

EVOLUTIONARY MEDICINE: A BIOCOSMOLOGICAL APPROACH FOR INFORMING FUTURE BIOMEDICINE

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Abstract. *Over the last fifteen years evolutionary or Darwinian medicine has become increasingly popularised in universities in North America and Europe. Over thirty universities in the United States have evolutionary courses in their medical curricula. While evolutionary medicine is becoming an important interpretive tool for understanding human susceptibility to disease, its approach may be improved via the application of principles from biocosmology. This article examines the nexus between evolutionary medicine and biocosmology and how such a relationship may inform future biomedicine.*

Keywords. *evolutionary medicine, biocosmology, biomedicine, causa finalis, organicist, complementary medicine, psychoneuroimmunology*

Introduction: Contributions of Evolutionary Medicine Towards Understanding the Human Body

Over the last fifteen years evolutionary or Darwinian medicine has become increasingly popularised in universities in North America and Europe. Over thirty universities in the United States have evolutionary courses in their medical curricula. The application of evolutionary mechanisms to understanding human illness has been a long time in coming according to Randolph Nesse, a chief proponent for the inclusion of evolutionary medicine at universities. Recent advances in evolutionary and molecular biology (i.e. genomics) have inevitably asked important questions in relation to human susceptibility to disease and how disease can be mitigated with wider knowledge of evolutionary theory (Nesse *et al* 2009). For example, why is sexual reproduction used in invertebrates and vertebrates when asexual reproduction is twice as productive (Nesse *et al* 2009). The reason for this is sexual reproduction increases genetically diverse offspring, thereby, increasing the chances for genes to be carried over to future generations. Why is cancer persistent in *Homo sapiens*? The answer may be due to evolutionary tradeoffs as well as limits in tissue regeneration (Greaves 2000). Why is altruism often committed on behalf of kin rather than strangers? One reason is that altruism conferred to kin may increase survival and reproductive success of one's genes since kin carry some of the individual's genes. Explorations into such questions have increased, thereby enabling the advent of new medical applications (Nesse and Williams 1994; Nesse *et al* 2009; Weiner 1998; Nesse and Stearns 2008; Stearns and Koella 2007; Williams and Nesse, 1991; Gluckman *et al* 2009; Trevathan *et al* 2007).

One of the positive ideas in evolutionary medicine has been to challenge the old Cartesian based model of thinking about the human body as a machine, but rather, as an evolving organism. Although, Descartes formulation of 'body as machine' was a significant development in understanding the human body, the analogy was used in

order to separate science from the enveloping religious model of the time (Nesse 2007). However, modern scientific developments have reaffirmed the inaccuracy of the Descartes body model. As Nesse argues, bodies were not designed but rather arose from the inter-reactions between genes and environment over long evolutionary periods (2007). Natural selection and genetic mutation were major driving forces in evolving the human body. Also unlike machines, the human body can regenerate cells and to heal damaged tissue. The last fifteen years has also showed the capacity for neurogenesis and for an understanding of the brain as being neuroplastic. The plethora of research available attesting to the brain's neuroplasticity is a case in point. Consequently, theories of neuroplasticity have become more refined over time. For example, Grafman (found in Doidge 2007, p. 276) identifies four kinds of neuroplasticity: map expansion, sensory reassignment, compensatory masquerade, and mirror region takeover. Each kind of neuroplasticity involves neural strategies for compensating and redirecting neural activity in the event of disease and trauma. The brain's commitment to neurogenesis is due to complex evolutionary processes over hundreds of millions of years which enabled the brain to evolve as an exceedingly complex organ possessing intricate cognitive, affective, sensory and healing capacities. The brain's 100 billion neurons begin producing in the second trimester (fifth month of pregnancy) and continue generating neurons for another year at a rate of 10 billion per day (Schwartz and Begley 2003, p. 121). At adulthood the neural mass has generated a staggering 100 trillion neural synaptic connections which underlies our intense reflexive consciousness. During juvenile and adolescence phases, right throughout adulthood, synaptic connections are constantly being produced and pruned. The driving force behind this neural matrix is the inter-reaction between genes and the environment which endows each human brain with a unique signature, never again emulated by any other brain. In Aristotelian terminology, the *causa finalis* of human brain development and complexification is the generation of self reflexive awareness – the hallmark of *Homo sapiens*.

A second important idea of evolutionary medicine has been to confirm Darwin's notion of the unity of life. This is an exemplary finding which deserves scholarly praise in its own right. Underpinning the unity of life is that all living organisms are made of DNA and are organically related to each other from a genetic viewpoint. Implicit to the unity of life is that life on earth originated from a single ancestor that existed approximately 3.9 billion years ago. Life on earth persisted in microbial form for over two billion years, which saw developments from pre-biotic phases, to the evolution of cell membranous prokaryotes with ATP/RNA metabolic enzymes, nuclear membrane DNA and unicellular eukaryotes (Boaz 2002, p. 19). The Archean and Proterozoic eons saw other eventful developments such as mitosis, meiosis, photosynthesis and microbial predation (Boaz, 2002). Multi-cellular life evolved around one billion years ago. From 600 million years ago and entering into the Cambrian period, an explosion of multi-cellular life was produced. During a short period of 10-40 million years most major phyla were produced. Science has been unable to explain why this evolution of phyla had occurred in such a relatively short period. The Cambrian period pathed the way for invertebrate and vertebrate evolution.

The following life periods on earth showcased a multitude of species of fauna and flora which in their genetic essence revealed the unity of all life forms.

A third contribution of evolutionary medicine lies in its explanatory power which combines various medical and biological disciplines. Evolutionary medicine poses that evolution should be viewed as an imperative constant in explaining intra-cellular life processes, and how such processes are inter-connected to the environment. Such a view enables scientists to view life as an on-going evolutionary process of kaleidoscopic dimensions. However, in contrary to prevalent materialist and reductionist scientific paradigms, evolution is apparently not a 'blind process' of random accidents, but rather a process imbued with an apparent purpose; inherent in this purpose is a movement towards greater complexity as is characterised in human brain evolution. Such an evolutionary process is assisted due to information in life systems which enhance self organisation or autopoiesis. As Gregory Bateson contended, 'mind' is an inherent property found in all open systems, and this 'mind' is predicated in information and cybernetic processes in nature (Bateson 1973; 2002). What this means is that every cell, every organism is "in relationship with its environment" and that this is the basic unit of survival (Charlton 2008, p. 120).

A fourth contribution of evolutionary medicine is challenging prevalent misinterpretations of the adaptationist approach that hint on the notion that bodies are somehow near perfect organisms. Such a notion is untenable in the light of recent scientific research on natural selection and the human body (Williams and Nesse 1991). A correct interpretation of adaptationism is that the human body is an evolutionary system of trade-offs and compromises. Furthermore, natural selection is an imperfect process. For example, the price of walking in an upright bi-pedal fashion is back problems; the narrowing of the pelvis problematises human birth (Williams and Nesse 1991), and the body's ability for tissue repair increases the onset of cancer (Williams and Nesse 1991). In short, the human body is imperfect. Armed with this knowledge, evolutionary medicine can improve medical understandings and revolutionise aetiology of illness.

Having outlined some of the major contributions of evolutionary medicine in relation to evolutionary understandings the author contends that a biocosmological approach may further improve and refine some of the rudiments of evolutionary medicine. The forthcoming sections will, firstly, discuss the human body within an organicist framework; the second section will explore evolutionary medicine and present human health dilemmas; the third section will examine wisdom of the body, while the fourth section will outline future improvements to evolutionary medicine and the need for biomedicine to incorporate a mind-body framework.

Human Body in Evolution: An Organicist Perspective

The notion of organic evolution is important for improving the basic precepts of evolutionary medicine. A key point in Aristotle's aetiology stresses the organic and coherent processes in nature. According to Aristotle's schema the cosmos is self evolving and is hierarchically organised, in which living organisms have their inherent place and purpose (Khroutski 2010, p. 68). Biocosmology takes up

Aristotle's theory by contending that *Homo sapiens* is undergoing a unique ontogenesis and evolutionary transformation. In light of Aristotle's four *causa* (*causa materialis*, *causa formalis*, *causa efficiens*, *causa finalis*) the human body may be viewed as a coherent and self-regulating system (Guja 2008). Moreover, the body is a product of micro-evolutionary and macro-evolutionary processes – an “organic whole self-evolving entity” (Guja 2008). The body, is therefore, not only a product of natural processes, but also a cosmic process; a cosmic developmental design – dynamic, complex and integral (Guja 2008). From an organic viewpoint, the human being embodies the properties of a “psychosomatic unity” (Khroutski 2010, p.67).

Aristotle's schema privileges a biology of coherent and inter-connecting systems, an aspect which has been taken up by systems theory (Laszlo 1972a, 1972b, 1995, 1996; Bertalanffy 1974; Capra 1997; Odum 1994; Snooks 2008; Checkland 1981; Montuori 1989; Morin 2008). For example, the photosynthesis discloses a remarkable kind of coherency (Laszlo and Currivan 2008). At a DNA level coherency is realised by the unique DNA helix that is ideal for receiving and transmitting electromagnetic waves. This process enables receptors in cell membranes to continuously interact at a selective resonance with their environment (Laszlo and Currivan 2008, p. 118). So crucial are the cellular membranes to the construction and organisation of human bodies that approximately 40 percent of coding DNA is directed towards body reproduction (Laszlo and Currivan 2008, p. 116). According to traditional biological theory, the cell's nucleus acts as a kind of ‘brain’. However, a more recent view espoused by biologist Bruce Lipton locates cellular membranes as actively mediating information with their environments. Consequently, in multi-cellular creatures, “whole-body membranes surrounding the organism act as information processors for the energetic and informational template of overall form” (Laszlo and Currivan 2008, p. 117).

Coherency also indicates metapatterns, coining Bateson (1973 2002), in organising body designs. The study of nature's patterns and their organic processes was inherited by the Pythagoreans and Aristotle, and refined over the centuries (Capra 1997, p. 153). In modern thinking networks have been analysed. An understanding of pattern is crucial in science since it is kernel to the organisation of life. To carry the pattern analogy further, a system's structure embodies an organisational pattern (Capra 1997, p. 154). The third component to this theory is process. Process is the activity in a system's organisational patterns. Thus, in Capra's terms, pattern, structure and process are intrinsic to all living systems (Capra 1997, p. 156). As he notes: “The pattern of organisation can only be recognized if it is embodied in a physical structure, and in living systems this embodiment is an ongoing process” (1997, p. 156). This triune biological schema concurs with Aristotle's four *causa* in that a living a system of organs, based on inherent body patterns are constantly influenced by their internal and external environments, and that this organic system is functionally adaptive and purposeful.

I would like to further discuss the pattern analogy as it has broad implications for evolutionary medicine. In the nineteenth century the anatomist Richard Owen found that there was an underlying pattern of the human arm, and that this pattern was

reflected in all living creatures with limbs (Shubin 2009, p. 30). The blueprint arm design is as follows – one bone in the upper arm, two bones in the lower arm, many bones making a wrist, and a series of five rods making fingers (Shubin 2009, p. 30).

The arm design begins with our fish ancestors, and was refined during the Devonian period to become a limb as found in the fossil remains of *Eusthenopteron* and *Acanthostega gunnari*. These creatures represent an evolutionary innovation between fish and future amphibians, reptiles, birds and mammals. The basic picture is clear; the human arm and hand represents hundreds of million of years in the making.

Even at a cellular level the architecture of the human body resembles that of more simple organisms such as sponges and placozoans; all possess collagen, the cellular building mortar; the human body, sponges and placozoans contain divisions of cells that hold their bodies together; all three are scaffolded by cellular adhesion and communication (Shubin 2009, p. 132).

Evolutionary Medicine and Present Human Health Dilemmas

Entellechy which according to Aristotle alludes to a purpose driven goal may also be defined as actuality or realisation. In evolutionary terms entelechy may be related to ontogenetic processes; a life sustaining and organising driver that underpins all life processes (Khroutski 2010, p. 67). One may take the view here that natural selection and genetic variation act as drivers for all evolutionary processes. As I have earlier suggested, this does not necessarily mean that natural selection is a blind process but has an apparent directive towards evolving organisms with greater complexity. For now, I would like to propose that human goals to health are presently in a massive dilemma due to changes in human lifestyle and diet.

Moreover, the model of western biomedicine which originates from the European Renaissance needs revamping, especially in the area of understanding evolutionary history and environment of evolutionary adaptedness (EEA). As suggested, the transformation to reductionistic and mechanistic models to viewing the human body are rooted in the humanist tradition of the European Renaissance. During this time the human body was reconfigured. No longer was it considered to be a sacred plenum, conferred with mystical and symbolic meaning, but rather as an elegant machine. The development of invasive techniques during the Renaissance such as human dissection further promoted the ‘machine like’ nature of the human body.

While this humanist understanding has been foundational to western biomedicine, its paradigm is in a current quandary. Biomedicine has been impotent in curtailing the prevalent pandemics of cardio-vascular disease, type 2 diabetes, cancer, and hypertension which are afflicting western and non-western societies. Evolutionary medicine explains that a major cause for this prevailing trend is due to an evolutionary ‘mismatch’ between the human genome and modern culture. In short, human genetic makeup has not had time to adapt to modern life. The discordance between ‘stone age’ bodies and 21st century lifestyles is disrupting homeostatic processes (Eaton et al 2002, p. 110; Williams and Nesse 1991; Neel 1998; Eaton et al 1988). The human genome is a sequential collage of evolutionary events and processes that date back before *Homo sapiens* (Eaton et al 2002, p. 111).

Evidence for this mismatch theory is confirmed by recent studies on hunter-gatherer and traditional societies. Overall, the evidence shows that “chronic degenerative diseases” are infrequent in these societies (Eaton et al 2002, p. 110; Lindeberg and Lundh 1993; Trowell and Burkett 1981; Shephard and Rode 1996). As Eaton et al (2002), point out: Bio- markers of incipient illness such as rising blood pressure, increasing adiposity, deficient lean body mass, hypercholesterolemia, nonocclusive atheromata, and insulin resistance are quite infrequent among foragers and other traditional peoples compared with their prevalence in similar-aged modern Western populations.

Ancestral humans evolved in environments which demanded high exertion of energy for food foraging and intermittent predator evasion. While modern humans evolved in Africa approximately 100,000 kya, cultural innovation during the last 50,000 kya has led to changes in food foraging techniques (Eaton et al, 2007, p. 129). The ancestral human diet before the agricultural revolution (circa 10,000 kya) mainly consisted of lean meat, fresh and salt water marine life and plant food. In comparison, the modern human diet is relatively high in refined carbohydrates, fat, sugar and sodium. The introduction of cereal cropping and animal husbandry enabled humans to store food in substantial quantities. Some genetic modifications have followed in the form of lactose tolerance in some human populations (Eaton *et al*, 2007, p. 129). However, excluding these, the human genome has been unable to adapt to novel diets and lack of exercise which have proven to be deleterious to human health.

Modern humans possess a ‘thrifty genotype’ which evolved during the Pleistocene period. The thrifty genotype enabled humans to access body energy reserves during times of diminished food availability. In biological terms this meant that the ‘famine or feast’ ancestral environment informed the amounts of insulin secretion in the blood. The high energy output of ancestral humans and low caloric intake would have maintained equilibrium of glucose levels in the blood. In contrast, the introduction of high sugar intake in the modern western diet combined with a sedentary lifestyle produce high amounts of insulin leading to the eventual degradation of insulin receptor sites along the cellular surfaces (Boaz 2002, p. 132).

The end result is type 2 diabetes due to overworked beta pancreatic cells (Boaz 2002, p. 132).

Wisdom of the Body

The adage, ‘wisdom of the body’ was first coined by the cardiac physiologist Frank Starling in the 1930s in relation to the body’s unique inter-relational properties which have not been fully understood by science. Recent discoveries in the medical sciences confirm Aristotle’s etiology in that the human body possesses its own way of knowing that is revealed by its healing proclivities. It seems that evolution has endowed the body and mind with a biofeedback system for maintaining health and alleviating stress response. Such a biofeedback system was evolutionary advantageous in the indeterminate ancestral environment.

One way in which the human biofeedback system has evolved is via the human

capacity to enter into altered states of consciousness. McClenon (1997) contends that the hypnotic capacity in humans which had developed in the Upper Paleolithic period provided significant evolutionary advantages. These included decrease in stress response, fertility increase and “lowering of sympathetic response in order to induce relaxation” (Henneberg and Saniotis 2009; McClenon 1997, p. 346). The use of shamanic rituals during ancestral times enabled the frequency of the hypnotizability genotype to spread in human populations (McClenon 1997, p. 347). Cross-cultural and scientific studies seem to support McClenon’s hypothesis (Ornstein 1972; Sabourin et al 1990; Santarcangelo and Sebastiani 2004; Crawford 1989; Holmquist 2000; Achterberg 1985).

The body is composed of approximately 11 trillion cells that are organised as an autopoietic network of stupendous complexity and proportion. Recent studies seem to indicate that cells are more than the building blocks of bodies, but may also provide the biochemical architecture of emotion. In her seminal work *Molecules of Emotion: the Science Behind Mind-Body Medicine* (1997), Candace Pert argues that the emotions have a biochemical basis in amino acid chains called neuropeptides. These neuropeptides do not just exist in specific sites of the brain but are found throughout the body. A new model proposes that only 2 percent of neuropeptides reside in the limbic system, while 98 percent are found in the body (Pert 1997). Neuropeptides provide a communicative interface between nervous, endocrine, immune, skeletal and muscle systems via the blood, and bind to neuropeptide cell receptors. Damasio (1999) also supports Pert’s hypothesis by suggesting that emotions and memories are biochemically composed by neuropeptides binding to cell receptors.

Features of Pert’s psychoneuroimmunological model concurs with Chinese medicine’s understanding of emotions as deriving from the body’s organs. Each organ in Chinese medicine is a site of emotional expression and has a positive and negative aspect. Emotions are classified according to five kinds. These are: excitement or joy, sympathy, grief, fear or shock and anger: heart = site of joy and happiness; kidney = site of anxiety; liver = site of anger; stomach = site of worry; lungs = site of grief.

Let us examine a hypothetical case study of the link between emotional states and diagnosis of illness in the Chinese medical model, in relation to the heart and depression. In Chinese medicine the heart is consigned to the element of fire. Both high and low blood pressure are considered to be conditions of compromised circulation. In the case of low blood pressure Chinese medicine explains this as due to lack of the fire element. Since the heart is linked with the emotions joy and happiness lack of fire element may lead to sadness and depression. According to the Chinese medical model, protracted depression means that the heart is seriously deficient which may lead to heart attack. To counteract this, medicine which enhances the fire element is given for people suffering from various forms of depression. Also, laughter is believed to enhance the heart by replenishing the fire element. It is interesting to note that medical researchers have recently found a correlation between heart disease and depression.

In a study by cardiologists at the University of Maryland Medical Center in

Baltimore, found “that found that people with heart disease are 40 percent less likely to laugh in a variety of situations compared to people of the same age without heart disease” (University of Maryland Medical Center 2000). One reason for this is that prolonged stress may impair the endothelium which can “cause a series of inflammatory reactions that lead to fat and cholesterol build-up in the coronary arteries and ultimately to a heart attack.” (University of Maryland Medical Center 2000).

Using Pert’s neuropeptide theory, one possible explanation of how Chinese medicine works is that it stimulates neuropeptide communication at nodal points throughout the body where there exist numerous neuropeptide receptors. These nodal points are connected to the brain in a network that secretes opiates (Pert 1997).

Our excursion of cellular memory and the wisdom of the body should also include the research of Andrew Armour’s concept of the ‘heart brain’. In his research Armour discovered that the heart is an intricate network of transmitters, proteins and types of neurons that can act independently of the cranial brain (Linton 2003, p. 3). “Neurological impulses by the heart’s nervous system...reach the medulla, located in the brain stem, where they have a regulatory role” of the body’s organic systems, and may inform various cognitive processes (Linton 2003, p. 3). The ability for the heart to still function once it is disconnected from the body is indicative of its autonomous nervous system (Linton 2003, p. 3). There have been various accounts of heart transplant recipients who have apparently embodied some of the characteristics and behaviours of their heart donors. One extraordinary case of apparent heart memory involved an eight year old female transplant heart recipient whose donor had been a ten year old murdered girl. After having received the murdered girl’s heart the recipient had persistent nightmares of being murdered by a man. The girl’s parents decided to inform the police, and the girl was able to describe key aspects of the murderer including the place of the murder, the murderer’s clothes, time of murder and the murder weapon. The girl’s incredibly accurate description enabled the police to find the murderer of the ten year old girl (Linton 2003, p. 5). While some scientists have argued that such phenomena may be explained by the possible psychotropic action of immunosuppressive drugs which are used by organ transplant recipients enabling them to recall long term memories and heighten perception, this theory cannot explain the eight year old girl’s accurate description of the donor’s murderer (Linton 2003, p. 5).

Improving Evolutionary Medicine

This essay has so far highlighted how aspects of Aristotle’s organicistic model and *causa* can increase the theoretical scope of evolutionary medicine. The author believes that an inclusion of Aristotelian theory as found in biocosmology is vital, and can curb some of the reductionism that is contained in evolutionary medicine, especially in the area of evolutionary psychology. Evolutionary medicine is a relatively new discipline, and hence, is wanting in various areas of analysis. One such area is understanding the mind/body inter-relationship and how this can inform healing states. The author contends that the mind/body healing dynamic evolved in

the ancestral environment for alleviating stress response, but may also have led to the greater experimentation of altered states of awareness, as found in extant indigenous shamanistic societies. Such experimentation with altered states of consciousness may have endowed ancestral humans with greater control of mind psychodynamics and in synchronising different areas of the brain (Winkelman 2000; Henneberg and Saniotis 2009). Evolutionary medicine is still working within a scientific paradigm that denies special modes of consciousness and that consciousness may be an inherent principle of the cosmos, instead of it being an epiphenomenon of brain activity (Russell 2005). Complementing future biomedicine would be the inclusion of Aristotle's organicistic model and focus on *causa finalis* in depicting human health in terms of mind/body unity (Khroutski 2010, p.82). Khroutski views that biocosmological principles could path the way for the acceptance of complementary medicine to conjoin conventional medical therapy (2010, p. 78). On a similar theme, the well known physician Larry Dossey (1997), foregrounds the importance of non-local therapeutic techniques such as prayer and spiritual healing. Moreover, the inclusion of complementary medicine by biomedical practitioners would not mean the discarding of conventional therapy (1997, p. 177). Research has shown that the effect of drug treatments on patients can be enhanced by the intentions of caring and compassionate biomedical practitioners (Dossey 1999). This is not surprising since caring and altruism are part of human evolutionary makeup. From an evolutionary viewpoint humans are psycho-physically primed to respond positively to caring attitudes.

Dossey argues for a future biomedicine that will focus on the mind as a key healing agent (1997, p. 19). For Dossey, future biomedicine may transcend disease diagnosis and eradication, and integrate the different levels of the human constitution. In this it concurs with biocosmological medicine. There have been numerous studies attesting to spiritual healing and spontaneous remission of illnesses without conventional medical treatment (Dossey 1998, 1999; Ginsburg 1987; Amorok *et al* 2004; Hirschberg *et al* 1990; Hirschberg and O'Regan 1993; Hirschberg and Barasch 1995; Braud 1990; Beltramello *et al* 1991; Herman *et al* 1990; Dickstein *et al* 1991; Barasch 2008). The veracity of numerous studies points to a need by biomedicine to reassess the various healing capacities of the body. Evolutionary medicine may be of service here. Since the human body is an on-going evolutionary organism, natural selection may have endowed the body with unusual healing abilities that have hitherto been ignored by biomedicine. In this way, evolutionary medicine may contribute in exploring the mind-body dynamic from an evolutionary perspective. The rise of complementary medicine in the West such as Chinese and Aryurvedic medicine has been important in enabling biomedical practitioners access these healing systems. More exposure of complementary medicine may eventually broaden the biomedical mindset.

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