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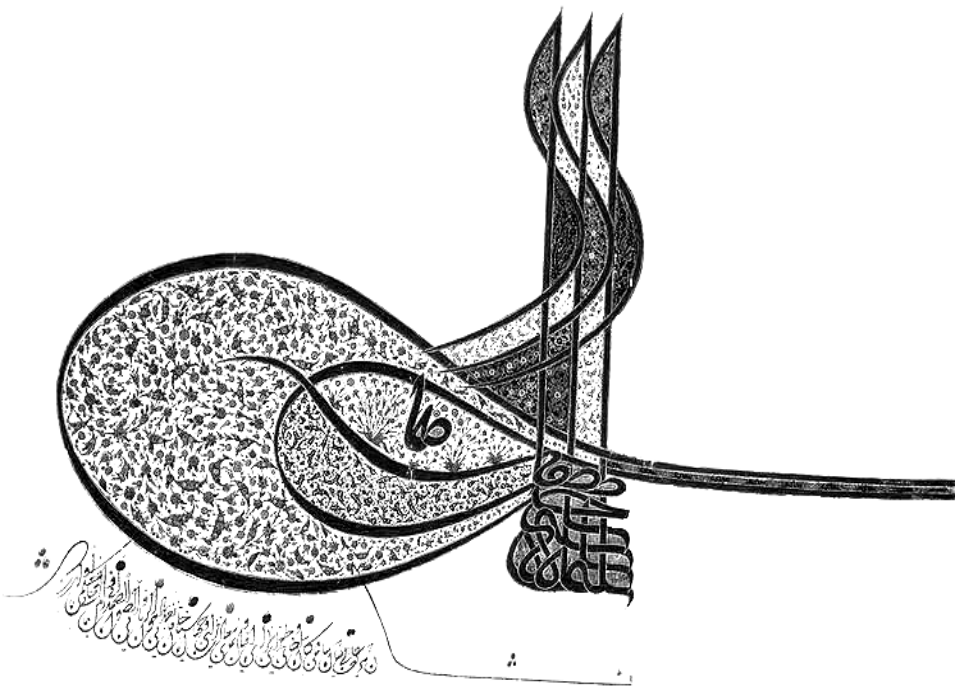


Signatures of Health

Graham Jones *James Le Fanu* *Isla Burgess* *Irun Cohen*

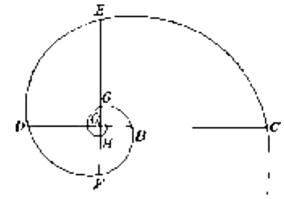
Cover & Art in this issue

"Tughra" of Suleiman the Magnificent (1520-66).

The Tughra was a royal signature, an imperial cipher, the official signature of the ruler of the Ottoman empire to guarantee authenticity of the document on which it was placed. Suleiman the Magnificent's era was the golden age of the Ottoman empire and he has been known as one of its greatest rulers. Under his reign the Ottoman's made amazing achievements in administration, law giving, making it a culturally prolific time with a lot of interest in poetry, calligraphy and other various arts. Artisans in service of the court included painters, book binders, furriers, jewellers and goldsmiths. It was a time of cultural renaissance for the Ottomans.
At the start of his reign, Suleiman performed many acts of kindness and mercy toward his people including freeing hundreds of slaves, bestowing his officers with gifts, and erecting a school for slaves. In return for his kindness, Suleiman demanded complete loyalty of all his subjects. Suleiman's kindness was a sharp contrast to the acts of his cruel father, who had become known as Selim the terrible. While Selim had only been interested in war, Suleiman filled his palace with music and poetry. Suleiman himself came to write many poems of his own.

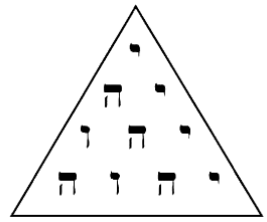
Sultan Suleiman's most famous verse is:

The people think of wealth and power as the greatest fate,
But in this world a spell of health is the best state.
What men call sovereignty is a worldly strife and constant war;
Worship of God is the highest throne, the happiest of all estates



The science of Arabic penmanship illuminates the geometric principles that underpin the visual harmony of all Islamic art and architecture. The arabesque can also be equally thought of as both art and science, some say. The artwork is at the same time mathematically precise, aesthetically pleasing, and symbolic.

Sacred Geometry sits at the nexus of art, science, religion and philosophy in diverse cultures around this planet and the universe. This ancient art and science is literally a universal language of simple yet elegant geometries, proportions and principles which reveal the universal archetypal processes, patterns, templates and dynamics underlying all life and all forms in existence, including that of the human. It is found in the mystery schools of Plato and Pythagoras, the esoteric brotherhoods throughout the ages, the Hebrew Kabala, during the Renaissance in the works of Vitruvius , Leonardo da Vinci, the native American, Arabic and Muslim architecture and calligraphy, the Hindu texts and so on. *(Courtesy : Karen Carty)*



In this issue, the abstract holistic science inquiry joins with research into the quality of health. At a workshop at Aboca, Italy in August 2011, Graham Jones presented a talk of the whole cognisance of the immune system. This led Graham to an article of Irun Cohen, also included in this issue.

The suggestion of Graham and Irun is that the whole quality of the organism pervades the working of the immune system, in the same way that 'mind' is the whole manifestation of the neurological system. In this way the proteins are actively involved in monitoring and responding to a sense of the whole identity of the organism.

The immune system is presented as a very special player with a whole overview of the body, comparable to the neurological system and the 'mind'. It is possible to read the status of the body's health from the self-reporting of certain key (stress) proteins that are monitoring the whole state of the organs and the body. The immune system is an inner mirroring of health at a high level of cognisance of the whole state of the body.

Potentially the paradigm by which we understand health is turned on its head. For although the article presupposes a holistic perspective of the whole cognisance of the immune system, the simple test of the 300 proteins into the health of a patient, gives a way for research to test the truth or otherwise of this tenet.

The issue looks further to where the signature of life is missing, as can be the case in science, and to the loss of cellular integrity in cancer. Simple signatures are explored in principal component analysis of the protein distribution of each herb; and how a herb can be seen to have a character that matches the personality of the person who benefits from its use.

The goal of health, as many authors argue, is where the dynamic of living parts escapes for a moment the isolation of separate existence, and animates am emergent essence of unified being. The freedom of potential distils nature to a common related web of being, in which we have found our place along with herbs. The issue goes beyond the high funded projects of genetics and neuroscience to respect again the sacred integrity of the cell in its context.

The issue brings together several threads from previous issues of HSJ – molecular language, hermeneutics, biosemiotics, diversity within unity and succeeds in transforming the abstract discussion into a living test of health.

These signatures of health all point to the need for further research, but from a different perspective.

Philip Franses

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Ariadne's Thread: *"The Tetractys [also known as the decad] is an equilateral triangle formed from the sequence of the first ten numbers aligned in four rows. It is both a mathematical idea and a metaphysical symbol that embraces within itself—in seed like form—the principles of the natural world, the harmony of the cosmos, the ascent to the divine, and the mysteries of the divine realm. So revered was this ancient symbol that it inspired ancient philosophers to swear by the name of the one who brought this gift to humanity — Pythagoras."*

Pg 5 Seed Pattern of Labyrinth http://www.celestial-labyrinths.org
Pg 6 Islamic Sacred Geometry – *datachurch.com*
Pgs 11, 38, 42, 49 Joseph Stodgel, Platonic solids, Quetzalcoatl & Jaguar Man, Sri Yantra Form, Icosahedron
Pg 16 Aloe plant, the leaves are arranged in the form of a golden spiral, based on Fibonacci numbers Picture from *CSSNZ*
Pg 20 Images from the sound and frequency project of Ernst Chladni(b.1756-d.1827) who demonstrated the organising power of sound and vibration by representing the frequencies visually.
http://www.mbq.ca/images/sacred%20geometrycymatics1.jpg
Pg 24 Dr. Hans Jenny's Platonic Solid formation in spherical vibrating fluid. *http://www.divinecosmos.com*
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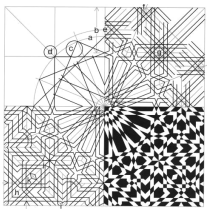

WHY IS THE SCIENCE OF LIFE SO DEAD? -6-

Paul Carter

Life means the same as the present.
There is no life that is not present: in and of the present.
In a lifeless world we are dealing only with past and future.
- Wolfgang Schad ***Man and Mammals***

Holes in the theory of life- are genes the right plug?

Modern evolutionary biology has Darwin as its starting point and biological knowledge has since been firmly cast within the theory of evolution by process of natural selection. This knowledge has continued undisrupted despite serious criticisms that the theory's success may result from possible tautological formulation[1]. A requisite of any traditional scientific theory subjectable to empirical testing is that it specifies logically distinct elements which are *observable*. If a theory fails to make specific the observations it claims to explain, the observable criterion is ubiquitous and thus approximates tautology. Ubiquity results because the parameter of the theory remains undefined so theory and evidence remain indistinguishable.

It is common knowledge that Darwin's original theory was incomplete, but to what degree is subject to a further debate [2]. The process by which inheritance is achieved constituted the missing link in Darwin's argument, and this was fulfilled by genetics in the rediscovery in the 1900s of Mendel's work published in 1866. The synthesis of Mendelian genetics with Darwin's theory of natural selection was accomplished during the Modern Synthesis (1920s-30s). This success, however, has had the unforeseen consequence of a science of life that is focused not on living things, but on the chemical processes–specifically the formation of proteins–that give rise to living organisms. Theoretical explanations aimed at the chemical molecular level completely overlook living organisms. Furthermore, despite dramatic success in revealing the patterns of gene activity in developing organisms, our understanding of genetics remains far from comprehensive. Most importantly, it is clear that genes fail to explain anything about how physical form arises. To be clear, genes do not explain the principles governing the process of morphogenesis.

There is little doubt that the logical formulation of Darwinian evolution provides the prerequisites of an explanation for the origins of morphological diversity and adaptation. But as it stands evolutionary biology merely interprets forms and adaptations in terms of historical explanations. For example, the remarkably complex structure of an eye is said to have evolved in increments from much simpler versions that had the same basic function. Such retrospective explanations seem to say a lot about how eyes came to exist, but fail to say anything about the generative process giving rise to this organ, and thus ignore the important question of how the form came to be created.

A further problem follows if we accept historical explanations as valid. These explanations cannot be tested because past, present and future instances of eyes appear as identical in theory and evidence. The failure to specify the logically distinct elements discussed in the beginning paragraph, lead to a peculiar blending of theory and evidence. The problem is evident in the imaginative and convincing arguments that emerge from *within* the logical structure of the theory in the form of evolutionary survival strategies; to continue with the example of the eye, those individuals benefiting from random variations of eye forms will produce more offspring with the superior and therefore naturally selected eyes. On their own it is evident these explanations are at best half-full. The curious thing about such widely accepted explanations is that they exhibit the rather unscientific ability of producing their evidence by interpreting our observations instead of being tested against

them. An un-testable scientific theory is tantamount to belief in a theory without recourse to empirical evidence. Belief, while necessary for the progression of knowledge, is, however, in some forms immune to doubt, especially when the theory appears to be supported by evidence. For those concerned with the future direction of the life sciences, and science at large, I argue for an expansion of the traditional scientific methodology of quantities (primary qualities) to incorporate *qualities* (secondary qualities), which, in addition to lending an ethical basis for the study of life, will open up new areas of enquiry that have been prematurely closed due to the theory of evolution's apparent success.

Living organisms: Between a rock and a hard place

The problem of the origin of species continues to evade scientific explanation. It has been observed numerous times that, despite its title, *On The Origin of Species* (1859) had much more to say about change *within* species than about the origin of new species. More recent insights arising in response to the mass of nucleotide sequences provided by computer-assisted analysis are accepted as constituting a more rational foundation from which to address this question [3]. This school of thought is influenced by Mayr's essentialist method which ignores the subtle 'variations on a theme' observable in a single species' population and argues that forms which vary discontinuously are putatively different in kind on the basis of genetic evidence[4].

According to this modern molecular view, genes are what define an organism, they are the fundamental units upon which natural selection act, so by understanding genes we can understand how organisms are formed and how new species arise. Yet the consequence of accepting this view is that we exit the study of life and are left only with the task of performing the rational classification of forms. Mayr(1963) conceived the ordering of forms in the philosophy of neo- Platonism and thus, as with similar essentialist species concepts, attempts to assign the variability of forms to a fixed number of basic kinds, i.e. taxon placed in ideal (Platonic) phylogenies (a hypothesised sequence of ancestor-descendent relationship of groups of organisms as reflected by their evolutionary history). As a result of this fixed ontological status, species taxa–the status of an organism's classification–have replace the living organism. In other words, the identity *taxon* is now interpreted as the individual 'organism' or 'wholes' – of which living organisms are merely a part. This philosophy (essentialism) has forced those who employ it to confront empirical variation, it is the very source of the 'species problem'. The key point here is that if genes are viewed as the sole agents responsible for determining the specific morphological traits of an organism, the resulting position is the *disappearance* of organism from biology.

Aside from the problems arising from a focus on genes as the answer to "What is a species?" there are other related problems resulting from the same focus on genes, these concern the *generation* of form. Darwinism as presently conceived assumes all facts of morphology are intelligible because of the genotype-phenotype causal relationship. In some cases we can claim with confidence that there is a genetic–chromosomal–difference that causes a difference in morphological properties. But this is at best only a partial explanation of the manifestation of properties for we do not know how the difference is made, nor why it is this difference rather than some other difference. The limited insights of genotype-phenotype patterns provided by the findings of Mendelian genetics are causing evolutionary biology to exhibit the character of a historical science, its purpose being confined to uncovering the genealogical–material and historical–relationships of organisms. This follows from the fact that the theory of evolution by process of natural selection and its effect on genes is taken as providing a general metaphysical foundation for explaining the origins of living beings. When this assumption is admitted it appears that there is no possibility of a scientific explanation of morphology as particular forms can only be explained by means of historical genesis. This is the case as explained above in the example of the origins of the eye. Webster and Goodwin ([2] p. 86) bring the point home: *[W]hile we do have real knowledge of some efficient causes or causal stimuli involved in the production of forms, we have, at present, little in the way of detailed knowledge of the causal*

mechanisms involved and, therefore, scant knowledge of how any particular form is possible, nor consequently of whether or not there are inherent constraints on the possible.

It is clear, if the above discussion is agreeable, that for biology to establish a *meaningful* understanding of life a dramatic re-orientation is necessary. To achieve this requires the development of a comprehensive theory of form which sets forth the principles governing the generation of organisms. Hitherto my enquiry has led to the recognition of two potentially complimentary candidates for such a theory. The first theory belongs to complexity science modelling, which links a theory of organism developmental dynamics to geometrical formations [2,,5]. By marked contrast, the second theory is that of *direct experience*. On the surface the latter approach appears in conflict with the former realist scientific perspective. However, this conflict only exists because the development of Western science has been one-sided. Sadly, this has caused us to neglect the rich source of knowledge at our finger-tips (our experience) as something less than real, as an inadequate form of knowledge.

"Secondary qualities" and the case for direct experience

The demotion of direct experience in Western science has occurred because the theory (that is ourselves) relies on 'secondary qualities' (colours, sounds, tastes and smells) that do not lend themselves to quantitative abstraction. Hence our experience is seen merely as *a* way of looking at the world and not *the* way of looking at the world. This discrepancy is the root of a problem which has only recently come in to view in our science and culture and can be formulated in the question "Is it possible for a world possessing only primary qualities to appear sensible?" To rephrase the question in relation to the subject of form: Can a computer model of morphogenesis which is comprised of primary qualities appear meaningful? In order to answer this question a brief overview of the assumptions and development of Western science is necessary. The discovery of a world that could be the object of numerical measurement was made by Galileo. In his feat of abstraction, the world became inhabited only by *bodies* divested of all but 'primary qualities' (shape, velocity, size, mass, position and number). In revealing this aspect of nature the development of mathematical physics was permitted. The enormous powers secured by this mode of investigation have produced such an overwhelming impression of success that its authority is beyond question. Yet the image of reality that the sciences have since developed excludes a great amount of our experience as uninformative–that is, *less than real.* But is this divorce of the scientific and the experiential a requirement for truth? The key concern here is that the truth of a measure is not able to *specify its meaning*, and, instead of feeling in the privileged position of possessing knowledge of the world, we are left with a scientific world picture that doesn't accord with the rich reality we experience as individuals.

A couple in love walking along the banks of the river Thames are shown to be mere particles in motion or mere genes acting selfishly. The act is left devoid of agency, absent of value. In order to make *sense* of the couple in love we need to engage our secondary qualities–that is, the *language* of the senses. We can thus say that we know the world of physics only mediated-ly as this knowledge is *deduced from the world of appearances*, and that the world of appearances is known more immediately, as it appears to experience [6].

Nevertheless, it is still entertained today that lawful mathematical relations revealed through measures testify to an underlying reality. The assumption that 'lawful' is identical with 'measurable' continues to be considered by many scientists to distinguish individual subjectivity from independent reality. In general, present scientific methodologies depend upon the measurement of primary qualities, and, since those qualities are assumed to be independent of the observer, methods of measurement are used that either omit the observer entirely or attempt to escape subjective variation by generalising on the reports of multiple observers. This is despite the inescapable fact that immediate experience is *individual* (not a good candidate for what is normally termed 'scientific observation') and is far richer than its measured relations. Scientific observations,

then, come to represent only a small part of the original content of our experience and hence necessitate their presentation taking the form of a "finished product" that is taken to represent something objective, static, a finished experiment.

By contrast, if we promote our senses as the method for our investigation, science becomes a living process aligned with the way we experience the world (I am not advancing this as *the* only method). The senses, just like in any scientific observation, will provide our primary data and the scrutiny of this information will be a cognitive exercise. It is important to remember that the senses do not *constitute* the observer. The conception of mind and senses as one indistinguishable process comprises what Bortoft calls the 'error of empiricism' [7]. It is now necessary to provide a brief explanation of how our experience can be an object of our attention, and how tending to this activity aids to bring for the appearance dynamic yet stable objects.

Making sense of our senses

Our knowledge of the world is based on sensory experience, but knowledge is not the same as sensory experience. Although we could not see the world without the senses, we also could not see it with the senses alone: We require cognition to make sense or to 'organise' the stimuli of the senses. This organisation is described by Hanson as not an element in the visual field, but "rather the way in which the elements are appreciated" [8].

For example, the lines, dots and dashes you perceive as the written text before you do not in themselves contain their meaning. Their meaning only exists in the way you are able to organise the words, that is, to make *sense* of them. If reading a written text is to be a meaningful act this requires more than the mere repetition of the sequence of words: A careful interpretation of the writing is necessary in order to gain its true meaning. However, a person who cannot read still perceives the same lines, dots and dashes– after all they exist on the page–but they will not be able to *organise* this perception in the way that someone who knows how to assimilate the words according to the grammatical rules governing their meaning. When the non-reader distinguishes the lines, dots and dashes as such this is also to perceive meaningful data. So when we are in the act of reading, the *meaning* that we are "seeing" is not in fact on the page, although it appears to be there. It comes in to existence in our cognition of it. Even in the case of the person who cannot read, the visual stimuli is subject to cognition. In the words of Henri Bortoft "In the act of seeing the world it *is* meaning that we see". [7]

Now we are in a position to better understand Goethe's remarks about the relationship between fact and theory:

Let the facts themselves speak for their theory.
Don't look for anything behind the phenomena; they are themselves the theory.
The greatest achievement would be to understand that everything factual is already theory. (Quoted from Bortoft[7])

I will draw my concluding remarks on considering how the science of life has fallen into a one-sided approach to the study of living beings. This imbalance can only be resolved by a science which values direct experience as much as, not instead of, quantities. Only when this is fully acknowledged will the science of life be able to come *back to life*.

Wholes in the theory of life

In postulating that the parts of an organism hold the key to understanding the underlying processes, or even laws, governing an organism's creation, modern biology no longer has its focus on the living organism but on its molecular parts. This is despite the general recognition that one cannot "deduce-up" from lower, more fundamental, levels of explanations. For example, the properties of water cannot be deduced, i.e. predicted, from a detailed knowledge of the way hydrogen and oxygen molecules interact. Nonetheless, some scientists think that many, if not all, facts about organisms are explainable by gaining an understanding of molecular interactions. [9]

Furthermore, this approach is grounded in chemistry, and not biology, that is to say, life. Chemical explanations in biology are inadequate, even when coupled with evolutionary narratives, because such accounts amount to little more than conveying the primitive notion of one thing "causing" another to happen. The method of explanation by mechanical models has been the way of

science from Descartes onwards, until its validity was called into question in the 20th century by the development of the quantum theory. The paralleled advance of biology in the 20th century has equally brought into question the appropriateness of not just mechanistic models but of complexity models, entertained within the discipline of systems biology. Complexity modelling may be more dynamic and therefore offer a better representation of biological phenomena, but it is clear that this approach violates Goethe's remark of not looking *beyond* the phenomena for a theoretical explanation. If, however, we practice an expanded science where secondary qualities are given an equal footing to primary qualities, our senses, and therefore our experience, become our method. Phenomena, then, can be discerned as unified 'wholes' and will no longer suffer the one-sided examination as mere collections of parts–the deadening grip of pure reductionism and quantitative abstraction (only aspects of this kind of whole, such as DNA, lend themselves to the equally valuable task of quantitative analysis).

A newly conceived biology that values qualities will pursue the phenomenology of form, dynamic forms which are empirically demonstrable [10]. In order to be brought forth as stable objects, unified wholes require the scientist's careful attention. When this is undertaken with skilled judgement the scientist is able to demonstrate her using the standard means- spoken language and/or written, numerical and schematic notational representations[10]. Such schematic representations, however valuable, are not recognised as the finished product of her work. Nor is it the aim of the investigation to produce and compile such knowledge. The process is continuous, living, dynamic and aims at understanding living beings as such. Notations, in this view, do not contain the whole *meaning*, or truth, of the scientist's knowledge; this exists primarily in the moments when the meaning is brought into being in the act of tending the appearance of the natural phenomena as it is, *in* and *of* the present. This admission means we are well on the way to rebalancing science from being theory-centered to putting the phenomenon first and supporting this with a complimentary theory.

De Profundis

The code for DNA may have been broken, but the language of the code remains distinctly foreign and incomprehensible. If we continue with our present commitment down the narrow roads of gene land, the only destination we have is the attempt to tackle the miraculous task of constructing an explanatory model capable of showing the processes of all molecular interactions in organismal generation. What I find disconcerting is the thought that this represents the path of the rational mind. For those tempted by this journey, I ask you: Will this quest be meaningful, especially in the darkening light of our present contributions to the rapid extinction of biodiversity? If we continue with this direction I doubt the outcome will be that of a triumph of science. Given the awareness we have that our science is steadily estranging our lives from the living world–the presence that Schad speaks of–we would do well to check our reasoning and *feel* the realness of the problems at hand. Countering our epistemological imbalance in this way is of great importance because it is the active neglect of our secondary qualities as a lesser form of knowing that leads us to unethical behaviour: Meaningless acts are invited in a meaningless world. Our present cultural-societal problems are the unwitting result of the one-sided development of a rational-analytical approach to knowledge. And yet at our finger-tips exists the means to escape the solitude and destruction we have found in these dead and narrowing roads.

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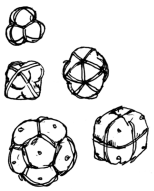


HOLISTIC PERSPECTIVES ON CANCER

Complexity, Coherence and Context

Laura Batson

When human life comes into form, during its period of organogenesis, tumours are not able to grow. Why is this? Dr. Pier Mario Biava explores this phenomenon and its implication for cancer treatment, in his groundbreaking book: *Cancer and the Search for Lost Meaning.*[1]

Before Dr. Biava's eureka moment in cancer treatment, he journeyed through a professional and personal transformation in thought; his understanding of health and disease evolved from a molecular epistemology, to a holistic epistemology that *included* molecular biology but also refused to reduce living beings to genetic material. With the realization that less than 2% of all diseases could be traced back to the alteration of a single gene, Dr. Biava knew something more than the gene had to be considered in order to grapple the complexities of disease in general, and of cancer in particular. With this insight, Dr. Biava turned to the mathematics of complexity theory, and together with pulses of intuition, he came to the conclusion that cancer genesis is due to a loss of complexity, coherence and meaningful context.

This paper proposes a more-than-molecular understanding of health and disease as it relates to cancer. Concepts of biological coherence are presented, along with the science of complexity theory, and the role of context in the generation of meaningful relationships. It then highlights the work of Dr. Pier Biava as an example of how this holistic epistemology is leading to exciting outcomes cancer research.

A More-than-Molecular Understanding

The Somatic Mutation Theory has dominated cancer research for the last 50 years.[2] This is a molecular theory stating that tumours originate from genetic mutations in a single cell. According to some proponents of this theory, "…all the complexity of cancer on any level (e.g., tissue) can be explained on the molecular level."[3] The error in this way of thinking was pointed out by Dr. Paul Weiss, professor of biology who, in 1951, introduced the term 'molecular biology' to his curriculum. He was attempting to reorganize biological studies into genres indicating the scale of magnitude of biological investigation.[4] According to Weiss, however, scientists mistakenly took molecular biology to mean the most important level of investigation. He defends: *"Nothing in the nomenclature insinuated that [molecular biology] should assume the role of pars pro toto. As I once put it, there is no phenomenon in a living system that is not molecular, but there is none that is only molecular, either."*[4]

Cancer cannot be understood solely through molecular theory.[5,6] Knowledge of molecules alone is not sufficient to explain the properties that arise at higher levels of organization, let alone the complex dynamics of how these multiple levels of organization are coordinated in health and disease. Both the molecular and more-than-molecular levels of organization must be considered. The truth is: the *whole* of cancer is more than the sum of mutations. After all, genes mutate all the time and yet cancer does not develop. This makes sense considering the regulatory systems in place at higher levels of organization such as tumour suppressor proteins which repair gene mutations or immune cells which detect and destroy cancerous cells.

As stated by Dr. Paolo Bellavite, MD: "If the molecular disorder is not compensated for by supramolecular systems, it is the latter that are responsible for the disease, and not the molecule."[7]

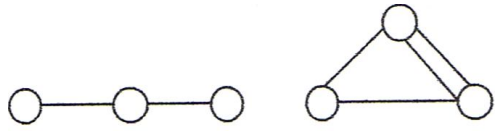
So which comes first: the genetic mutation or the cellular dysfunction? According to Tissue Organization Field Theory, the latter comes first. Carcinogenesis takes place at the level of tissue organization by disrupting the normal communication between cells and their surrounding matrix.[8] It is the disruption of normal cell function that then leads to alterations in gene expression. This is referred to as an epigenetic causation.

While scientists debate over chickens and eggs, the relevant conclusion is that *both* events are occurring: 1) information is altered on a genetic level—in the form of gene mutation, and 2) communication is altered on an epigenetic level—by errors in the interpretation of information from gene-to-proteins and cell-to-cells. The result is a cancerous growth, in which malignant cells proliferate ceaselessly while losing coherence with the whole organism.
To better understand this incoherence between the part (cell) and the whole (organism), it helps to understand how coherence emerges in states of health.

Coherence
In health, a living system is poised between maximum freedom of its parts and maximum coherence of its whole.[9] In similar thought, Paul Weiss wrote in his 1968 publication, *Dynamics of Development*: *"elements are subject to constraints of their degrees of freedom so as to yield a resultant in the direction of maintaining the optimum stability of the collective."*[10]
Weiss offers this equation to explain:
Vs < (va + vb + vc +.....vn)

The variance (V) of the whole system (s) is significantly less than the sum variance of its parts. "In short," he says, "the basic characteristic of a system is its essential invariance beyond the much more variant flux and fluctuations of its elements or constituents." The whole acquires coherence, maintains stability, while at the same time the parts retain their flexibility and variations. Maintaining maximum variation of the parts in context with maximum coherence of the whole means creative and adaptive changes can arise at the level of the parts while maintaining meaningful relation to the whole. In the organism, this means: 1) the cells are exploring possibilities while always relating back to what is appropriate and most meaningful for all other cells and the organism; and 2) The organism is actively interpreting the cells and engaging their potentials in a direction most appropriate for coherence and stability. It is a hermeneutic circle of sorts.
In cancer, the healthy part-whole relationship is altered. Cancer cells proliferate relentlessly, exploring maximum freedom without perceiving what is best for the whole organism. At the same time, the organism is not interpreting this sudden freedom as being detrimental to its health. This breakdown in part-whole relationship is a breakdown in communication. And it can be attributed to a loss of information complexity.

Complexity
Essentially, when a system gets its level of complexity right, communication takes care of itself. This is a key concept that will be elaborated in the section on Dr. Biava's discoveries in cancer treatment. For now, what is meant by complexity?
Complexity theory describes how order emerges from highly complex systems, where 'complex systems' are not defined as systems with a high *quantity of things* per se, but a high *quality of expressions.* It is not so much the number of components in a system, but the number of possible relationships between these components, that defines its complexity. The two images below provide a simple example.



The diagram on the left is less complex than the one on the right, not because it has fewer components (circles) but because it has fewer relationships between its components (lines). Another example is the genome of humans compared to fruit-flies. Humans have nearly the same number of codifying genes as the fruit-fly, however humans are far more complex beings. Our complexity is not due to greater quantity of genes, but due to greater regulation capacity: we have more flexibility and possibilities of relationships between our genes. Through splicing and recombination, the same gene can code for multiple different proteins. As well, genes are turned on and off at different times and in a multiplicity of combinations, depending on when certain proteins are required. Moreover the same molecule can have different functions depending on its cellular environment. For example, lactate dehydrogenase is an enzyme

found in muscle. This same molecule, under a different name: crystalline, is a structural component in the eye's lens. This redefinition ability is important for the robustness of a system.

Complexity ensures that multiple possibilities are available at any given moment, adaptive changes can readily be made, part-whole relationships are balanced between freedom and coherence, and order is never too still while disorder is never too rampant. Achieving optimal complexity means having just the right amount of dynamic connections between the component parts and the whole, so that dynamic order emerges in the direction of health.

In cancer, this complexity between the part and the whole is lost on many levels: "The malignancy of cancer results from a breakdown of the fundamental rules that govern how cells organize within tissues, tissues within organs, and organs within the whole living organism."[11] The cancerous cell is no longer in meaningful communication with all other cells and the organism. For example, cells normally grow until they make contact with other cells, at which point they send signals back and forth to tell one another to stop growing. In cancer there is a significant loss of gap junctions – small pores in the cell membrane which allow signal to transfer between adjacent cells. As a result, signals that stop cell growth are no longer being perceived by cancer cells.

It must be noted that the tumour itself is not disordered, otherwise it would not be able to survive and proliferate. Rather, the tumour has assumed a new order of complexity, one that is not in resonance with the complexities of all other cells and the whole organism. This new order of complexity is called a new "attractor state" in the mathematics of complexity theory. The gene networks are 'attracted' into a new and stable configuration of relationship, resulting in a transition in cell phenotype and function, from differentiation to proliferation. The pathways of communication are many and tangled within the cancer attractor state. Molecular and cellular biologists have produced impressive amounts of work, mapping these multiple pathways (see figure below). The idea being, if specific genes or proteins or signal transduction pathways can be identified, then they can be targeted and disrupted by pharmaceutical therapies, causing cell death. In practice however, over 100 oncogenes and over 15 tumour suppressor genes have been identified and yet we are still far from a cure.[8] Many problems arise when specific genes and proteins are targeted in cancer therapy. Most notably, cancer adapts. Malignant cells are highly robust; they find ways around obstacles to growth. This is because, as mentioned earlier, carcinogenesis is a state of complexity, where flexibility and redefinition ability are in full swing. Cancer is too intelligent for our linear approaches.

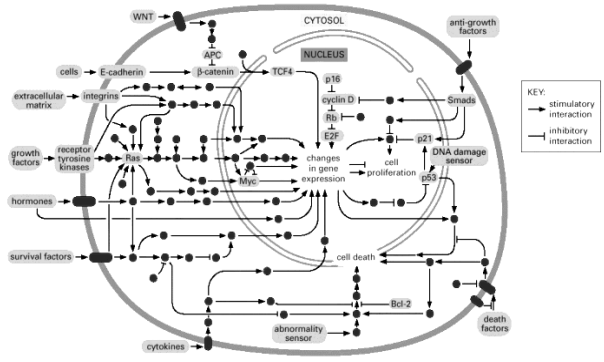


Fig. 2: Major signaling pathways relevant to cancer in human cells.[12]

As maps continue to be filled with more and more lines of causation, the dilemma continues to be: "The great increase in the *extent* of our knowledge is not enough to guarantee an *intensive* understanding of the deeper meaning which the abnormalities observed have in the dynamics of the onset and development of disease process."[7] The disease is deeper than the component parts and all their miscommunications. The underlying dynamics have been altered. And, as the cancer cell transforms from one order of complexity into another order of complexity, there is a break in the meaningful connection between cell and organism.

So, rather than intervening in individual communication pathways, what if we exposed malignant cells to a level of complexity that informed them how to re-connect with the whole again? This is exactly what Dr. Biava had in mind.

Restoring a Meaningful Context: the experiments of Dr. Biava

Rather than attempting to kill cancer by deleting single genes or targeting single

pathways through the use of pharmaceuticals, we can teach cancerous cells how to re-differentiate by providing them with the information complexity necessary to re-relate to their environment in a coherent way. In other words, when a system gets its level of complexity right, communication takes care of itself.

Where will this information complexity come from? Dr. Biava did not turn to a cocktail of pharmaceuticals. Rather he looked within, literally. Our very own embryos hold answers. The greatest regulation capacity of our genes occurs during embryonic development, when the multiplication and specialization of over one quadrillion cells occurs at an extraordinary pace. An impressive level of coordination and coherency must balance the high amount of multiplicity and diversity occurring simultaneously. By the third week of gestation, rapidly dividing stem cells are beginning to commit themselves to specific organ systems. This stage of development is called organogenesis. Certain genes are turned on and others are turned off, shifting the cellular morphology from proliferation into differentiation - a process of specialization into tissues and organs of the foetus.

Remarkably, during this stage of organogenesis, tumours do not develop. In his research on toxicology and cancer, Dr. Biava discovered that embryos, exposed to toxins during organogenesis, did not develop tumours. Rather, the cells mutated and were either repaired completely, repaired partially and resulted in life-compatible malformations, or the mutations were too severe and the cells spontaneously aborted. Malignant transformations were never an option.

There must be something about the embryonic environment during this stage of development that is resistant to tumour growth. And if so, then perhaps the embryonic environment could resist growth of cancer cells *introduced* into the embryo. To test this hypothesis, Dr. Biava performed in vitro experiments implanting human cancer cells into cultures of zebrafish embryonic tissue. To his amazement, the cancerous cells reversed their malignant phenotype.

Dr. Biava is not alone in this paradigm of thought. Dr. Paul Kulesa and a team of researchers[13] transplanted melanoma cells into embryonic chick tissues. The cancerous cells incorporated themselves into the surrounding chick tissues, becoming *re-programmed* into neural-crest-like morphologies and distributing along host neural-crest pathways.

In similar experiments, Lee et al. [14] transplanted human metastatic melanoma cells into zebrafish embryos. The cells survived and divided without forming metastatic tumours, rather they became incorporated into the interstitial spaces of the embryo.

Intrigued by these findings, Dr. Biava wanted to know *how* this was possible.

First, he noted that embryonic cells are very similar to cancer cells. Characteristics of cancer cells include processes such as proliferation, migration, tissue invasion and stimulation of blood vessel growth; these are all characteristics of cells during embryonic development. Cancer and embryonic cells share similar metabolic pathways; rather than oxidative phosphorlyation, they use glycolytic energy production. Also, there is a convergence of signalling pathways with common molecular messengers and protein expressions such as alpha-fetoprotein and placental alkaline phosphatase. It is as though the cancerous cell has reverted back to the attractor state of an embryonic cell, and thus reactivating embryonic genes – genes that have long been turned off.

The difference between cancer and embryonic cells is that cancer cells are trapped in a state of proliferation, whereas embryonic cells eventually change their program of proliferation into a program of differentiation when the time and place is appropriate for organs to form. Embryonic cells have an extraordinary sense of spatial-temporal order, relating to one-another and the whole in a complex and coherent manner. The cancer cell does not have this context. The cancer cell is proliferating without coherent relation to all other cells and the whole. The difference is: context. The context of the embryo includes not only the part-whole relationships of the developing embryo but the entire microenvironment encasing the embryo, that of the mother's womb.

The mother's womb creates a micro-environment with maternal factors responsible for guiding embryonic gene and protein

networks. This 'embryonic milieu' [13] between embryo and womb is an information rich exchange.

The cancer attractor state is not appropriate in the context of a fully formed being; there is incoherence between the cancerous states and the whole organism. However, when a cancer attractor state is placed into an environment with a similar attractor state (in embryo), within a microenvironment that provides a relevant context (womb), then proper communication occurs. The cancerous cell is informed to differentiate and become integrated into the whole again. By providing the right level of information complexity, cancer cells become reprogrammed.

The hope is that this pool of embryonic and maternal regulation factors can be collected and compiled in a way that they can be administered to people with malignant tumours, to induce a reversal of malignant phenotype. In Dr. Biava's words, it is a "shift from therapies centered on synthesis molecules that do not repair the organism and have adverse effects, to therapy using networks of biological molecules that constitute a correct information therapy aimed at balancing the networks of which the organism is made." The dilemma we face now is: how can the embryonic and maternal *context* be extracted and preserved so that the information complexity is not lost? Dr. Biava is working to decipher this mystery as we speak.

Epilogue: The Larger Context

While Dr. Biava's experiments are of a molecular nature, they are founded upon a holistic understanding - a way of knowing that includes molecular biology but also refuses to reduce living beings to genetic material and deterministic fates. Old truths speak loud in his work: the whole is more than the sum of the parts; the wisdom to heal resides within, and; meaning is not held in the parts, but comes forth through their relationship.

Dr. Biava presents a story of cancer in which coherence, complexity and meaningful relationships are lost.

As an extension of this understanding, we must note that this loss of meaning is not limited to the molecular and cellular level of organization. Cancer is a pathology of our modern society, psychology and relationship with our environment. Cancer will only be healed once we realize the healing that must occur on all levels of life, for which we are all connected. With this insight, Dr. Pier Biava brings his book, *Cancer and the Search for Lost Meaning, to a close:*

"Never before has society lacked so much meaning…cancer is one of the by products of this loss of meaning. Cancer, as I said earlier, is a pathology of significance: the codes needed to communicate in living beings are changed in tumour pathologies. These codes attempt to reorganize and re-establish life in instances where it has lost meaning. Healing caner also means finding meaning in our existence…We belong to the world and must reclaim our sense of belonging in order to widen our consciousness and give meaning to our existence…"

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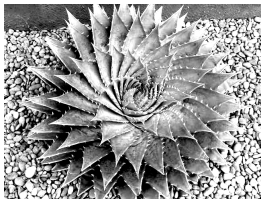

PLANT–PERSON ATTRACTORS

Isla Burgess

The physicist Erwin Schrodinger in 1944 wrote a paper headed "What is Life?" in which he discussed life's two secrets. The first secret, that of genetic inheritance, has been well researched successfully by Biochemists and Geneticists but it is the second, that of "the spontaneous emergence of self-organised order"[1] that requires an investigation from a more integrated world view.

This "spontaneous emergence of self-organised order" as it relates to a human being is a moment by moment response to intrinsic and extrinsic factors. The effectiveness with which a person achieves that emergence is an indication of their state of health. So with apologies to Schrodinger the first part of this human-centric paper investigates "What is health?" Part Two investigates a novel theory about how to nudge the "spontaneous emergence of self-organised order" in the direction of 'health'.

PART ONE
The Macro-level

Intrinsic factors and their impact on health studied in physiology and biochemistry provide causal associations and are indicators of various dis-ease states. These include changes in blood chemistry (due to nutritional variations), blood tests for various disease markers, understanding cytokines and urine analysis to name a few. Each healing 'system' or modality has its idiosyncratic view, some less fragmentary than others. For example conventional medicine being more fragmentary than say Ayurveda or Traditional Chinese Medicine. BUT "Reductionism cannot solve the secrets of emergence"[1] therefore we need to look beyond the macro-level to the micro-level of Chaos and Complexity theories for further insights.

The Micro-level
Chaos Theory
The story begins with the work of Edward Lorenz, a climatologist, who in 1963 demonstrated that the solutions of equations involving atmospheric variables are unstable and unpredictable, irrespective of input and advances in the computational ability of computers. The new field of mathematics that leads on from Lorenz's work was called "deterministic chaos", because the process described by the equations could behave in unpredictable yet uniquely patterned pathways, showing a subtle order within what appears to be disorder. When graphed, these equations demonstrate a dynamical system (a state that evolves over time), whose activity can be represented by what is called an "attractor", a bounded area within space. An "attractor" could therefore be defined as a bounded state that incorporates the potential for and display of patterned variability (deterministic chaos) over time.
The application of these concepts to health is relatively new in the literature yet all the factors are present. For example there is chaos and patterned variability (within boundaries) in the human body.

Chaotic systems in the body
Deterministic chaos (within boundaries) appears to play an essential role in "good health",[3]in the heart beat, [4] and in the brain. [5] These are characterized by complicated irregular moments out of which a pattern arises. When the dynamic form becomes more stable as seen in the development of pathologies, (those that develop over time), the attractor is more like a "limit cycle", a system that cycles periodically over the same set of states", indicating no chaos. [3]
The human body has bounded states within which it functions optimally. Each system within the body has its own intrinsic pattern and is also connected with all the other systems through feedback. This is seen in the

menstrual cycle and its hormones, chemical signalling in the immune system and microbiological interactions in the digestive tract. In the whole organism, health is a state that could be seen as an "attractor", bounded by the parameters that allow life to exist but within which there is both order and chaos. [4]

Complex systems in the body

"The key differences between chaotic systems and complex ones lie in the number of interacting parts and the effect that this has on the properties and behaviour of the system as a whole". [3] Chaos can be seen in complex systems involving fewer parts or subunits of that system. It produces "very intricate dynamics" [3] that are deterministic and sensitive to minute changes in input.
Complexity theory develops this further to explain the complex effect that emerges from the interactions of the many parts found in dynamic nonlinear systems, for example, in the human body.
People with the same dis-ease states exhibit similar symptoms. The interaction between the systems of the body normally generates complexity. This is reduced during disease from a more complex system (health) to a more ordered one (disease).

This may appear to question Schrodinger's second of "life's secrets" but in fact it supports it. While intrinsic chaos is reduced in disease patterns and therefore changes the complex relationships within the body, it is the overall 'health attractor' that is the "the spontaneous emergence of self-organised order". [1]
It is a person's ability to respond to any change in input with flexibility, adaptability and resilience, that contributes moment by moment to the ongoing emerging state of health.

PART TWO

A novel theory about how to nudge the "spontaneous emergence of self-organised order" in the direction of 'health'.

There are references in the herbal folklore that a person has a plant 'ally'; a plant that acts for that person in a way that is more than the sum of all of its known actions. The idea of using a whole plant to restore or maintain the 'health attractor' supports this traditional idea.
Could the introduction of an appropriate complex and chaotic system into the human body such as a whole plant restore and maintain, the "health attractor"?
That plants and humans have the same origins and share many similar cellular functions is as certain as anything can be in science and although little research has been carried out to date there is evidence that plants exhibit deterministic chaos and they are complex systems. [7,8,9,10]
The question that now needs to be asked is that since not every plant could facilitate the restoration of the 'health attractor' for every person, how can we determine what plant for what person?
One way to build this person/plant relationship is through phenomenological and qualitative assessment from a Goethean science perspective.

To match the qualities of the person and the plant means that one would have to know both well. The author has carried out some preliminary work on using a guide as a way to assess these qualities and has facilitated workshops among both health professionals and interested public. The Guide includes questions on 'Qualities *in situ,* physical characteristics, cycles, growth and Seeing-in-Beholding'. It is still being refined and a before and after Health Questionnaire is being used as a gauge to changes in health status after using the plant at three and six months.
It is early stages in the research but one anecdotal report with one person demonstrated that even a very small dose of the chosen plant had a significant positive impact on the person's wellness.

Perceiving Qualities through exact sensorial perception

The chart below is a guide to summarizing the qualities of both the plant and the person. An initial list of qualities of plants was prepared from prior knowledge through spending time working with and observing medicinal plants. These qualities are the focus for questions for interviewing people. Some observational qualities could be added to those identified through questioning.

General Qualities for Plants and People. A practitioners guide.

Plant	**Person**
Qualities *in situ*	**Qualities *in situ***
Thrives in	**Thrives in**
Open, forest, edge of forest	Open, forest, edge of forest
Mountains, lowland, cultivation	Mountains, lowland, cultivation
Coastal, inland, inland waters	Coastal, inland, inland waters
Shade, full sun, mixed	Shade, full sun, mixed
Dry, wet, moist, tolerant	Dry, wet, moist, tolerant
Rich soil, medium, shallow, sandy, rocky, all	Rich, medium, light, all (food requirements)
In communities, in "nuclear" family, singly, all	In communities, in "nuclear" family, singly, all
Found in many places	Lived in many places
Physical features	**Physical features**
Appearance	**Appearance**
Plant - Glossy, dull, midway, blushed, pale	**Hair and skin -** Glossy, dull, midway, blushed, pale
Dark, light, medium	Dark, light, medium
Dry, moist, warm, cool	Dry, moist, warm, cool
Thick, fine	Thick, fine
Flower – bright, sparkling, dull	**Eyes**– bright, sparkling, dull
Obvious, hidden, watchful	Obvious, hidden, watchful
Pistil – White, red, coloured, dry, moist	**Tongue** – White, red, coloured, dry, moist
Touch Harsh, soft, velvety, rough, smooth, hairy, prickly, thorns	**Skin**- Harsh, soft, velvety, rough, smooth, hairy, prickly, thorns
Smell None, light, fragrant, unpleasant	**Smell** None, light, fragrant, unpleasant
Stature – Tall, medium, short, close to the ground	**Stature** – Tall, medium, short, close to the ground
Upright, stooped, bent, flexible, cascade	Upright, stooped, bent, flexible, cascade
Nutrient Preference	**Nutrient preference**
Amount Regular feeding, irregular	**Amount** Regular, irregular
Rainfall	**Fluid Preference**
High/Medium/Low	Always thirsty, >8glasses per day, 6-8 glasses per day, <6 glasses per day
Cycle	**Cycles**
Annual, biennial, perennial, evergreen	Same all year, different energy seasonally
Growth	**Metabolism**
Fast, average, slow	Fast, average, slow
"Seeing in beholding"	**"Seeing in beholding"**
Noticeable, hidden, partially hidden, secretive	Noticeable, hidden, partially hidden, secretive
Watchful, attracting, repelling	Watchful, attracting, repelling
Strong, fragile, average	Strong, fragile, average
Competitive, non-competitive,	Competitive, non-competitive,
Earthed deep, superficial , average	Earthed deep, superficial , average

Method used in assessing qualities.

I first interviewed each person asking questions relating to each of the qualities seen in plants. I then used "exact sensorial imagining" to come up with a possible plant and then listed its qualities alongside that of the appropriate person. I then added the number of similar and dissimilar qualities shared or not between both plants and people for each section. They are totalled to give an overall number of similar and dissimilar qualities and written as a percentage of similarity.

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Totals for each assessment

Participant 1

Similar qualities = 25
Different qualities = 8
= 75.45% similarity

Participant 2

Similar qualities = 27
Different qualities = 4
= 84% similarity

Participant 3

Similar qualities = 26
Different qualities = 7
= 78.48% similarity

Participant 4

Similar qualities = 26
Different qualities = 6
= 81.25% similarity

Participant 5

Similar qualities = 19
Different qualities = 12
= 61% similarity

Participant 6

Similar qualities = 32
Different qualities = 6
= 84.2% similarity

Conclusion

This theory about using a plant as a 'health attractor' could be tested by using an objective and subjective health assessment before ingesting the plant daily for a year. This assessment could be done again at six months and at the end of the year. As a herbal medicine practitioner I feel the addition a more qualitative assessment of a person, to the more formal clinical case note intake form would be a beneficial one. It provides a more holistic approach to the claim of being a 'holistic practitioner'.

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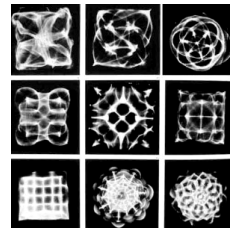
Decorative pattern from Pithoi (storage jars) ca. 700 BCE, found in Ialysos, (possibly an abstraction for water swirling around rocks)

Philip Franses, Andrea Lugli, Bruno d'Udine

(In collaboration with Massimo Mercati and Aboca herbal products in Italy)



Introduction

Though herbs have been used since antiquity for healing and prevention of sickness, scientific discoveries in the 19th century supplanted the traditional remedy with what was considered a superior knowledge of pharmaceutical agency. A herb was then reduced from its chemical diversity to an active principle that could be isolated and synthesised as a chemical drug. The testing of a reproducible effect at the micro level supplanted the need to consider the working of the herb at a macro level.

In this paper, we move beyond a strict underlying analytical order and will encounter the herb in its essential wholeness, embracing once again the living aspect of the herb and its qualities. As the typical properties of a complex system are in strong relation with the number of components of the system, variation is considered a measure of the quality of living health granted by the herb. This approach is used to interpret results from metabolomic fingerprinting, characterizing the fluidity of the micro-level composition of the herb, and to explore its macro-scale signature by principal component analysis.

Micro and macro

The question addressed here: 'is there such a thing as the whole herb that defies description into its parts?' What is it about the internal structure of the herb that allows us to identify its taste, recognise its smell and trust in its particular healing properties? There are three approaches one might use to explore the whole character of the herbal phytocomplex, here defined as the total constituents of the living herb.

A molecular approach might separate the different parts to highlight their connection in relationship. This research inquiry, full of its own terms for entities, processes and interactions, relates, through an exquisitely conceived logic, to another piece of research equally delicately conceived about a proximate collection of functions. A layman is astonished that this logic, which is a perfect exposition of the necessary connection to allow both systems their small but required place, occurs in a minute context with no sense of the whole that will be realised through their interaction.

A holistic perspective on the other hand might begin with the whole qualities and work down into the manner of operation. A treatise on the herb interprets areas of function simply for their contribution to inform the whole encounter, be it in taste, smell, healing, as if the character of the whole determines identifiable parts in their proper place. The logic of the research is paradoxically hidden as if behind a veil in the clarity of qualitative response and the surety of the world it makes visible.

Finally it is the task of complexity theory to investigate the dynamic between molecular and holistic approaches. The micro-level is seen as an active potential, which influences and is influenced by the macro-existence. The potential at the micro-level, instead of committing itself to a fixed order, realises qualities at the macro-level that characterise the whole herb dynamically according to context.

Information

Mathematical theory explores the world at the boundary between the potential at one level of existence and the properties of bounded though unpredictable order that occur at a higher level.

Information differentiates an object from its surrounds by separating a property when one asks the right question of it. A redundancy of possibilities at the micro-level is interrogated to reveal properties of the macro-existence.

The more freedom in the micro-layer, the more questions we can ask to differentiate which way a potential is constructed to arrive at the whole.

The point about information is that it describes a quality or property of an object by making use of a redundancy of description at a micro level compared to the macro-level existence. A quality is present to the whole existence only due to an excess of possibilities at the micro-level, which can code for that information.

A quality slips in, through the discrepancy between two layers of description of phenomena. If there was only the micro-layer, a taste would have no significance, but be an arbitrary side-product, like heat dissipation. If there were only the macro-layer then there would be only a sameness in all circumstances without differentiation. It is in having both, that the property realised by one potential path at the micro-level is identified with the common whole experience at the macro-level.

Thus we have an example of how information stands between the scientific arena of the small and the holistic domain of large principle as an intermediary notion.

We can follow this journey from the micro to the macro in complexity theory. In complexity theory too, it is possible to generate computer models which track the development of associated variables to the whole emergent forms they realise. Again one finds that a simple prescription of interacting variables have attractors that limit and organise the phenomena at a higher level.

The original and most famous exploration is the Lorenz attractor that defines the micro-level through the variables (such as temperature) that characterise a simple atmospheric model. The variables are joined by equations depicting their interaction. Computer simulation then gives a visualisation of the three-dimensional macro-attractor regulating how the qualities of micro-variation play out. Again if there was only the micro-level there would be no constancy in weather pattern for life to evolve; if there was only the macro-level there would be no variation; it is in the interplay that the dynamic is born where coherent qualities of climate are recognisable and utilisable by life.

The interweaving of potential and form has a rhythm, which defines an adaptive relation to order. The characterising, fractal, self-repeating pattern is not limited to a pre-existing order, be it space or time. In life, quality is rather something, which defines the order of the micro and the macro-level by characterising potential in some defining act of distinction of the whole existence. Quality embodies the pattern bridging potential and order.

Life typifies itself by the enormous latent potential for different behaviour to emerge according to context. Unlike a table that is committed to a certain order and requires great energy input to become anything else, a plant has latent potential which has many different combinatorial possibilities for realisation.
Yet the herb in its fruit and flower demonstrates an aesthetic and effective unity far surpassing any object designed on ordered principles. Where does this coherence come from, if we look beyond a template of order fixed in its genes?

One has to enter into the dimension of the herb to appreciate the completing quality of order out of potential. As the dynamic relation between potential and order reveals itself as pattern when confined to static linear dimensions of space and time, so the herb appears in its qualities when viewed in the intensive dimension of its own completion. Any analysis of the herb in terms of space and time comes after the herb has defined order for itself through the qualities that mediate with the unordered potential.

Pharmaceuticals have taken the body further and further into order, as if there lies the taming of something unruly, while the healing of the herb in its natural qualities, exists in the tune of the body's own flexibility.

Herbal Complexity

This relationship between micro and macro level existence is illustrated in the production

of herbal remedies. The micro-level redundancy of possibilities relates directly to the abundant mix of compounds, the folding of surfaces to align potentials together, the effect of genetic variations, the contextual stimuli, the amount of sunlight to give energy, the availability of minerals in the soil, the competition on resources etc. The herb will still be recognisable through its qualities of appearance, taste, smell and healing traits at a macro level whatever its particular variation of composition at the micro-level.
There is a choice to be made, whether the pharmaceutical compound is more reliable because it has eliminated redundancy, or whether the multiple possibilities in the herb contribute to its qualities.

The processing of the living herb to make an extract will necessarily diminish the compound richness. Any kind of handling/processing changes and reduces the original complexity of the herb. One assumes that a range exists in which such a reduction in complexity is acceptable, while if the loss in complexity falls below this, the result may be to lose information on which the higher qualities are dependent.

Although one cannot play back the unfolding of emergence, as this occurs outside the frame of repeatability, one can inquire into what are the necessary starting conditions for emergent qualities to emerge.
We can show this diagrammatically as follows:

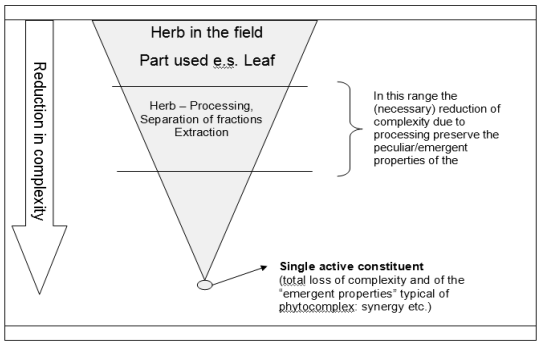


Figure 1 The typical properties of a complex system are in strong relation with the number of components of the system. While a certain diminution of components is tolerated, when the level drops below a certain threshold, the complexity falls away.

Implication of variability
Using mass spectrometry, L. Mattoli et al analysed the constitution of plants through metabolomic fingerprinting. The abundance and classes of component molecules were recorded for a variety of samples of several different plant types. The herb sample's composition was then classified as a point in a three-dimensional plot using principal component analysis. ('PCA is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called *principal components*, which are linear combinations of the original variables. ('The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for the remaining variability.')

As the iron filings shows the presence of the magnetic field, so the clustering of samples of a particular herb indicate the presence of a morphogenetic attractor, arising out of the complexity of the herb potential. We interpret the clustering of sample constituents about a herb-type as the influence on the different samples of an intangible source of herbal quality.

If we delimit the common spread of samples about a herb-type norm within a box, then *the breadth of the sides of the box measuring relational difference expresses indirectly the depth of quality of the whole herb.*

The greater the diversity of possible sample constitutions to which the herbal quality gives coherence, the stronger the attractor that influences them. The more variation in the herbal compositions, then the stronger is the qualitative attractor of the herbal source. The herb samples express a characteristic quality, despite their differences in compositional make-up.

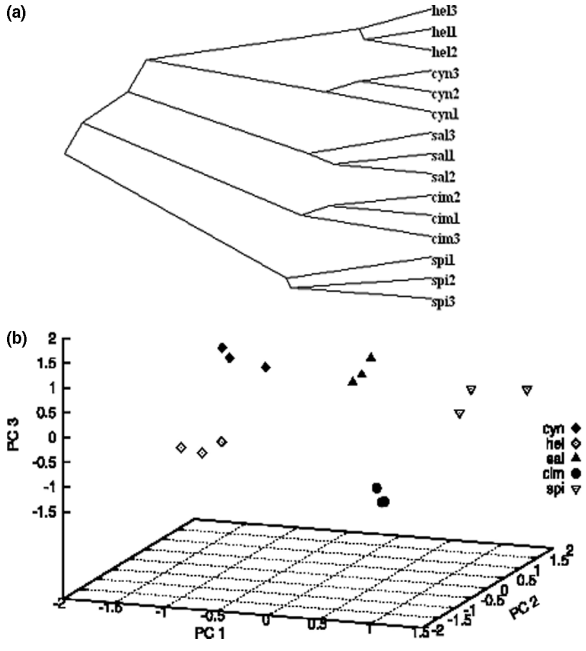


Figure 2 The characterising of the herb on a three dimensional plot demonstrates the balance between variation in potential and the influence of the herbal quality.
Cluster analysis (a) resolution of sample variability is true to herb type; principal component analysis (b) of the negative ions characterises a selective consistency for each of the five considered species:
cyn = artichoke; hel = everlasting;
sal = sage;cim = black cohosh; spi = meadowsweet.

The possibilities at a lower level of the system stays indeterminate and a quality appears at a higher level that encompasses all the potential in what exists below it. As soon as we try to focus upon the question of the parts to determine how the quality arose we lose the insight that every route to the whole is encompassed in the higher quality. If we look down from the higher quality (of the taste of a herb) then it is impossible to extract how the wholeness originates, it bestows a feeling of floating over the world of causes from which it originates.

Conclusion

Our approach shows how *variation* in the samples allows for the quality of the *whole* herb to manifest. This contrasts with the usual direction in science, where an initial *sameness*, a picture of molecular interactions, accounts for the herb in all its potency through the application of laws that account for *diversity*.

When we try to limit the potentialities to any exact mechanically functioning entity we have a flat picture without informational depth. While allowing variation, the study finds that there is a clear window of identity for each herb. An area/box in the three-dimensional graphical plot of principal component analysis encloses all the variants within a limit of deviation for each herb. The spectra of compounds in different batches are observed to exhibit minor differences, but each sample occurs in a specific region, typical for that plant.

The variability in composition of ingredients that results in the same quality of the plant coheres under the influence of the same outcome of quality. The breadth of relational variability of the plant is a measure of the reach of influence of the assertion of the quality.

The principle of variation being a natural route to explore unity, leads to exciting new ways of applying science to health.

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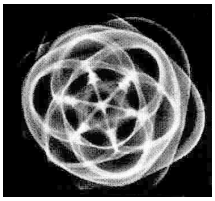

BIOMARKERS, SELF-ANTIGENS & THE IMMUNOLOGICAL HOMUNCULUS

Irun R. Cohen

Authors note

[Since 2007 when this article first appeared], we are still working on the development of the normal autoantibody repertoire and cannot say at this time that we have uncovered a specific signature indicative of health.

Abstract

The notion of the immunological homunculus arose from the observations [1] that the healthy adaptive immune system is inclined to respond (T cell reactivity and auto antibodies) to particular sets of body molecules (self-antigens) and [2] that autoimmune diseases are characterized by sets of autoimmune reactivity to some of the very same self-antigens recognized by healthy subjects - with an obvious difference in outcome. I termed this natural autoimmune structuring of the immune system, the immunological homunculus - the immune system's representation of the body. What might be the selective advantage of an immune system expressing patterns of built-in autoimmunity to particular sets of self-molecules? To better characterize the homunculus, we have used informatic tools to study patterns of antibodies to many hundreds of self-molecules arrayed on glass slides - an antigen chip of our design. Results using the antigen chip suggest that the particular self-reactivities comprising the homunculus could serve as a set of biomarkers that help the immune system initiate and regulate the inflammatory processes that maintain the body.

1. Biomarkers

A biomarker is a substance or measurement that indicates important facts about a living organism, usually a patient. The Wikipedia defines a biomarker to be "a substance used as an indicator of a biological state .. More specifically, a 'biomarker' indicates a change in expression or state of a protein that correlates with the risk or progression of a disease, or with the susceptibility of the disease to a given treatment. . . it can be used … to tailor treatments for the disease in an individual . [and] …may be used as a surrogate for a natural endpoint.'' (*http://en.wikipedia.org/wiki/Biomarker*).

In other words, biomarkers can provide the physician with useful information about:
1. biologic state of an individual;
2. disease risk;
3. disease diagnosis;
4. disease progression;
5. treatments of choice;
6. monitoring responses to treatment; and
7. endpoints for assessing treatment efficacy.

Biomarkers thus allow the physician a preventive or therapeutic jump on the individual's disease process. How can a biomarker provide so much information?

Biomarkers serve because they make life simple. Complexity characterizes biology: the healthy state of a cell, organ, or organism emerges from dazzling amounts of information involving molecules, processes, cells, and organ systems. Disease too is the outcome of a great complexity of factors; so is risk; so is effective treatment. Biomarkers replace with a relatively few simple measurements our need to otherwise detect, collect and judge all the facts of the matter. An effective biomarker, a high concentration of 'bad' cholesterol, for example, can inform us about associated complexities related to genes, heredity,

metabolism, diet, blood vessel walls, and the risks of vascular embolism and occlusion [1]. The biomarker, in short, reflects and summarizes all the agents and processes that are needed to produce it - however many and complex these agents and processes may be. A simple biomarker is informative when it faithfully signifies for us the complex factors from which the biomarker emerges. This reduction of biological complexity to one or a few simple biomarkers makes it possible to act quickly without having to wait for real-time events to take place; you can, for example, anticipate, treat and monitor the state of the individual to prevent a future heart attack or stroke. Medical health-maintenance systems do well to prioritize biomarkers.

2. Immune health maintenance

The immune system in both its innate and adaptive arms can be viewed as a type of biological health-maintenance system. In this paper we attempt to place in perspective in physiological terms, the immune system with respect to the self. In physiological terms, we can say that the cells and molecules comprising the immune system act to manage inflammation[2,3]. Inflammation is classically defined as the processes activated by injury that lead to healing [4]. The immune system, by the way it initiates and manages inflammation, maintains health by healing wounds, containing pathogens, organizing the structure of connective tissue, growing (angiogenesis) or destroying blood vessels, triggering regeneration of certain organs, activating the apoptosis of aged, sick or dangerous cells, degrading accumulations of abnormal molecules, disposing of waste, and performing other vital activities [2]. These varied expressions of inflammation maintain the integrity of the organism in response to its relentless postdevelopmental decomposition caused by environmental injuries and infections, accumulations of metabolic products, waste, and other intoxications, and the inexorable advance of entropy. Well-regulated and timely inflammation maintains health. Hence, to the extent that the immune system initiates and regulates healthy inflammation, the immune system is a health-maintenance system. But, like many other well-intentioned agents, inflammation itself can cause harm; dysregulated or misapplied inflammation produces disease that may require anti-inflammatory therapy [5]. There is considerable discussion on immune regulation in patients with autoimmune disease[6-8]. Let us focus, for now, on the immune regulation of healthy inflammation.

3. Immune computation for health maintenance

Health maintenance performed by the immune system, like health-maintenance systems devised by humans, requires that the systems have access to information regarding biologic state (is something wrong?) and information regarding disease process and choice of therapy - how the problem can best be handled (choice of inflammatory response type: Th1 or Th2; induce cell growth or apoptosis; and so forth). Moreover, the inflammatory process has to be adjusted dynamically as healing progresses and terminated when repair is achieved. It may be said that the healthy immune system functions to translate the dynamic state of the body into the dynamic state of the immune response (Fig. 1). Elsewhere I have proposed that the translation of body state into a fitting immune response state can be termed immune computation [9-10]. Successful immune computation is a boon; immune miscalculation is a misfortune. How can the immune system manage inflammation properly given the complexity of the organism?

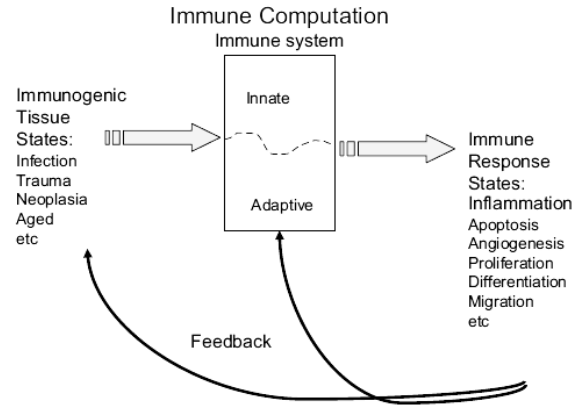

Fig.1. Immune computation. The immune system in both its innate and adaptive arms is affected by signals that reflect the immunogenic states of body tissues; these signals are

molecular patterns generated by infection, neoplasia, trauma, aging, and so forth. The immune system transforms these signals into varieties of immune response - immune response states - leading to a variety of inflammatory effects: apoptosis, angiogenesis, etc. The transformation of immunogenic tissue states into immune response states constitutes computation [9]. The immune response feeds back to affect the state of the tissues - usually to induce healing. Note that the immune system itself is influenced by feedback from its own reactions; in this way, the immune system is self-organizing [2].

4. Biomarkers for immune health maintenance

Complexity reduction is key; living systems are just too complex to control without reducing the information to manageably small pieces [11]. It is impossible to measure every factor relevant to the state of any living organism; indeed, even a sample of the information, if too large, can be confusing if not paralyzing. The immune system, like any good physician, has to focus on essentials; to function, the immune system needs to attend to a relatively few, but informative signals.
The immune system, like health-maintenance systems generally, needs biomarkers. I propose that an important function of the immunological homunculus is to create and detect biomarkers (Fig. 2).

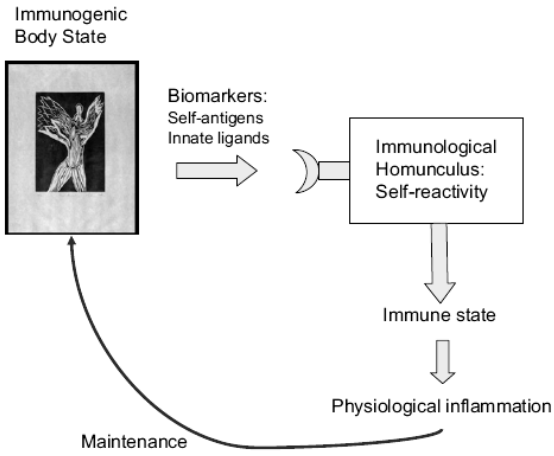

Fig. 2. Immune biomarkers. The self-antigens and innate ligands that transmit the states of the body to the immune system can be viewed as biomarkers. These biomarkers are detected by natural autoimmunity - the immunological homunculus – leading to immune response states that initiate and regulate inflammation. Physiological inflammation maintains the health of the body.

5. Innate-ligand and self-antigen biomarkers

The classical formulation of the clonal selection theory proposed that the healthy immune system must be blinded to body molecules by the deletion of self-reactive lymphocytes during development [12]. Neo-clonal selection theories continue to teach that the healthy immune system must not respond to self-molecules, but add ignorance [13] and/or active regulation [14] to clonal deletion to annul autoimmunity. To regulate healthy inflammation, however, the immune system must be sensitive to the state of the body and intimately responsive to it; autoimmunity, rather than shunned, has to be built into the system; a degree of autoimmunity must be physiological. Indeed, the immune system appears to scan and respond to body molecules by way of several sets of receptors. Innate receptors belonging to the Toll-like receptor family respond to both foreign and self-molecules [15]; innate receptors for cytokines, chemokines and other molecules allow immune cells to detect and respond to molecules produced by body cells[16]. The classical clonal selection theory did not view innate receptors as 'real' immune receptors; 'real' receptors were limited to adaptive antigen receptors [12]. Now, however, it is clear to immunology that the innate and adaptive classes of immune receptors are functionally integrated into a single immune system [2,9]. The immune system inspects the body using both its innate and adaptive receptors. Which body molecules are recognized by adaptive antigen receptors?

6. Homuncular biomarkers

We recently studied the autoantibodies present at birth in human cord blood - the congenital immunological homunculus – using an antigen microarray chip [17]. We surveyed IgG, IgA and IgM antibodies binding to about 300 self-antigens. IgG antibodies are actively transported from the mother to her developing fetus, so the repertoire of IgG autoantibodies in cord blood represents primarily the homunculus repertoire developed by the mother. The cord blood IgA and IgM antibodies, which do not cross the placenta, were produced by the babies in utero. Although the 300 self-molecules spotted on the microarray are likely to be a relatively small selection of homunculus reactivities, the set of self-antigens bound by the congenital repertoire of homuncular autoantibodies is

informative: The self-molecules included tissue antigens (glutamic acid decarboxylase, myelin oligodendrocyte glycoprotein, myosin, collagen 1, thyroglobulin), immune modulator molecules (gelectins, ubiquitin, gelsolin, interleukins), and stress proteins (HSP40, HSP47, HSP60 peptides, HSP70 peptides) [17]. It seems reasonable to suspect that these selfmolecules can provide the immune system with just the right kinds of biomarker information about body state needed to manage a healthy inflammatory program (Fig. 2). Tissue-associated antigens can mark the address - the site where immune intervention is needed; stress-associated molecules can mark the nature of the insult and its progression. Indeed, the immune system - by anti-ergotypic T cells and antibodies, cytokine networks and immune memory - is able to monitor its own state in the course of the immune response [2,9,10,16].

7. Advantages of the immunological homunculus

Many of the self-antigens implicated in autoimmune diseases are recognized by autoimmune T cells and B cells present in the healthy immunological homunculus from birth [17]. Thus it is reasonable to conclude that the structuring of autoimmune reactivity encoded in the homunculus in health probably plays a role in the pathophysiology of autoimmune disease; disease-causing T cells and autoantibodies could arise from the pathogenic activation of autoimmune progenitor clones resident within the homunculus set of natural autoreactivities [2]. Hence, the immunological homunculus, from an evolutionary perspective, is costly to maintain. The fact that the homunculus exists implies that the occasional cost in disease must be offset by a general benefit of natural autoimmunity to health. What are the advantages of having natural autoimmunity built into the immune system?

It has been proposed that natural autoimmunity could help rid the body of troublesome waste molecules and cells [18]. Natural autoimmune T cells and B cells and autoantibodies, in addition, could provide an early immune response to pathogens expressing molecules that are cross-reactive with particular self-antigens [19]; an example is the response to bacterial heat shock proteins and other molecules that are highly conserved and cross-reactive with self [20]. Natural autoimmunity has also been proposed to prevent pathogenic autoimmunity by generating regulatory circuits [21,22] or by blocking the access of potentially pathogenic agents to key self-antigens [23]. Note that these proposed health-promoting attributes of natural autoimmunity are not mutually exclusive; the immunological homunculus might help maintain health in a variety of ways. Here I suggest we might add to the list of benefits the idea that the self-antigens recognized by homuncular agents can also serve as biomarkers that inform the immune system of the state of the body, both locally and globally. If this is true, then we might be able to gain some insight into states of health and disease by studying an individual's patterns of autoimmunity [9]. The immunological homunculus, as a natural biomarker system for immune health-maintenance, might be enlisted to serve our medical health-maintenance system. It might also help us choose the correct medication for patients [24]. We just have to listen to what the immunological homunculus can tell us [25,26].

Acknowledgement

I thank artist Elly Rubin (http://www.ellyrubin.com/) for allowing me to insert a photograph of her print into Fig. 2.

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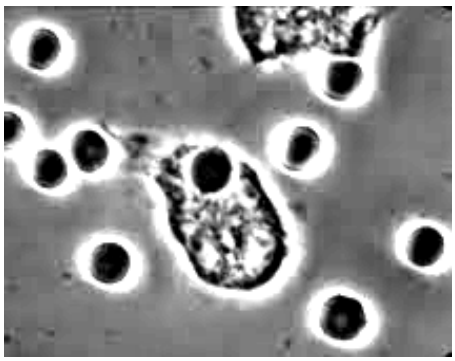
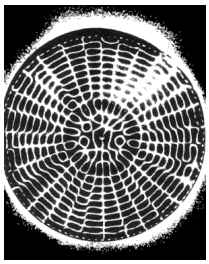


Photo: Dr. Sondra Barrett: A living human white blood cell (neutrophil) recognizing and going after a cell (red blood cell) from another species (sheep). An example of immune recognition. ***www.sondrabarrett.com***

SELF AND OTHER

Toward An Expanded View of the Immune System in Health & Disease



Graham Jones

(Acknowledgements to Philip Franses, Daisy Allen Richard Dryden and our continuing conversation)

'It is to be prayed that the mind be sound in a sound body' Juvenal

Overview

From the outset of scientific investigation, the application of metaphor has informed and expanded biology . Such metaphors as the Darwinian 'survival of the fittest' (interestingly not Darwin's original metaphor at all) and the selfish gene hypothesis of Richard Dawkins and the neo-Darwinians, have added much value but are exhausted when proceeding beyond the domains of reductionist causality of modern molecular biology. It is becoming increasingly more evident, [1] that mechanisms involving biological co-option and co-operativity are of equal importance in the evolution of higher organisms.

It is crucial here to understand the reciprocity involved in the use and abuse of metaphor in biology. Survival of the fittest and the selfish gene metaphors both come from and reflect back to a capitalist society based on individual greed and marketplace competition. I make no moral judgement here. These are powerful drivers for wealth creation and social progress but this comes at a cost which may be unsustainable. However, it must also be said that given the observation that biological evolution is driven as much by the 'urge to merge' as it is by 'winner takes all' - particularly in the development of multicellular creatures - one would be foolish to assume that a society based solely on individual greed and marketplace competition is the only biologically viable option. To reflect this deeper, more holistic view of evolution it is necessary to develop metaphors based on the simple understanding that in a healthy society self-interest and individual freedom can only be maximised within the context of a shared vision of the common good.

The elucidation of the base pair ATGC coding sequence of the entire human genome is undoubtedly a singular triumph of modern biology, but to more fully understand the functionality of the organism we need to supplement the gene-centred view with a process oriented whole organism approach [2]. The current metaphor, based on the triumph of molecular biology, sees the organism as the hardware executing the master software codes contained within the DNA sequence however Denis Noble [3] and others have pointed out the problems of applying such a relentlessly reductionist approach to the inherently messy world of biology. It is the conversation between the digital (DNA) and analogue coding embedded in constantly iterated feedback loops, responding in a moment by moment dance with the environment which makes organisms so interesting, responsive, resilient and adaptive. Rather than being the master controller of the cell, the DNA sequence may instead be seen as one historical dataset among other more contemporary datasets available to the cell during its particular trajectory within the body. In cellular ontogeny, and by extension whole organism ontogeny, the DNA acts as a sacred text which is brought to life differentially in each generation by a process of cellular hermeneutics [4].

This is why it is necessary to develop new perspectives communicable through new metaphors and viewpoints from which to analyse specific functionalities such as the immune system. In this paper, I will explore emerging views of the expanded function of the immune system in health and disease in both utilitarian and metaphoric mode.

Is the immune system more than a defence system?

The concept of immunity and susceptibility has a long history. Pre-scientific views of disease involved ideas of punishment by supernatural forces, which may or may not be amenable to intervention in the form of sympathetic magic. The modern word immunity is derived from the latin 'immunis', meaning exemption, and it is still used in this context in law as in the phase 'diplomatic immunity'. The gradual development of evidence-based medicine saw the development of agents called vaccines (after the latin 'vacca', cow). Louis Pasteur and Robert Koch, pioneers of the germ theory of disease, together with others, began to explain how bacteria caused disease and how the body could develop immunity following infection. Thus the science of immunology was born in a very empirical approach to health and disease resulting in the development of vaccines which with increasing safety and efficacy have become cornerstones of modern medicine. It is no wonder then that, with one or two notable exceptions, other non-defensive roles of the immune system have been overlooked. Perhaps it is also noteworthy that our current models and metaphors (military notions of attack and defence) to explain the functioning of the immune system were conceived and nurtured following two catastrophic world wars.

Indeed, it is very difficult to avoid using military metaphors when describing the immune system. Consider the following paragraph which provides a very brief summary of the action of the immune system. For more detailed information refer to 'Roitts Essential Immunology' - a good, comprehensive middle-range text - although there are many other excellent immunology texts across the spectrum some of which are available as free downloads.

Summary of the action of the immune system
Primary defensive barriers include physical and chemical properties of the skin and other epithelial surfaces. Pathogens that breach these barriers meet various types of phagocytic cells drawn in to the fray by chemicals (cytokines) secreted as part of the inflammatory response. At the same time other chemicals help raise the temperature of the body inducing a fever.

This first phase of the immune response is mediated by cells and chemicals which are part of the 'innate immune system', so-called because we are born with it in a preformed and fully active fashion. Innate immunity is sometimes misleadingly called 'non-specific' immunity when it should really be called 'group-specific' since the phagocytes express receptors on their surface which recognise and respond to common molecular patterns expressed on the surface of invasive pathogens. Thus, innate immunity can prevent entry, colonisation and spread of pathogens.

The second phase of the immune response involves adaptive immunity. Phagocytic cells, and indeed most of the cells of the body, can present peptides to T cells of different kinds, whose surface receptors are elaborated by complex genetic processes using DNA code found within a relatively restricted set of genes, to produce a dazzlingly diverse set of T cell receptor proteins. By stochastic means it is possible to produce a virtually unlimited set of T cells with the ability to recognise almost any shape in space. T cells whose receptors have the best fit expand by cloning. T helper cells (Th) can then communicate with naïve B cells which are also primed to the same antigen and which have similar but separately DNA-encoded B cell receptors. If this is an allowed communication, the naïve B cells then clonally expand into billions of antibody producing plasma cells.

These antibodies are secreted into the blood and other parts of the body and become the effector arm of the adaptive humoural immune system. Th cells can also, under the right conditions, stimulate other T cells also binding the same antigen to differentiate and clonally proliferate into killer or cytotoxic T cells which become the main effector arm of the cellular adaptive immune system. (Note here that natural killer (NK) cells have a similar armament to cytotoxic T cells but recognise their targets through relatively non-specific lectin-like binding and are therefore considered part of the innate immune system.) When the

threat has been resolved most of these cells undergo apoptosis (or programmed cell death) but a very few specialised T and B cells reactive to the presented antigen may persist as memory B and T cells for up to the lifetime of the whole organism. Should the organism encounter the invading pathogen on second and subsequent occasions, the adaptive immune response is much faster and of much enhanced magnitude. Though not known in the early empirical days of vaccine development, this provides the physiological basis for contemporary vaccination protocols where the body is challenged with killed or attenuated pathogens which stimulate the production of specific memory without causing the disease.

Self and not-self

While writing this brief summary of the immune system, I have tried to use instrumental language only. But, as you see, the military metaphor is already embedded in the way we describe the immune system. Again, I do not wish to make a value judgement. Indeed, as an extended metaphor this helps convey some, but not all, of the flavour of the immune system. When considering how and why such a powerfully armed and potentially lethal defence system does not turn against the body whose integrity it is charged to protect, in what has been famously termed by Paul Ehrlich as 'horror autotoxicus', McFarlane-Burnett coined a particularly potent metaphor of the 'immune self'. While both innate and acquired systems would identify, vigorously pursue and eliminate anything the body encountered with not-self markers, it would ignore self-markers. However, as we will see, the immunological notion of self and not-self, while useful, is highly contestable.

Firstly, the very notion of a separate and discrete 'immune system' is a useful but abstract construct. In many respects, properties and processes that we refer to as immunity are shared by most of the cells of the body. For instance, nearly all body cells display an individual's MHC class 1 markers loaded with either self or not-self peptides and are capable (like good community watch citizens) of communicating through the two way cytokine discourse with the more professional cells of the immune system, such as dendritic cells. Secondly, the mucosal immune system normally does not respond to the many and varied not-self peptides produced in the digestion of our food. When this does occur we may develop pathologies ranging from minor food allergies to life threatening anaphylaxis. Thirdly, the body, as we call it, consists of a superorganism with over ten trillion cells with our peculiar genetic signature - derived from the original fertilised zygote along with its genetically separate, largely maternally-inherited mitochondrial endosymbionts, as well as more than 100 trillion other cells with different genetic signatures. Most of these cells are bacteria. We call these cells commensals. They are usually tolerated by the immune system and are beneficial in many ways. They help to digest our food and produce vitamins; they encourage the immune system to develop in the right way and prevent colonisation by pathogenic bacteria through a process of niche competition. Interestingly, many of these 'friendly' bacteria can turn into dangerous pathogens when they are moved from one place in the body to another or when the body is immunocompromised. There are over 500 recognised separate species of 'friendly' bacteria in the digestive system alone. The mucosal immune system has to recognise these bacteria and ignore them, while being ever vigilant against very similar pathogens. Clearly this is a hard ask and sometimes the system malfunctions resulting in pathologies such as Crohn's disease.

Autoimmunity

Autoimmune diseases constitute an increasing proportion of the morbidity load in western countries. Typically, autoimmunity is associated with a breakdown of immunological tolerance which allows an immune response to be mounted against the bodies' own cells and tissues. Examples include coeliac disease, diabetes mellitus type 1, systemic lupus erythematosus (SLE), rheumatoid arthritis (RA) and multiple sclerosis (MS). Many of these diseases are associated with a high level of autoantibodies against a relatively restricted set of auto-antigens. The loss of tolerance seen in spontaneous human autoimmunity is

overwhelmingly manifested in B cells. In RA for instance, there are autoantibodies to the constant region of IgG but no corresponding T cell response. In SLE there are autoantibodies to DNA which itself is unable to stimulate a T cell response.

The genesis of tolerance is still not well understood. Indeed, as already noted the very distinction between self and not-self is problematic. Several hypotheses to explain immune tolerance have been proposed including the clonal deletion theory of McFarlane-Burnet, in which self-reactive lymphoid cells are deleted during immune maturation; the clonal anergy theory proposed by Nossal and the idiotype network theory of Jerne, whereby a network of antibodies and mirror-image idiotypes exist in the body capable of neutralising dangerous levels of self-reactive antibodies (see [5]). Though these theories explain much about the discrimination of the immune system, we really are still struggling to understand the genesis of autoimmune disease.
Certainly genetic factors are in play. Genes related to immunoglobulins, to T cell receptors and to the major histocompatibility complexes (MHC) may all play a part in predisposing certain individuals to autoimmunity. Gender too, plays a significant role. Of over 24 million Americans who suffer from autoimmune disease about 75% are female, although for particular diseases such as type 1 diabetes and Crohn's disease men are just as, or even more susceptible.

Environmental factors also have profound significance in the aetiology of autoimmunity. It may be more than a coincidence that the rise in the incidence of autoimmune diseases parallels the ubiquitous use of a variety of chemicals, such as pesticides and plasticisers which are capable of cross-linking both endogenous and exogenous proteins in such a manner as to confuse the process of immunological discrimination. On the other hand, in areas of the developing world where multiple infectious diseases are endemic, autoimmune diseases have a low incidence. Given then, the inexorable rise in the incidence of autoimmune disease in the West, there are those who advocate the 'hygiene hypothesis'.

For several generations, children in the West have had dramatically reduced contact with many common organisms so that their immune systems lack a full immunological education, which may then result in inappropriate self-responses to infections at a later stage.
The routine repeated use of antibiotics, especially at an early age, will skew the distribution of intestinal bacteria away from optimal. This may have more profound consequences than previously realised. A recent report [6] has established the critical role of the colonic commensals in peripheral education of the immune system and how this might feed into the action of the thymus in neo-natal and early childhood development. Commenting on possible long-term consequences of antibiotic induced changes in the human intestinal microbiota, Blaser [7] demonstrates a troubling but robust correlation between the risk of developing inflammatory bowel diseases and the number of courses of antibiotics taken during early childhood.

Interestingly, there is some evidence that infection with some species of parasitic worms will alleviate the symptoms of some autoimmune conditions. Again, I do not make any value judgements here. This is not some 'nostalgie de la boue' plea for a return to an imagined golden age of pre-civilisation humanity where average life expectancy was around 25.

During the past century, sanitation and other public health measures, as well as widespread vaccination and antibiotic use have saved countless lives to the extent that average life expectancy in this country has risen from 45 to nearly 80.

The point I do make, however, is the importance of extending our models of the immune system in health and disease. We shall now examine some more holistic perspectives by which we might examine the immune system more from a process-oriented viewpoint.

Information, signatures, discourse and biosemiotics

Information is more than simply a code of instruction, but a route that can be traversed dynamically to give a composite sense of the whole by journeying over the landscape of the particular. This subtle route to the whole is able to bring together different aspects of the self, different particulars of current context, in order to give a whole, moment by moment assessment of the wellbeing of the composite identity (i.e. the organismal self). In particular, the signalling that takes place in the immune system is then the input to this whole distinguishing of informational wellbeing and thus the moment by moment arbiter of self and other.

Equally, questions posed by the whole organism as it moves through the world inform the choices made by the individual processes using signs to distinguish the task of health, a whole bounded integrity, from that of disease, the broaching of this integrity by foreign assailants or indeed by rogue cancer cells. Information is in the form of dynamic questions put before the whole organism. The choices made by cells to articulate the whole activate signs which distinguish a collective path to health from the threat of fragmentation, introduced by attack from without or within. At the molecular level these signs include self and not-self antigens and peptides derived there-from; as well as B- and T cell surface receptor proteins which bind these antigen-derived peptides after processing and presentation by cells of the innate immune system (antigen presenting cells, APCs). These presented peptides are bound with exquisite sensitivity and discrimination in the presence of the appropriate highly polymorphic major histocompatibility antigens (MHCs). Given a suitable cytokine cocktail, these initiating events lead through several sequential stages to the elaboration by plasma cells (terminally differentiated B cells) of antigen-specific antibodies and then antibodies to these antibodies, called idiotypes, and so forth leading to a (usually) self-limiting network of sign/object topological reflections as if in a hall of mirrors. Fehr and Caspar have provided a good overview of the implications of idiotype network theory for our understanding of the immune system.[5]
At the cellular level the various players such as the macrophages and dendritic cells, DCs (presenting cells providing a link between the innate and the adaptive immune systems), the T helper cells, Th, (which assist the development and maturation of both cytotoxic T cells, Tc) and antibody producing B cell-derived plasma cells, as well as the long-lived memory cells, constantly communicate in the language of the cytokines. In this continuing conversation it is crucial not only that all voices, including possible danger signals [8] from any body cell, can be heard but that each voice is heard at the right time. The language of the organism then has the role of distinguishing those actions that promote the assertion of health, carried as an informational imperative, by differentially and decisively responding to those signs indicative of danger - such as pathogen invasion or cancer transformation that threaten the integrity of the whole. Equally, the health of the organism as a whole can be defined as that state which allows the maximum freedom of each individual cell to respond in a moment to moment fashion to these informational imperatives.

Since the immune system is in many respects the example par excellence of biological signalling, further insight into the immune system may be gained by applying a biosemiotic approach in which the various molecular and cellular players (following the principles of Pierce and others) are assigned roles within sequentially embedded and highly iterated triadic relationships involving sign, object and interpretant. This approach has been recently adopted [9]in an extended analysis of signal transduction in B cell activation, but it is yet to yield practical insights.

This biosemiotic paradigm has great potential in uniting top-down and bottom-up approaches to the immune system, and in particular should provide insights into the overall effects of herbs - both in terms of the perceptions of current users and practitioners and possible identification of novel uses, in particular in the treatment of autoimmune conditions. Soukand and Kalle [10] have recently used a biosemiotic

approach to examine the role of the plant within a herbal landscape as part of embedded signalling triads, leading to particular therapeutic indications, and in so doing have extended the old herbal concept of the doctrine of signatures. Allen [11] has recently argued that a further analysis of the proportionate relatedness of phyto-, zoo- and anthropo-sign processes in sickness and in health might help address the mind-body distinction. In the next section I will consider the mind-body connection as it may be manifested in the realm of psychoneuroimmunology.

Psychoneuroimmunology

The mechanisms by which social, psychological and physiological stressors impact on the body's immune system have been recently discussed by Lorentz [12]. By adversely affecting the immune system in individuals with poor coping skills, certain constellations of stressors may have a pivotal role in the genesis of some cancers as well as increasing the risk of auto-immune conditions such as psoriasis, rheumatoid arthritis (RA) and multiple sclerosis (MS). Lorentz suggests that clinicians may help patients by employing a suite of practices including (as appropriate for the individual) meditation, relaxation therapy, prayer, therapeutic touch and directed imagery. Though there is conflicting evidence for the efficacy of any of these particular interventions, it is now becoming well accepted that the immune system is regulated in large measure through the inflammatory reflex.

Inflammatory cytokines and endotoxins produced by cells of the immune system act as afferents through the vagus nerve to the brain. Following processing in the brain the motor efferents from the brain inhibit inflammation by suppressing inflammatory cytokine synthesis through the release of acetylcholine in key organs of the reticuloendothelial system. Acetylcholine binds to alpha 7 nicotinic acetylcholine receptors expressed by macrophages and other cytokine elaborating cells, hence suppressing proinflammatory cytokines and limiting tissue damage. Further research into this intimate association between the nervous system and the immune system informed by the pairing and superposition of the neurohomunculus and the immunological homunculus will lead to a profound shift in our view of the immune system. [13]

The immunological homunculus

Unsatisfied with the limitations of the self/not-self divide and the widespread perception that the role of the immune system is restricted to body defence only, Irun Cohen [14][15] began to elaborate his vision of the immunological homunculus. Homunculi (both neuro and immuno) are virtual images of the body, functional maps with ever changing dynamic representations in health and disease. This notion and the view of the immune system as a secondary cognitive system [16] involved in body maintenance was informed by several intriguing immunological phenomena whose significance has only recently emerged from the obfuscating fog of the self/not-self orthodoxy.

The healthy adaptive immune system seems programmed to respond to particular constellations of body molecules. These self-antigens constitute limited overlapping sets of immunodominant epitopes whose expression acts as biomarkers for the health, or otherwise, of particular tissues and organs. Autoimmune conditions are characterised by aberrant sets of reactivity to the same self-antigens with catastrophic results. Interestingly, this common repertoire of autoantibodies is also subject to aberrant expression in cancer[17]

Cohen referred to the natural autoimmune coherence of the immune system as the immunological homunculus. Using antigen microarray chip technology, Cohen and co-workers identified autoantibodies in the cord blood of immunologically naïve neonates to about 300 self-antigens, including various tissue specific antigens as well as immune modulator molecules such as gelectins and interleukins and the stress proteins hsps 40, 47, 60 and 70 [18]. Referring to this constellation of autoantibodies as the 'congenital immunological homunculus', Cohen suggests that during an individual's life

trajectory these self molecules can provide the immune system with the optimal level of biomarker information consistent with the moment by moment management of a healthy inflammatory programme [15].

A suitably optimised diagnostic microarray test employing a panel of these biomarker self-antigens anchored on a microscope slide, has the potential of providing a personalised whole health assessment from a small amount of serum and could monitor subtle effects of therapeutic intervention (in the form of herbal extracts for example) that may not otherwise be detectable. Such a test may be suitable for monitoring the progress of many of the pathological states mentioned in this paper, indicating patterns of appropriate intervention not otherwise obvious.

Extending the idea of the immunological homunculus into the informatics domain, Cohen explored possible mechanisms of immune system cognition and computation [14]. Given the continual feedback and monitoring of the system as a whole by each of its parts, a key aspect of the system is that it is self-referential - it looks at itself looking at the system. This notion of self-reference, also implicit in the previously mentioned idiotypic networks of Jerne (see [5]), points to information in the immune system being distributed in a fractal and holographic manner. Many aspects of the immune system, such as its robustness and adaptability, are consistent with such a view.
This extended view of the immune system has already resulted in proposals to treat autoimmune conditions by vaccinating with appropriate autoantigens.

Mood disorders and the immune system

Aberrant inflammatory responses are pivotal in the pathophysiology of many modern maladies from autoimmune diseases to cancer, and of course the ageing process itself. Given the role of the nervous system in the control of inflammation and the widespread observation that psychological stress (a major factor in the aetiology of depression) can promote inflammation through effects on both sympathetic and parasympathetic pathways, it is not surprising that aberrant inflammatory responses have an important role in the pathogenesis of depression [19]. The association between major depression and immune dysfunction is compelling but until fairly recently has focussed on immune activation and cytokines. Commenting on various clinical and demographic correspondences and the increasingly widespread observation of changes in the autoimmune constellation, Chen et al. [20] have suggested that autoantibodies are primarily responsible for the pathogenesis of depression and, just as in many other autoimmune diseases, the aberrant inflammatory responses are associative rather than causal.

Be this as it may, it is clear that, as already mentioned in the section on psychoneuroimmunology, the immune system and a person's state of mind are closely linked. Owen [21], for example, has recently shown in a cohort of individuals living with AIDS that expressing forgiveness can improve immune function.

Herbs and the immune system

In the recent literature of herbal medicine [22] claims are made for the effects of a variety of herbs on various aspects of the immune system. Allergies, for example, may be treated with variously prepared extracts of chamomile, plantain, nettle, elderflower and milk thistle. Other 'healing herbs' include lime, willow, yarrow, mugwort, dog rose, elderflower, mint and feverfew.

Although of course many of the truly effective contemporary medical treatments and orthodox therapeutics owe their origin to herbal remedies and their descriptions in herbal folklore, there is a relative paucity of mainstream scientific research on the role of herbs in promoting a healthy immune system. In part this can be explained by the difficulty researchers find in funding such research but

also it must be said, both conceptually and operationally, herbalism and orthodox reductionist science occupy different worlds with few bridges to connect them. This situation is however changing.

Many researchers are now investigating the claims of western, oriental and various indigenous herbal traditions and gaining valuable new leads for the development of novel therapeutics. We have recently published work detailing the biomedical activities of some Australian endemic plants that are highly prized in the traditional medicinal practices of indigenous Australians [23][24]

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With respect to effects on the immune system, work in our laboratory at UNE [25] indicates that following ingestion of 'Echinacea Premium' (supplied by Mediherb - each tablet containing ethanolic extracts of 675 mg of E. purpurae and 675 mg E. angustifolia; 2tabs/day for 14 days) a modest, but significantly important, increase in white cell count (WCC) is accompanied by up-regulation of stress protein hsp 70.

A recent review by Gertsch [26] raises the general issue of bridging the gulf between the art and practice of traditional herbalism and the incorporation of the use of herbal extracts into the 'target network' of cause and effect in evidence-based medicine. Gertsch makes some interesting suggestions very pertinent to problems inherent in addressing the scientific study of the influence of herbs on the immune system.

Therapeutic herbal mixtures are almost always taken by mouth and clearly any effects of specifics contained within are modified by intestinal processes of digestion and assimilation. Equally, however, the reciprocating effects of such extracts on the intestinal commensals and subsequent immunomodulation and peripheral re-education of the immune system with subtle but possibly profound influence on the immunohomunculus must be taken into account, as well as the summative effect of individual metabolites on specific targets. It is at this level that the complex molecular mixtures constituting herbal extracts may exert their most beneficial effect on the immune system and health in general.

An important technical tool to study the effects of herbs on the immune system at this level involves an investigation of the effects on the expression of the autoantibody biomarkers of the immune homunculus using antigen microarray chip technology as previously mentioned.

Such an approach would also be of value in attempts to gain a useful overview of the immune system in any or all of the pathophysiologies previously mentioned in this article, and may well lead to gentler and more effective treatments for a range of maladies affecting an ageing population.

Mens sana in corpore sano

Given the thrust of the preceding sections the often quoted latin phrase from the poet Juvenal might serve as a convenient talisman for a healthy immune system.

We have seen a move away from the notion of the healthy immune system as a tightly regimented and rigorously disciplined body defence force capable of absolute discrimination between an objective immune self and not-self and thereby dealing with any threat to the self in a timely, efficient and essentially pre-programmed manner. We have seen a move toward the notion of the immune system performing its crucial defensive role as part of its wider role as a self-referential organ of cognition; a fully integrated embodied mind, a part of the whole but containing a map of the whole in all of its parts.

Self and not-self should no longer be seen as discrete objective categories but as fluid and negotiable processes; a dance through space and time, an endlessly fascinating conversation where bodily health is expressed most fully at the fractal interpenetrating boundary between self and other.

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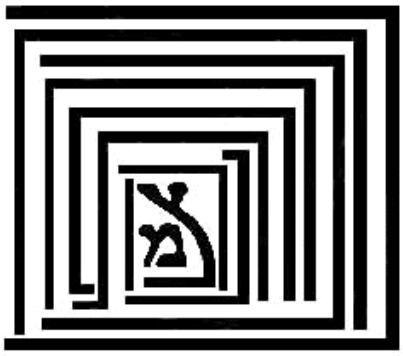


The path into the center winds in a clockwise pattern, and the path back unwinds counterclockwise. The spiral is a basic form of nature, although the labyrinth spiral is more complex. The path inward cleanses and quiets the mind. The unwinding path integrates and empowers on the walk back out.

(A labyrinth composed of the first letters of each of the ten sefirot. Based on a published edition of Pardes Rimmonim by Moses Cordovero)

The starting point of the ancient geometric thought is not a network of intellectual definitions or abstractions but instead a meditation upon a metaphysical unity followed by an attempt to symbolize it visually.

YOUR VERY GOOD HEALTH

Murray McGrath

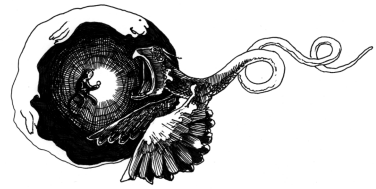
The well-known, so-called 'Laughter Doctor', Patch Adams M.D., when quoted as saying "laughter is the best medicine", responds: "No, the best medicine is friendship."

From birth we are immersed in a world that conveys to us many unfortunate messages, including the notion that when we are ill we need medical remedies. Feeling ill does bring needs, but they can be most effectively served by supportive, friendly and loving relationships. Even the doctor should, in my opinion, be your expert friend.

However, true to human nature, there are always those who will take advantage of the needy and, when there is an opportunity to make money (for example, the germ theory of disease), a profitable business comes into being. How common is this phenomenon?

It is important to acknowledge that the vast majority of doctors and other healthcare professionals are, or at least start off being, caring dedicated people who bestow huge benefits on their patients in spite of the inappropriate and often harmful methods of medical science.

So, what's the answer? It came for me over 40 years ago when I encountered and was convinced by the philosophy of the Kingston Clinic in Edinburgh, Scotland. Simply put this says that, if you look after yourself with good and appropriate food, exercise and rest, and, if your relationships, interests and occupation are positive and happy, you have an excellent chance of being healthy. You will develop understanding and confidence in your health. You will realise that it is normal to have the capacity to be well, that being ill now and then is part of being healthy and that healthy bodily processes require time. Rather than reacting with fear, take an interest in your illnesses, viewing them as having a purpose, even when it is hard to understand. You may then develop calm confidence, enabling your vital bodily functions to work at their best. Every time you come through an upset of health without medical intervention, your confidence grows and your emotions become more positive. I myself have not used any medical remedy or treatment (apart from cataract surgery) since discovering this approach. I have been ill on a number of occasions, sometimes apparently quite seriously, but have always recovered without any form of medical attention.



Positive beliefs and emotions are the keys to a healthy happy life. If your beliefs are positive, your emotions will be also, and every cell in your body will respond. If you have a pain, ask yourself: "What does that mean to me?" If it means "something's wrong, it's going to get worse unless I get a cure", you will suffer more and for longer. If it means "something is happening that needs to happen", you will suffer less and for less time. But you may ask, "What if it is something serious?" The most damaging thing to any upset of health is to be told by a doctor that it is something serious. The resulting reaction not only inhibits healthy bodily functions, but can bring about unhealthy developments. An unfortunate number of people die unexpectedly quickly after being diagnosed with cancer or heart disease. This is a very sad side-effect of medical practice. The fear resulting from such a diagnosis affects your every cell and bodily function. If you doubt the effect of emotions on the body, consider how the placebo effect is present in every area of medical research. Science is now proving the truth of these assertions. Rigorously designed scientific experiments involving placebos in the form of inert pills, saline injections, sham surgery, inactivated heart pacemakers and others have shown dramatic benefits. What is the explanation? The "meaning" of treatments to those treated determines the effects. Those who benefit "know" they are being cured if everything about the process suggests it to them. They believe it. So, all the bodily functions are enabled to work at prime efficiency and

wonderful results can ensue. Orthodox drug treatments are also affected by these influences. becomes more beneficial. The belief is subtly transmitted to the patient. Similarly, old drugs become less effective when new versions come along. Meanings for people of different nationalities and cultures can vary to a surprising degree affecting the way they respond to placebos and drugs. [1]

And it turns out your genetic inheritance plays only a minor role in determining your health. Culture, upbringing and life experiences, and the way you react to them are the main influences, and in the case of the developing foetus, those of the mother. [2]

So, what can we learn from all this? If the secret of health and happiness lies in our beliefs and the meaning we attach to the experiences we encounter in life, how can we achieve positive, healthy, happy beliefs and avoid attributing negative meanings to happenings and observations? The answer lies with each individual. You, the reader, must find your own way of dealing with this challenge. Seek to understand it through observation, particularly of yourself, relevant reading, contemplation and meditation. Discussion with others, irrespective of whether they agree with you, can stimulate new ideas and understanding. Writing about one's beliefs clarifies thinking. You can experiment. Try a different way

Properly designed scientific experiments have shown that when the doctor believes in the drug, it of reacting to minor health upsets. In the end, you should be able to find the path that looks and feels right. Consider every new idea that comes along, but accept only what you feel will lead you to a better understanding, a more truthful awareness. Set the rest aside for another day, but don't forget that finding your truths requires a mind open to ideas that initially may seem alien.

Self-observation and study hold an almost infinite potential for finding new understanding of your life. Of course, it isn't easy. Passively observing oneself is a skill that can take a lifetime to perfect, and the most important thing in life is not what happens to you, but how you react. Your reactions depend on what your experiences mean to you. So, watch how you react, think about why and ask the question "Is this really how I want to be?" If you are honest with yourself, it is a fascinating study. And what you believe in can become 'yourself', rather than a placebo.

But be patient.

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FOREST GARDENS

Health through Diversity

Martin Crawford

Forest gardens are a type of land use common in many parts of the world, and fast becoming more popular in Britain, for growing a wide variety of edible and other crops in a sustainable and low-input system. They have a long history in the tropics and sub-tropics (where they are often called home gardens) with evidence for their use as long as 12,000 to 14,000 years ago in parts of Asia.

This diverse system involves mixing trees, shrub and ground-level plants in an integrated system which provides food and other crops, mimicking the structure of a forest but using plants of direct or indirect use to people. So as well as the obvious fruit and nut trees, there will usually also be many perennial vegetables, trees and shrubs for edible leaf crops, fibre plants used for tying, construction materials like bamboos, medicinal plants and dye plants. Plants of indirect use usually include nitrogen-fixing plants and mineral accumulators (deep rooted plants which efficiently raise nutrients into the topsoil layers) which help feed the whole system.

Although annual plants may be included in forest gardens, the majority of plants are perennial and the majority of the soil is not cultivated, which gives tremendous benefits, the most significant of which is that a healthy mat of beneficial fungi (called mycorrhizae) grows throughout the topsoil. These beneficial fungi have many important functions, none more so than linking up the whole system into one by forming symbiotic associations with almost all plant roots.

Mycorrhizae form symbiotic associations with most plant roots, giving the plants difficult-to-find nutrients in return for some sugars. They protect plant roots from pathogens. They move nutrients around from areas where they are abundant to where they are lacking. And perhaps most important of all, they are a vital part of the process of carbon sequestration, where carbon is locked into the soil in stable forms.

It is this interconnectedness of the system which gives it not only resilience but also health – most pests and diseases just cannot make much impact. They do not move easily from one species to a quite different one, nor can they easily find their way by smelling their way because of the myriad of aromatic plants which 'block their senses'. Also there is increasing evidence that eating from a healthy system like this also aids human health. Perennial plants usually have more substantial root systems than annuals, can access more soil volume and thus in most cases contain more nutrients than annuals. The mycorrhizal fungi help increase nutrient levels too. A survey of 25 perennial vegetables found that they contained on average 200-300% of the amounts found in common annual vegetables of potassium, magnesium, iron, vitamin C and protein [1].

It is unfortunate that the last couple of hundred years have been dominated by the development of annual-based agriculture and horticulture. It is a clear consequence of linear thinking as opposed to holistic thinking. Whilst annual plants can be very productive, it is the case that annual cultivation is detrimental to both the soil, and in terms of the carbon emissions. Every time soil is dug or ploughed, carbon is released into the air as humus oxidises. Annual cultivation never achieves a healthy mycorrhizal mat, so it can't sequester much carbon.

In the natural world, annual plants are relatively uncommon, usually only being found where there has been a disturbance of soil by animals, fallen trees, or weather extremes. On

these sites annuals are the first plants to re-colonise, but they are quickly replaced by longer-lived perennial plants in a succession. So it is true to say that an annual-based agriculture is profoundly unnatural. Forest gardens and agroforestry systems are a reflection of the real world.

The development of an annual-based agriculture has gone hand in hand with increased mechanisation and the domination of agriculture by fewer and fewer corporations controlling seeds and other factors. Forest gardens are inherently complex systems which are not suitable for mechanisation or large individual scale implementation. *Small is Beautiful* indeed.

In Britain the history of forest gardens is short, with Robert Hart starting his experiments some 40 years ago, and Martin Crawford some 20 years ago in Devon. In this country the same principles can be applied, though the spacing of trees needs to be wider than in the tropics to allow enough sun energy to filter down to crops below. Most forest gardens here contain fruit trees (apple, pear, plum etc.), nut trees (hazel, sweet chestnut), perennial vegetables (Alliums, purslane, Hostas, Solomon's Seal, Pokeroot, herbs etc.), tying materials (New Zealand flax), leaf crops (lime trees), nitrogen fixing trees and shrubs (Alders, Elaeagnus) and so on.

Diversity is key to the resilience, stability and health of forest gardens – diversity in structure and diversity of species. Most forest gardens in different parts of the world contain 150-250 species, sometimes more. This sounds a lot compared with the few dozen food plants that most people in the 'developed' world eat, but it isn't really. Some of our nearest relatives, orang-utans, regularly eat 300-400 different plant species. Diversity in diet is likely to be linked to health in many ways.

Most forest gardens achieve diversity through using a mixture of native and non-native plants. Just as most of the annual and tree crops grown in Britain are non-native (wheat, barley, potatoes, onions, garlic, sweet corn, squash, apples, pears, plums etc.) so many of the plants in forest gardens here are non native too. I don't regard this as a problem, for there is increasing evidence that diversity of structure (giving many niches) and of species is just as valuable for wildlife as nativeness. The likelihood of continued climate change is a further factor which makes reliance on natives only in both forest gardens and forests themselves a risky strategy. We desperately need resilience in the decades to come.

Forest garden and similar agroforestry systems offer a sustainable and low-carbon alternative for growing crops for people, which also protects the soil, stores carbon, and is excellent for wildlife. Oh yes, and forest gardens are very beautiful and being in them surely increases health too!

Reference:

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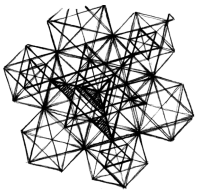


SURPRISING SCIENCE

James Le Fanu

There is something really fascinating going on in science at the moment, of particular interest to those for whom – to paraphrase Hamlet – "there is more in Heaven and Earth than can be dreamt of in [materialist] philosophy". It is just ten years since the bastions of genetics and neuroscience were on the brink of resolving the most fundamental questions about 'life' and the 'human mind'. The astonishing achievement of spelling out the full sequence of human genes, the Human Genome Project completed in 2001, marked "The closing phase of the search for the Holy Grail of who we are", observed Harvard University's Walter Gilbert; "Just as Copernicus changed our understanding of the solar system" remarked another of its architects, "so the knowledge of the human genome will change how we see ourselves".

Simultaneously, positron emission tomography (PET) and similar scanning techniques were revolutionising neuroscience with their capacity to observe, for the first time, the brain 'in action' from the inside – thinking, imagining and looking out on the world 'out there'. Professor Stephen Pinker of the Massachusetts Institute of Technology, writing in the journal Scientific American noted how these techniques had investigated everything "from mental imagery to moral sense", and confidently anticipated "cracking the mystery of the brain".

Both disciplines have proved immensely productive, generating thousands of millions of 'bytes' of basic biological data every week and a tidal wave of papers in scientific journals. Meanwhile the ingenious techniques of biotechnology have provided us with a range of useful therapeutic compounds – genetically engineered human insulin and growth factor, protease inhibitors for the treatment of AIDS, Herceptin and similar anti-cancer drugs and much more besides.

Yet, looking back over the last decade it is possible to see how the really significant findings of this great endeavour lie in a rather different direction, deepening our understanding of ourselves certainly – but in a way quite contrary to that anticipated.

The Human Genome Project, together with research describing the genetics of mice, flies, chimps and many others, were all predicated on the reasonable assumption that elucidating the full sequence of genes would clarify, to a greater or lesser extent, the source of that near infinite diversity of forms and attributes that mark out the major categories of life. However that is certainly not how it has turned out – rather the reverse, with a near equivalence of a modest 20,000 genes across the vast range of organismic complexity from the millimetre long worm C. elegans to ourselves. It is no less disconcerting to learn that the same regulatory or homeotic genes that cause a fly to be a fly cause humans to be humans. There is, in short, nothing in the genomes of fly or man to explain why the fly should have two wings, four legs and a dot sized brain and we should have two arms, two legs and a mind capable of understanding the origins of the universe. The genetic instructions must exist for otherwise those diverse forms of life would not reproduce themselves with such fidelity from generation to generation. We have moved in the light of these, and similar extraordinary findings, from supposing those instructions are at least knowable in principle to recognising we have no conception of what they might be.
It might seem futile to enquire why this might be so but the explanation must lie, at least in part, in the simple elegance of the double helix - the structure that for so long has held out the promise that its discovery might reveal 'the secret of life'. On reflection, the simple elegance of that double helix structure cannot be because it is simple but because it has to be simple – if it is to copy the genetic material every time the cell divides. That obligation to

be simple requires the double helix to condense, within the one dimensional sequence of nucleotides strung out along its intertwined strands, the billion fold biological complexities that determine the unique three dimensional form and attributes that so readily distinguish flies from ourselves and the tens of millions of other species, living and long since extinct. The semblance of simplicity of the double helix then becomes a measure of its inscrutable profundity, or, as Philip Gell, Professor of Genetics at the University of Birmingham anticipated so presciently twenty years ago: "The gap in our knowledge is not merely unabridged, but in principle unbridgeable and our ignorance will remain ineluctable".

It has been a similar story for neuroscientists observing the active brain which, clear from the beginning, must work in ways radically different from those supposed. The simplest of tasks, such as associating the noun 'chair' with the verb 'sit' cause vast tracts of the brain to be activated, prompting a sense of bafflement at what even the most mundane conversation must entail. Again the sights and sounds of every transient moment, it has emerged, are fragmented into a myriad of separate components without the slightest hint of the mechanism that would reintegrate those fragments back into that personal experience of living at the centre of a coherent, unified, ever-changing world.

Meanwhile, the great conundrum remains how the monotonous electrical activity of the billions of neurons in the brain translate into the limitless range and quality of the subjective experience of our everyday lives – where every transient, fleeting moment has its own distinct, unique, intangible feel, where the cadences of a Bach cantata are so utterly different from the taste of bourbon or the lingering memory of that first kiss.

The implications are obvious enough. While it might be possible to know everything about the physical materiality of the brain down to the last atom, its product (the five cardinal mysteries of the non-material mind) would remain unaccounted for: subjective awareness; mental causation or 'free will' (how our non-material thoughts cause us to choose one course of action over another); how memories are stored and retrieved; the 'higher' faculties of reason and imagination; and that unique sense of self or personal identity that changes and matures over time but also remains the same.

These may be mysteries to science, but they are certainly not to ourselves. Indeed there is nothing we can be more certain of than the reality of our sense of self and our everyday perceptions of the world around us, our thoughts and memories. This distinction between the electrochemical activity of the material brain that might be knowable to science and the non-material mind (our thoughts and ideas) knowable only to ourselves as being two quite different 'things' might seem so self evident as to be scarcely worth commenting on. However for neuroscientists, the question of how the brain's electrical activity translates into thoughts and sensations was precisely what needed explaining – and so the late John Maddox, editor of Nature, acknowledged: "We seem as far from understanding [the brain] as we were a century ago. Nobody understands how decisions are made or how imagination is set free".

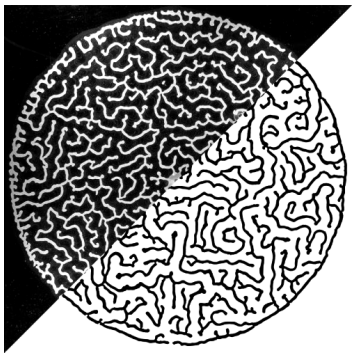
The usual response to such perplexities is to acknowledge that perhaps things have turned out to be rather more complex than originally presumed, and to insist it is still too early to predict what might yet emerge over the next two decades. Certainly both genetics and neuroscience could continue generating further megabytes of basic biological and neuroscientific data almost indefinitely, but it is possible, in broad outline, to anticipate what they will reveal. Biologists could, if they so wished, spell out the genomes of each of the millions of species with which we share the planet, but that would only confirm they are composed of several thousand similar genes that code for the nuts and bolts of the cells from which all living things are made. Meanwhile the really interesting question of how genes determine the unique form and attributes of those diverse creatures would remain unsolved. So too for observing the brain 'in action', whereby a million scans of

subjects watching a bouncing red ball would not progress understanding an iota further of what needs explaining – how those neuronal circuits experience the ball as being round, red and bouncing.

At any other time these twin setbacks of the scientific enterprise might simply have been relegated to the category of problems for which science does not as yet have the answer. But when cosmologists can reliably infer what happened in the first few minutes following the birth of the universe, and geologists can measure the movements of vast continents to the nearest centimetre, then the inscrutability of those genetic instructions (that should distinguish a human from a fly), or the failure to account for something as elementary as a thought (or how we recall a telephone number) throws into sharp relief the limits of science's claims to knowledge. There is a powerful impression that science has been looking in the wrong place, seeking to resolve questions whose answers lie somehow outside its narrow materialist domain. This is not just a matter of 'not yet knowing all the facts', rather there is the sense that something of immense importance is missing that might transform the bare bones of genes into the wondrous diversity of the living world, and the monotonous electrical firing of the neurons of the brain into the vast spectrum of sensations and ideas of the human mind.

It is impossible, of course, to know what that missing factor might be but if, as would seem to be the case, it lies beyond the reach of material science then the Holy Grail of who we are would remain as elusive as ever.

From this perspective the supreme achievement of the great endeavour of the last ten years has been to compel us to confront that profound truth – so familiar to philosophers and scientists of the past, historically so powerful an impetus to the religious view and yet so long neglected – that there is 'more in Heaven and Earth' than we can know.



Physicists in Norway have created beautiful maze-like patterns by simply allowing a mixture of tiny glass beads, water and glycerol to dry out slowly. Computer simulations suggest that the labyrinthine patterns are formed when "fingers" of air invade the solid-liquid mixture and push the beads apart. Bjornar Sandnes and colleagues at the University of Oslo created such patterns by combining glass beads (50-100 μm diameter) with water and glycerol and injecting the mixture into the narrow gap between two circular plates. The liquid was slowly pumped from a hole at the centre of the disk. After about three hours, the first fingers of air pushed into the edges of the disk and gradually moved towards the centre. After about three days, the entire disk was covered by a labyrinthine pattern made by dried beads that were pushed aside by the air

Courtesy: reproduced from an article by Hamish Johnston in http://physicsworld.com/cws/article/news/30704

CELLS AND THE SACRED

Sondra Barrett

What if you were given a laboratory and told to discover the coding for normal cells and malignant cells? Where would you start? What strategies could you learn to quiet your racing mind to listen to other ways of knowing? And how in the world do you leap into the great unknown with only a microscope in hand?

My decoding prowess began as I looked at human white blood cells with a microscope seeking clues to growth patterns, normal, and not so normal. Trained in observation I reacted to that first blip into my consciousness - normal cells revealed predictable patterns of form while abnormal leukemic cells showed chaotic shapes. My mind tried to make sense of this, concluding that form followed function - abnormal cells functioning in an unpredictable fashion looked misshapen and disorganized compared to healthy normal functioning cells.

To quiet and soothe my ever-questioning mind I studied a variety of traditions - shamanism and aikido, qigong and Buddhism, astrology and creative expression. One concept began emerging from my mental and metaphysical meanderings with the microscope; our cells can be guides in living well while our molecules hold clues to their divine design. A short discourse into the wonders of the invisible will provide the awesome possibility that messages from our cells far surpass messages in simple water.

Carl Jung and Joseph Campbell educated us in the last century on the universal power of symbols and consciousness. They saw these symbols present everywhere and Jung posited that these images structured our imagination, shaped matter and mind. He called these elemental patterns “archetypes.”

I posit that the architecture of our cells and the structure of our molecules are also archetypes; that they served as templates for essential teachings throughout the ages. They can be discovered by looking at sacred and indigenous art. Does form inform spiritual intelligence? Can cells show us the Way?

Here we’ll close the gap between science and spirituality by taking a peek into the essence and archetypes of the cellular universe. Our oldest living ancestors, our cells, have much to tell us of the evolutionary journey from cell to SELF. Each of us is a community of trillions of cells, microscopic individuals merged to create sanctuary for one human soul. Within and **beyond** the scientific paradigm, the microscopic universe reveals an invisible world that carries meaning beyond physical form. I promise this fascinating exploration into our inner nature will transform your experience of science, art, and your own divinity.

Blending science, art and spirituality, ten lessons from our cells offer a practical understanding of the wonders of our sacred cellular nature. To unearth their story, perhaps a brief glimpse into its author will help you appreciate more the adventure.

As teller of this tale, I call myself Sondra Barrett “cellular archaeologist and code finder,” though in real life I was trained as a biochemist exploring the nature of human disease. While still a faculty member and research scientist at the University of California Medical School, my curiosity also had me exploring the non-traditional medicine of the shaman, Asian energy practices and graphic arts. My penchant for connecting disparate points of view soon had me seeing Native American pictographs as cells, and interpreting cells and molecules as mystical.

In this tale that celebrates our cells as sacred we start with creation. In order for life to survive, it needs a place. Over eons, molecules formed, became more complex and eventually merged to shape the sanctuary for life. That sanctuary, with poetic license omitting all the evolutionary permutations it took to arrive at a human cell, was created by the embrace of molecules. Imagine that! The great Jesuit theologian Teilhard de Chardin wrote that because of the ability for molecules to connect, we connect with each other; that love exists.

If there were no internal propensity to unite…
in the molecule itself
it would be physically impossible for love to appear higher up, with us.
By rights… we should assume its presence… in everything that is..[1]

Atoms touch and share electrons. And so we have the first lesson from our cells, the essentials to life - embrace. New molecules cannot form without uniting with another, Newborn babies will not survive without being touched and embraced by another. We thrive when we embrace love. A question that our cells may ask us - what else do you embrace? What touches you? What is important for your life; what gives you meaning?

As the cellular scientist, searching for how cells grew and matured, what made them choose life or death, maturity, or the same old repetitive pattern, answers came again in the hidden structures of the cell.

Inside our cellular sanctuary is a vast shimmering fabric constructed of gossamer strings, long tubes and thin filaments. The fabric, named the cytoskeleton, may, in fact be the seat of consciousness and the actual intelligence of the cell. Dr Donald Ingber[2] at Harvard Medical School discovered that the tension placed on this cellular webbing influenced whether the cell made carbon copies of itself, changed the program and matured, or switched to the ultimate recycle and died a gentle death. Pulling on the tension of the cell changed its genetic expression. Taut and stretched out, attached to a surface, the cell repeated its genetic program, making more of the same self. Yet when the cell lets go of some of those attachments, it shifted to a pattern of maturity. Letting go of attachments allowed maturity to develop? Sounds like a Buddhist teaching to me. And when the cell fully let go, it was time to surrender into the great unknown. Often the trigger for fully letting go was the "altruistic" need for limited resources is made available to the younger cells.

A few lessons come from our cells - what do I attach myself to, what do I need to let go of, and what permits my maturity? Ingber [3] showed that our cells can be regulated mechanically. Thus, along with mind or consciousness-altering messages of the cell, bodymind practices may enhance our experience. When we stretch in yoga we shift our cells' tensions. Physical exercises handed down from ancient Mexican sorcerers and taught by Carlos Castaneda were said to change consciousness and help a person shape-shift to another form. Castaneda called these tensegrity practices. Interestingly, from the architect and biologist's points of view, changing tension on a structure to maintain its integrity is called, you guessed it, tensegrity.

This very basic property of our cells to change their state through mechanical forces and movement is mirrored in many physical and spiritual healing practices like yoga and shamanic dance. Scientists have learned even more about the shimmering cytoskeleton; its strings and strands vibrate in order to change shape, its structures can respond to sound and energy. The centriole, one unique tubular construction within the cell, guides cell division. It also 'reads' infrared energy and according to scientists Roger Penrose [4] and Stuart Hameroff[5], moves electrons and is the seat of human consciousness.

Our cellular wisdom tells us to create sanctuary, embrace and attend to what we attach to, letting go of whatever prevents our maturity. We do this from our molecules on up.

Another set of properties of our cells is their ability to recognize self and other, to communicate. And of course, the cell asks us

how do we recognize our self and communicate with others.

The final cellular or universal law I'd like to discuss here is the law of three. Our basic genetic code is built from a threesome of the four nucleic acid bases, nicknamed ATCG. A genetic codon is something like ATA, CCC, CAT. Threesomes are everywhere in biology. Three embryonic layers form once the egg is fertilized egg. These layers, the ectoderm, mesoderm and endoderm, give rise to a living being. We have a triune brain - the reptilian brain stem, the emotional limbic brain, and the thinking cerebral cortex. At a human level, threes are also very popular - maiden, wife, crone; father, mother, child; beginning, middle end. And let's not forget the threesomes in spiritual traditions; the Christian Father, Son, and Holy Spirit; Jesus, Mary, and Joseph. In Hebrew, we have the three mother sounds SH, MM, AH of the most sacred prayer, and the three forms of God - Yahveh, Shekinah, Ruach. The Hindus have their triad - Brahma, Shiva and Vishnu. And so it goes on and on. Does the ever-present philosophical threesomes have their roots in our biology, in our molecular codes for life and consciousness?

And to make this information practical, think where we enjoy threesomes in everyday life - ready, set, go. We can put the threesome into action. Imagine attaching your attention to an intention, moving and stretching with it, and letting it go into the action or goal you want manifested. Simple as one, two, three.

There's a lot more to say about the sacred messages from our cells and the exquisite beauty of our molecules and their metaphysical stories [6].

Finally, though modern scientists discovered the functioning of our cellular domains, perhaps the ancient artist and seeker saw them and made them holy. This idea is not unprecedented. Leonard Shlain in *Art and Physics*[7] offers a convincing story that the artist's work preceded the physicist's discoveries. To me, it is compelling to interpret our cells as divinely inspired, that their teachings and designs have been carried through the ages. I will end with three final impressions for you. A few visuals may help clinch these ideas. The **ten lessons or messages** our cells offer us may help us sustain a fulfilling life. Ancient cave paintings hold some of those mysteries. Take a look at this ninth century **Medicine Wheel.** It convinced me that the ancients saw inside, and it was good.

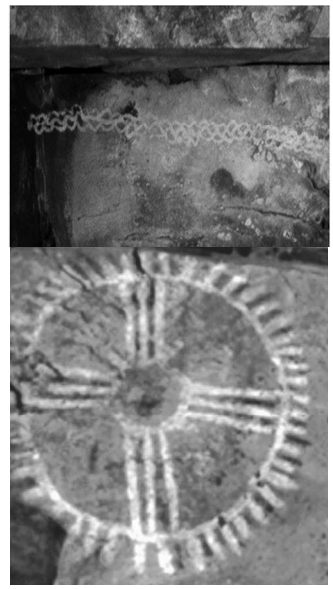


Fig 1 Cave drawing

Compare it to my drawing of a cell. Maybe this wheel of life stood for the essence of our lives - the cell as well as the universe. And just maybe its image originated in the inner vision of the ancient peoples.

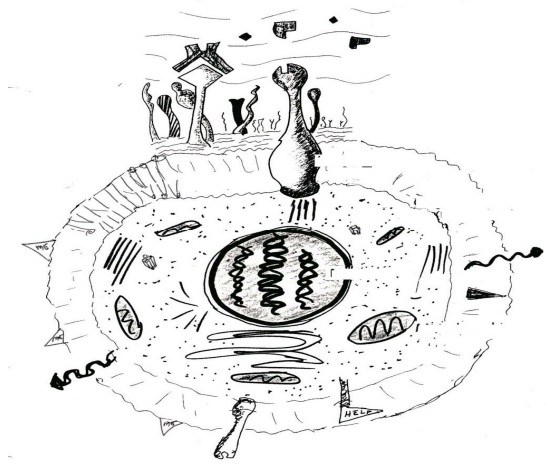


Fig 2.Cell drawing

A Tibetan mandala?

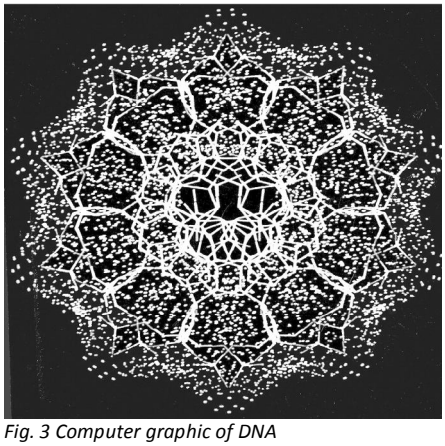


Fig. 3 Computer graphic of DNA

Take a look at this mandala of DNA as well as what I interpret as strands of **DNA** on that same cave wall as the medicine wheel (on the opposite page) that was painted a thousand years ago.

LESSONS FROM OUR CELLS

Embrace
Recognize
Respond
Move
Communicate
Create
Repair, Recycle, Rest
Energize
Remember
Purpose

Molecules awoke one morning to find that atoms were inside them, enfolded in their very being. Cells awoke one morning to find that molecules were actually inside them, as part of their being. And you might awake one morning and find that nature is a part of you, literally internal to your being.

Ken Wilber [8]

Acknowledgements

The computer graphic of DNA is shown with the compliments of Robert Langridge, PhD.

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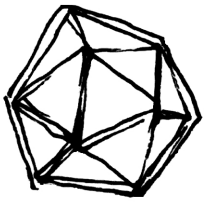

Authors Bios

Paul Carter *graduated from the University of Plymouth with a degree in wildlife conservation. He is a keen GO player and is a member of the British GO Association and the British GO Club. He is currently studying the Masters in Holistic Science at Schumacher College.*

Laura Batson *has completed a bachelors degree in Biology from the University of Western Ontario, CA (2004). In search of a more satisfying and encompassing understanding of living form, she pursued a Masters in Holistic Science from Schumacher College, UK (2007). Bringing it all together now, she is completing her 4th and final year of Naturopathic Medicine, at the Canadian College of Naturopathic Medicine.* ***www.LauraBatsonND.com***

Isla Burgess *has been an educator for the past 40 years, firstly as a teacher of Science and Biology and then as Director of the International College of Herbal Medicine (2000-2010) and Director of the Waikato Centre for Herbal Medicine, Waikato, New Zealand (1990-2000). She is also an experienced herbal medicine. She is the interim convener for the International Research Group for the Conservation of Medicinal Plants* ***www.irgcmp.org***

Philip Franses *is faculty lecturer in Holistic Science at Schumacher College. From his search to the source of science and spirit, there has flowed a series of presentations, workshops, papers. The Process and Pilgrimage forum, which he began in 2009 using elements of Basil Hiley's mathematics of process and Satish Kumar's philosophy of pilgrimage, has broadened into a widely engaged inquiry.*

Andrea Lugli *is an expert advisor on medicinal plants. He is also the Technical Manager, International department at Aboca S.p.a. He is also a lecturer at the University of Cagliari and Scientific Director at Planta Medica.*

Bruno d'Udine *studied Pharmacology at the University of Bologna and obtained his doctorate at the International Institute of Genetics and Bio-physics at Napoli. He then worked in Cambridge and Edinburgh before joining the University of Parma and then Bergamo as a Professor. He recently co-ordinated the International Lectures on Nature and Human Ecology at Aboca, Sansepolcro.*

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Murray McGrath *was born and brought up in Edinburgh. He practiced as an optometrist, specialising in contact lenses. He has lived and studied the philosophy of the Kingston Clinic (the alternative to medicine) for 40 years. He also ran a vegetarian, yoga retreat centre in the Scottish Borders, and a Natural Health Centre in Edinburgh. Currently he is working on a book,* ***Your Guide to Health and Happiness****, a down to earth look at the meaning of your life.*

Martin Crawford *is a Director of the Agroforestry Research Trust, a British charity which conducts research into temperate agroforestry. Martin has spent over twenty years in organic agriculture and researching all aspects of plant cropping and uses, with a focus on tree, shrub and perennial crops. The Agroforestry Research Trust produces several publications and a quarterly journal, and sells plants and seeds from its forest gardens. Martin is the author of Creating a Forest Garden (published by Green Books).* ***www.agroforestry.co.uk***

James Le Fanu *has combined working in General Practice with writing a weekly column for the Sunday and Daily Telegraph for the last twenty years. His books include 'The Rise & Fall of Modern Medicine' and 'Why Us? How Science Rediscovered the Mystery of Ourselves'.*

Sondra Barrett *is a renowned medical scientist- artist who sheds light on life's mysteries, from cells and molecules to wine. She earned her PhD in biochemistry from the University of Illinois Medical School and completed post-doctoral training in immunology and hematology at the University of California Medical School (UCSF). Her new book* ***Secrets of Your Cells*** published by ***Sounds True, USA*** will be out in August 2012. ***www.sondrabarrett.com***

Satish Kumar *was only nine years old when he renounced the world and joined the wandering brotherhood of Jain monks. At the age of eighteen, he left the monastic order and became a campaigner, working to turn Gandhi's vision of renewed India and a peaceful world into reality. Fired by the example of Bertrand Russell, he undertook an 8,000 mile peace pilgrimage, walking from India to America without any money delivering packets of 'peace tea' to the leaders of the four nuclear powers. Since 1973, he has been the Editor of Resurgence magazine.* ***www.resurgence.org***

AYURVEDA

Satish Kumar

Traditionally in India, the training and teaching of Ayurveda took place in forest schools where students will spend a number of years learning the art of living and healing and exploring the secrets of nature.
At the end of their training period the students will be asked to pack a picnic lunch and to go out into the forest to spend the day looking for plants which have no nutritional or medicinal value.

If by the evening, a student returns having failed to find such a plant then the teachers will give their blessings, "now you are ready to practice, go and serve your community". If a student returns with a plant or two not knowing what their healing properties are then the teachers will say, "stay a bit longer and learn more!" The implication is loud and clear; every plant, tree, shrub or herb is endowed with nourishing and curing qualities. The challenge for teachers and students is to discover those qualities through trial and error and through experiment and experience over a period of time.
In Ayurveda there is no distinction between food and medicine. Cumin and coriander, basil and bay leaf, ginger and turmeric, pepper and cinnamon are all food as well as medicine.
The word 'Ayurveda' means 'knowledge of living a healthy life'. Thus, Ayurveda is more than a collection of herbal remedies it is the science of life.

Ayurveda is based on three physical and three metaphysical principles, these are: vata (air), pitta (fire), kapha (water). Our physique is made of the earth element and its health is maintained by the equilibrium, balance and harmony of air, fire and water. These three elements are within our bodies and our bodies are within them. The outer landscape and the inner landscape are indistinguishable for total wellbeing. If air is polluted then our breathing will suffer. If the temperature in the atmosphere rises then fire energy in our bodies will also be out of balance, and if water is contaminated then we will lose our health as the health of natural environment is a prerequisite for personal health.
The symptoms of a disease are simply a signpost. The most important practice in Ayurveda is to understand the causes of ill health and work to remove them. This practice helps to build defences as preventative measures. 'As farmers construct dams to prevent their fields being flooded, likewise human beings take conscious precautions to stem the forces of disequilibrium and thus preserve the health of mind, body and spirit of the individuals, their human community and the planet earth at large. The three metaphysical principles are sattvic, rajasic, tamasic.

Sattvic means simple, natural, true and elegant. ***Rajasic*** means glamorous, greedy and excessive. ***Tamasic*** means heavy, depressing and destructive. These three qualities of life are as much external attributes as they are an internal state of being and therefore they are the touchstone of healthy living. In everything – thinking, speaking, eating, etc one of the three qualities is predominant. For instance, foods that promote vitality and easy to digest are sattvic. Glamorous and wasteful foods are rajasic, intoxicating and heavy foods are tamasic. Similarly the clothes we wear, the houses we inhabit, the language we speak and the relationships we develop are all built on these qualities. A healthy life is achieved when the sattvic quality is prominent. To be sattvic means to be gentle, kind and truthful. These soul qualities are health imperative in Ayurvedic way of life. Physical health, emotional health and spiritual health are indivisible.

In Sanskrit a healthy person is called 'svastha' which means established in the self; being rooted, grounded and based within oneself. When earth, air, fire and water within our body and within our planet earth are in a condition of equilibrium and when we are in tune with our true self we are in the state of health.

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