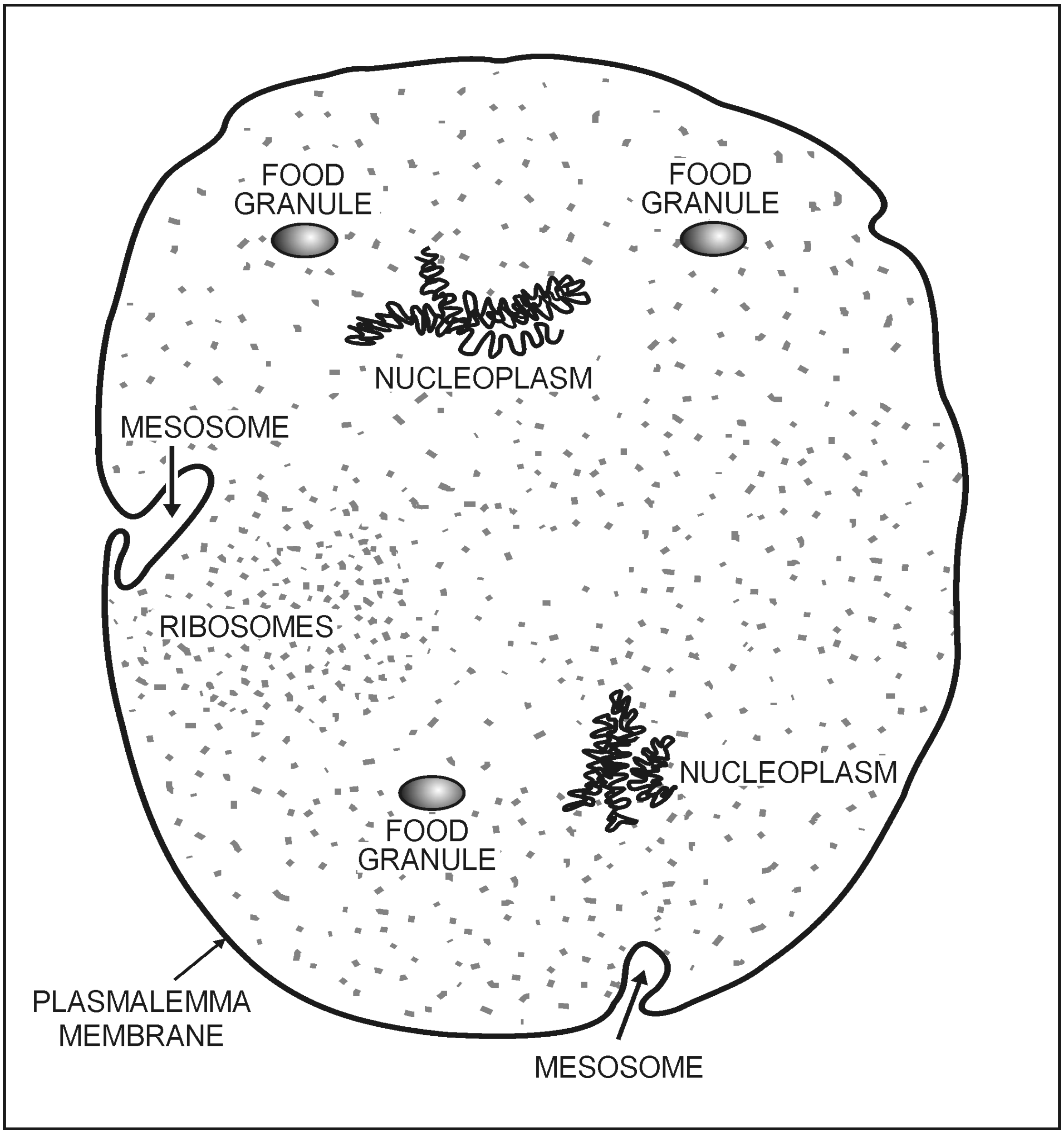


Figure 4: The chemical systems of the Eukarya. The eukaryotic cell is an advanced chemical system in which the various sites of specific chemical reactions are isolated by their own semi-permeable membrane, from the hostile chemicals in the surrounding cellular material.

- The lysosome is involved with the digestion of bacteria and other foreign bodies.
- The centriole is involved in cell division.
- The mitochondria are the main sources of energy for chemical reactions.
- The endoplasmic reticulum is involved either in protein or lipid synthesis, depending upon their location.
- The Golgi body is involved in moving material across the plasma lemma.
- Vacuoles store metabolic products and water.
- The nucleus is the control center.

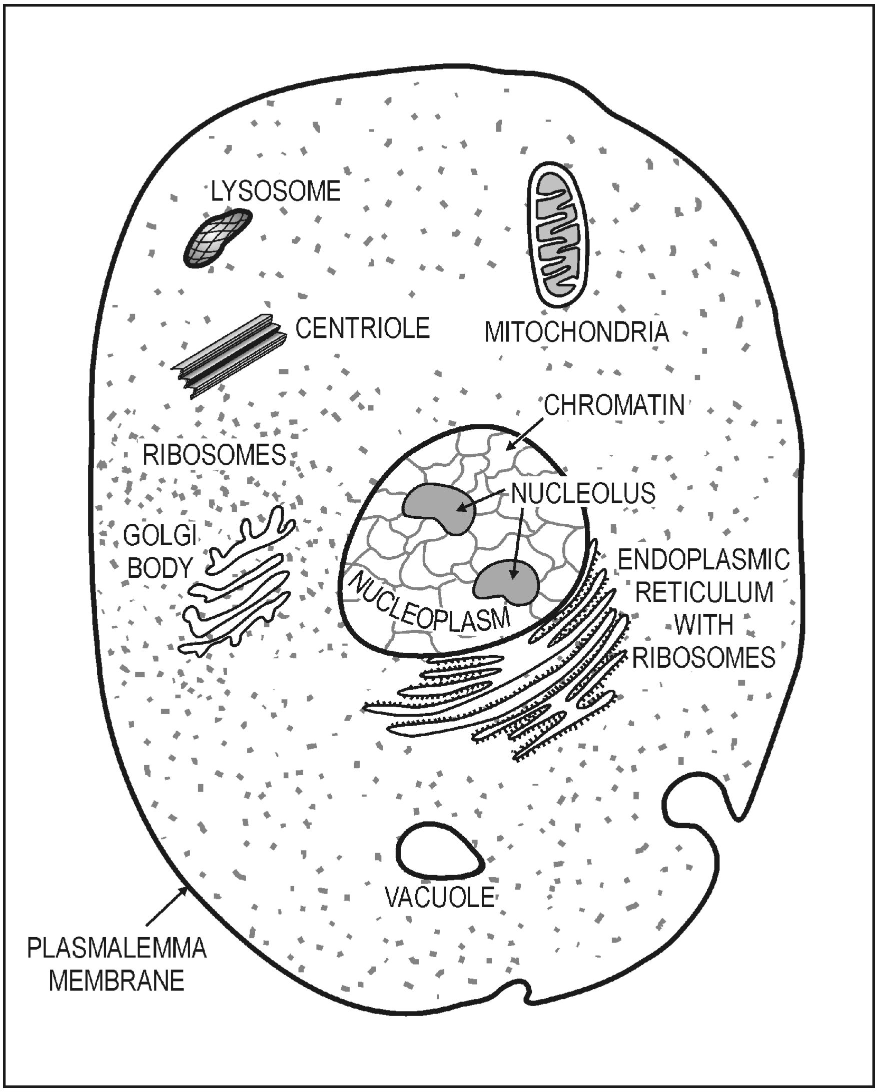


Figure 5: Showing how a single trait can be the result of more than one gene.

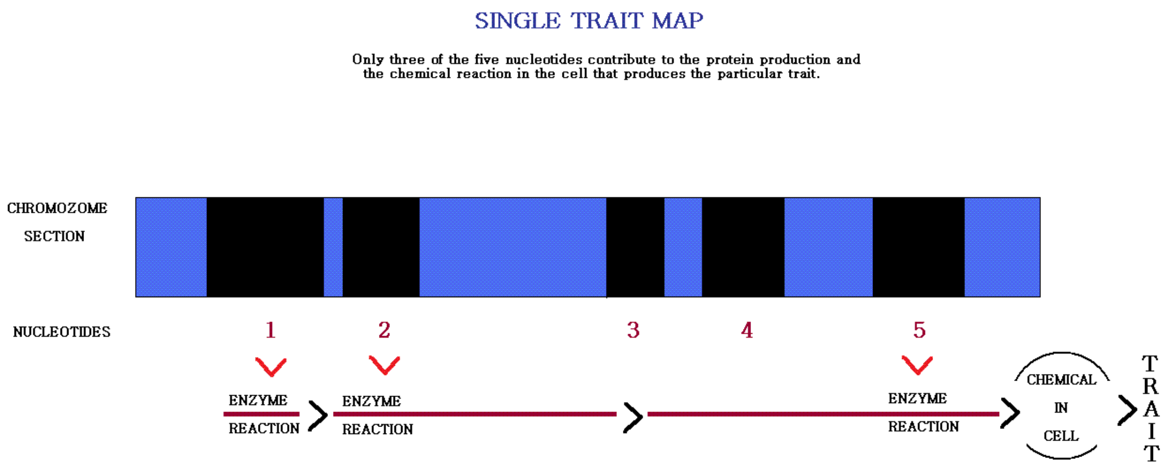
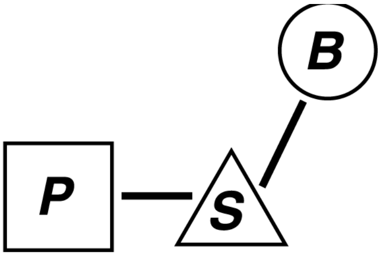


Figure 6: Structure of the chromosome.
The basic unit of the DNA molecule is a chemical compound called a nucleotide that comprises a phosphate [P] attached to a sugar [S] attached to a base [B].



PHOSPHATE + SUGAR + BASE

NUCLEOTIDE

Figure 7: Attachment of the nucleotides

The nucleotides are attached together forming long lines in which the basic links are P to S to P to S etc. In the DNA molecule two of these lines are attached laterally to one another by the bases on one string, linking with the bases on the other string. The distribution of the chemical forces involved cause the two strings to twist into the double helix structure commonly shown as a DNA molecule.

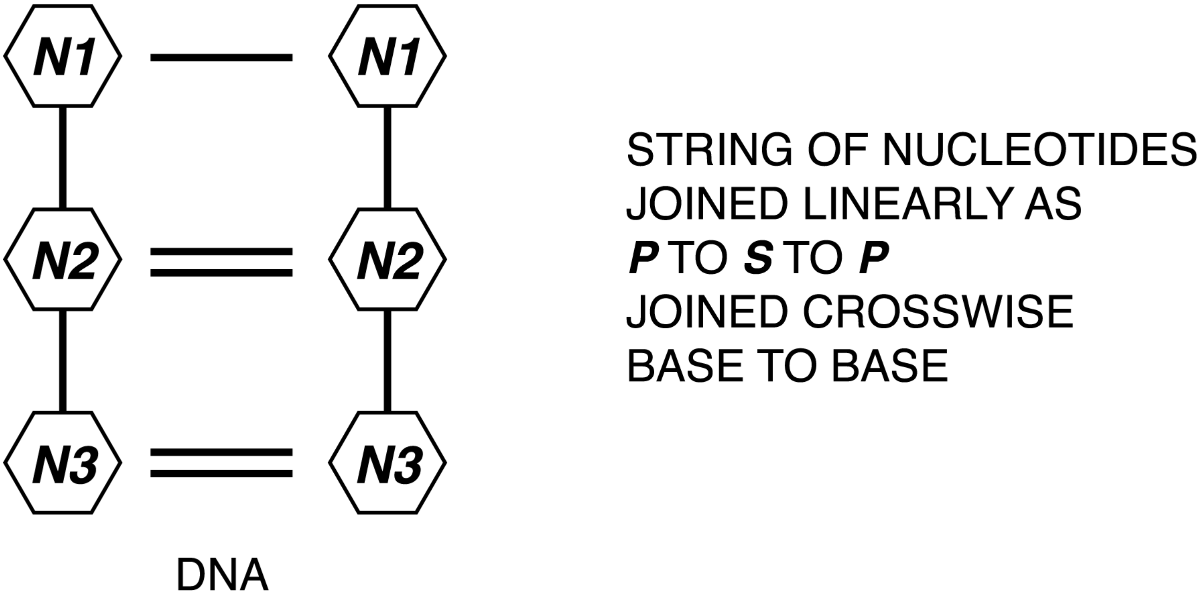
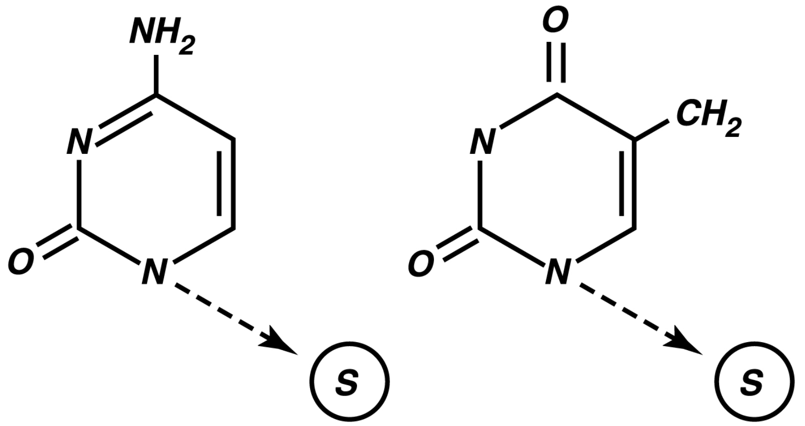


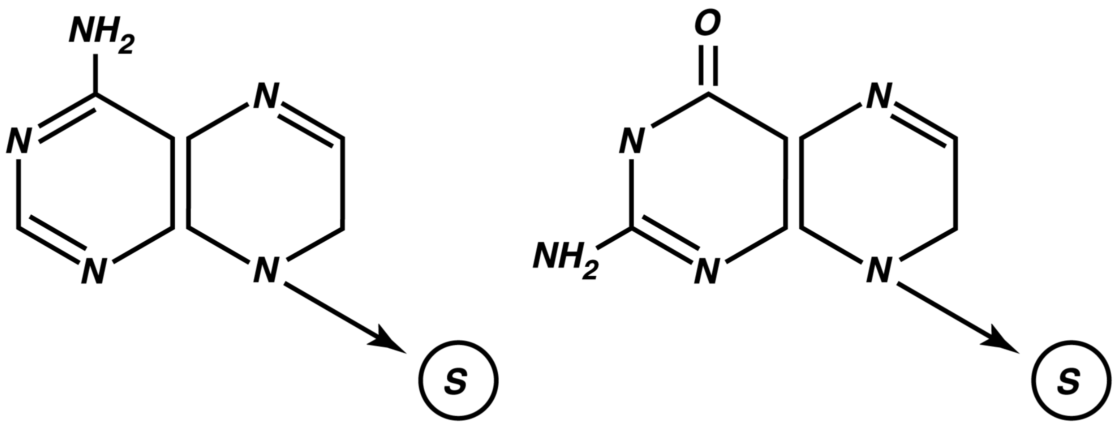
Figure 8: Chemical structure of the chromosome bases

The chemical bases form two groups. The pyrimidines include cytosine [C] and thymine [T]; the purines include adenine [A] and Guanine [G]. The chemical properties of the CTAG bases are such that C and G can bond together and A and T can bond together, other links are not possible.

THE PYRIMIDINES: CYTOSINE AND THYMINE



THE PURINES: ADANINE AND GUANINE



THE STRUCTURES OF THE CHROMOSOME BASES

Figure 9: The process of mitosis

The process of mitosis makes a copy of each chromosome during the division of the cell such that the two new daughter cells that result from cell division contain replicas of the DNA in the original cell. Although the process is remarkably accurate the diagram shows it is chemically quite complicated and errors [mutations] can occur at a number of places in the replication sequence. A phase of relative chemical stability [G1], when the cell is preparing for DNA synthesis is followed by intense metabolic activity [S phase], when DNA replication occurs. This is followed by a phase of growth and expansion [G2]. Finally, the actual formation of the two new daughter cells occurs [M phase].

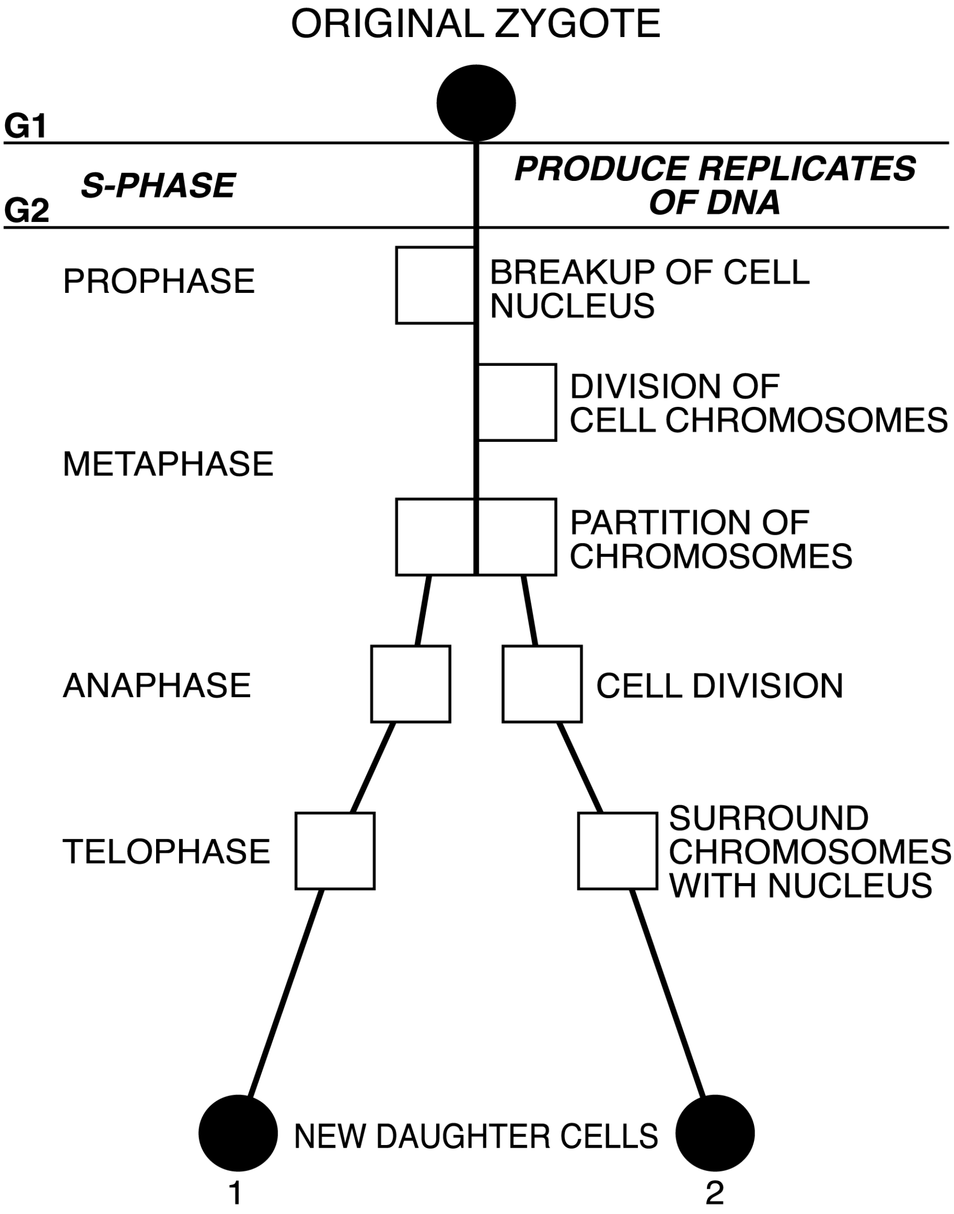


Figure 10: The process of meiosis

Meiosis is involved with the making of the sex cells [gametes] by a process of reductive division which reduces the number of chromosomes by half [from a diploid cell to a haploid cell]. Again there are many chemical reactions involved in this sequence, where errors can arise resulting in a mutation.

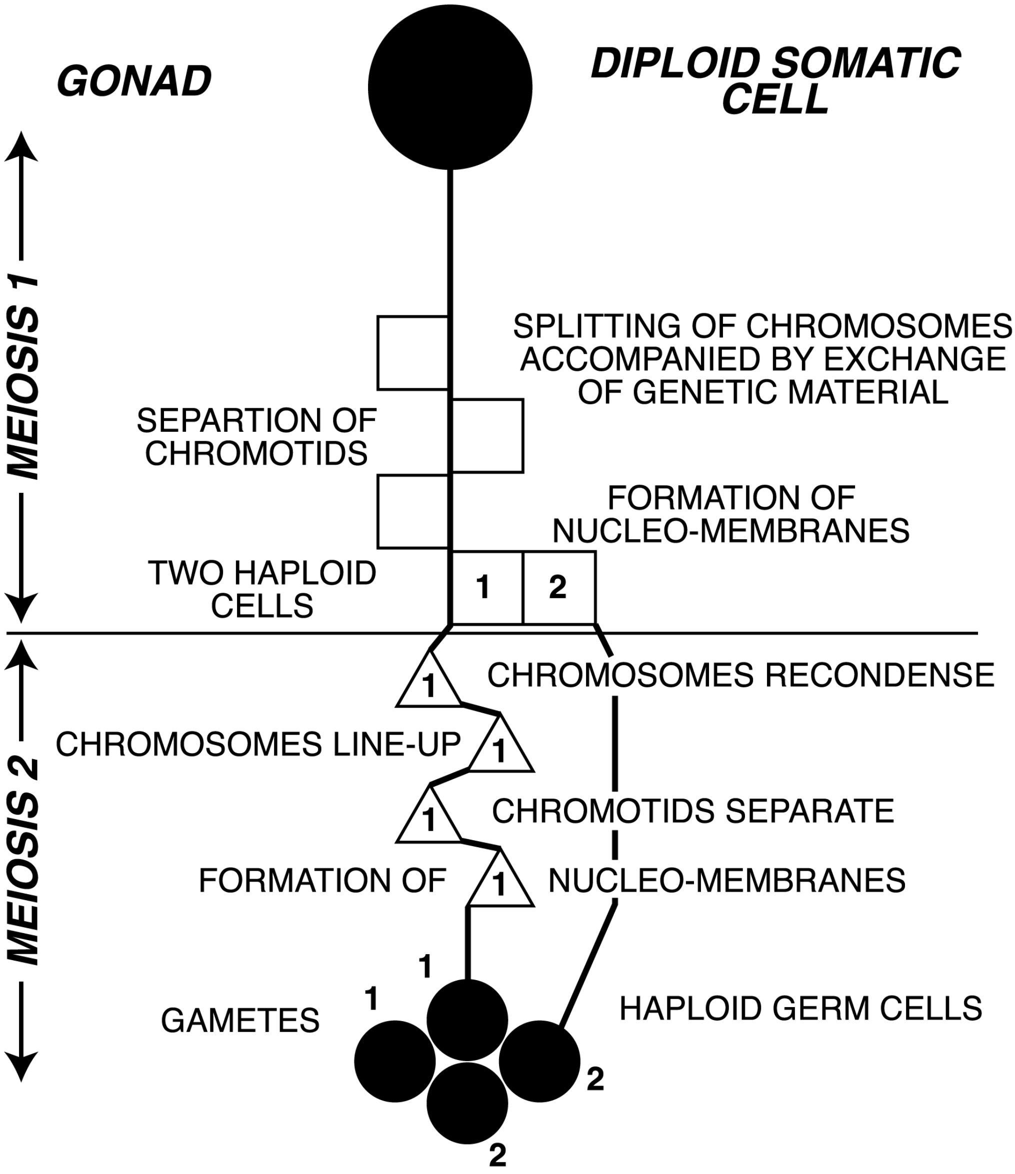


Figure 11: Protein synthesis [After Percus, 2001].

During protein synthesis parts of the DNA produce a chemical string called messenger mRNA which consist of groups of three bases [called a codon] linked laterally. A second kind of RNA [tRNA] present in the cell attaches itself to the mRNA, read the triple code and produces an amino acid. A linear sequence of amino acids is a protein.

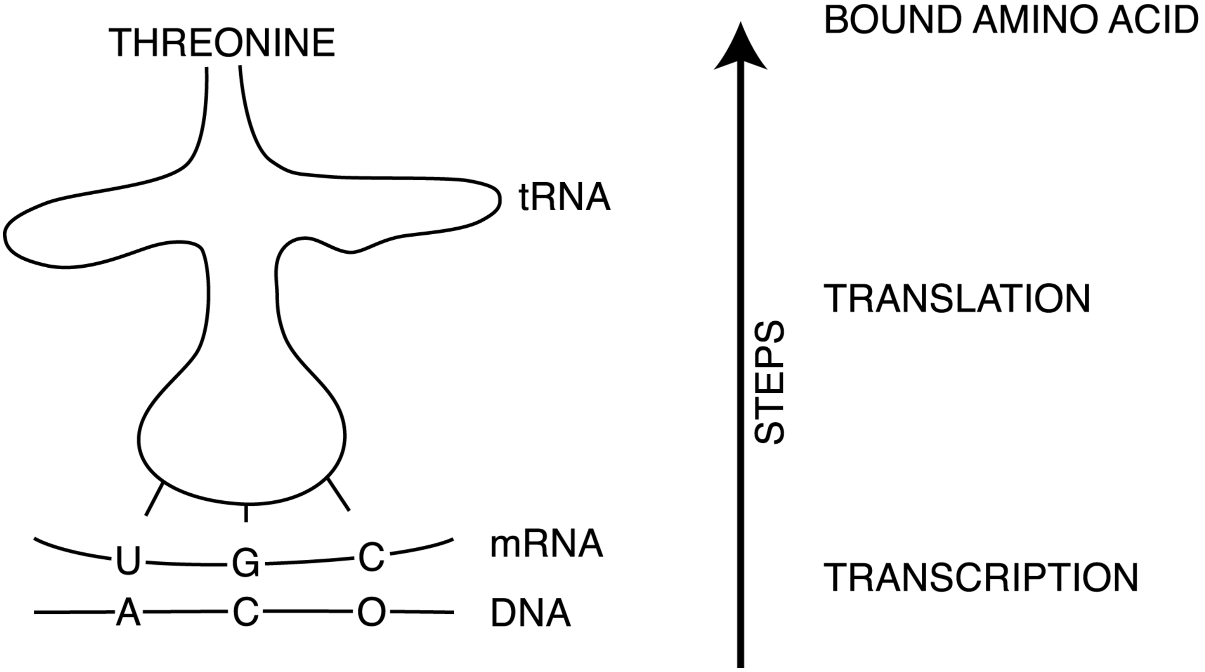


Figure 12: Species definition using the gamodeme concept.

Here four gamodemes [A-D] are present. C and D are adjacent and capable of interbreeding one with the other and as a result show morphological overlap. A is capable of breeding and giving fertile offspring with either C or D but is geographically isolated from these two gamodemes. B is incapable of interbreeding with either A, C or D. Thus two biospecies are present. The first is composed of gamodemes A, C and D, and the second of gamodeme B.

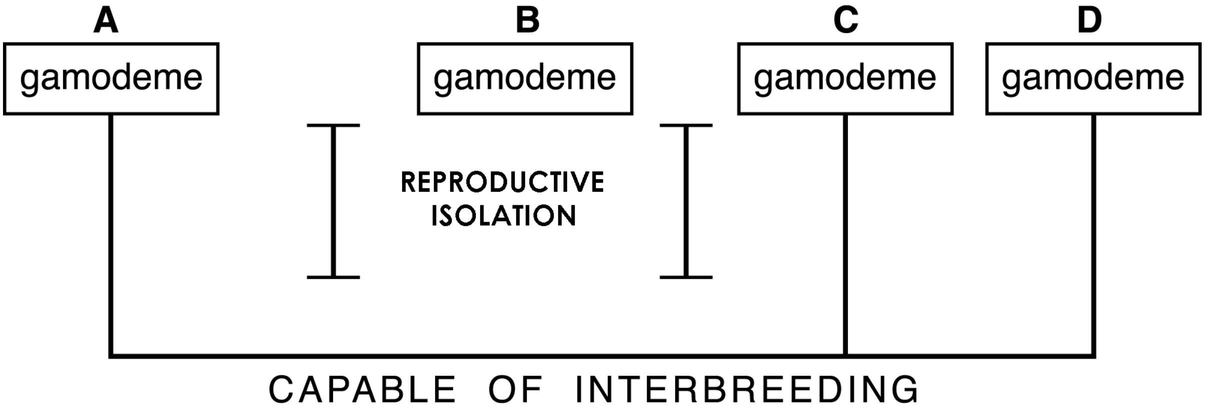


Figure 13: Chronospecies definition using the gamodeme concept. Here four paleontological chronospecies are represented. Each chronospecies shows a set amount of trait variation. With time and orthogenetic evolution trait variation gradually changes through the five chronospecies populations. The morphological similarity of each successive population with the previous population indicates they all belong to one genetic [evolutionary] line and a chronospecies can be defined.

C5	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
C4	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
C3	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**
C2	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
C1	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**

CHRONOSPECIES

VARIATION

Figure 14: Styles of evolutionary tempo.
The tempo of evolutionary change is dependant on the selection pressure acting upon the population. Higher selection pressure tends to drive evolution more quickly. It is convenient to recognize four different temps of evolution to accommodate sudden [typogenesis], rapid [anagenesis], normal [orthogenesis] or slow [stasigenesis] rates of change.

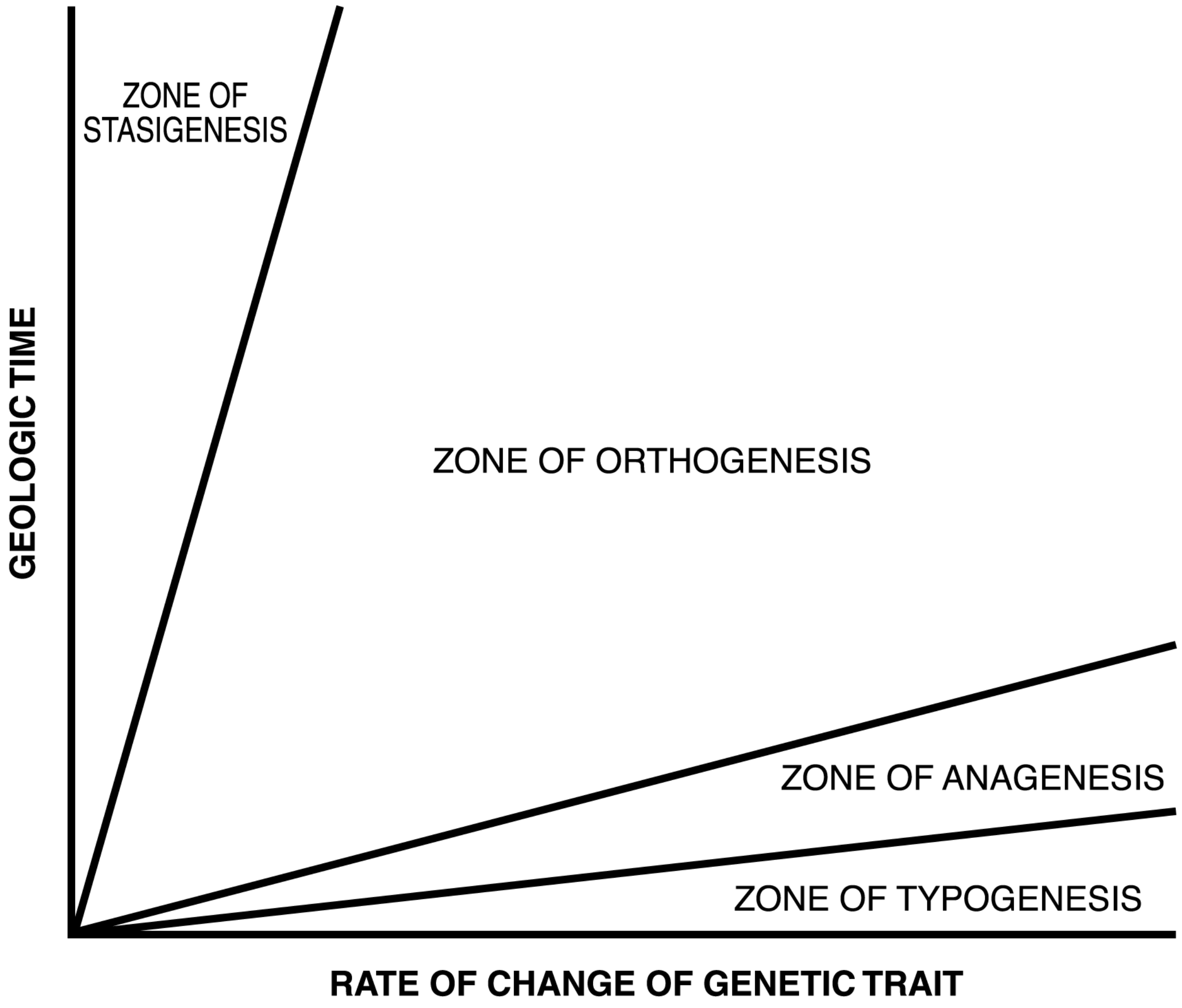


Figure 15: Effects of selection pressure upon survival.
From the viewpoint of evolution, selection pressure acts on the life cycle of individuals in the interbreeding population. The critical point is that of sexual maturity. If an organism dies before reaching sexual maturity it cannot pass on its genetic material to offspring. High selection pressure means a large number of individuals will die before reaching sexual maturity.

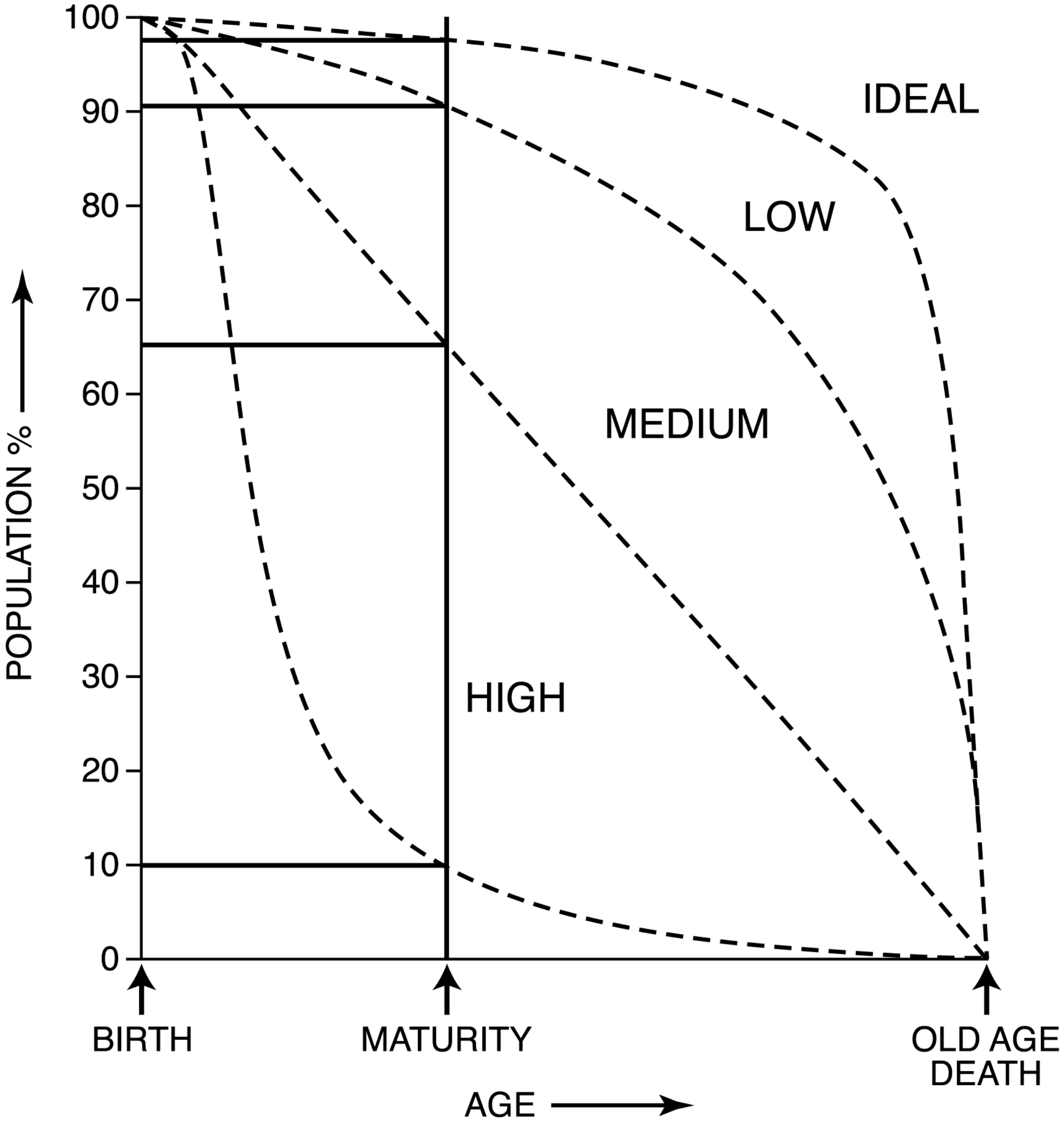


Figure 16: Cartoon of E. B. Ford's observations.
The Ford data on the Marsh Fritillary butterfly colony can be interpreted as a cycle of changing selection pressure: from moderate to high to low to moderate.

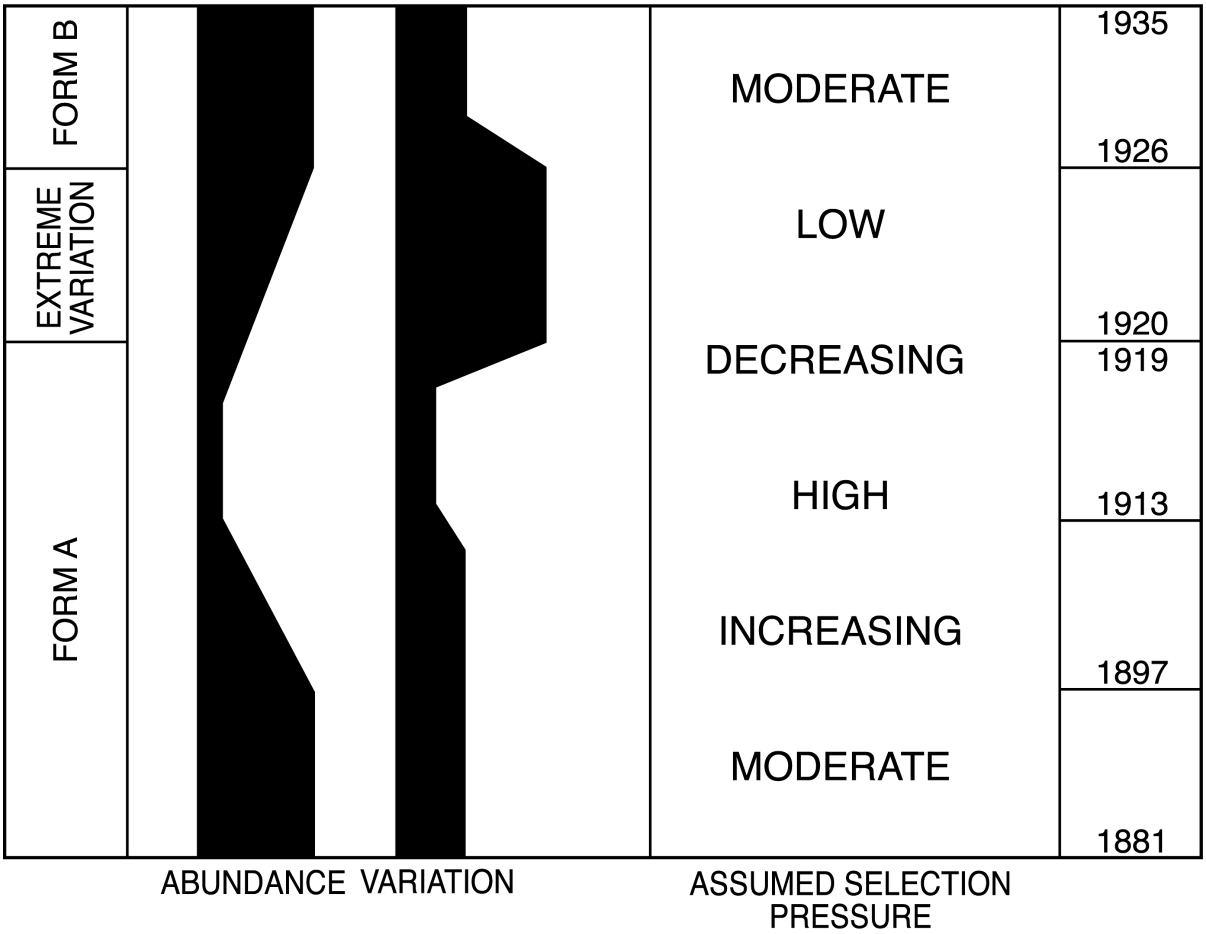


Figure 17: Phases of cladogenesis.
As selection pressure changes and organisms adapt into new environments they eventually comes a time when different types become reproductively isolated from one another, and then they progress along their own evolutionary lines as genetically isolated interbreeding systems. In this way biospecies are formed.

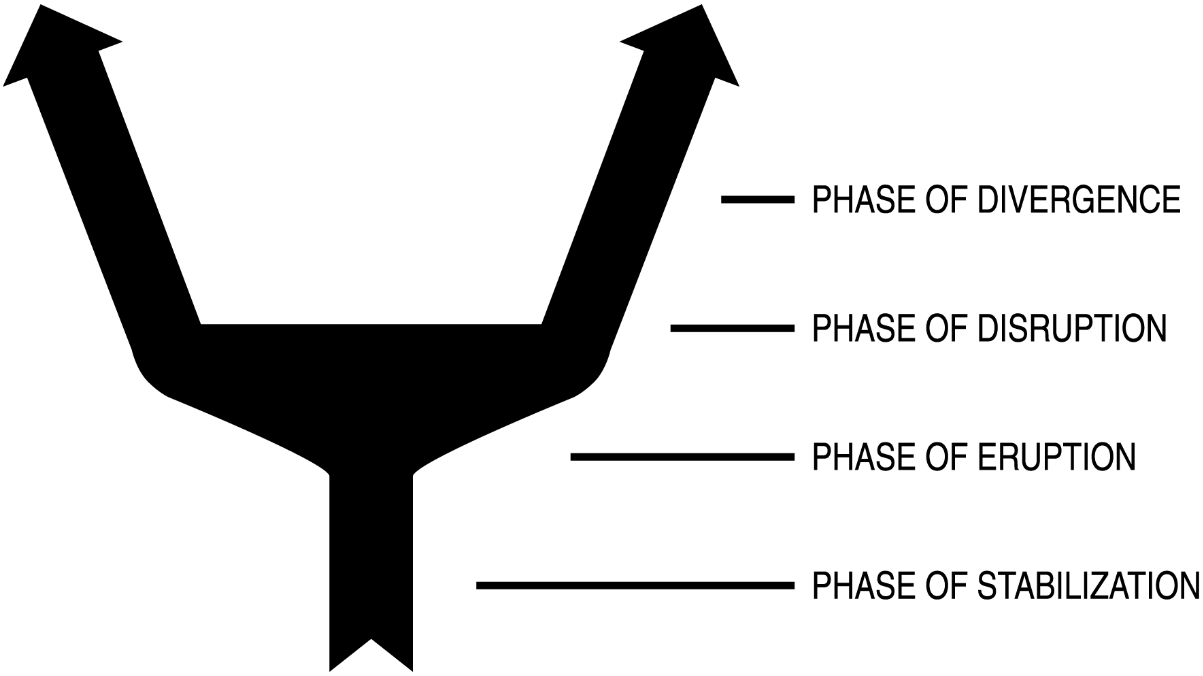


Figure 18: Rates of phylogenesis.
To accommodate the data observed in the fossil record different rates of species formation are recognized. Rapid changes are evolutionary bursts triggered by very low selection pressure and cause divergence into numerous environmental niches. Normal, simple divergence is essentially dichotomous and evolution that involves a long period of stasis followed by rapid explosive activity is punctuated evolution.

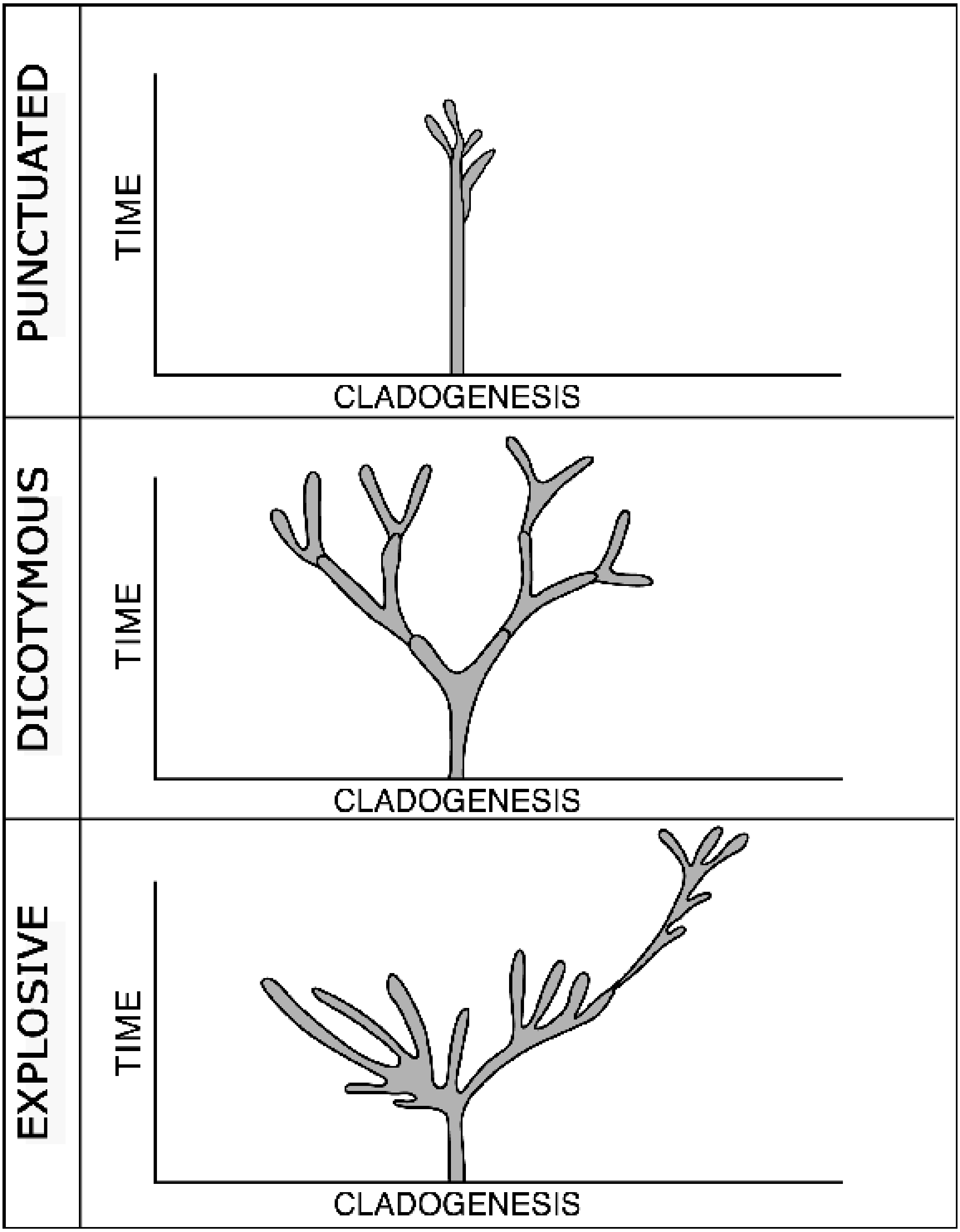


Figure 19: The evolution of the Primates.

A generalized geological time scale showing the dichotomous evolution of the major primate groups as a phenomenon of the Cenozoic Era. The Miocene Epoch saw numerous evolutionary offshoots of the Dryopithecines, eventually producing the Apes and ***Homo***. The ***Homo*** lineage had two major branches; one led to ***H. neanderthalensis*** the other to ***Homo sapiens.***

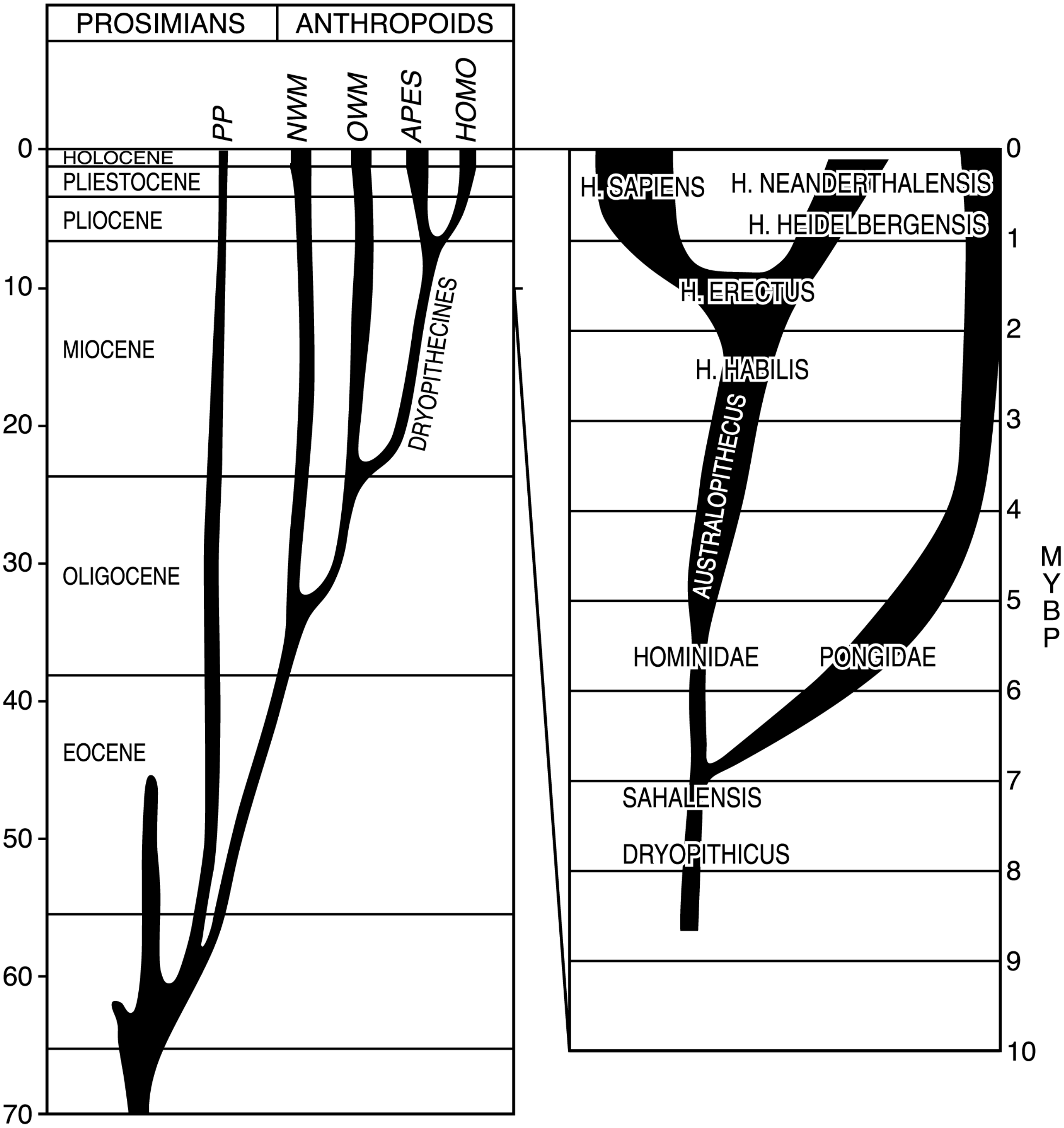
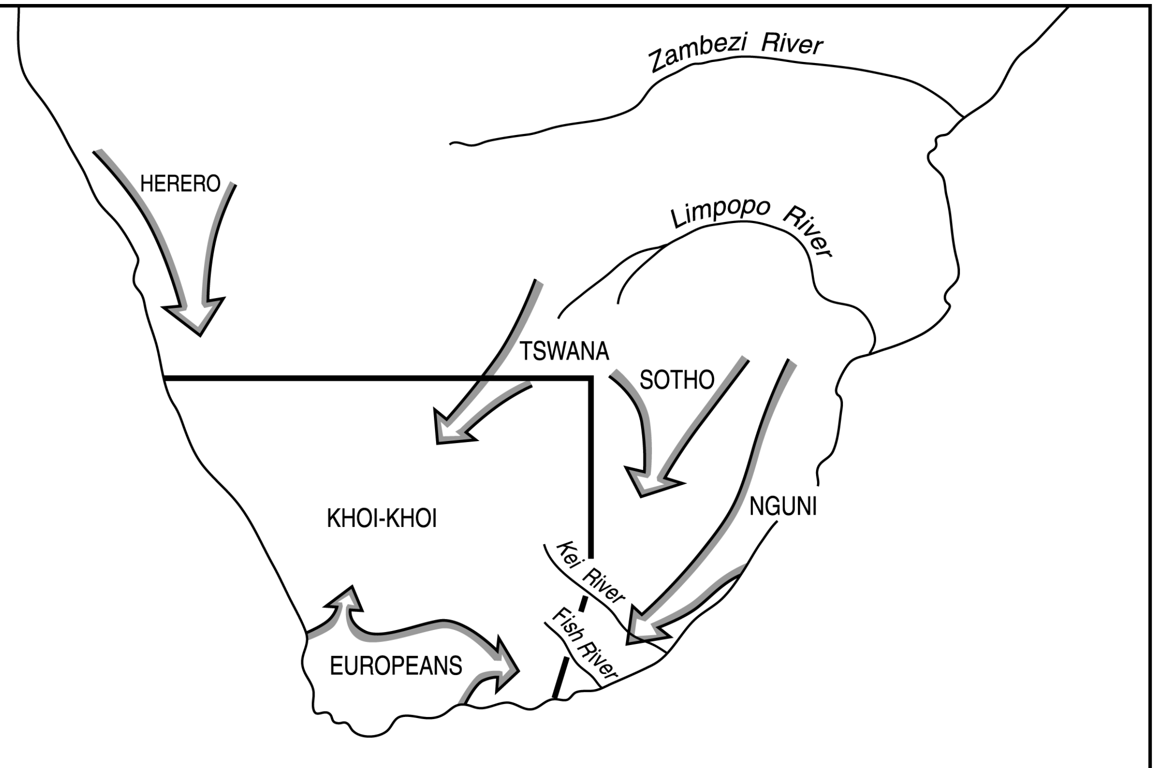


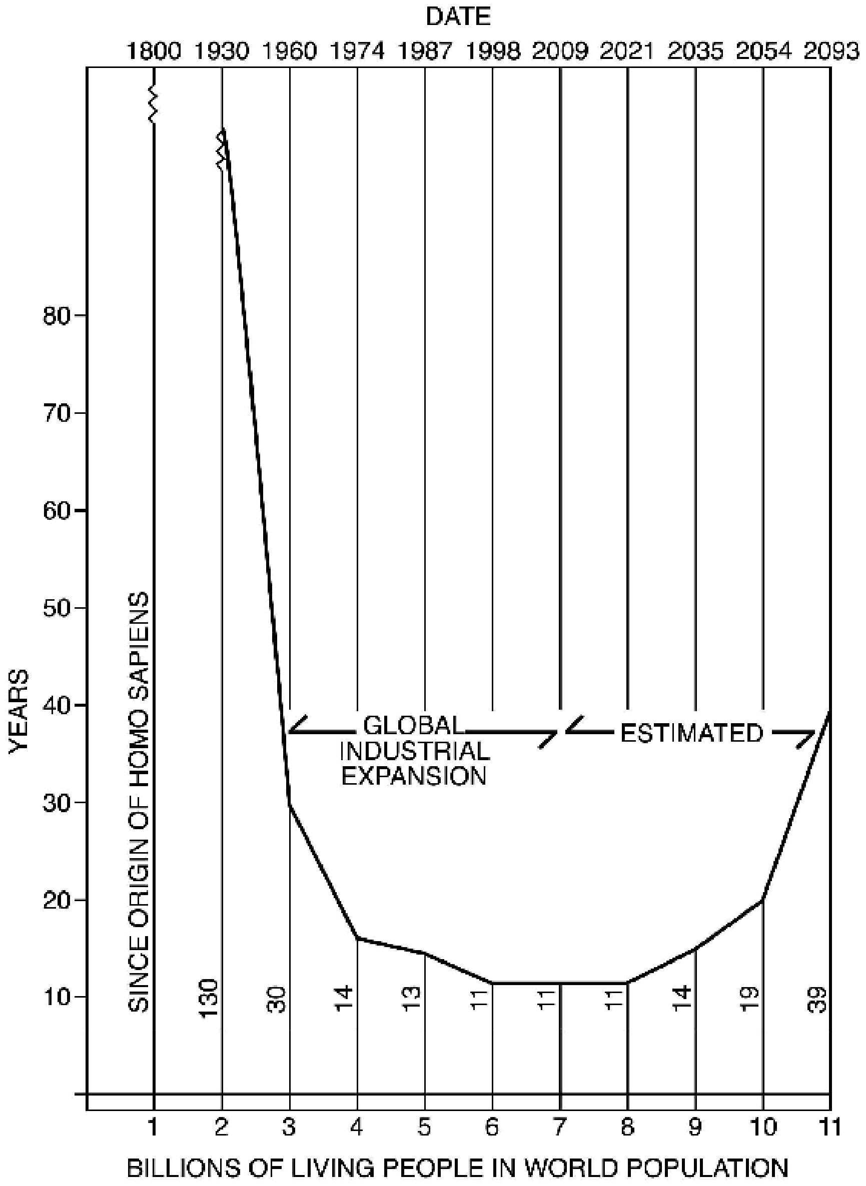
Figure 20: Southern migration of the tribes.
Based on oral history [mainly after Lye and Murray]. The Khoi-Khoi may represent the first wave of ***Homo sapiens*** out of central Africa. Their geographic area was later greatly restricted by the expansion of other groups. The dates of the Nguni migrations down the East coast are well documented in the historic record. There were no substantial numbers of Bantu in the western part of Cape Province when the Europeans arrive, and it has been reported that they did not intrude into the area until the middle of the last century.



SOUTHERN MIGRATION OF AFRICAN PEOPLE

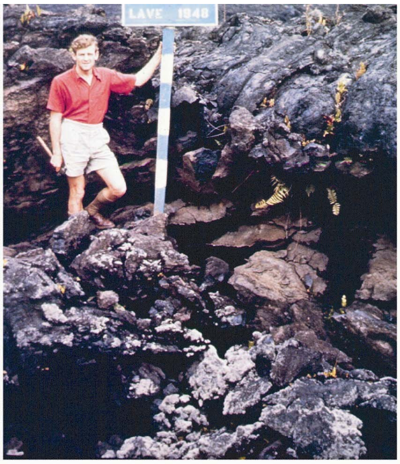
Figure 21: Rate of growth of the World population.

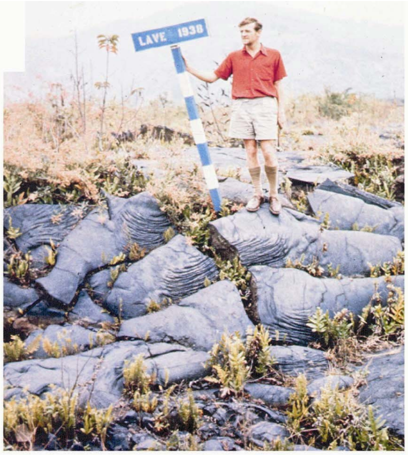
The population density of Earth has increased rapidly since the Industrial Revolution. The chart shows how many years it took to add a billion people to the living population. Prior to 1800 the entire evolution of H. sapiens was never able to reach large numbers. By 1800 it is estimated there were 1 billion folk alive in the world. It took 130 years for the world population to reach 2 billion but only 30 more years to reach 3 billion. By 2000 about 1 billion people were being added to the world population every eleven years, as global industrial expansion occurred. Estimates for the future suggest that by the end of the present century the global population will be 11 billion. It is highly unlikely that war or pestilence will do much more than delay this development. Only a strategy of population regulation can have any real effect. Data from Haub [1995] based upon Population Reference Bureau estimates from United Nations 1990 and 1994 projections.



LIST OF PHOTOSERIES

1. Minerals are adapted to their environment just as are organism. In lava flows the minerals in the rock were formed at high temperatures, moderate pressures, and a chemical environment that lacked much oxygen and water. When the lavas are extruded at the surface the minerals are in a new chemical and physical environment. The selection pressure is higher on some minerals than others. Quartz tends to respond very slowly forming sand grains but the other minerals, particularly feldspars are quite unstable. The chemical lattice adapts to the new environment of low pressure, low temperature, and high O and H2O by forming clay minerals. Clay minerals and sand with the addition of organic debris form soils, and soils allow vegetation to grow. The photo sequence shows my former colleague [Tony Brink] standing on older and older lava flows in central Africa. The vegetation density can be seen by using Tony for size comparison. Photographs courtesy of the late Tony Brink, University of the Witwatersrand.





2. A normal pristine swamp in southern Louisiana before and after blockage of drainage and the intrusion of salt brine due to drilling operations. The effect is essentially immediate and within half a generation [15 years] no trees will remain standing unless drainage is unblocked and fresh water allowed back into the area.

3. The classical predator selection pressure case involving the British Pepper Moth. Source unknown: pre-1965 teaching photo archive: University of Witwatersrand, South Africa.

ENDNOTES

PREFACE

1. Bill Ross: manuscript review, 2005.
2. Although the most probable period for development of a manufactured consciousness is within the next 300 years one cannot predict the rate of scientific progress for more than about half a generation [15 years] if experience is a guide. A deep understanding of the molecular biology and embryology of the cell is imminent and mathematics is long due for a break-through. Both of these areas of intellect will affect the future of consciousness.
3. Life on Earth has evolved into three major biochemical domains: groupings based upon ribosomal RNA. These are classed as the Archea, the Bacteria, and the Eukarya of Woese, Kandler and Wheelis [1990].

INTRODUCTION

1. www.arxiv.org/abs/quant-ph/0703060 by D. Doering and C. Isham.
2. As far as I can determine the only thing known to exist outside of our Universe is mathematics, which within our Universe has an objective reality as the laws governing our physical Universe. In this sense mathematics can be thought of as the language of god.
3. The chemistry and the purpose of these materials is irrelevant for our discussion, the point being that common and abundant chemical systems gave rise to living systems.
4. I have argued this point for over half a century and find the mumbo-jumbo [New Age] scientists much less inclined to its validity than the religious folk, I presume this is because many of them consider the concept of emergence as part of their belief system.
5. Unfortunately, the idea of ethics has been utilized by lobbying groups of the religious-right to thwart the People's will and bully politicians. A recent example is Stem Cell research. Recent polls show that most Catholics, mainline Protestants, Jews, Evangelicals and Islamists support Stem Cell Research, recognizing it could save their own, their children's and their grand-children's lives in the future. This observation holds true irrespective of racial category, gender, sexual orientation, ideology, or politics yet the vocal mob have set-up personal, pseudo-ethical principles that they claim science should not violate. They have influenced the outcome of debate by the threat of the block vote of their brain-washed core

constituents.

PREAMBLE

1. At the root of humankind's understanding of the Universe is consciousness. What consciousness is and how it evolved will be discussed later but for the moment I prefer to stick with the simplistic, understandable definition of Edelman and Tononi [2000]: "It [consciousness] is what abandons you every evening when you fall asleep and reappears the next morning when you wake up". Dreams are part of the conscious state that occurs without external stimuli.
2. Scientists are well aware that the mega-processes, such as erosion transportation and deposition, do not occur at constant rates because they are affected by so many variables, however, the micro-processes such as hydrogen and oxygen producing water under fixed conditions are invariant.

CHAPTER ONE

1. When I first made this statement [1961] to undergraduate students at the University of Witwatersrand there was general acceptance. Making the same statement to undergraduates at Louisiana State University in 1966 brought forth intelligent questions but no real opposition. By 1973, with the rise of the religious zealots, there was a small but vocal opposition. Today with the rise of unconstrained religious extremism the result is either a tirade grounded in religious fervor; or, New Age dogma based upon pseudo-scientific reasoning.
2. GeV = giga-electron–volt or 109 electron volts.
3. The string hypothesis has 10-dimensional space in which 6 are coiled up and 4 are the common dimensions of time, x, y, and z. All particles and forces are formed from different resonances of these strings.

[http://www.wired.com/news/technology/0,71828-0.html?tw=rss.index]

4. Varela and Maturana's [1980, 1987] concept of autopoiesis attempted to define the special self-organizational properties of living systems within a mechanistic framework. Autopoiesis refers to a self-organizing and self-maintaining system. As a natural stage in the evolution of matter the development of a new mode of organization, such as autopoiesis presents, definitively declares it as an emergent phenomenon.
5. The Haldane-Wickramasinghe hypothesis propounded in the book Lifecloud goes so far as to suggest that macromolecules could build-up in the interstellar clouds and even life forms exist in such places.
6. Although the original atmosphere might have been rich in hydrogen

and helium, these gases were too light to be retained and were blown away by the solar wind.

7. Large ocean organisms such as fish and mammals, and land animals and plants, keep their internal salinity close to 0.16 molar.
8. Biological systems based upon different constraints could be present in other parts of our Universe. Moreover, bio-nanotechnology has the potential to design living systems using chemical reactions outside those evolved on Earth. This opens up the possibility, and indeed the probability, that humankind can populate the Solar System and beyond by developing or incorporating novel traits into the gene pool[s] present on Earth.
9. Oparin [1924] and Haldane [1929] first suggested this phenomenon.
10. Berg and Gordon in 'Trends in Microbiology' estimate 100 trillion digestive system bacteria comprising 500-1000 species. This compares with an estimated 10 trillion somatic cells found in the human body [NYT, April 2003].
11. For example the oxidation of reduced forms of sulfur viz: $6CO_2 + 6H_2S + 6O_2 + 6H_2O = C_6H_{12}O_6 + 6H_2SO_4$
12. Evidence for this based upon carbon isotopes is located at [http://www.sciencedaily.com/releases/2006/10/0661017085135.htm].
13. In respiration the basic process is the oxidation of the reduced form of carbon viz: $6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$
14. Visible radiation has a spectral range of 400-750 nm and is attenuated as it passes through water. Red wavelengths [600-700nm] are absorbed more readily than blue wavelengths [400-500nm] by water, thus those organisms using blue light occur at greater depths. Photosynthetic bacteria for example absorb at 700-800 nm and 300-400 nm wavelengths as green and purple sulfur bacteria.
15. $2H_2O + 2NADP^+ + 3ADP^{3-} + 3HPO_4^{2-} + H^+ = O_2 + 2NADPH + 3ATP + 3H_20$

CHAPTER TWO

1. With advances in biochemistry since 1941 today this is expressed as "one gene – one polypeptide". A polypeptide is either a protein or a protein component and a number of genes are known to give rise to two or more different proteins depending upon which segments are treated as exons during RNA processing i.e. two genes may have overlapping sequences and two or more genes may contribute to the synthesizing of s single enzyme. Moreover, some products of genes are not enzymes but are structural proteins.
2. The Prokaryotic cells have a single circular chromosome molecule that contains about 2,000 – 4,000 genes. The Eukaryotic cell has

multiple linear chromosome molecules, and contains many thousands of genes. From the viewpoint of the evolutionary process this makes a difference of many orders of magnitude. It is the basis for the vast diversity derived from Eukaryotic organisms.

3. The structure of the rungs is built-up from alternating phosphate [PO_4] and deoxyribose sugar [S] chemical groups. Chemically the deoxyribose sugar is composed of carbon, oxygen, and hydrogen. Three hydrogen atoms bond with the phosphate group to form the chemical phosphoric acid [H_3PO_4]. An entire side-bar is simply held together by the various chemical charges on each element. However, one important feature is that extending from each sugar group on the side-bar are links with additional chemicals called *bases*, which extend laterally as the rungs of the ladder. The complete ladder is formed when the bases that form the rung on the left side-bar are linked with the bases that form the rung on the right side-bar.
4. Each 'sugar + base' grouping is called a *nucleoside* and each 'nucleoside + phosphate group' is called a *nucleotide*.
5. Chemically pyrimidines are constructed as 6-member rings of 4-carbon and 2-nitrogen atoms. Purines are larger chemical groups than the pyrimidines and constructed as a double ring of atoms [a joined 5-member and a 6-member ring].
6. As a consequence of their individual chemistry all chromosome molecules, in a eukaryotic cell, are not physically alike. Their distinctive morphologies are used to given them specific names, such as chromosome X or Y, chromosome 1, 2, 3 etc.
7. When a new organism is produced sexually, a male cell (gamete) and a female cell (gamete) unite to form a fertilized egg (zygote). Theoretically, this would produce a zygote with double the number of chromosomes if the process was the same as occurs in somatic cell division [mitosis]. This does not happen because a process of reductive division occurs during the formation of the germ cells themselves [both male and female gametes]. In reductive division the chromosome number is reduced by half ensuring that the offspring (zygote) has the correct number when the two gametes join. Four bases taken in combinations of 3 is 43 = 64.
8. The 21st discovered in 1986 is selenocysteine. The 22nd, discovered in 2002 is pyrrolysine.
9. In humankind the chromosomes are named 1 through 22, X and Y recognized by their distinctive morphologies. For example, if a trait is controlled by alleles at three loci on the chromosome; and, assuming the each parent had a dominant and a recessive allele for each locus the possible zygote variation is large [Table 12].
10. Modern geneticists recognize a variety of processes that can be expressed in this way, ranging from point mutations at a single loci to gross mutations of the entire chromosome.
11. Nucleotide excision repair [NER] is a mechanism that monitors the

DNA sequence for damage and attempts to re-build the correct sequence. Damage caused by the external environment, such as the effect of ultraviolet radiation or ionizing radiation [gamma and x-rays] may be fixed by NER. Base excision repair [BER] monitors damage to the bases, that could cause point source mutations and replaces them. Similarly, during replication, a format verification mechanism checks that there is no mismatch during splitting and if it finds a mismatch corrects it. Finally, a mechanism is initiated during recombination of the DNA molecule that attempts to repair any errors in recombination.

CHAPTER THREE

1. Recently it was reported that a large percentage of the Monarch butterfly was eliminated by a blizzard during the annual migration southward to Mexico. This reduction in population pressure could initiate an increase in the variation in the future generations.
2. The UEP's define haplogroups which are all paternal descendants of the single person who first showed the UEP mutation.
3. STR's refer to short segments of DNA that are repeated numerous times along the molecule. Differences in the number of repeats from one individual to another allow a statistical appraisal of the degree of similarity to be given of the time to the most recent common ancestor [TMRCA]. A common method assumes a mutation rate of .002 per year or simply counts the number of mutations different.
4. Paleontologists, amongst others, consider the mitochondria to be derived from symbiotic bacteria that became trapped within the Eukaryotic cell at that stage in the Pre-Cambrian evolution of life when cell membranes formed.
5. Sykes indicates that approximately 20,000 years is represented by one mutation.

CHAPTER FOUR

1. Most certainly I have left some out and surely more have been defined since I initially wrote this book in 2004.
2. Based on recent work on OMOI and OMOII fossils from the Kibash Formation of Ethiopia this was at most 190,000 ybp. The Herta, Ethiopian ***H. sapiens*** samples are dated at 160,000 ybp.
3. My late colleague Raymond Dart expressed the belief that the real separation was as "man the weapon maker" and was the 'killer ape'. Brain repudiated this by showing that most, if not all, of the associated fauna was killed by other large African predators.
4. Leading to the concept of three, or more, sub-species or variants occurring in semi-isolated gamodemes [var. ***africanensis***, ***mongolensis***, ***caucasensis***].

5. From a paleontological time-scale it ceased immediately after it began which is why humankind can be represented genetically by a single genome.
6. The use of y-chromosome and Mitochondrial markers has greatly improved our knowledge of ***H. sapiens*** migrations but should be tempered by recognizing that the factual data of paleobiology [fossil remains of Hominoids], and archaeology [artifacts excavated at specific locations] measured by conventional geological absolute dating, are the framework into which genetic data must be placed.
7. Alan Wilson [1980] determined that the mtDNA, from a sample of 35 females taken world-wide, indicated they were all derived from a female ancestor who lived 150,000 ybp. This was the Eve M[itochondria]. Wilson et al used the entire mitochondrial chromosome whereas Sykes used that part called the control region: which is a non-functional part of the molecule.
8. This does not mean the whole of humankind evolved from this one female but simply that is the only one in the plexus of human evolution that links to all others members of our phylogeny.
9. This is Adam Y [chromosome] based on a sample of 1062 males.
10. The term sub-species is out-of-vogue because it is politically incorrect, however, it is a useful way to conceptualize interbreeding end-members of humankind prior to mass transport resulting in the presently emerging global gamodeme. To be classified as ***Homo sapiens africanensis***, ***Homo sapiens caucasensis***, ***Homo sapiens mongolensis*** etc meant something in the real world of a few centuries ago, and can be used to understand social history prior to more recent times.
11. The reason that this aspect of genetics has been politicized is that this alternative can provide a weapon to racists who would see fundamental differences between human groups that are long standing. Fortunately, the work on mitochondrial DNA severely damaged that argument and shows that all humans are basically similar.
12. Sykes suggests an intriguing, but unlikely, hypothesis that a chromosomal mutation may have been the reason for such a complete failure of the novel ***Homo sapiens*** to successfully interbreed with either ***Homo erectus*** or ***Homo neanderthalensis*** i.e. this is a case of Typogenesis.
13. In the pure out-of-Africa replacement hypothesis ***H. sapiens*** evolved in Africa from ***H. erectus*** or ***H. habilis*** and did not interbreed with either the central European ***H. neanderthalensis*** or the central Asiatic ***H. erectus***. If ***H. sapiens*** was already a true biospecies when it migrated from Africa it is scientifically impossible for the various species to interbreed. Although cases of partial genetic compatibility are known the taxonomy of the ***Homo*** lineage can only have it one way: either separate biospecies or all one! In the latter case the whole human plexus is one biospecies capable of

interbreeding when they are together. In this case ***Homo erectus*** and ***Homo neanderthalensis*** would be varieties i.e. ***Homo sapiens var. erectus*** and ***Homo sapiens var. neanderthalensis.***

CHAPTER FIVE

1. During embryological changes tetrapod vertebrates do not develop gills because differentiation from the brachial arches produces a throat structure early in cellular development.
2. One of my more enjoyable anthropological experiences was questioning and listening to Credo Mutwa as he wrote part of his manuscript "Indaba my Children" in my laboratory at the Bernard Price Institute of Paleontology, when he worked as Ray Dart's assistant. An enormously erudite and gifted man who held the tribal history of the Zulu Nation in his heard, he was the first to convince me that Oral history had some basis in fact.
3. Social control in some African tribal societies was discussed by Hart C. C. O. [1972].
4. Here implying a belief in a supernatural and interfering being.
5. 'Do unto others first that which they will do unto you if they get the chance' – Ernest Gellner, 1985. Origin of Society in Origins ed. A> C. Fabian, Cambridge University Press, 1988, 168 pages, ISBN 0521351898.
6. At least 80% according to Sykes.
7. The lineage of religious belief, with or without change. Any continuous history of ancestral and descendant churches is termed a theogeny [here defined]. The term theogenesis [here defined] is the historical process of descent of a churches belief with time, with or without modification.

CHAPTER SIX

1. A common statistical trick is to divide the amount of pollution by the number of people rather than area of land surface or volume of air. The overpopulated regions of the Earth thus come out falsely looking as low polluters.
2. Part of my time in the former Soviet Union was during the period that T. D. Lysenko was still influential. Single handedly he destroyed fundamental biological research throughout the Soviet Union for 30 years, in addition to causing personal hardship to soviet scientists, who opposed his ideas. As president of the Soviet Academy of Sciences [1938-1953] and later Director of the Institute of Genetics [1960-1965] he had tremendous influence during a critical stage in the development of soviet agricultural policy. In line with Marxist-Leninist concepts Lysenko embraced Lamarckism and convinced Stalin that he could solve the Soviet

agricultural problem by sowing seed on frozen ground because some of the seeds would germinate and become the basis of crops that could be grown in the frigid climate of most of Siberia.

3. This terminology I attribute to a former colleague in South Africa who maintained that, in publication, it was not necessary to prove something if you could quote someone what had already pronounced it as fact –whether it was true or not. This became a point of acrimonious discussion between us.

CHAPTER SEVEN

1. Not withstanding an important effect of the physical environment which societies attempt to control.
2. During 1960-61, when I was a Ph. D. student at Moscow State University I lived in the Political Wing [Zone-D, room 401]. One of the main themes of argument presented to me by soviet students was that society could change the nature of man, from a competitive to a cooperative creature; from a selfish to an altruistic creature; and, from a being that is egotistical to one that is group centered. To the soviet students in the political wind of Russia's premier university, there arguments embody the desired traits of the 'new soviet man' concept. My main argument against this was "Why would you want to change these attributes that define humankind's adaptability and success". I see no reason to change this view with the passage of time.
3. The drawback in the US model are that issues of individual rights restrict progress because they disallow strong discipline, eschew streaming, and batter-down elitism. Nevertheless, immense progress has occurred in pre-university education during the last century, and some aspects are of significance for developing a global educational model. The weakness of the US model from the academic viewpoint [poor performance in mathematics, science technology and language skills when compared with global standards], is concerned with the inner core. However, this weakness is a major factor contributing to its overall strength from the social viewpoint [extensive amounts of time to the social sciences with emphasis on government, justice and fairness]. This strengthens the outer layers.
4. For example, a 14 years old female child who drops her pants, squats on the floor, and urinates in front of a teacher who is trying to verbally discipline her, needs removal to a place of severe discipline: not simply chided and given a week off classes. The fact that the reality of the situation indicates that the discipline problem is severely confounded with race, single parent families and other volatile social issues is irrelevant.
5. By equitable I mean equally obtainable to all within the framework of Meritocracy.

6. Such as the National Academy of Sciences and various co-opted specialists.
7. Personal statement of an Assistant Warden of a major penitentiary in the USA.
8. Joel J. Schwartz on the New Soviet Man.
9. Recently it was reported that the retrovirus that was used to insert the gene took up a loci that was adjacent to, and turned on, a cancer causing gene already on the chromosom.
10. Associated Press, 22nd October, 2002.
11. Daf-2 encodes for both a receptor for insulin and a hormone called insulin-like growth factor.
12. Linda Fried, Johns Hopkins Medical Institutions, Center for Aging and Health as reported by Gina Kolata, The New York Times, November 21st, 2002.

CHAPTER EIGHT

1. See for example the Vertebrate supplementary ready on this interactive eBook.
2. I have asked these two questions to many people over the years and most answered 'yes' to both. Many want the ability to commit suicide to be part of the 'package'.

CHAPTER NINE

1. Science, volume 297, number 5578, 5th July, 2002.
2. February 17th, 2003, American Association for the Advancement of Science in Denver lecture by Bill Feldman.
3. http://www.lanl.gov/worldview/news/pdf/MarsWater.pdf.
4. This does not represent the God of myth, legend or religion; nor does it have any relationship to Intelligent Design of the Creationists. These all require the existence of an interfering God.
5. Today M-theory with its higher dimension strings, called branes, and its 11 dimensions is the reigning idea for the origin of the Universe. Oddly enough M-theory suggests that time and space does not exist as fundamental building blocks. Mlodinow [2001] notes: **"M-theory appears to have the property that what we perceived as position and time, that is, the coordinates of a string or brane, are really mathematical arrays known as matrices. Only in an approximate sense, when strings are far apart [but still close on the scale of everyday life], do the matrices resemble coordinates – because all the diagonal elements of the array become identical and the off-diagonal elements tend toward zero"**.

TEXT BOXES

SOVIET CONSERVATISM: AN ANALOG OF RELIGIOUS FUNDAMENTALISM

My family and I lived in the Soviet Union during 1960-61 and again during 1973-74. The first year was under the Khrushchev regime, at Moscow State University, the second was under Brezhnev, at the Academy of Sciences of the USSR. We know first hand, that Sovietism bred an awesome lot of worthwhile ideas but the system provided no way for them to develop because it was so fundamentally conservative. Sovietism was a religion and they had their God pickled and on view in Red Square, along with a principal disciple: Stalin [who was later downgraded to a Judas level and buried]. The free-enterprise system festered under the surface as did the market-place-of-ideas but there was an over-riding political correctness that killed numerous new social ideas. Fundamental Sovietism bore much in common with fundamental religion in that it represented extremely conservative views that consistently killed ideas because of a fear that change would undermine the system and destroy it.

BRITISH EDUCATION: TO SERVE THE EMPIRE

Having taught in educational institutions in Europe, Asia, Africa and North America I have some insight into the value of differing educational methods. My conclusion is that meritocracy must prevail, both in education and in society; and, that elitism based within a meritocratic system is of great benefit to the social gamodeme. The rigor of the British educational system of the twentieth century was designed to produce highly trained specialists, essentially to serve the upper class and the Empire. The system did produce excellent results that were not emulated by either the USA or the USSR. Much of this was a consequence of the British Grammar School [boys] and High School [girls] system that allowed specialization early in an undergraduate education. Many people are incredulous when I relate that my very first undergraduate lecture in geology at Sheffield University [1953, by one Arnold Curral] was entitled: "*The use of the Tri-axial ellipsoid in determinative mineralogy*". Yet this was possible because the British Grammar School system had allowed me to spend one-third of my time, for two years, learning basic Geology, before entering University.

C. P. SNOW AND THE TWO CULTURES

I received most of my higher education in the later 1950's and for my colleagues and me at British Universities the work of C. P. Snow on 'The Two Cultures' brought into focus a concern of the educated working class that the social condition of Britain needed a radical overhaul despite over ten years of socialist control. The alpha-scientists, resulting from the scholarship programs that garnished intellect from the working class, were being superbly trained in their individual fields of expertise. However, these same scientists were being directed into a social order that was still molded by the financial system of the monied upper class. At the time it was published Snow's essay caused debate for months and led to an interesting polarization that pitted the humanity students against the scientist and engineers. The humanities decidedly lost this debate: as the 1960's were to show. However, as a corporate ethic continues to take over government the old evils are beginning to appear once again. Wealth and privilege are intruding

A CONVERSATION WITH OPARIN: 1961

As a student at Moscow State University in 1960-61, I had the good fortune to spend a little time with A. I. Oparin, who when I spoke about his logical approach to the origin of life on Earth replied "Ah - yes – it really is obvious – to the scientist". Already steeped in the idea of a natural origin because of my studies with Peter Sylvester-Bradley, at Sheffield University, I had no problem with this statement, and readily admitted to him that western scientists saw that the problem was with the non-scientists who were decidedly in the global majority. As he walked off he chuckled and said, "Now that IS logical". The situation has not changed in the past 45 years.

INCORPORATING WATSON AND CRICKS IDEAS 1953-1962

In 1953 Watson and Crick published the code that would reveal the informational sequence used by cells to produce proteins. In 1955 I was an undergraduate studying Geology, Mathematics and Vertebrate Zoology, at Sheffield University; and, one of the courses was on Human Genetics. A few years ago when I retired I looked at my old Human Genetics notes. They were principally concerned with Mendelian genetics and probability, and the idea of Watson and Crick was mentioned only in one small section that outlined the double helix. Essentially the precise mechanism of evolution was still unknown as far as me and my fellow students in Biology were concerned.

By the time Watson and Crick became Nobel Laureates in 1962, they had changed the world of evolutionary mechanics; and I was a NATO Postdoctoral Fellow at the University of Witwatersrand, South Africa, teaching Paleobiology; and, using the genetic code as the mechanism of evolution. There had been a paradigm shift and for those who wish to know more about this history I suggest reading an older book such as Suzuki, Griffiths and Lewontin: "An introduction to Genetic Analysis".

INDIA'S POPULATION PRESSURE

A medical friend of mine, who worked for Sister Teresa in the 1970's, noted that if all the doctors in the whole of India worked on nothing but sterilization individuals there would still be a population explosion by the end of the century. Since I personally started working in India, in 1983, the population has doubled from 500,000,000 to 1,000,000,000, at my last visit [2000]. My visits averaged every two years and each time I observed an increased population pressure on all resources.

GLOSSARY

Actualism, Law of

The process - response law of nature. “Physical processes at work today operate consistently in the same way whether in past, present or future, if all environmental conditions remain equal. Moreover, under such conditions they will produce the same responses”.

Adenine

Chemically a purine. It is a major component of DNA and RNA.

Agnatha

Within the Linnaean system of taxonomy all organisms that are jawless fish falling within *Animalia: Chordata:* Sub-phylum *Vertebrata*.

Alleles

Different forms of a gene.

Amino-acid

Alpha amino acids are the chemical building blocks of proteins and their differing sequences produce the variation in proteins.

Amniotic egg

The egg produced by the tetrapod vertebrates that resists dehydration and allow gases to move from inside the egg to the external environment. Found in the mammal-like reptiles, reptiles, birds and mammals.

Amphibia

Within the Linnaean system of taxonomy *Animalia: Chordata: Sub-phylum Vertebrata.* Tetrapoda Vertebrates that do not reproduce using an amniotic egg.

Anagenesis

This is the rate of evolution observed in a phylogeny in which superficially it appears to indicate that a new type of species suddenly arises with few if any intermediate types.

Animalia

Within the Linnaean system of taxonomy all organisms that are within the Kingdom *Animalia.*

Apoda

Within the Linnaean system of taxonomy *Animalia: Chordata: Amphibia: Apoda.* These are a group of snake-like amphibians lacking limbs.

Archaea

The Domain Archaea of Woese [1977]. Individuals with the traits s shown in Table 1.

DOMAIN-M	ARCHAEA	BACTERIA	EUKARYA
Cell type	Prokaryote	Prokaryote	Eukaryote
Cell wall	Muriatic acid absent. The protein carbohydrate peptidoglycon absent.	Muriatic acid present. The protein carbohydrate peptidoglycon present.	Muriatic acid absent.
Ribosome	70S	70S	80S
Organelle	Absent	Absent	Present
DNA	Non-nucleated. Operans present	Non-nucleated. Operans present	Nucleated. Operans absent
tRNA	Methionine[i] initiator	Formyl-methionine initiator	Methionine initiator
mRNA	No capping or poly-A tailing.	No capping or poly-A tailing.	Capping and poly-A tailing.

[i] Methionine is an amino-acid that contains sulfur and occurs within polypeptide chains. It has two forms L- and D-methonine which can be used to separate taxa e. g. liverworts and mosses.

Archaebacteria

Within the Linnaean system of taxonomy these are prokaryotic single celled organism within the Kingdom Monera. Within the three domain system of Woese [1977] they are those organisms placed within the Domain Archaea

Archaeopteryx

Traditionally these are the transitional organisms that evolved from the Theropod dinosaurian Reptilia into the Birds. Living in the Jurassic Period around 155-150 mybp.

Archaeosociety

The earliest form of society represented by the hunter-gatherers.

Artificial uterus

A synthetic uterus located externally to its parent organism, within which an embryo can grow.

ATP

Adenosine triphosphate is a nucleotide involved in energy transfer within a cell.

Australopithecus

The probable ancestral genus of *Homo,* existing from 3.0 to 3.9 mybp in Africa. Within the Linnaean system of Taxonomy: *Animalia: Chordata: Mammalia: Primates: Hominidae.*

Autopoiesis

A non-equilibrium system that is stable for long periods [metastability] despite matter and energy continually passing through them e. g. a cell.

Bacteria

A domain of the life. See Table 1.

Base-pairs

Two nucleotides that lie on opposite strands of DNA/RNA connected by hydrogen bonds.

Brain transplant

The physically transference of a brain from a living individual into the skull of a brain-dead, donor body, from which the brain has been removed. The brain is connected to all of the functional systems of the donor body [nerves, blood etc].

British peppered moth

Within the Linnaean system of taxonomy *Biston betularia.* Two forms *f. carbonaria* [dark colored] and *f. typica* [light colored] exist.

Buddhism

A religion based upon the teaching of Gautama Buddha that believe that existence is controlled by karma: that ones actions have consequences that determine ones present and future state.

Cambrian

The first geological Period of the Palaeozoic Era extending from 542 mybp to 488.3 mybp.

Catarrhini

Within the Linnaean system of taxonomy: *Animalia: Chordata: Mammalia: Primates: Catarrhini,* containing the Old World Monkey's and the Apes.

Caudata

Within the Linnaean system of taxonomy *Animalia: Chordata: Amphibia: Lissamphibia: Caudata.* Commonly called the Salamander and first evolved in the Middle Permian Period.

Ceboidea

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates.* The New World Monkey's.

Cell

Chemical reactions that are contained within a spherical molecule membrane forming a definable living system.

Cenozoic

The most recent geological Era extending from 65.6 mybp to today.

Cercopithecoidea

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates.* The Old World Monkey's

Chemosynthesis

The oxidation of inorganic molecules or methane as a source of energy for biological conversion of carbon molecules and nutrients within the cells of chemoautotrophic organism.

Chimera

A designed chimera is an organism that contains functional genetically distinct cells derived from different species; a natural chimera is a more restricted view and is formed from different zygotes of the same parents joining during embryological development. In the text chimera are organisms that combine genetic material from two or more species.

Chlorophyta

Within the Linnaean system of taxonomy all organisms that are within the photosynthetic prokaryotic green algae belonging to the Class Chlorophyceae.

Chondrichthyes

Within the Linnaean system of taxonomy a Class of the Vertebrates that contain all organisms that are jawed cartilaginous fish.

Christianity

A religion, named by Ignatius of Antioch and based around the early writings of Ignatius of Antioch [Theophorus], Polycarp, Justin Martyr, Irenaeus, Tertullian, Clement of Alexandria and Origen that professes to incorporate the teachings and belief system of the Jewish prophet Jesus of Nazareth.

Chromosome

Composite DNA molecules found in the cell.

Chronodeme

An assumed succession of interbreeding populations that is defined by the traits of its representatives extending through a period of time. Based upon paleontological evidence.

Chronospecies

A species that is defined by the traits of its representatives extending through a period of time i. e. based upon a chronodeme.

Cladogenesis

The process whereby ancestral populations give rise to descendant groups by divergence, each of which remains discrete from every other throughout their subsequent history. Fundamentally, it is the process by which new species and higher taxa arise.

Classification

The simple division of objects, ideas, etc. into groups [either hierarchical or otherwise] represents their classification system. Human reasoning allows different classification systems to exist for different purposes: even of the same objects. Moreover, such classifications are not a predetermined structure of objects but are developed and can be modified over time and space.

Cloning

Making an identical copy of something.

Combinational outcome , Law of

The law of nature in which multiple inputs produce the outcome.

Complex systems

A system composed of interconnected parts that can exhibit properties not apparent from the properties of the individual parts: referred to as emergent phenomena. A system that has no largest model that is simulable [Rosen].

Consciousness

The encoding-decoding process that takes place in a brain.

Cotylosaurs

Within the Linnaean system of taxonomy all organisms that are within the

Cultural gamodeme

The ethnic, social and cultural aspects of an interbreeding population.

Cycles

A series of causes and effects that cycle back repeatedly.

Cytosine

One of the five main bases found in DNA, forming links with Guanine. A member of the Pyrimidines that is metastable and can change into Uracil.

Deliberative democracy

Making political decisions within a representative democracy using consensus of the effected citizens.

Democracy

Making political decisions by voting.

Devonian

A geological Period of the Palaeozoic Era extending from 416 mybp to 359.2 mybp.

Diapsida

Within the Linnaean system of taxonomy Animalia: Chordata: Sauropsida: Diapsida. Reptiles that evolved two temporal fenestra [holes] on either side of the skull. They include the Dinosaurs, Pterosaurs and Plesiosaurs.

Disruption phase

That phase of cladogenesis during which selection pressure is increasing and with this harshness the species can undergo a drastic drop in numbers. The individuals living in the less favorable parts of the environmental range are wiped out.

Divergence phase

That phase of cladogenesis during which the selection pressure is moderate once more. The surviving groups start to diverge from each other. At first the differences are only slight but they continue to become more and more pronounced until they reach specific, generic or even familial distinction. In the fossil record this is seen when two or more later-fossil populations form a distinctly new taxonomic group that can be related to an earlier form.

Diversity

Variation within a gamodeme; politically: allowing tolerance for people of different views.

Divinity

The study of God.

DNA

Deoxyribonucleic Acid molecules that contains the genetic code.

Bryopithecus

Within the Linnaean system of taxonomy all organisms that are within the

Emergence

The development of a complex pattern or system from a multiplicity of simple reactions.

Eocene

A geological Epoch of the Cenozoic Era extending form 55.8 mybp to 33.9 mybp.

Eruption phase

That phase of Cladogenesis during which the population undergoes rapid increase in numbers and variation because the selection pressure is decreasing and with this lenience the species increases its numbers and inhabits a wider geographic area. In the fossil record the result is a wider range of morphologic types, living in a wider range of environmental conditions, over a wider geographic area with time.

Eubacteria

All organisms that are within the Domain Bacteria. Unicellular Prokaryotes separate from the Domain Archaea.

Eugenics

The improvement of a genetic line by the removal of individuals from the physical gamodeme who have unwanted traits. Eugenics keeps on returning as an issue relating to social condition because repeatedly some people see the concept as not only logical but a clear way to improve the cultural gamodeme. Others cannot separate modern eugenics from the inhuman ideas of the last Millennium, and do not accept that germ line genetic engineering [GLGE] could improve the human condition.

Eukarya

A Domain of life. See Table 1.

Europa

One of Jupiter’s four main satellites having a frozen water surface with a presumed ocean below the thin ice. Europa has a magnetic field, and heat derived from its core is believed to be sufficient to keep the water liquid below the ice. It is likely that the oceans have existed for millions of years and this presents the possibility of living systems having evolved.

Eusociety

Society based upon industrialization and the replacement of war by cooperation amongst nations, empires and religious hegemonies. A need for strong internal regulation clearly understood by the population is evident in Eusociety, and rules and regulations pertaining to all manner of social interaction occur as common law. The role of government is fundamentally one of regulation, the development of regulation, and the imposing of regulation upon the population. An important constraint is that government is perceived as providing access to the basic resource needs of individuals within the cultural gamodeme.

Euthanasia

The act of *deliberately* dying painlessly and quickly. Ethically it is initiated by a need to avoid pain and unnecessary suffering in an individual when it is called 'mercy killing'. Some religious fundamentalists take a stance against mercy killing because it is immoral within their belief system, but this infringes upon individual rights or the rights of kinsfolk in a democratic society. Euthanasia is practiced throughout the animal kingdom.

Exo-hystera genesis

The acts of conception, development and birth outside of the human body.

Experimental design

A statistically designed experiment performed under rigorous constraints and methods of analysis and interpretation.

Extinction

The death of every member of a phylogeny so that the ancestor - descendent process ceases.

Fascism

Originally a movement initiated by Mussolini in Italy. A totalitarian dictatorship with fundamentalist overtones of superiority over the masses.

Gamete

A reproductive cell of an individual, that carries a single set [half or haploid] of the parents chromosomes i.e. is principally derived from the grandmother or grandfather. This genetic material is derived via meiosis and is not an exact replicate of the individuals somatic [body] cell. In female individuals the gamete is the egg. In male individuals the gamete is a sperm. Two gametes fuse to form the Zygote.

Gametophyte

The haploid reproductive cell of a plant containing a single set of chromosomes.

Gamodeme

An interbreeding population.

Genetic drift

The gradual change of allele frequency within a gamodeme over time. Most precisely it refers to random change in allele frequency due to the probability of unknown effects altering the chromosome [i.e. contained in the 'error term']. Less precisely it is change in the allele frequency due to very minor effects [i.e. known effects in addition to the error term] that occur randomly.

Genotype

The genetic makeup [based upon alleles] of an individual.

Germ cells

Gametes.

Gilgamesh

The King hero of Babylonian and Sumerian epic myths.

God

With a capital 'G' an entity that interferes into events in our Universe. With a small 'g' a non-interfering entity that exists outside of our Universe i. e. outside of space-time, responsible for initiating our Universe. No scientific evidence exists for the former.

Great apes

Within the Linnaean system of taxonomy all Primates that are within the family Hominidae. They include such common forms as orangutans, gorillas, humans and chimpanzees.

Guanine

A purine. One of the five main bases in DNA and RNA. It binds to Cytosine in the chromosome molecule.

Hinduism

The religious system initiated and practiced by Hindu's of Peninsular India based upon ancient writings and oral tradition. The all embracing nature of Hinduism in the cultural gamodeme suggests it is a proto-religion.

Holomorphospecies

A morphospecies that can be traced over a wide geographic area such that it can encompass more than one morphospecies determined as existing within a single time frame.

Hominidae

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: family Hominidae*. The Great Apes are the tailless Primates, which include orangutan, gorilla, chimpanzee and humans.

Hominoidea

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: superfamily Hominoidea*. Together with the Great Apes they include the Lesser Apes [Hylobatidae] such as the Gibbon.

Homo

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo.* The genus that includes all of humankind.

Homo cosmos

A theoretical name for those members of *Homo sapiens* that will result from extra-terrestrial isolated gamodemes i.e. effectively do not interbreed with *Homo sapiens*.

Homo erectus

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *erectus.*

Homo habilis

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *habilis.*

Homo heidelburgensis

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *heidelburgensis.*

Homo roboticus

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *roboticus.*

Homo neanderthalensis

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *neanderthalensis.*

Homo sapiens

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Homo:* species *sapiens.*

Human genome

The complete genetic sequence of a human being as seen in the chromosomes.

Humanism

An educational ideal, one of the foundations of which is the human potential to achieve good. Humanism is often associated with the related concept of humanity but humanism is not a necessary part of humanity. The humanist approach has been neither accepted nor used much by *Homo sapiens* during the history of the species.

Humanity

The study of humankind.

Humankind

All members of the genus *Homo.* In a restricted sense only members of the species *H. sapiens* are included.

Hunting-gathering

The early method of obtaining resources practiced in archaeosociety.

Ichthyostegidae

Within the Linnaean system of taxonomy *Animalia: Chordata: Ichthyostegalia: Ichthyostegidae*. Tetrapoda that lived in the Upper Devonian Period.

Immigrant population

The group of individual people who move from one or more physical gamodemes into another physical gamodeme where they remain as part of the interbreeding population.

Immigration

The migration of individuals from one location [commonly a country] to another to become a permanent member of the gamodeme.

Immortality

Perpetual life.

In vitro

Development within an artificial environment e.g. a test tube.

Industrial revolution

The beginning of Eusociety. The point in time when production became mechanized, starting around 1760 in England. This is the period when major social changes took place in western civilization. It was the beginning of Modernism and the influence of the Enlightenment philosophers. In the book Cosmopolis: the hidden agenda of modernity, Stephen Toulmin writes that by the turn of the seventeenth century, Europe was embarking on "what we now call modernity, an intellectual and practical agenda which set aside the tolerant, skeptical attitude of the sixteenth-century humanists and focused on the seventeenth-century pursuit of mathematical exactitude and logical rigor, intellectual certainty and moral purity." With this came the whole notion of individual rights. It coincides with the Age of Reason.

Intelligent reaction

The physical-chemical response to a physical-chemical interaction following the laws of conditional statistics.

Islam

A religion, based primarily upon the writings of the prophet Mohamed that professes to be the words of the one true God [Allah].

Junk sequences

The intron regions of the chromosome molecule. These sequences are probably important in controlling the development of traits in some way or another because chromosome duplication processes are far too precise to allow replication of useless materials.

Jurassic

The middle geological Period of the Mesozoic Era extending from 199.6 mybp to 145.5 mybp..

Khoi

The San people of Southern Africa and especially the Kalahari Desert of Botswana. Zulu myth stories portray the San of present Southern Africa and the Pygmies of the Congo River Basin as the first people put on Earth by the Goddess of Creation. The Khoi were both absorbed and dispossessed by the waves of the Tswana and the Sotho tribes, during a later migration of Bantu from the north down through the central part of Southern Africa.

Kinship

Genetically related individuals forming a family group.

Labyrinthodonta

Within the Linnaean system of taxonomy *Animalia: Chordata: Amphibia,* existing during the Upper Palaeozoic, Lower Mesozoic eras. Some modern usage places them as pre-amphibians.

Mammalia

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia.* They are characterized by a brain containing a neocortex, sweat glands, hair, and triple middle ear bones modified for hearing.

Mammal-like reptiles

Within the Linnaean system of taxonomy *Animalia: Chordata: Vertebrata: Tetrapoda: Synapsida. They have a temporal fenestra behind each eye orbit and the side of the skull.* Principally including the Therapsids and Pelycosaurs, but 'clade' taxonomy includes the mammals which are directly descended from the traditional 'mammal-like reptiles".

Marxism

A political system, based primarily upon the writings of Karl Marx.

Meiosis

The kind of chromosomal replication that occurs in sexually reproducing organism resulting in the formation of germ cells

Meritocracy

A social concept that equates a persons merits with his/her ability plus effort. The Rule of Meritocracy states simply that Ability + Effort = Merit and merit is the basis for social worth.

Mesolithic

The Middle Stone Age.

Mesozoic

The middle Geological Era of the Phanerozoic, extending from 251 mybp to 65.5 mybp.

Metabolic pathways

The linear sequences of chemical reactions performed within a cell.

Militant fundamentalists

People who believe their religion is the fundamental political system within which all should live. Other views are completely unacceptable and must be eliminated from the cultural gamodeme.

Missing link

Anything that is discovered, or merely recognized, as occurring between any two adjacent elements of a trend.

Mississippian

A geological Period of the Palaeozoic Era extending from 359.2 mybp to 318.1 mybp.

Mitochondria

Mitochondria are circular molecules of DNA that occur outside of the nucleus of the cell. They probably originated as isolated sites of chemical reactions during the proto-biologic phase of evolution of organic matter, but today they are localized within a cellular system. Mitochondrial DNA[mtDNA] is inherited only though the maternal line, derived from the maternal germ cell. The mitochondrial DNA does not recombine with any nuclear DNA, although its function is partially controlled by the nucleus i. e. it is passed on unchanged except for mutations.

Mitosis

A process makes a copy of each chromosome during the division of the cell such that the two new daughter cells that result from cell division contain replicas of the DNA in the original cell.

Monotheism

Any religion that accepts only a single God

Monotreme

Animalia: Chordata: Mammalia: Monotremata. Mammals that lay eggs such as the *Platypus* and the *Echidnas.*

Morphospecies

A group of individuals with similar or the same morphological characters, the limits of variation allowed in such a species being arbitrarily defined by a competent worker. Mayr, 1942.

mRNA

Mitochondrial DNA.

Muslim

A person who believes the Arab prophet Mohamed wrote down the words of the one true God [Allah] in the book called the Koran.

Mutation

A change in the DNA structure of the chromosome molecule. Early ideas suggested mutations were driven by external criteria but although such may be the ultimate cause the proximate cause is internal due to slight inconsistencies in replication and protein synthesis. The phenomenon of chromosomal mutation is in general lethal to the cell or causes sterile offspring such as the mule. Genetic mutations, on the other hand, cause most of the diversity seen in a gamodeme and phylogeny.

Nanotechnology

The manipulation of matter at the scale of 100 nanometers or less.

Neolithic

Beginning during the last phase of the Stone Age with the incoming of agriculture and ending with the beginning of the Metal Age [Copper, Bronze, and Iron ages]. Beginning in the Levant around 8500 BC it spread outwards from its core. Characterized by *Homo sapiens* Protosociety.

Neontology

That branch of biology that deals with extant and living organism.

New soviet man

The evolution by Lamarckian processes to produce the ideal citizen to serve the Soviet under Leninist-Stalinist hypotheses. In the 1960's the argument went along the following lines. The 'new soviet man' is a wonderful ideal for society; therefore, it is valid to manipulate the educational and cultural environment to mold the population into that image.

New world monkeys

Within the Linnaean system of taxonomy all Primates that are within the Platyrrhini and characterized by a flattened nose with nostrils pointing sideways. They have 12 pre-molar teeth. They include such common forms as the marmoset, tamarin, and spider monkey.

Nucleic acid

A family of biopolymer molecules occurring as a single, double or multiple strands. The common DNA and RNA molecules of living systems are macromolecules of nucleic acid.

Nucleotides

Monomers comprising three components: a base, a pentose sugar and a phosphate group. They are the structural units of DNA and RNA.

Old world monkeys

Within the Linnaean system of taxonomy all Primates that are within the Catarrhini and characterized by a narrow nose with nostrils pointing forwards and downwards. They have 8 pre-molar teeth. They include such common forms as the baboon, gibbon and macaques.

Oligocene

A geological Epoch of the Cenozoic Era extending from 33.9 mybp to 23.03 mybp.

Organelles

A specialized structure within a cell that is enclosed in it's own cellular membrane.

Origin of life

That stage in the evolution of matter in which chemical reactions become enclosed in a spherical molecule and autonomously reproduced themselves.

Ornithischia

Within the Linnaean system of taxonomy *Animalia: Chordata: Sauropsida: Dinosauria: Ornithischia.* An order of beaked herbivorous dinosaurs characterized by its pelvic structure. .

Orthogenesis

This is a moderate rate of evolution observed in a phylogeny in which there is a gradual change with time.

Osteichthyes

Within the Linnaean system of taxonomy *Animalia: Chordata: Vertebrata: Gnathostomata: Osteichthyes.* These are the bony fish.

Paleocene

An Epoch of the Mesozoic Era extending from 65.5 mybp to 55.8 mybp.

Paleontology

That branch of biology and geology that deals with extinct and fossil organisms.

Paleospecies

A species based upon morphological variation.

Paleozoic

The first geological Era of the Phanerozoic extending from 542 mybp to 251 mybp.

Pelycosauria

Within the Linnaean system of taxonomy *Animalia: Chordata: Tetrapoda: Synapsida: Pelycosauria.* A group of Upper Paleozoic Synapsida evolving in the Upper Carboniferous and becoming extinct at the end of the Permian. They gave raise to the Therapsids.

Permian

A geological Period of the Palaeozoic Era extending from 299 mybp to 251 mybp.

PGD

Preimplantation genetic diagnosis. Genetic testing of embryo's prior to implantation.

Phaeophyta

Within the Linnaean system of taxonomy Eukaryota: Chromalveolata: Heterokontophyta: Phaeophyceas. These are the Brown Algae.

Pharming

The insertion of genes that code for pharmaceuticals into a host so that large quantities of the pharmaceutical can be produced by biological breeding.

Physical gamodeme

The interbreeding population.

Phenotype

The appearance of an organism, primarily as a result of the environment drawing out the genetic potential.

Photosynthesis

The conversion of light energy into chemical energy in living systems, especially in plants, algae and photosynthesizing bacteria.

Phylogenesis

The sequence of ancestor - descendent that forms a phylogenic line or Phylogeny.

Placental Mammal

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Eutheria.* Those mammals that reproduce using a placenta and in which the offspring are carried in a uterus until birth.

Placoderma

Within the Linnaean system of taxonomy *Animalia: Chordata: Vertebrata: Gnathostomata: Placodermi.* The Lower Palaeozoic armored fish living from the Upper Silurian to the Upper Devonian.

Planck distance

The present stance taken by science is that the original size of the Universe was *Planck distance*. This is because at present we are unable to delve deeper into time beyond a Universe of such size. The Planck distance, which is 10^{-33} centimeters, represents the original space and time from which the Universe evolved. From this space-time on, scientists can logically develop a Theory for the formation of our present Universe.

Planck Era

The first 10^{-43} seconds of existence of our Universe. Understanding what happened during the Planck Era requires examining what happens within vacuums at the scale at which quantum mechanics operates. The Plank Era was a seething mass of energy and elementary particles constantly coming in and out of existence

Planck space

The place beyond Planck distance. To go beyond Planck distance is to delve into a world explored by quantum mechanics where the conventional laws of physics break down and the curvature of space-time has no meaning: it is the Era of *Planck Space*. Planck Space has some startling properties. First, it has a mass of 10^{-8} kilograms and energy of about 10^{19}GeV i. e. a very small size and mass with a very high energy. Einstein's most famous equation suggests that the energy of Planck Space will create a material universe at the speed of light. [1 GeV = a giga-electron–volt or 10^{9} electron volts].

Planck time

The time it takes light to travel across Planck distance.

Platyrrhini

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Platyrrhini.* The New World Monkeys.

Pleistocene

A geological Epoch of the Cenozoic Era extending from 1.806 mybp to 0.0115 mybp.

Plesiadapiformes

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Eutheria: Plesiadapiformes.* An extinct group of mammals that evolved in the Cretaceous Period and are related to the Primates.

Pollution

The addition to a system of some external elements, commonly regarded as undesirable elements.

Population pressure

Selection pressure imposed on the cultural or physical gamodeme due to increase numbers or increased density of individuals.

Prenatal testing

Testing a fetus or embryo for disease and birth defects before birth.

Primates

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Eutheria: Primates.* They include the Lemurs, monkeys and apes.

Prokaryotes

Within the Linnaean system of taxonomy a Domain of living systems in which the cells lack a cell nucleus.

Prosimian

Within the Linnaean system of taxonomy all organisms that are within the Suborder Prosimii of the Order Primates.

Protein

A biomolecule made up of a linear chain of amino acids.

Protosociety

The form of cultural gamodeme that accompanied the development of agricultural societies.

Race

A group of individuals within a species that share similar physical traits. The definition of a race is based on the decision of a 'competent' taxonomist knowledgeable of the variation within the species.

Reductionism

The method of understanding a complex system by examining and understanding the interactions of the sum of its parts.

Religion

A belief system based upon one or more supernatural entities manifested as an interfering God or Gods.

Rhetoric

The spoken method of communication using reason, emotions and authority to persuade others to adopt one's own views.

Rhipidisian

Within the Linnaean system of taxonomy *Animalia: Chordata: Sarcopterygii: Crossopterygii: Rhipidistia.* The lobe finned fish that were the ancestors of the tetrapoda.

Rhodophyta

Within the Linnaean system of taxonomy *Eukaryota: Plantae: Rhodophyta.* The Red Algae.

Right to die

An individual right that asserts that any individual can terminate his/her own life either directly by suicide or indirectly by using an external agent [individuals or the State].

RNA

Ribonucleic acid. A nucleic acid that contains ribose sugar contrasting with DNA which contains deoxyribose sugar. In cells it is usually single stranded

Robotico

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Robotico.* A genus of Hominoids that has a manufactured body and a manufactured consciousness. Argument will exist as to whether or not a biological machine [*Homo sapiens*] can manufacture a member of its phylogeny [as a mechanical machine] as opposed to biologically evolving it.

Robotico earthensis

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Robotico: earthensis.* The type species of *Robotico:* the first humanoid descendent of *Homo sapiens.*

Robotico roboticus

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Robotico: roboticus.* The first species that the genus ***Robotico*** designs by itself.

Sahelanthropus

Within the Linnaean system of taxonomy *Animalia: Chordata: Mammalia: Primates: Catarrhini: Hominidae: Sahelanthropus.* A fossil ape that lived approximately 7 mybp [Miocene Epoch] that may be an ancestor of *Homo*.

Saurischians

Within the Linnaean system of taxonomy *Animalia: Chordata: Sauropsida: Dinosauria: Saurischia.* The lizard hipped dinosaurs.

SCID

Severe combined immunodeficiency is a genetic disorder in which the organism fails to develop an immune system.

Selection pressure

The effect of the environment [in its broadest sense] on the development of an individual.

Senescence

The old age stage of a biological system.

Seymouria

Within the Linnaean system of taxonomy *Animalia: Chordata: Tetrapoda: Reptiliomorpha: Seymouriidae: Seymouria.* A reptile like tetrapod that evolved in the Lower Permian.

Social condition

Those conditions that effect the cultural gamodeme.

Solar system

Within the astronomical system of taxonomy the stellar system that consists of the Sun and its surrounding planets.

Somatic cell

A body cell.

Sotho

A tribe of the Bantu speaking people of Africa.

Soul

A religious concept involving a none material entity that inhabits a living system, and can survive death. Comparable with the inner Id which is the source of primeval urge and instinctive energy.

Soviet

The concept of subjugating individual freedoms to the rights of the group by a ruling committee.

Space liner

A massive 'mother ship' containing upwards of a thousand individuals that will allow *Homo sapiens* to explore the Solar System and *Robotico earthensis* to explore the Milky Way Galaxy and beyond.

Spherical molecule

A hollow spherical molecule that forms the semi-permeable cell membrane which protects the chemical systems on the inside of the cell from those on the outside but allows certain needed chemicals to pass into the cell interior and waste products to pass out into the environment.

Stabilization

That phase of Cladogenesis when selection pressure is moderate and the ancestral species is confined to a constricted habitat, with a closely controlled population size.

Stasigenesis

This is the rate of evolution observed in a phylogeny in which little or no modification is observed with descent. The organisms that form the phylogeny remain fairly much the same over a long time period.

Stem-cell

Cells that can renew themselves by mitosis and can differentiate into a many different kinds of specialized cell types.

Synapsida

Within the Linnaean system of taxonomy *Animalia: Chordata: Vertebrata: Gnathostomata: Tetrapoda: Amniota: Synapsida.* They have a single temporal fenestra opening in the skull behind each eye.

Systematics

The actual process of placing individual objects into a classification is called systematics i. e. the actual classification of individual things within a taxonomic framework.

Taxonomy

Taxonomy is the theoretical framework used to establish a classification. Different theoretical frameworks may be used for different purposes; although, in the human mind there appears to be a singular underlying taxonomy for interpreting external and internal stimuli. The mind contains a holistic system operating within the brain, which utilizes both serial and parallel connections to group and retrieve objects following the law of combinatorial outcome. Such a system divides things and events into different groups and assesses how they are arranged one to another.

Terraforming

The transformation of an astronomical body into an Earth like system.

Tetrapoda

Within the Linnaean system of taxonomy *Animalia: Chordata: Vertebrata: Tetrapoda.* The four limbed vertebrates.

Theory

According to the National Academy of Sciences,
"Some scientific explanations are so well established that no new evidence is likely to alter them. The explanation becomes a scientific theory........ In science, the word theory refers to a comprehensive explanation of an important feature of nature that is supported by many facts gathered over time."

A scientific Theory is but one step below reality itself: derived from rigorous scientific analysis. Science itself is NOT a belief system. It is more in the nature of a language by which we can understand and explain reality.

Thymine

A pyrimidine that is one of the 5 bases in the nuclei acid of DNA. In RNA it is usually replaced by Uracil.

Time-scale

A number scale that represents the passage of time measured either as relative units or absolute units.

Trends

A directed sequence of events in which the changes are conditional over time i. e. what happens now is totally or partially dependant, in some way, upon what happened previously. If conditional changes are fairly obvious they are termed trends or sometimes cycles (if they twist back on themselves). A more general term for conditional changes is a developmental sequence.

Triassic

A geological Period of the Mesozoic Era. Extending from 251 mybp to 199.6 mybp.

Tswana

A tribe of the Bantu speaking people of Africa.

Typogenesis

This is the rate of evolution observed in a phylogeny in which there is a real jump in phylogenic lineage - a new form being introduced between one generation and the next.

Unified theory

The, as yet unrealized, theory in mathematical physics that will combine all the forces of our Universe in order to understand our Universe.

Upanishads

The ancient texts of Hinduism originating, mainly as dialog, between the 800 and 600 BC, and first written down around 1300 AD.

Virus

Ultramicroscopic infectious agents that today need a biological host within which to proliferate.

X-chromosome

The chromosome that is inherited through the maternal line, composed of about 150 million base pairs. Maleness is determined by the possession of an XY pair and femaleness by an XX pair in the somatic cell. A human female has one x-chromosome from her mother and one x-chromosome from her paternal grandmother.

Xenotransplantation

The transplantation of living cells from one species into another, especially pertaining to clinical implantation of organs and tissue, derived from other species, into human beings

Y-chromosome

The human sex-determining chromosome inherited through the paternal line, composed of about 60 million base pairs. Maleness is determined by the possession of an XY pair and femaleness by an XX pair in the somatic cell. A trait inherited through the Y-chromosome is called an holandric trait.

Zygote

A zygote is formed when two gametes [sex cells] combine to form an offspring cell during sexual reproduction, the chromosomes from one parent combine with the same kind of chromosomes from the other parent. The zygote becomes the embryo and the embryo becomes the individual.

SUPPLEMENTARY READING

A SHORT OUTLINE OF THE EVOLUTION OF THE VERTEBRATES

These lectures examines the mechanisms and processes involved in the Evolution of the continuous and diversifying lineage of the Vertebrates. The purpose is to illustrate the magnitude of changes that can occur in a long and single evolutionary line, as adaptations accumulate through time. Much smaller segments could be used for the same purpose. For example, the evolution of the Horses in North America, but essentially the same ideas prevails at all levels i.e. evolutionary theory is scalable. I choose the evolution of the ***Vertebrata*** because ***Homo*** is a vertebrate and examining this group will outline our own ancestral lineage.

The early history of cellular life that led to the Vertebrates began with the clumping together of eukaryotic cells into cooperating bundles, which proved a useful adaptation for survival. With specialization of outer and inner cells, as a symbiotic colony, the beginning of a multi-cellular organism can be seen. Once such a colony was established, the development of other specialized cells could provide a strong adaptive advantage leading to a true multi-cellular organism. Once a viable multicellular base was established other novel mutations could evolve that had adaptive advantages towards living under a variety of selection pressures. The evolution of novel survival adaptations involved the development of one or more bio-chemical sequences at a time and their incorporation into the genome of the species / gamodeme. This was a slow process because most novel bio-chemical reactions that appeared were not incorporated into the metabolic pathways of the organism. Because the fundamental process is the extension of the metabolic pathways by modification not innovation evolution links all living system together. The process goes back to the primordial cells and is a *legacy system*.

The organization of some cells into highly specialized bundles called tissue seems to be a *natural* consequence of multicellular organization, because it occurred so many times during evolution of the Eukaryotes. The development of tissue resulted in major survival advantages. In a real sense this cellular survival mechanism, dating back to early multi-cellular invertebrates, led to the eventual evolution of humankind.

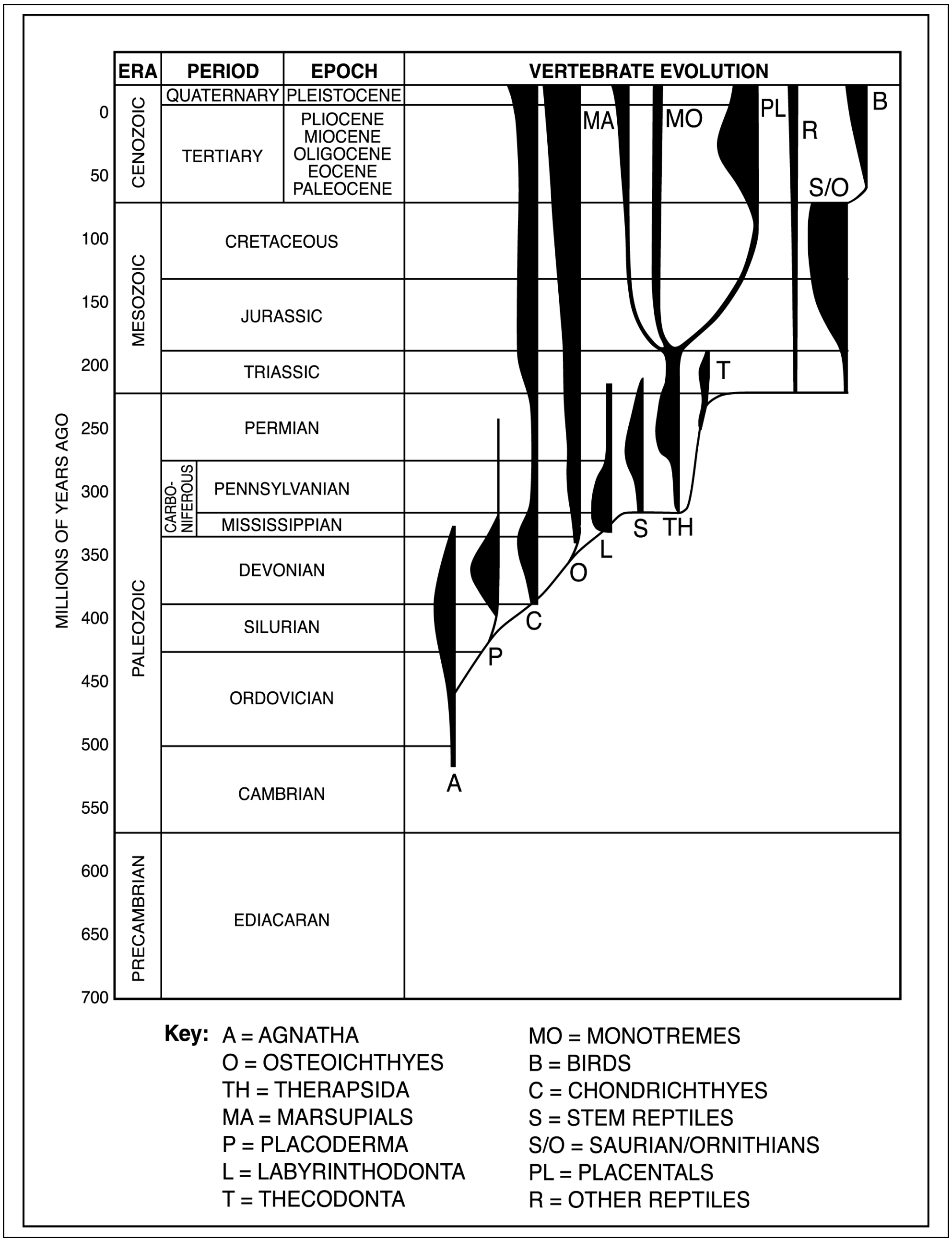
One further thing is clear. It was the increasing availability of oxygen produced by the earliest evolution of photosynthetic organisms living submerged in water [both fresh and marine] that was the primary selection pressure, driving the evolution of those organisms that used oxidative reduction in their metabolic processes, and leading to the evolution of the Kingdom Animalia. Moreover, the evolution of the land vertebrates is directly linked to the evolution of the land plants which established the environmental triggers for vertebrate adaptations. Once the ancient plants began to move onto the terrestrial land masses, during the late Silurian and early Devonian periods, both the oceans and the continents became the sites of prodigious production of oxygen and the partial pressure of oxygen, in both the atmosphere and hydrosphere, gradually increased to its present level. With the adaptation of plants to the land the oxygen levels would climb even higher and in addition represent an attractive food source to any animal that could adapt to the terrestrial environment. Within the Kingdom Animalia, the vertebrate phylogeny evolved many significant adaptations leading to the successful invasion of all terrestrial land areas. Other animal groups, such as the insects, were even more successful: but is the lineage of the vertebrates that eventually led to the most significant adaptation: the evolution of human consciousness. Knowledge from genetics is rapidly improving our understanding of relationships among the Vertebrates, and, in addition, the adoption of a cladistic framework is providing a more testable taxonomy [see, for example Prothero, 2007].

THE LINEAGES OF FISH

At the base of the vertebrate phylogeny are a group of fossilized mobile tetrapods, informally referred to as the fish. In actuality, the 'fish' include a variety of Vertebrata. Using Linnaean taxonomy they are divided into the Agnatha, the Placoderma, the Chondrichthyes and the Osteichthyes, but both living and fossil anatomy suggests that their joint soft bodied ancestor evolved for millions of years prior to the development of forms that could be fossilized. Carroll [1988] in a seminal work on vertebrate evolution suggested an ancestral soft bodied form something like that depicted in **figure 16**. These were mainly bottom dwellers and probably fresh water organisms, and, have features including a notochord, head, paired fins, vertebrae and fusiform body scales.

Early in the lineage of the fishes eyes, ears, and a single nostril on the top of the head evolved. These all point to the development of a central nervous system, which reacted to visual, auditory, olfactory and electrical inputs from biological sensors. This proved an enormously adaptive advantage when the Law of Combinatorial Outcome is applied to analyzing the results obtained from the sense organs.

A geological time chart showing the generalized evolution of the Vertebrata is given in **figure 17**. The earliest fossilized fish occur in deposits from the Cambrian Period and belong to the Class ***Agnatha*** or jawless fishes. Threat, attack, escape, defense and perhaps appeasement are vertebrate traits that caused predatory and defensive behavior to emerge as adaptive advantages. The Agnatha underwent an explosive evolutionary burst during the Devonian Period, at the end of which most forms became extinct. During this time, the development of a structure that could bite, grasp, and manipulate, that had emerged at the end of the Silurian Period, evolved into a whole new predatory way of life. This structure eventually emerged as the jawed fishes belonging to the Classes ***Placoderma*** [armored forms that are now extinct], ***Chondrichthyes*** [cartilaginous forms that include the sharks and rays] and ***Osteichthyes*** [bony forms are the majority of fish found in modern oceans]. Other developments were the emergence of true pectoral and pelvic fins that increased swimming ability, and a more evolved cranium. It must be emphasized that it took some 100,000,000 years for the adaptations found in these Classes to evolve from their ***Agnatha*** ancestors. However, with these developments the jawed fishes became browsers on algae and predators on other water dwelling animals. The cartilaginous forms that developed during the explosive burst of the ***Agnatha*** were the ancient sharks. They underwent further evolutionary radiation at the end of the Triassic Period when they gave rise to the modern sharks and rays. The bony fish possibly arose from an early shark-like form in the early Paleozoic Era and dominated the oceans by the middle of the Paleozoic Era. Their adaptive advantages were a platy exoskeleton and a strong ossified endoskeleton. They also had a swim bladder which increased their stability. It is from a specialized group of bony fish [called the Rhipidisian fishes] that the early amphibians diverged during the Middle Paleozoic Era. Carroll notes that the Rhipidisians were commonly occurring freshwater predators throughout the Upper Paleozoic Era. Amongst other features, these fish had fleshy lobed fins and well developed dorsal fins. The muscular nature of the fins is possibly an adaptation to pushing themselves along the bottom and proved critical in the eventual evolution of the four limbed [tetrapod] vertebrates as they progressed onto land.



Text figure 17

The series of adaptations that led to existence on the land were just as formidable for the animals as they had been for the plants. In particular, adaptation to land had to overcome those problems associated with oxygen supply, dehydration and skeletal support. Under-water organisms are not only supported by the medium in which they live, the water also keeps them moist and supplies them with dissolved oxygen. All three of these problems were eventually solved by the appearance and selection of new adaptive traits.

The initial adaptation to oxygen existing in the atmosphere was developed by several fish groups during the Devonian Period. Proto-lungs evolved probably from an extension of the gut as an adaptation to living in waters with low oxygen. Fishes with these rudimentary lungs could gulp in air and as the fish dived, air would bubble into the blood vessels in the proto-lungs. The combination of use of oxygen, muscular lobed fins for movement, and scales which helped to protect against dehydration were major adaptive traits that allowed access to the terrestrial environment.

Once vertebrates had developed the adaptations that allowed them to exist for a short while in the raw atmosphere, their further evolution was strongly directed by available food sources. The development of the terrestrial vertebrates is intimately linked with the migration of plants onto the land, not only at this early stage in their evolution but also in later stages involving the reptiles and the mammals. A landscape already occupied by plants is a landscape with a lenient selection pressure from the viewpoint of availability of food and competition.

THE LINEAGES OF AMPHIBIANS

Arising out of the group known as the Rhipidisian fish, the true amphibians retain some characteristics of fish, particularly in their young forms. In fact, the early ancestors of the amphibians were not adapted to lead an active life on land. They probably used their primitive lungs to allow them to move from one pool, where oxygen was becoming depleted, to another where the oxygen level was higher. Eventually a mechanism evolved that was essentially a pump which forced air into lungs: the development of a rib cage and attached muscles. By the late Paleozoic Era, once the amphibians became active land dwellers, they underwent an explosive evolutionary burst, with numerous adaptations into the coastal, lacustrine [lake], paludal [swamp and marsh], and riverine [river and stream] environments. The important characteristics the Amphibia had to develop in order to become true land dwellers are given in **Table 3**.

Initially the amphibians had no enemies, for they were the only large animals on the land and they were probably all herbivorous. As they gradually evolved during their migration onto the land, the appendicular skeleton [limbs] strengthened to bear the weight of the body. This resulted in an elevation of the body that became an adaptive advantage because the organism could move with less friction and thus move faster. Eventually competition led to the cost-benefit adaptation in which carnivorous forms evolved. Associated with the elevation of the body a dermal shoulder shield separated from the back of the skull, possibly signifying an adaptation to predatory behavior. These early amphibians are called the **Labyrinthodonta** and are derived from the stem amphibians, called the **Ichthyostegidae,** from which all the other forms originated. The leniency of the selection pressure initiated an explosive evolutionary burst at the beginning of the Mississippian Period with a plethora of new taxonomic groups within the Labyrinthodonta, arising

TABLE 3: ADAPTIVE CHARACTERISTICS OF THE AMPHIBIA	
Skin	The skin is smooth, thin and usually moist allowing transfer of materials between the surrounding water or air.
Feet	Usually webbed with toes that are soft and lack claws.
Feeding habits	The immature forms are vegetarian and the adults usually carnivorous.
Eggs	Lain in moist places and fertilized externally as soon as laid.
Respiration	By gills, lung and through the skin.
Vascular system	Immature forms have a two chambered heart; adults have a three chambered heart (2 auricles in parallel and one ventricle).
Breathing system	Pair of well developed nasal passages leading to the throat which improves breathing in air.
Appendicular skeleton	Strengthened pectoral and pelvic structures to support the body weight. The bones were enlarged and improved for the attachment of powerful link muscles.
Vigilance	Pectoral girdle is free from an attachment to the skull thus permitting movement of the head independently of the body.
Axial skeleton	Changes in spinal column to a flexible yet sturdy series of interlocking bones with a series of modifications for muscle attachments. The earliest amphibians had a spinal column similar to the Crossopterygian fish.
Auditory senses	Fish sense sound in liquid media because vibrations are readily transmitted in water and received by the lateral line of sensor receptors. In amphibians the media is a gas [air] and there was an adaptive need to transmit sound to the inner ear. A bone (the stapes) which originally was part of a gill arch and subsequently became a connector of the jaw to the cranium was modified as a sound transmitter.
Visual sensors	Eyes required modification because they were no longer continually immersed in water. Thus eyelids developed and also a mechanism of lubricating the eyes.
Olfactory sensors	A sense of smell developed. The parts of the brain connected with association moved forward toward the olfactory organs. Associated with this was an increase in the size of the bones in the front part of the skull and a decrease in those in the rear of the skull.

TABLE 3

during a short period of time. The earliest forms were reptile-like, more so than today's amphibians, and some species grew to at least 10 feet long. However, of the numerous groups of organisms that evolved during their heyday, only the salamanders and newts (Order ***Caudata***), the frogs and toads (Order ***Salientia***) and some legless amphibians (Order ***Apoda***) survive today.

One fact that is frequently overlooked about this part of the Vertebrate phylogeny is that it took some fifty million [50,000,000] years of trial-and-error adaptation before the amphibians truly mastered the terrestrial environment. Even then, they could not stray far from water. Not only was dehydration a problem but the ozone layer was weak and ultraviolet radiation from the Sun could be lethal for organisms exposed to it for any length of time. Fifty million years is a long time, and numerous living systems developed that could not pass the barriers placed by the Law of Instability. This long time for experimentation is the reason that such exquisite adaptive strategies could evolve leading to the Reptilia.

From out of the numerous amphibians that evolved during the latter part of the Paleozoic Era, important adaptations occurred that led to the rise of the reptilian body plan. Needless to say, the abundance and associated diversity of the amphibians declined rapidly with the advent of carnivorous reptilian forms.

THE LINEAGES OF REPTILES

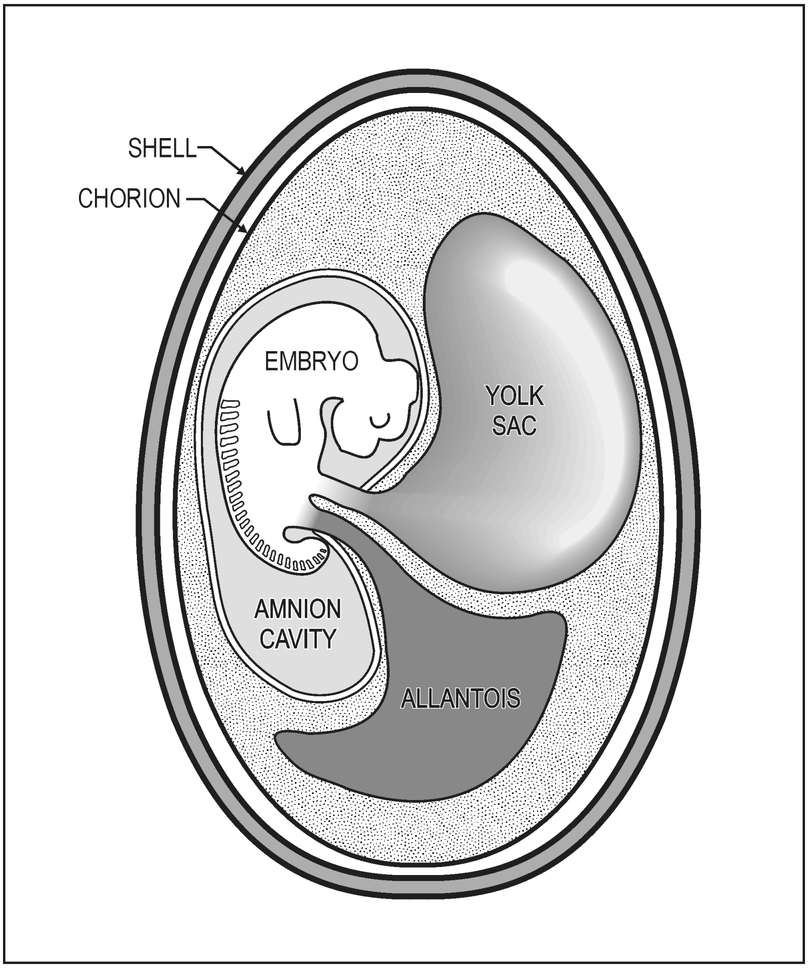
The Reptilia are the first truly terrestrial vertebrates in that they do not have a stage in their life cycle that requires a return to the aquatic environment. The major adaptive feature leading to the Reptiles and Mammals was the evolution of the amniotic egg. Additional important characteristics are given in **Table 4**.

TABLE 4: **MAJOR ADAPTIVE CHARACTERISTICS OF THE REPTILIA**	
Skin	Scales such that the skin is dry and thickened to prevent dehydration.
Limbs	If present the limbs have claws.
Breathing system	Well developed lungs.
Vascular system	Partial division of ventricle, which separates oxygenated blood from de-oxygenated blood. This adaptation is complete in the crocodiles.
Skelton	Some of the bone structures are different from the amphibians e.g. shape of ribs, vertebrae, pelvic region and the skull. These are adaptations for specific needs.

TABLE 4

These features are associated with an improved efficiency for dwelling on land. It is possible that the increasing level of atmospheric oxygen caused the build-up of the ozone layer and this global environmental change helped the Reptilia to dominate the land. The selection pressure for the early reptiles was again minimal. They could migrate further onto land away from permanent water sources for they had developed the amniotic egg and a scaly skin as a major dehydration preventative.

Moreover, in the hinterland there was plenty of food because the plants were already established in the interior parts of continents and the amphibians had not been able to migrate that far away from a permanent water source. However, the key to success was the development of one major adaptation: the amniotic egg [**figure 18**]. Reptiles, birds and mammals all share the amniotic egg and are grouped together as the ***Amniota***. The amniotic egg is a reproductive adaptation that frees the egg from the aqueous environment. In the amniotic egg, the young develop in an aqueous media within the egg and leave the egg in an adult form (although it is not yet itself sexually mature). In addition, the egg is fertilized internally and either expelled as soon as the shell is formed or kept within the body until the young hatches (internal live-birth). Some modern amphibians, as an adaptive mechanism against predation, have evolved a live-birth strategy in more recent times.



Text figure 18

As would be expected, the earliest reptiles e.g. ***Seymouria*** of the Carboniferous Period were amphibian-like. These are classified as the ***Cotylosaurs*** and, because they gave rise to all of the other reptiles, they are called the stem reptiles. From these stem reptiles' two main groups arose: the ***Synapsida*** [mammal-like reptiles] and the ***Diapsida*** [dinosaur-like reptiles]. Examining the evolution of the early forms of the Cotylosaurs it is seen that they were present during the late Pennsylvanian Period as the group called the ***Pelycosaurians*** [e.g.

Dimetrodon]. They gave rise to the ***Therapsids*** which show mammal-like characteristics including enlargement of the dental bone at the expense of the other lower-jaw bones; and, the development of firmly rooted teeth divided into incisors, canines, and cheek teeth. These teeth allow food to be sliced and chewed to small particles (and thus a greater total surface area for digestive processes to act upon). In addition, the limbs in the Therapsids evolved so that they were more or less directly under the body, and the toe bones were reduced to the characteristic mammalian formulae of 2-3-3-3-3. All Therapsids became extinct during the Triassic Period, due to competition from the early Dinosaurs, but not before they had passed along their important adaptations as they evolved into the small mammals. Although the mammal-like reptiles dominated the landscape during the Permian and Early Triassic periods additional adaptations in the Stem Reptiles were continuing to take place that would prove highly competitive. These adaptations proved to be a set of extremely successful modifications that led to a group of vertebrates called the **Thecodonta.** These were the original dinosaurs which successfully occupied most of Earth's terrestrial, aerial and shallow aquatic environments.

The ***Thecodonta*** were small, lightly constructed ancestral dinosaurs. They had a tendency to be bi-pedal and thus were probably quite agile. Bi-pedalism necessitated a strengthening and modification of the hind legs and the re-arrangement of the bones in the hip region, and this provided the means whereby dinosaurs are classified into two major groups: the Ornithischians and the Saurischians. Their adaptive characteristics are outlined in **Table 5**.

TABLE 5: **ADAPTIVE CHARACTERISTICS OF THE DINOSAURS**	
Ornithischian dinosaurs	They were plant eaters and the forward teeth were lost and a beak developed to chop vegetation. They had a pelvic structure similar to the birds. Quadra-pedal forms evolved e.g. **Stegosaurus**, some of which had considerable bulk e.g. **Ankylosaurus** and **Triceratops**.
Saurian dinosaurs	They evolved two main lines adapted to feeding. a) Carnivorous bipeds [the **Theropods]** e.g. **Tyrannosaurus, Megalosaurus.** b) Herbivorous quadrupeds e.g. **Apatosaurus**, **Diplodocus** and **Cetiosaurus.** They were long necked, long tailed, large reptiles that presumably reverted to quadrupedalism to support their weight e.g. **Brontosaurus** (60' long and weighed more than 30 tons). **Brachiosaurus** weighed up to 100 tons and probably consumed 500 lbs. of food per day! They appeared at beginning of Jurassic Period.

TABLE 5

The Ornithischians were the bird-like dinosaurs but oddly enough it was the Saurian group that eventually gave rise to the birds. The Saurischians are what most people think of when they hear the name dinosaur. They showed a wondrous divergence during the late Mesozoic Era as they adapted to the land, the sea, and the air. It is not known for certain what initiated their extinction, but the Meteoritic Impact Hypothesis is gaining continued support as the ultimate cause. The most likely proximate cause was a global climatic effect that was suddenly imposed. This placed an intense selection pressure on all dinosaur individuals.

In general, the changing abundances of the major taxa of the vertebrates can all be related to changes in a major selective pressure, especially the opening-up of new living space, new food resources, and the advent of new predators into an established environment. The advent of an extra-terrestrial source that removed the dinosaur lineage might have been an isolated event, yet it is an example on a grand scale of the effects of selection pressure.

Flight evolved in the reptiles, the birds and the mammals. This once more indicates the amazingly adaptive nature of living systems, utilizing a myriad of cellular processes to take advantage of a low selection pressure. The main adaptive characteristics of the birds are given in **Table 6**.

TABLE 6: **ADAPTIVE CHARACTERISTICS OF THE BIRDS**	
Skin	Feathers which prevent dehydration provide warmth and form an extremely light-weight plane when extended for flight.
Skeleton	Light, porous bones that reduced weight to allow flying.
Appendicular skeleton	Forelimbs are specialized as wings and the hind limbs are used for body support.
Axial skeleton	Cranium has teeth modified into a beak.
Vascular system	4-chambered heart and warm blooded.
Reproduction	Amniotic egg encased in a lime-shell.

TABLE 6

The birds observed today are a group of evolved Dinosauria that diverged from the Theropods sometime during the Jurassic Period. Even today they retain scales on their feet. There was a branch of the dinosaurs that had leathery wings and dominated the air, but the true birds had feathers. The ability to fly was probably a result of developing a mechanism for either gliding from tree to tree or allowing them to flee, flapping their wings whilst on the ground to gain upward momentum as is observed in partridges today. Although the first birds probably appeared during the Jurassic Period it was not until the Later Cretaceous Period and the early part of the Cenozoic Era that they really became abundant. The finding of fossilized transitional forms that are birds with a reptilian body plan [assuming feathers are definitive of birds] has confirmed the evolutionary relationships of the reptiles and birds. The traditional Jurassic transitional fossil is the reptile-bird ***Archaeopteryx***, and this remains a good model despite the many other forms now known. Cretaceous birds still had teeth in their jaws but they gradually evolved a beak, and the finger bones gradually grew closer together forming stronger wings. The dinosaurs dominated the Earth's biocoenosis [all of the organisms in the living system] from the Triassic Period and during the rest of the Mesozoic Era. That they were essentially wiped out at the beginning of the Cenozoic Era was probably the most unfortunate accident in the evolution of life on Earth. If the dinosaurs had not become extinct the mammals would probably never have evolved into ***Homo sapiens***. On the other hand if the dinosaurs themselves had never evolved then advanced mammals may have developed some 100,000,000 years earlier. This is an interesting aspect of the 'chance' aspect of evolution. Consider a sister Earth in which humankind evolved some 50 or even 100 million years earlier than it actually did here on Earth. As an alternative, consider the situation where the dinosaurs had not become extinct and had developed consciousness akin to that in humankind. Awareness that these possibilities could have become a reality, and knowledge of what actually did happen, reinforce the belief that in the vastness of the universe, there are almost certainly far greater intellects than apparent in humankind's present accumulated consciousness.

THE LINEAGES OF MAMMALS

From the few small mammals that survived the catastrophic event that killed off the classical dinosaurs, eventually arose the modern mammals. In their early stages of their divergence, the main differences between mammals and reptiles were physiologic and reproductive, rather than skeletal and these might have contained the differentiating traits that saved one group and exterminated the other. Perhaps the most important mammalian adaptations were the internal embryo and the mammary glands: both of which improved the survival rate of the young. Other factors, such as more efficient heart and lungs evolved, and with the addition of temperature control to maintain a warm blood supply this culminated in an improved vascular system. The warm blood of the bird, mammals and some Dinosaurs permitted them to survive in cold regions; they could search for food in all seasons and during the cool of the night. In addition, insulating hair in the mammals helped regulate body heat. It is possibly this group of traits that gave the mammals the critical edge in surviving conditions after the meteorite impact.

It must be noted that the Synapsida, which led to the Mammalia, were one of the earliest group of Amniota and evolved prior to the Reptilia and their decedents [Diapsida, Sauria, Dinosauria]. Tooth and jaw adaptations allow mammals to eat and digest food more efficiently than reptiles do. The lower jaw is a single bone which is more efficient for chewing. One aspect that must not be lost sight of is that, coincidentally with the improvements in the cardio-vascular system, was improvement in the neural coordination between the brain and the senses. This led to improved accuracy in the senses of smell and hearing: probably much more than ever developed in the reptiles.

The primary control system for the Mammalia is in the skull, and fossilized skulls form an important characteristic in the taxonomy of all Mammalia. The primitive mammalian skull is basically the same as the reptilian structure found in the mammal-like reptiles but with a greatly expanded brain case. Eyes, ears and especially the nose are important sense organs in all vertebrates, but the cerebral hemispheres originally dedicated to the olfactory function in the lower vertebrates are greatly enlarged in the mammals. From the cerebral hemispheres arose the higher brain centers of the advanced mammals. Although the Cenozoic Era has been called the age of the mammals, the Mesozoic Era was their time for experimentation and adaptation. The way in which they met the competition of the reptiles was to develop more efficient nervous and reproductive systems, greater speed and agility, and a more reliable system of bodily temperature control. The reproductive adaptation of advanced mammals was live-birth. However of the three major mammalian groups, only one of them [the Monotreme mammals] continued to lay the amniotic egg. The Marsupial mammals retained the embryo in a pouch essentially as an amniotic egg without a shell. Only the Placental mammals use live-birth after a long period of gestation. Although the three divergent lines of the Mammalia show other fundamental differences in the adaptive strategy they use in caring for the young, they all show a unison of characteristics. Excepting Australia and Antarctica, the placental mammals dominated the terrestrial environments since the beginning of the Cenozoic Era.

The primates were an adaptation, within the placental mammals, that became omnivorous and arboreal. Their basic characteristics are generally the same as those of Mammalia in general. These include an embryonic notochord replaced by individual bony vertebrae, mammary glands for nourishment of the young, hair on the bodies, and young that are retained within the uterus of the mother during early development. Their only truly distinctive feature that differentiates them from all other mammals is the tendency for the growth, development and enlargement of the brain. The differentiation characteristics of the primates are given in **Table 7**.

TABLE 7: **CHARACTERISTICS OF THE PRIMATES**	
Reproductive system	Placental mammals with enlarged mammary glands in the females, and a pendulous penis and scrotum in the males.
Axial Skeleton	On the cranium the eye orbits are encircled by bone. There are three kinds of teeth, at least during one period of growth.
Appendicular skeleton	Quadrupeds or bipeds with four limbs each of which bears five digits with flattened nails. The innermost digits of at least one pair of extremities are opposable.
Brain	The brain always possesses a posterior lobe.

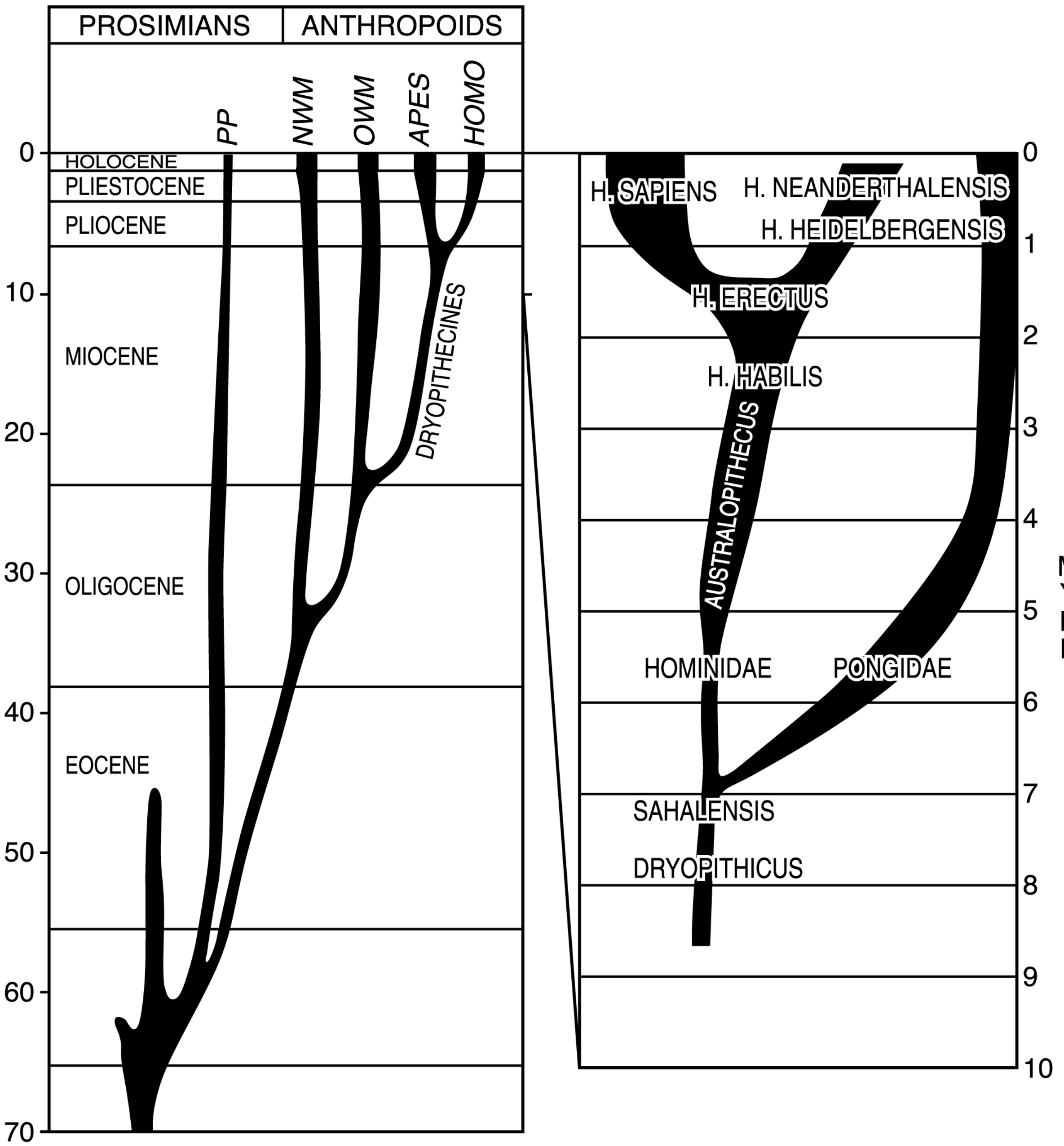
TABLE 8: **CHANGES AFFECTING THE MAMMALIA**	
Mesozoic Era	The Triassic mammal-like reptiles produced the egg laying Monotreme mammals which evolved in isolated areas. The small Mesozoic mammals may have been egg-laying but towards the end of the Era the Marsupials and the Placental Mammals arose. The specialized reproduction mechanisms were probably major trait adaptive traits: especially in the Placental mammals.
Transitional Period	The development of the Insectivore body plan became the basis for all the later Placental mammals and enabled it to survive the major extinction period at the end of the Cretaceous Period which wiped out the major competition [the Dinosaurs].
Early Cenozoic Era	Explosive development into all of the environments abandoned by the Reptiles.
Middle Cenozoic Era	The development of grass in the Miocene Epoch allowed the evolution of the plains mammals: the ungulates in particular became prominent. The early primates adapted to the arboreal ecosystem.
Late Cenozoic Era	The reduction in temperature caused swings in the severity of the selection pressure on both the plains and the forest ecosystems. The Pleistocene Epoch Ice Age put particular stress on the primates.

Table 8 outlines the major developments of the Mesozoic - Cenozoic eras that affected the evolutionary tempo.

A geological time chart of the Cenozoic Era showing the evolution of the primates is given in **Figure 19**.

The earliest primates evolved during the period of mammalian expansion after the demise of the dinosaurs. The ancestral forms are found in the Lower Paleocene Epoch where they are represented by a group called the ***Plesiadapiformes*** which eventually gave rise to the two major groups of modern primates: the Prosimii and the Anthropoidea. Adaptations to the arboreal habitat that characterize these two groups, led to changes in the skeletal structure, particularly the development of the grasping inner digit, and stereoscopic vision. Associated with the development of the stereoscopic vision was a forward movement of the eye sockets and the flattening of the face. The grasping inner digit and the stereoscopic vision were the two adaptations that allowed the brain to develop such excellent coordination of hand and foot with vision. It eventually led to ***Homo,*** the weapon maker and hunter.

The ***Prosimii*** [pre-monkeys] are tree dwelling. The evidence of fossil finds in Eurasia and North America indicate that a grasping hand and stereoscopic vision developed in this group as early as the Eocene Epoch. Modern prosimians are well adapted to mild, moist climates and during the early part of Cenozoic Era they are found in what were the tropical and subtropical climatic regions of Earth. Fossil remains indicate that the prosimians were widespread in the Paleocene, Eocene and Oligocene epochs, but began to decrease drastically when the Anthropoidea evolved in the Oligocene Epoch.



Text figure 19

Today the most primitive surviving form of the Prosimians is the lemur, a form that does not have stereoscopic vision. The lemur is distinctly quadrupedal, has a long bushy tail, and a small brain behind a slender pointed muzzle. Its eyes are fairly far apart, and the animal resembles an insectivore. Today the lemur is found only on the island of Malagasy [Madagascar], where they survived apparently because the island separated from the rest of Africa during the early Cenozoic Era and only a few mammalian predators ever developed on that island. Two other groups of Prosimians have survived. The tarsiers occur in Borneo, Sumatra and the Philippines and look like monkeys. They have a shorter muzzle than the lemur and eyes that are closer together with stereoscopic vision. The second group is the Loris which today lives in

Africa, India and Southeast Asia.

The second group of primates is the ***Anthropoidea*** and this also diverged into two groups referred to as the infra-orders ***Platyrrhini*** and ***Catarrhini***. The Infra-order Platyrrhini contains the ***Ceboidea,*** commonly called the New World Monkeys e.g., ***Vakari*** (cat sized animal from the Amazon), ***Marmoset,*** and the Squirrel Monkey. The Infra-order ***Catarrhini*** contains the Old World Monkeys and the Great Apes.

The New World Monkeys were evolving at the same time as the Old World Monkeys during the Oligocene Epoch, both probably diverging from a tarsier-like ancestor. They have a prehensile tail and an extra premolar. Modifications are seen by their forward facing eyes, more complex molar teeth, larger brain case, improved hands, and a bony bar protecting the eye orbit. These two groups evolved in a parallel manner into similar environmental niches. The New World Monkeys evolved in the New World, although it is only found today in South America; the Old World Monkeys evolved in Africa and Asia.

Within the ***Catarrhini*** the Old World Monkeys are grouped under the Super Family ***Cercopithecoidea*** and include forms such as the snow monkey, Indian langur, mandrill, and Barbary ape. The Great Apes are grouped under the Super Family ***Hominoidea*** which, along with ***Homo,*** includes the orangutan, ***Gorilla*** and ***Pan*** [chimpanzee and bonono], and the fossil genus ***Australopithecus.*** Most recent work that adds the evidence from mitochondrial DNA has shown that humans, chimpanzee and bonono form a close genetic group separated from ***Gorilla***. Furthermore the evidence indicates that they all came from a common African ancestor and somewhat isolated from the Asian great ape, the Orangutan. This evidence has led to a new classification of the super-family ***Hominoidea*** in which the family ***Hominidae*** is divided into two sub-families: the ***Ponginae*** [Orangutan] and the ***Homininae*** [including the ***Hominini*** and African apes] [**Hilton-Barber** and **Berger, 2002**]. ***Australopithecus*** and ***Homo*** lie within the ***Hominini***.

The Great Apes diverged around the same time as the two monkey groups [old world and new world] were evolving i. e., during the Oligocene Epoch. Already by the Miocene Epoch, fossil finds indicate differentiation between the Great Apes and monkeys, with the New World Monkey living in isolation but the Old World Monkey and Great Apes existing in similar locations. The evolutionary closeness of the members of the ***Homininae*** is apparent when it is recognized that the chimpanzee and modern humankind share an estimated 96+% of their genome. The characteristics that separate the ***African apes*** from the ***Hominini*** are given in **Table 9**.

TABLE 9: **DIFFERENTIATING CHARACTERISTICS BETWEEN AFRICAN APES AND HOMININI**

AFRICAN GREAT APES	**HOMININI**
Brachiating posture often adopting quadrupedal locomotion.	Erect walking posture. The upright posture required modification of other skeletal features such as the basin-like pelvis in which the viscera are supported

	and the specialization of the hind limbs for bipedal locomotion.
The brain size is never greater than 650cc. In humans a brain size of less than 900cc produces an imbecile, which strongly suggests the importance of brain size to the development of intelligence.	An enlarged brain. Generally the brain size is 800 -1475 cc.
None articulate speech method of communication	Articulate speech method of communication. Articulate speech depends on the use of a large mouth cavity. This is seen in the shape of the jaw.
Elongated face.	Shortened face.
The rows of cheek teeth are parallel	The rows of cheek teeth tend to diverge posteriorly.
Enlarged canine teeth.	Short canine teeth.
Usually with a brachiating posture.	Distinctly bi-pedal.
Hind limbs shorter than the fore limbs.	Hind limbs are longer than fore limbs.
Opposable big toe on hind limbs.	Non-opposable big toe on fore limb.

TABLE 9

Gaps remain in our knowledge of the humanoid lineage, as in any phylogenic line of terrestrial organisms. This is because organisms that die on the terrestrial landscape are generally subjected to excessive biological and chemical decay and only a few fossils are preserved. In the early days of studying primate evolution the preservation problem was a major one because phylogeny and divergence rested heavily upon the evidence from the fossil record supported by comparative anatomy. Fortunately, much of the evidence is now supplemented, and confirmed, by genetics.

COMMENTS

Examination of a single lineage such as the Vertebrates emphasizes the enormous amount of time needed for mutations to produce a viable adaptation. Nevertheless, combining the speed at which mutations occur with the enormity of the available time the process does produce the necessary adaptations for evolution to occur. The vertebrate phylogeny shows the accumulative nature of Evolution and how the environment affects lineages.

The perception of innovation in evolution is a reflection of the processes that produce the results. Early chemical changes in the chromosome molecules are used to build new lineages with the adoption of new chemical processes thus making evolution a legacy system in which much of the past is retrievable from the present. Understanding this fact suggests intriguing possibilities for reinventing extinct organisms. For the Futurist the knowledge that Evolution is a legacy system offers unique opportunities to develop chimera that can be manufactured to survive within specified environments.

As fishes, the vertebrates had a long period of diversification within the aqueous environment before they gave raise to the Amphibians. Evolutionary development has continued in some fish groups for 450,000,000 years, producing the plethora of forms seen in the modern rivers, lakes and oceans. Once the fishes evolved into the Amphibians at the Silurian-Devonian transition a whole new set of selection pressures acted upon the organisms as they entered the terrestrial environment. One of the prime leniencies at this stage of vertebrate evolution was the availability of a huge food supply in the form of the terrestrial plants, which had evolved a few million years earlier. Without the availability of this food supply the selection pressures would have been much higher. Plant life marginal to the aqueous environments effectively encouraged the Amphibians to evolve onto the land and into the reptiles.

The mass extinction at the Permian-Triassic transition had a terrific toll on terrestrial life, killing off some 85% of all terrestrial species. However, this set the stage for the development of the reptiles and the mammals. Plant life also controlled the expansion of the Reptiles away from the convenience of a water supply because the truly terrestrial land plants had already adapted to the dryer interiors of land masses a few millions of years earlier. The reptiles simply followed the food source which represented a domain without predators and with a lenient selection pressure. Most extinctions are caused by sea level changes which increases selection pressure on the continental shelves. This process plus the northward movement of Euro-Asia such that it missed the north pole and in doing so rapidly changed from a south-north body into an west-east body, accelerated both climate change and extinction rate [Hart,1976]. Massive volcanism at the end of the Paleozoic Era provided additional selection pressure on the biocoenosis.

The period of mass extinction at the Cretaceous-Paleogene boundary thought to have been caused by an extra-terrestrial event, removed the majority of the Reptiles and allowed the mammals to spread into the numerous environmental niches left empty. One interesting aspect is that vegetation again controlled much of this evolution. The development of grass allowed the herbivores to expand, and the development for forests provided numerous niches for the arboreal mammals: eventually leading to the New and Old World Monkeys and the Great Apes.

Carroll [2005] points out that the potential for the development of such things as tissue, may have evolved only once as a set of controller genes.

Loomis [1988, p: 204] notes that in addition, the chemical evolution of the endocrinal system gave adaptive advantage to the early vertebrates.

Or reptiles with feathers if feathers are not taken as definitive].

The origin 98% congruence was reduced to this figure in 2003.

ABOUT THE AUTHOR

George Hart was born in Yorkshire, England and educated at Sheffield University, England, and Moscow State University, Russia. He is Professor emeritus in Geology & Geophysics at Louisiana State University. He has extensive teaching, research, consulting and administrative credentials in the Earth Sciences that have spanned a professional career of over 50 years as a paleobiologist and geologist, with digressions into statistics, computer science and economics.

Professor Hart's reputation as an internationally recognized scientist is backed by the fact that he has held many prestigious international Research Fellowships and Awards. This commenced when he was awarded a British Council Studentship to West Germany and Belgium [1959] and later became a British Council - Soviet Ministry of Education Fellow to the USSR [1960-61]. At that time he was the first western geologist allowed into the Soviet Union on a long term basis after Stalin's death, and the first western Geologist to teach Field Methods at the Moscow State University Field Camp in the Crimea. During 1961-63 he held a NATO Fellowship to South Africa; followed by an Anglo-American Senior Fellowship at the Bernard Price Institute of Paleontology in Johannesburg. In 1973-74 he was the National Academy of Sciences of the USA Senior Fellow to the former Soviet Union and was awarded a Fulbright Fellowship to India in 1983.

In addition to his work in Europe, the former Soviet Union, and South Africa, he undertook research for approximately 20 years in India where he initially went as a United Nations Consultant [1983-84] and later became affiliated with the American Institute of Indian Studies in New Delhi, sponsored by The Smithsonian Institution, USA.

As an educator Professor Hart taught graduate classes in nineteen different subjects and supervised Ph.D. students in Geology, Economics, Computer Science, Petroleum Engineering and Marine Sciences. He has lectured, taught or undertaken general geological field visits in Britain, Norway, Sweden, Finland, USSR, France, Germany, Belgium, Switzerland, Austria, Italy, Yugoslavia, India, Nepal, Tibet, Australia, Botswana, Republic of South Africa, Swaziland, Lesotho, Zimbabwe, Zambia, Mozambique, Brazil, Guatemala, Mexico, Canada, and the USA. In addition, he has worked on material from Antarctica, Tanzania, China, Turkey, Saudi Arabia, Congo, South West Africa, and Pakistan.

Administratively George Hart progressed from Head of the Microstratigraphy Research Unit in the Bernard Price Institute of Paleontology, Johannesburg, South Africa, where he was the curator in Micropaleontology; to Professor and Director of the Museum of Geosciences at Louisiana State University; and finally Director of Research for the Louisiana Geological Survey.

Professor Hart is the author of over 100 publications and appeared on television and radio in both the USA and South Africa. He currently lives in the Front Range of the Colorado Rocky Mountains with his wife Clare.

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Although there are many who have formulated my outlook on science there are a few who were anchor points. As a young person, at Darlington Grammar School, England I was so very fortunate to receive an education at one of the few schools that provided an advanced geology curriculum. Jack Waltham and the late George Chapman took me under their tutelage and provided not only a direction for my future [paleontology] but an intense desire to learn more about the taxonomy, classification and systematics of organisms. Endeavors that I learned later were very basic to understanding humankind's nature, culture and civilization. Six years after leaving Darlington I finished my Ph. D. in the taxonomy of spores and pre-pollen of Permian plants, at Sheffield University, and began an eventful career, first in the former Soviet Union at Moscow State University, then at the University of Witwatersrand in South Africa and finally at Louisiana State University in Baton Rouge. During my time at LSU I was able to spend just over 2 years working in India, under a Smithsonian Institution Contract at the University of Andhra Pradesh, Visakhapatnam; and, two years working for Texaco Inc., in their New Orleans office. Throughout the past 50 years I have been involved with studies on all continents and over 30 countries.

It was during my first year at Sheffield that Charles Downie introduced me to empirical classification techniques and systematics [the process of actually classifying things]. Charles directed me towards a lifelong investigation of statistical methods of classification. In my second year at Sheffield I came under the influence of Peter Sylvester-Bradley, who remained a friend until his untimely death. Peter Bradley introduced me to theoretical taxonomy and interests in the origin of life and the origin of species, and encouraged me to write my first scientific review papers, as an undergraduate, on those topics [Hart, 1956, 1957]. Shortly afterwards during my Ph. D. studies under Leslie R. Moore I learned how to apply the empirical taxonomic method to understanding both areal and temporal changes seen in multi-variate populations. This avenue was enlarged later in 1960-61, when, as a British Council Exchange student at Moscow State University under the renowned structural geologist and stratigrapher Alex. A. Bogdarnov I worked with Sophia Naumova, N. N. Luber, and N. Valts. This work was picked up again in 1973, when I returned to the Soviet Union as the Senior Fellow of the National Academy of Sciences of the USA and worked with Sergei Meyen on the importance of climate and geographic isolation as factors in global changes of multi-variate populations.

There are many others who directly influenced my growth as a scientist. During my tenure as NATO Fellow, and later Senior Anglo-American Fellow at the Bernard Price Institute of Paleontology at the University of the Witwatersrand, South Africa my colleagues were

Raymond Dart the palaeo-anatomist, and, Edna Plumstead the palaeo-botanist, who allowed me to study her extensive collections from Gondwanaland. Over the years I have been privileged to discuss my ideas with, E. S. Barghoorn, who gave me confidence to emigrate to the USA, by asking me to work with him at Harvard [which I never did]; G. G. Simpson who expounded on the geographic distribution of Marsupials for two weeks when we shared a room together in Brazil and with whom I had corresponded on biostatistics since I was an undergraduate; and Robert Potonie, and Hilda Grebe, of Germany who convinced me that all classifications should be empirically based within a strong theoretical taxonomic framework.

No Professor is uninfluenced by his own graduate students and of the many I have been associated with I especially enjoyed the joint learning experiences I had with Pat Ryan, the late Tom Stratten, Vice-chancellor Dick Pienaar, Sylvana DeGasparis and my dear friend A. J. [Tony] Cessford, in South Africa; and Professor Ray Christopher, Bob Pierce, Macombe Jervey, Mark Pasley, Bill Gregory, Bill Harrison, Bill Evans, John Grace and Anne Lenoir in the United States of America.

For many years I have had regular discussion concerning the evolution of humanity with my close friend Faith Lagay, a long time editor and currently with the AMA in Chicago and editor of the journal "Medical Reviews". Faith is a very human specimen of humankind who has moderated some of my more extreme views on humanity. She very kindly sat with me and discussed and edited the second draft of the first two sections of this book, in 2004. For this and for our long friendship I am very grateful.

Any scientist of my generation grew up with the development of computers and I think the inventors of those machines, if not the actual machines, should be recognized. Starting with the old IBM 320 and 370 and those wonderful hollerith cards that taught me how error creeps into things that later become scientific concepts; through my first personal computer, a WICAT using UNIX that instilled in me the idea that from a very small and simple set of commands, a whole universe can be built. An Amiga 1000 followed, which provided me with knowledge of computer graphics long before it was in the mainstream. Zenith PC's allowed me to explore DOS on twelve machines at once; Teserac which gave me insight into parallel systems, and, finally Silicon Graphics who by inventing the Indigo I and later series of SGI machines led me to a more consolidated world of computing. Most recently, I have discovered the world of the PS3, not for gaming but for its ability to allow parallel-processing on an inexpensive 9-core processing system: the future will indeed be full of fun!

No one who has worked with computers since the 1960's can avoid being in debt to Bill Gates, who opened up the floodgate to allow numerous useful programs to be developed. Not having to write code any more allowed all scientists to make major strides in the interpretation of data; and, by simply studying how other peoples specific programs

worked provided a world view into how machines could be made to think.

I thank Lauri Anderson, Gary Byerly, Jeffery Nunn, and the succession of chairpersons of the Department of Geology and Geophysics at LSU, for their continued support. LSU graphic artists Mary Lee Eggart and Clifford P. Duplechin have supplied artwork, not only for this book but for numerous earlier publications: their friendship during decade's long association is appreciated. Finally, the valued help of some of my close friends, who read all or part of the manuscript prior to publication, is needed. Most especially I thank Faith Lagay, of the American Medical Association, Chicago; and Bill Ross, Geological Manager of GeoGraphix Inc., Colorado who gave much of time for discussion and reviewing the manuscript. At LSU Professor Barun Sen Gupta, kindly read the first section of this book.

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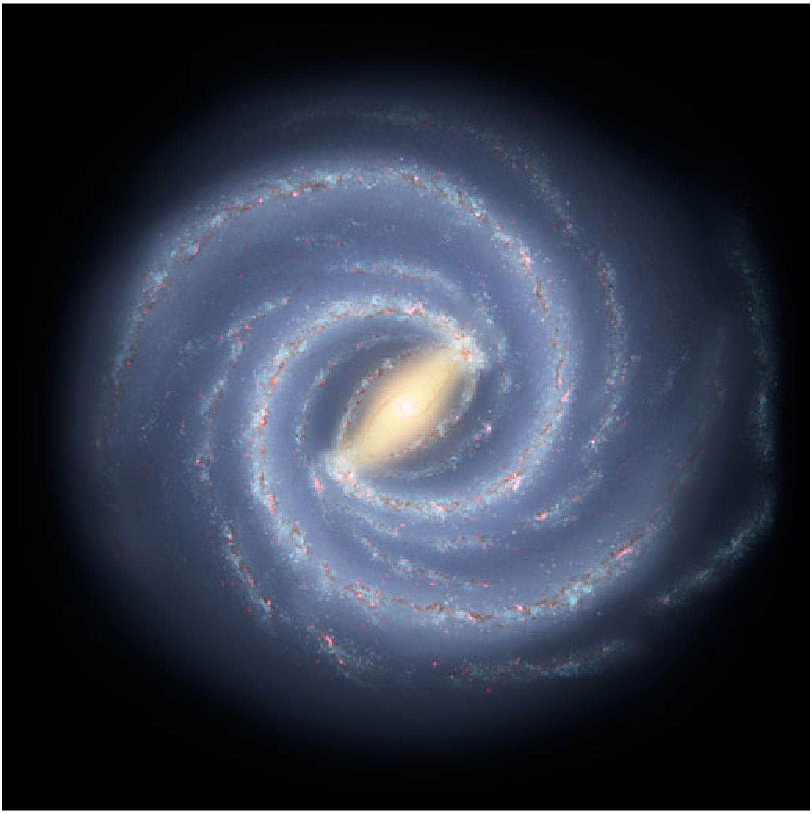
Homo sapiens' galactic future!

Our most recent understanding of the structure of our own Milky Way Galaxy.



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