An Open Systems Science

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1. Introduction: Wither Science?

I am a social scientist who, together with Fred Emery and others, has spent many years developing the conceptual framework known as Open Systems Theory (OST). This conceptual framework is itself the product of a long line of development but is particularly associated with the names of Fred Emery and Eric Trist who led this development at the Tavistock Institute in London in the period 1951-1969. The Tavistock contribution is documented in three volume series called the *The Social Engagement of Social Science* (Trist & Murray, 1990).

OST has proven to be an extraordinarily successful conceptual framework as all of its concepts, practices and methods work in practice and reliably deliver what they promise. That is why our website is called www.socialsciencethatactuallyworks.com. OST has high predictive power.

Emery & Trist explicitly based their work on one particular tradition or mode of discovery called realism. Its characteristics are described below. They were highly aware of the historical tradition they were heir to and its importance in a world where the world hypothesis of mechanism was seemingly running riot. They called the outstanding historical stream of realism and its major contributors the *Thin Red Line* (TRL) (Emery M, 2000).

I have been reading the *New Scientist* for as long as I can remember, certainly since about 1970. This allows me to keep up with all the various specialist sciences through the medium of that weekly journal. Over time it had become obvious that much mainstream science appears to have lost its awareness of its history and its philosophy and the choices it can make in its practices. Time after time, scientists and science reporters express shock when a result or set of results totally destroys the assumptions built into a mechanistic science, a strange science that denies the most fundamental facts about the world as can be observed any day by any human being. Certainly, any kid brought up in the bush and allowed to wander freely as both Fred and I were allowed to do, is acutely aware that all systems are open. It is surprising that so few scientists seem to know so little about *the reality of open systems* and the fact that the discipline they may be following is a denial of that reality.

This book explores what an open systems science would look like. That assumes we do not have a science which is based on open systems and I content that in large measure, that assumption is correct. In this book we document a few instances where mechanistic and other misguided belief systems have produced scientific results which are often plain wrong or resulted in negative if not disastrous outcomes. Frequently, these results are contrasted or corrected with other empirical evidence which is based on open systems. From these discussions, we can start to see the contours of a genuinely *real science*, one based firmly on good hard solid observation and the reality given by material universals.

Why don't more scientists in general learn from their experiences and their own observations? With accelerating climate change we need science more today than we have ever needed it before. But we need a science that puts away the world hypothesis of mechanism flowing from the Newtonian universe (Pepper, 1942). We need a science that acknowledges reality as it is and employs practices that are congruent with, and flow from that reality.

The effects of our ever rising emissions of CO2e have been investigated by mainly mechanistic scientific methods, and its predictions are from models based on linear projections. These models are hugely complex but the methods are still at odds with the fact that the Earth is an open system. One of the results is that the effects are showing up much faster and with greater intensity than the models predict. Had systemic statistics been used,

for example, those of Renee Thom, we may have a more accurate idea of what we are in for and when. The choice of material or abstract universals really does have consequences.

The choices for science

As introduced above, historically, we can discern two major streams of accumulating knowledge based on two views of the nature of reality (see Table I). Within each stream many different schools of thought have waxed and waned over the centuries but each has distinct identifiable characteristics, some of which are in opposition. The streams have been summed up as 'realism' and 'idealism' (Mead, 1932). Realism runs from the later Platonic era through the philosopher Leibnitz to the physicists Maxwell, Faraday and Wigner who explored electrical *fields*, and then to the polymath philosopher Charles S Peirce. This stream is the TRL.

Human knowledge develops from the identification of the universal in the particular and the two competing views of reality identify entirely different types of taxonomies. Cassirer and Lewin define them as the "class concept and the series concept" which are also described as phenotypical (superficial appearances or similarities) and genotypical or 'genetic' (Lewin, 1931, 10-11). These classes or laws are called 'universals' and there appear to be only two basic forms of universal, known as *material* and *abstract*. *Material universals* describe a material or real world (Feibleman, 1946, 451) and derive from particular dynamic instances or events. "One of these views accepts as real physical bodies and their activities; the other nontangible formal qualities and logical and mathematical truths" (Chein, 1972, 146). Material universals identify the limits of reality within which a claim to 'truth' is made so that the search for material universals inclines more to 'verities' than to an abstract 'truth' (Chein, 1972, 319-336). The TRL, therefore, traces the development of a science based on material universals and that science included a component dealing with people, a social science component.

The TRL contrasts with a stream running from Aristotle, through the philosophers concerned with ideal types such as Kant to Newton and Locke, Herbart, Thorndike, Freud and Hull in social science. This line concerns *abstract universals*, identifying what is true about a thing or event under any circumstances, the 'thing-in-itself', or its 'essence'. The question is 'what is it?' The properties define the essence of the entity and the entity or substance explains the properties. Thus extroverted behaviour defines the class of 'extrovert' and the 'fact' that a person is an 'extrovert' explains the extroverted behaviour.

As Table I shows, each of the streams provides a constellation of internally consistent dimensions.

M*aterial universals* derive from each particular instance. They answer the question 'what does it do?' They identify the exact and particular environmental factor which effects the focal thing or event and what changes in that thing make what changes in the environment. This make it immediately obvious that material universals, realism, is based on the concept of an open system. Realism conceptualizes systems:

- i.e. with permeable boundaries and
- where the system is defined by its system principle, the unique relation between that entity and the environment (Angyal 1941).

Idealism renders things context free, in other words, it assumes, and practices methods which are based on, closed systems.

Table I. Material and Abstract Universals (Emery M, 2000**)**		
	Material Universals - ***Thin Red Line***	*Abstract Universals*
The question is:	'What does it do?'	'What is it?'
Identification:	What in a particular context has effects on the focal thing or event and what changes in that thing make what changes in the context - grasped in the grasping of the particular	The 'thing in itself', its essence, context free - what is true about a thing or event under any circumstances
Proceeds by:	Structural corroboration - corroboration of a 'facts' by its relation to other 'facts'	Multiplicative corroboration - confirmation of the same 'facts' by replication
Language based on:	Serial genetic constructs	Generic things, nouns
Systems	Are open with permeable, dynamic boundaries	Are closed within impermeable, static boundaries
Novelty or emergence:	Recognized as novelty or emergence from *transaction* or *coevolution*	Handled by reductionism or postulation of other entities
Area of research:	Science	Disciplines, specializations
Emphasis:	Synthesis	Analysis
Assumption - sufficient conditions of behaviour are:	In system-in -environment	Within the organism or social unit
People	*Transact*	*self act* or *interact*
	Can purposefully change their environments	Subject to 'drives' and forces
	Can consciously *extract* knowledge from environments	*Tabulae rasae*, must be taught

The open systems scientific venture uses a language based on *serial genetic constructs* or functional entities that have testable relations with other entities, including context (Cassirer, 1923). This language is very different from the everyday usage of nouns to express the *generic* nature of things which is one of the reasons that popularizing science is so difficult. Emery (1995) pointed out our language has its origins in a pre-scientific conception of the world and illustrates the difficulties this creates with the word 'metal' as metal has been around for a very long time. 'Metal' was originally confined to a small group of substances with definite properties but over time more and more substances were included as 'metal' while the number of definitive properties diminished. However, the definition would still be recognizable to most people. Today's definition where the number of valency electrons in the outer shell holds the key to metallic properties and are the active agents to a chemical reaction, would not be known or understood by most people. It also cannot definitely distinguish between metal and non metal meaning 'metal' is no longer a discrete class of entity. Therefore, using the noun 'metal' as an identifier is no longer accurate. Only the operational or scientific definition can identify a particular substance.

The identification of material universals proceeds by 'structural corroboration' (Pepper, 1942, 39-70) whereby a 'fact' becomes a 'fact' only when it can be corroborated by its relation to other different 'facts'. The search for material universals is seen as the nature of the genuine scientific enterprise despite recent sorties into dead ends such as an ultimate 'theory of everything' (Wertheim, 1995). Physics in particular seems to have gotten itself trouble by deserting some of the accepted forms of definition and premises of scientific method (see Chapter 11 physics). Science generally proceeds by structural corroboration (Pepper, 1942,

39-70) or the identification of invariants (Gibson, 1966), the same actions happening in different places at different times.

That science has a bad case of falling for abstract universals can be seen in the first sentence of an article in *New Scientist*: "Reproducibility is the cornerstone of science. What we hold as definitive scientific fact has been tested over and over again" (Iorns, 2012, 24). The article discusses the alarm that a "shocking amount of the published literature...is not reproducible". Failure to replicate was running at about two thirds or more of results. It is not at all surprising that the replication rate is so high as reductionist studies should be notoriously unreliable. This is because the number of matters that are determined solely by one variable is low. Most diseases or other matters are the result of many different variables all contributing to the final appearance or outcome. If they want to improve the rate of replicability, they should move to systemic studies.

When system boundaries are permeable, it is clear that system and environment determine each other and novelty and emergence can be seen to arise from transaction or coevolution. Without open systems, explanations of novelty can be handled only by reductionism or the postulation of other entities. Hence we see the endless multiplication of specializations, taxonomies and the search for smaller, determining units. This approach proceeds by 'multiplicative corroboration' (Pepper as above) or the confirmation of the same 'facts' by repetitive studies, frequently by the mere refinement of techniques. When experimental data fails to verify the theory, additional entities are hypothesized. We only have to look at the mess physics has got itself into over the creation of dark matter and then dark energy to see where that line of development leads.

With open systems, the emphasis is on synthesis rather than analysis although analysis is necessarily involved in exploring how an open system works or functions. But the analysis is merely the instrument used to arrive at an understanding of the whole system in environment. This stands in contrast to the process of analysis involved in reductionism where the only way left to go is down. There is no way back to an appreciation of the whole or synthesis. As Fry (2008, p20) states “I will never be fully explained as the sum of my biomolecular processes.” He was commenting on the fact that the need to move beyond reductionism appeared only at the end of a major commentary on reason. He continued “In the latter part of the 20th century some scientists started to recognize that natural phenomena, from consciousness to climate, occur on various levels that may not be adequately explicable by reference to the levels below.” How many scientists have so little knowledge of the history and philosophy of science that they do not know that there has always been a different, and much more productive, approach to generating understanding of our world?

Stuart Kauffman (2008, p32-33) believes that we need some serious rethinking, particularly of the way we conceptualize ‘science’, but his rethinking is not particularly radical. It actually perpetuates the present.

Kauffman is right in saying that Newton’s formula cannot produce the natural laws of creativity. Newton’s formula lies within the world hypothesis of mechanism which as students of Stephen C Pepper know, is incapable of dealing with problems of novelty and emergence. The only world hypothesis that can encompass novelty is contextualism. The appropriate unit of study in a contextualist science is the ‘open system in its environment’, a system with boundaries permeable to its environments.

The world demonstrably consists of open systems yet many scientists are always surprised when the evidence for this turns up. In addition, we have never been able to construct a fully closed system. So why continue to use a science that accepts closed systems? A science based on the reality of our world would appear to be a more promising and productive choice than one based on theoretical improbabilities.

When the world is viewed through the lens of open systems, it becomes perfectly possible to start hypothesizing natural laws that govern *coevolution* and produce novelty. However, it means that much of our science will have to move from studying 'the thing in itself', the abstract universal, to studying 'what does this thing do in this environment?' *and* 'what is this environment doing to this thing?, the material universal. Can mainstream science make the leap to overcome its own dogma? The examples documented here show that some disciplines and areas of research have become more adept at this than others.

As above, the dominant world hypothesis of mechanism finds it impossible to conceptualize people as they obviously are; open purposeful systems who "can produce (1) the same functional type of outcome in different structural ways in the same structural environment and (2) can produce functionally different outcomes in the same and different structural environments." They display *will* (Ackoff & Emery 1972: 31). By constantly acting as active, responsible agents (Chein 1972: 6), people change the environment. Part of the definition of 'purposeful' involves consciousness defined as 'awareness of awareness' (Chein, 1972, p95).

In the special report on differences between humans and animals, Kenneally (2008), writes off language as a difference along with culture, the ability to deceive, emotion, tool use, morality and personality. What possible candidates are left for marking people as unique? Art, cooking, religion, humour and sport.

Note the difference between these various activities in which some people may engage and Chein's definition of consciousness. The activities are at the phenotypical level: consciousness or awareness of awareness is at the genotypical level. I suggest that what really makes humans unique is their capacity for consciousness and it is this capacity that underlies the many quite special but by no means unique activities in which some humans *may* indulge. Religion for example cannot distinguish animals from humans if not all humans practice or believe in religion.

The endless definitions of a 'human nature', a static generic concept, contrast sharply with the serial genetic construct of a purposeful system as above, one who "can produce…". This is one of the most ubiquitous, and pernicious, misconceptions flowing from abstract universals as its applications lead to a series of caricatures of humans, quite irreconcilable with more realistic descriptions (Emery M, 2000).

One of the far reaching consequences of this clash of beliefs involves the extensions into mental health. The realism stream employs the definition of mental health as "the capacity both for *autonomous expansion AND* for *homonomous integration*" with others (Angyal 1965: 254). It acknowledges that humans are social or group animals constantly seeking the best balance between the two vectors of autonomy and homonomy. This contrasts sharply with the assumption that humans are individuals, complete in themselves, masters of their own fate. This choice of assumption will obviously influence the design and processes of experiments.

It is quite obvious from some of work discussed below that in some areas of research such as clinical trials in medicine, some researchers do not understand the ethical implications of working with systems that are of the same system level as themselves. a sociopsychological system (where researchers work directly with other people rather than a technical or technological system). This renders it particularly distressing when things go wrong and also destructive of the reputation of medical research. It destroys trust.

This has been a long introduction to the choices for science but it is fair to say that over time, there has been a noticeable improvement in the quality of the science reported and its reporting. The hit rate for inclusion in this book has slowed, showing that there appears to be a growing recognition of the necessity for adopting open systems. We make progress.

The Politics of Science

Science like most of our major institutions and organizations today is structured on the first design principle (DP1). As we have seen, this authoritarian structure inhibits cooperation and induces competition. Science is no more immune to the effects of competition than is every other activity that takes place within DP1 structures. While there are examples of cooperation, there are also numerous examples of competition and many of these illustrate the fact that the competition advanced personal aggrandisement and held back scientific progress.

Such an example is discussed by Andrew Koob in *The Root of Thought* (Thomson, 2009). The two neuroscientists Golgi and Ramony Cajal engaged in a competition to prove the other wrong about how neurons work. In this personal competition, they both overlooked the function of the glial cells that actually comprise 90 per cent of the brain. This in itself is a quite remarkable instance of not seeing the wood for the trees. That is, it is an instance of reductionism, concentrating on one component of a system, in this case the brain, and totally ignoring the function of the whole.

While they fought their personal battle for supremacy, neuroscience suffered as it is only now that the glia are being acknowledged as critical for both cell regeneration and cell death.

A new book by Stuart Richie, *Science Fictions* (2020) goes further in the sense of exploring more generally some of the malaise affecting the effectiveness of science as published. He was interviewed by Graham Lawton (2020a).

Four major causes of the rot in science are identified first as fraud, merging into bias arising from so wanting to find significant results and make a difference. The third cause is unforced errors such as a typo which throws an important result off track, sheer negligence. And the fourth is "hype, where scientists are pushed towards writing up their results as if they are much more exciting than they are" (Lawton, 2020a, p37).

The problem has worsened because of a system of perverse incentives, to publish papers and bring in grants – which is an incentive to publish papers and apply for grants, "but not an incentive to discover the truth" (p38). PhDs are now expected to have about 19 peer reviewed publications, up from about 5-6 30 years ago. Quantity has out muscled quality.

Peer review is a far from perfect system to correct before publication for several reasons, reviewers are often rushed, getting hold of raw data can be difficult and there are "personal vendettas" which can bias reviews. Here again we see the negative effect of competition on the quality of the science. Such problems also hinder the work of replication which is done far less often than it should, and when it is done, results can be different or not statistically significant.

Richie's own field psychology shows that 50% of studies don't seem to be replicable. In the related field of social science or more specifically, organizational change, replication seems to be rarely attempted and there is a tremendous hype problem. Richie points out that neither the university system nor the journals encourage replication, it is not what they want which is flashy news and headlines.

The managers of organizations who try to replicate the results of new, exciting methods they have found in journals often fail to find anything like the published results but they rarely write for academic journals, so the hype continues without constraint. "But if people keep publishing these hyped results which end up not actually delivering on the promise, trust

in science will decline" (p39). We are so reliant on science for so much of our progress in this world, it is vital that people continue to trust science as it advances in every field.

The answer lies in a few solutions such as universities stopping hiring people merely on the basis of how many peer reviewed papers and citations they have and start rewarding a different kind of science. This he calls "Being a good scientific citizen" – contributing data to the world, participating in large replication projects, and creating new tools for better, easier science (p39). "Science is not an endless march of exciting, flashy findings" but more incremental and requires a new kind of intellectual humility.

I would add a good dose of genuine cooperation with the subjects of the research as well as other researchers in the field (Emery & Emery, 1997).

Basic Problems Arising from science pursuing abstract universals

As we contemplate the shift from a closed systems science to an open one, from one pursuing abstract to material universals, we find we are not alone in noting some of the very basic problems that arise from the practice of this craft. The following examples are simply glimpses of the multifaceted and convoluted problem science has created for itself in following the world hypothesis of mechanism, and the difficulties it faces in attempting to solve this problem.

1. **Linear logic**

Assumptions of linearity are ubiquitous in today's sciences. Dedication to the narrow reductionist approach to science and its experimentation and the assumptions commonly held within it today appears to continuously get in the way of making sense of our world. The assumptions in particular appear to be a major obstacle. In another ground breaking, but chance, piece of work, it has been discovered that assumptions of linearity do not hold when substances are dissolved in water and then further diluted. The *New Scientist* in something of a departure from its normally aware stance stated "*common sense* says it shouldn't work" (emphasis added) and the author adds "it defies belief" (Coghlan, 2001, p5).

It defies belief and is common sense only if you follow the linear logic that says that the more you dilute a substance, the more space there is between the molecules of the substance. Take away that assumption and there is no reason why you shouldn't believe that diluting a substance could improve its potency. In fact there are many reasons why you should believe it, not the least of which is continued observation over long periods of time by many people in many fields. The reason their observations were ridiculed was that they violated a mechanistic assumption. Now repeated tests have shown that as a solution is sequentially diluted, the molecules do not spread apart, they clump together, providing evidence for homeopathic claims that potency increases with further dilutions. The growth of the clumps was not linear and it depended on the concentration of the original solution. Also, it only worked in polar solvents like water, in which one end of the molecule has a pronounced positive charge while the other end is negative. One researcher was quoted as saying "Its surprising and worrying" (Coghlan, 2001, p5).

Now another example has come to light (New Scientist, 2007, p20). Complex flow patterns such as those down the side of honey jars, silt in river deltas and fat particles in yoghurt have been shown to be explained simply by the ratio of big to small particles in the fluid, regardless of what it is. "Why has it taken so long to understand this underlying simplicity? Buchanan has a simple answer to this too: 'Sometimes you can't see the wood for the trees'." Especially when you look only at the trees one by one.

2. Specialization

In the issue of 18 November, 2006 New Scientist explored ‘the biggest breakthroughs in the next 50 years’. I discovered that Robert May believes we have made little progress in understanding cooperative behaviour since Darwin recognized its importance [p49]. May's belief is nonsense of course because we now know a great deal about cooperation and its generation. This totally misguided and misleading belief is simply a product of May's specialization in the very narrow field of *Cooperation Theory* which uses a limited set of instruments and methods and can be highly mathematical. Social science like its physical and biological cousins has also become split into a mass of little fragments such as this which have long lost track of the fact that they are part of a body of knowledge about human behaviour and long lost any intention of communicating and learning from each other. Specialization has become the road to fame and fortune. But in seeking fame and fortune, May and others have lost the person. This example is explored in more detail in the chapter on social science.

3. Replication

In a paper titled 'Failure to replicate', Clare Wilson (2022) confessed that some of the article she had written for *New Scientist*, and probably many others, were wrong. Not deliberately wrong but had fallen foul of some ubiquitous failings from the beginning of the research process right through to assessment by peer review and publication. In the field of biotech, only 1 in 10 was able to be replicated.

Here we are going to ignore the fact that replication is the second best option for validation as it is the method of multiplicative corroboration used in the sort of science based on abstract universals, most notably, reductionism. Rather than confirmation of the same 'facts' by replication, we need structural corroboration - corroboration of 'facts' by its relation to other 'facts'. This is the sort of validation required by the sciences based on material universals. As so much science today is based on abstract universals and reductionism in particular, the failure to replicate is serious.

While a few researchers have been found of distorting results or just making them up, most of the problems seem to come from cherry picking, a preference for positive rather than negative findings, newsworthiness and researcher status as judged by citations. Three factors "seem locked in a self-perpetuating cycle of dysfunction. Journals want flashy results to boost their impact factors and gain prestige. Funders award grants to people who have published in the most prestigious journals. And universities hire those who bring in the big grant money" (Wilson, 2022, p48).

One particularly problem which is briefly mentioned in nutrition or food research for example, but not really elaborated on is the pure effect of reductionism itself. Wilson does use an example from genetics where researchers firstly claimed the isolation of genes causing depression, schizophrenia etc, only to gradually discover that conditions such as depression are caused by sometimes huge groups of genes each with a small effect. Not one of the original discoveries was valid. The whole initial set of 'breakthroughs' was a mirage.

As we know, there is almost no known one to one relation between cause and effect. Studying the effect of one variable at a time is doomed to failure. It is a wholly stupid and inappropriate method.

Efforts to get over these problems are underway but progress seems slow. In the meantime, the real core of the problem seems untouched as methods such as 'preregistering' appear to be more about the superficialities than the basics. Until researchers start undertaking multiple causation studies with accompanying statistical methods such as causal path analysis where there is no limit on the number of variables and the analysis contains no subjective

components (Emery F, 1976), scientific research will continue to be plagued with these problems.

The method used in this book

You will not find in here any of those 'rigorous' or exhaustive discussions or analyses so beloved of many of our conventional academics, far from it. The method used is simply to record, analyze and discuss instances, wherever I find them, of scientific reports which clearly spring from closed systems science. As an OST theorist and practitioner I am always alert to such instances and can see immediately how they deviate from any sense of reality.

To use anything approaching the 'rigorous' academic method would not serve my ***purpose*** which is ***to highlight the continuing use of closed systems science to its detriment and the detriment of all our people and the planet***. It is not only that closed system science produce wrong results but also that they continue to bias our thinking in many ways.

Some of the aspects of this problem documented in these pages derive from the continuing assumption that people are the top of the evolutionary heap, that they possess various abilities that other species do not, and that, therefore, they should be allowed to lord it over the rest of the natural world. Slowly but surely, that assumption has been proven wrong (see chapter 8 specifically).

The assumption itself is yet another manifestation of the first design principle (DP1) (Emery F, 1967; Emery & Emery, 1974) which gives us dominant hierarchies where some have the right and responsibility to tell other what to do and how to do it. These design principles are set out in chapter 2. At the planetary level, it has assumed the form of humans believing they are the evolutionary pinnacle and therefore, have the right to use other lower species in any way they wish, to the human benefit. This has led to some bizarre forms of beliefs and behaviours which have cost us dearly in terms of the health of the planet and our future. The use of DP1 is directly responsible for the parlous condition of life on planet Earth and its continuing degradation.

As many would now be aware, our Indigenous cultures and those of most of the ancient cultures around the world had the opposite system of beliefs, i.e. based on the second design principle (DP2) which gives us flat structures based on self managing groups of equals. In these ancient cultures, humans are a part of the natural world and cooperate with it to ensure the health and survival of all. Rather than the domination and exploitation of other species, plants as well as animals, the ancient people devised elaborate, comprehensive bodies of knowledge which to his day serve us well. This is specifically the subject of chapter 9. These ancient peoples were open systems scientists and our Western sciences are slowly catching up with their time immemorial observations (Knudtson & Susuki, 1992). Our efforts to establish an open system science from our own foundations is I hope, complementing theirs.

The structure of the book is very simple. Apart from a few chapters such as Human Hubris which are transdisciplinary, it proceeds with a chapter per discipline. This was purely for logistical reasons as rightly or wrongly, that is still the way our entire knowledge store is organized and based.

Apart from my main source which is *New Scientist*, I have not shied away from using reports in the popular press. Wherever possible, they have been checked against the original sources but I have found that the vast majority of press reports have been accurate.

The style again is not exactly academic. The heavy style, full of technical and disciplinary jargons so beloved of many academics, and designed I believe to mystify rather than

enlighten, is not ever my preferred style and is far from what you will find here. Rather, it is a more light hearted romp through the evidence, using colloquial language and well known linguistic devices that are more likely to appeal to, and be understood by the ordinary mortal.

There are 10 offerings not counting the introduction and conclusions, starting with a broad overview of the choices for science, introducing the genotypical design principles and surveying something of their ubiquity. We follow this with a brief chapter on Economics, mainly because it includes description of the conceptual basis of open systems, the nature of the relationship between system and environment.

We proceed through what many would consider central to science, biology, medical science, genetics and neurophysiology. We then look at the social sciences, and some of the critical issues these attempts at science have encountered. These include some seriously erroneous assumptions about our ancestors and human history, errors springing unambiguously from hubris and our assumptions that we are the top of the evolutionary heap.

Finally we tackle physics which of course, many traditionalists would consider the queen of the sciences, all else being stamp collecting, but alas, physics is not in great shape. It illustrates perfectly the terrible path closed systems have bequeathed to science and so we come full circle. Physics is the cautionary tale, a reminder that we must take open systems seriously, and quickly, if we are to have a future at all.

At this stage, the book is not completed but then, given life goes on, it never will be. I had intended to finish it when my backlog of New Scientists was read. Nor is it perfect but I am sure you will get the critical message. Now the ravages of age intervene. If this is the end, so be it. Enjoy what is there.

2. Are There Universal Principles Governing Architecture in the Mechanical, Biological and Social Realms? The Evidence So Far.

Here I examine a set of principles that appear to operate across the natural world. They are called the genotypical organizational design principles and they were originally discovered in the process of making and studying organizational change (Emery F, 1967). Before we examine the evidence for the operation of these genotypical principles across both biological and social forms, it is worth asking whether such a search for basic laws or principles of operation through diverse realms of life is even feasible. Well, yes. Perhaps one of the best known examples of such ubiquity is the Fibernachy number series found to be operating through many areas of life. Another more recent, and still controversial with far reaching consequences for human endeavour if confirmed, is the log-periodic oscillations preceding the catastrophic rupture of materials, everything from concrete to tectonic plates to uterine muscles to stock markets. While such phenomena as earth quakes and landslides have been determined to be too unpredictable to utter warnings, it would appear as if once again, science may have been looking at the phenotypes rather than searching for the underlying genotypes.

Didier Sornette has found evidence of "a subtle underlying signal, common to many catastrophes, that can sound the alarm before it's too late" (Ravilious, 2001, p31). Sornette originally listened to the sounds made by the materials as they developed microcracks that grew, eventually resulting in rupture. Regardless of the nature of the material studies, a pattern appeared over time, allowing him to accurately predict the time of rupture. Testing his laboratory findings on real life events such as seismic data for landslides and earthquakes, and the electrical signals sent by uterine contractions for birth, he has thrown a spanner into the orthodoxy that "there's no fundamental difference behind different sized cracks. Most researchers follow the model that crack networks in any brittle material…are 'scale invariant'" (Ravilious, 2001, p33). Sornette has shown that there is a discrete scale invariance for systems under stress, with variations for each different material but also with a discernible pattern of log-periodic signals which herald collapse. For financial data to also show the same patterning for what is in effect a humanly constructed system, the stock market, has worried other researchers of critical systems. As Ravilious (p34) points out, it seems "just too good to be plausible, let alone true - although so far no one has come out and told him flat that he's wrong". Yet we must ask why it is too good to be true, when in other fields it has been long established that there do appear to be invariant laws operating across different sphere of life.

Dedication to the narrow reductionist approach to science and its experimentation and the assumptions commonly held within it today appears to continuously get in the way of making sense of our world. The assumptions in particular appear to be a major obstacle. In another ground breaking, but chance, piece of work, it has been discovered that assumptions of linearity do not hold when substances are dissolved in water and then further diluted. The *New Scientist* in something of a departure from its normally aware stance stated "*common sense* says it shouldn't work" (emphasis added) and the author adds "it defies belief" (Coghlan, 2001, p5).

It defies belief and is common sense only if you follow the linear logic that says that the more you dilute a substance, the more space there is between the molecules of the substance. Take away that assumption and there is no reason why you shouldn't believe that diluting a substance could improve its potency. In fact there are many reasons why you should believe it, not the least of which is continued observation over long periods of time by many people in many fields. The reason their observations were ridiculed was that they violated a

mechanistic assumption. Now repeated tests have shown that as a solution is sequentially diluted, the molecules do not spread apart, they clump together, providing evidence for homeopathic claims that potency increases with further dilutions. The growth of the clumps was not linear and it depended on the concentration of the original solution. Also, it only worked in polar solvents like water, in which one end of the molecule has a pronounced positive charge while the other end is negative. One researcher was quoted as saying "Its surprising and worrying" (Coghlan, 2001, p5).

Now another example has come to light (New Scientist, 2007, p20). Complex flow patterns such as those down the side of honey jars, silt in river deltas and fat particles in yoghurt have been shown to be explained simply by the ratio of big to small particles in the fluid, regardless of what it is. “Why has it taken so long to understand this underlying simplicity? Buchanan has a simple answer to this too: ‘Sometimes you can’t see the wood for the trees’.” Especially when you look only at the trees one by one.

So if we:

- put away our equating of common sense with linear logic,
- substitute systems thinking for reductionism and,
- keep an open mind on whether Mother Nature employed a basic set of design principles and formula for her inventions, merely exploiting variations on a theme for the myriad of phenotypical differences we see around us,

we may have a better chance of speeding up our understanding of our world. In other words, let us look behind the phenotypical diversity for the genotypical laws and principles that govern the operations of the apparently diverse phenomena.

Noting a Coincidence

In the January edition of *Scientific American* 1998, Ingber published an article on ‘tensegrity’, the architecture of life. While reading this article I recognized a set of social and biological parallels which I was prompted to explore in greater depth. Writing them down could partly test whether they stood up to more rigorous analysis, and they appeared to. The other part of the prompt came from Don deGuerre who then read the note, told me to elaborate it and pointed me to Volk’s 1995 book on *Metapatterns*. Volk too had noticed ubiquitous parallels in biological and social organization. While Volk explored the patterns in both biology and society, Ingber explored the fundamental principles underlying these patterns. It is these fundamental or genotypical principles which suggested the parallels I noted, specifically, with the two organizational design principles (Emery F, 1967; Emery & Emery, 1974).

Ingber rejects the biological quest which copycats the reductionist physical quest, for discovering and cataloguing the smallest most critical particles of matter and life as fundamental to understanding life. “Understanding what the parts of a complex machine are made of...does little to explain how the whole systems works...Identifying and describing the molecular puzzle pieces will do little if we do not understand the rules for their assembly” (Ingber, 1998a, p30). With a lot of observation, clear thinking and some ingenious experiments, he has shown that there is a set of simple rules governing the genotypical structure or architecture of life forms. Towards the end he speculates that this may also govern the structure of the physical universe or cosmology, but he does not touch upon the

structure of social forms. If nature is, however, as economical in her genotypes as his work implies, then there is good reason to assume that they also apply to natural stable forms of social arrangement. Nature can be extremely wasteful or so it would appear in cases such as sperm production but in other cases such as basic structures and genes, it would appear that she is very economical (Ananthaswamy, 2003). Fuller (1975, p334) wondered how nature formulated these "lovely geometries" so rapidly. His answer was that she must have some fundamentally *pure and simple* way of developing them. This paper explores the possibility that the pure and simple principles found to operate in the physical and biological realms are exactly the same principles found in the social realm. As we see below, some parallels appear to be there.

Synergetics and Tensegrity

Ingber whose work on cells sparked my interest himself recognized the correspondence between the architecture of cells and the work of Buckminster Fuller on stable structures as he gave the name ‘tensegrity’ to his genotypical concept. Fuller coined the term 'tensegrity' as a contraction of 'tensional integrity'. It describes a common form of architecture governing normal stable self-assembly. "Tensegrity describes a structural-relationship principle in which structural shape is guaranteed by the finitely closed, comprehensively continuous, tensional behaviors of the system and not by the discontinuous and exclusively local compressional member behaviors. Tensegrity provides the ability to yield increasingly without ultimately breaking or coming asunder" (Fuller, 1975, p372). Fuller is known for Bucky Balls and his best known invention is the geodesic dome, a geodesic tensegrity sphere.

Tension and compression are inseparable and coordinate functions of structural systems. At any stage one may be prominent while the other is less prominent (Fuller, 1975, p356). "They are always and only interfunctioning covariables" (p359).

If you tighten one point in a tensegrity system, all the other parts of it tighten evenly. As tensegrity systems are taughtened, they approach but never attain rigidity, being nonredundant structures. Every part is nonredundant. Note again here that Fuller is referring strictly to redundancy of parts as he makes clear in his discussion of redundant parts and systems in aeroplanes, other machines and building codes. Fuller distinguishes 'structural' or physical and 'metaphysical' redundancies, the latter of which appear to correspond to redundancy of functions in human beings. He refers to them as "redundant acts", either "conscious and knowledgeably competent, and subconscious and ignorantly fearful cautionaries" (1975, p397).

"The tensegrity system is synergetic - a behavior of the whole system unpredicted by the behavior of the parts. Old stone-age columns and lintels are energetic and only interact locally with whole buildings. The whole tensegrity-icosahedron system, when loaded oppositely at two diametric points, contracts symmetrically, and because it contracts symmetrically, its parts get symmetrically closer to one another; therefore, gravity increases as of the second power, and the whole system gets uniformly stronger. This is the way atoms behave" (Fuller, 1975, p401). This is opposite to the way in which compression based structures, by acting independently of the whole, weaken the whole when force is applied.

Fuller searched for the highest order generalizations, those that hold without exception (p14). "Pure principles are usable. They are reducible from theory to practice" (p32). And of course, the theory can be derived from practice and observation. While being an abstract theorist, he was also a realist, e.g. "mathematicians feel that they can do anything with their abstraction because they don't relate it to reality. And of course, they *can* really do anything

they want with their abstractions, even though, like masturbation, it is irrelevant to the propagation of life" (Fuller, 1975, p32).

Fuller's overall principle is that of '*synergy*' which "means behavior of whole systems unpredicted by the behavior of their parts taken separately" (Fuller, 1975, p3). Synergy and energy are companions but energy studies are more familiar. "Energy relates to differentiating out sub-functions of nature, studying objects isolated out of the whole complex of Universe - for instance, studying soil minerals without consideration of hydraulics or of plant genetics" (Fuller, 1975, p3), i.e. energy in this sense yields a reductionist science. Synergy is an ecological or systemic concept with its associated congruent practices. One can only start from the whole and work back to the behaviour of the parts. "The solving of problems in synergetics starts with the known behavior of the whole system plus the known behavior of some of the system's parts, which makes possible the discovery of other heretofore unknown parts of the system and their respective behaviors" (Fuller, 1975, p29). This is called the *principle of synergetic advantage* where synergetic advantage is only to be gained by macro to micro procedures. Micro to macro procedures are inherently frustrated (p61). Here we see the impossibility of arguing from bits of DNA to human behaviour, the discussion of which deserves a whole article to itself.

Synergetics derives from experientially invoked mathematics and is a triangular and tetrahedral system. At the heart of Fuller's concept of structure is the "discontinuous-compression, continuous-tension system" (Fuller, 1975, p29). Only triangles are structure and lacking triangulation, there is no structural integrity (p44). It uses 60-degree coordination instead of 90-degree coordination (pp22-3). The tetrahedron is the prime structural *system* in nature (p48). Without 4 nodes and 6 sides (i.e. relationships) there is no stable structure. The tetrahedron encloses the least volume with the most surface (p51). By implication, therefore, it provides maximum exposure to the environment. This is vitally important for social structures because those with maximum exposure to their social and physical environments have the opportunity to be more actively adaptive (Emery M, 1999). One of the great advantages of DP2 structures is that change can be initiated by anybody anywhere in the structure as they note important changes in either the external or internal fields.

Within this one system, it is possible to incorporate quantum and vector based geometric mechanics. "It embraces all of the known mathematics" (Fuller, 1975, p23) and rejects all a priori and 'self evident' assumptions. Fuller argues that our more conventional, non-systemic approach, has created the gap between the sciences and the humanities (p24) through the inability of the non-systemic approaches to model their concepts and principles.

Note here that when Fuller uses the word 'closed' he does not mean a 'closed system' in the sense of impermeable boundaries. He makes this perfectly clear in other sections where he refers to geodesic structures being designed to keep out the weather while admitting microwaves and light from the sun (p409). There is always a coexistent insideness-outsideness of systems (p38) and "there is no absolutely enclosed surface, and there is no absolutely enclosed volume. Universe means 'toward one-ness' and implies a minimum of twoness" (Fuller, 1975, p83). In other words, any entity or system has an environment. He says (Fuller, 1975, p98) that "systems are unpredicted by oneness, twoness, or threeness". Only when four entities, relationships or 'events' are considered can we define or predict a system. This gives us the minimum set of L11, L22 and the two 'transport equations' of L21 and L12, the basic lawful parameters of the open system (Emery & Trist, 1965). In fact, Fuller appears to recognize the directive correlation (Sommerhoff, 1969) as the fundamental building block of an open system. In 1962 (p12) when arguing for an education

for creativity rather than conformity, he said of the new form he was seeking, "The new form must be spontaneously complimentary to the innate faculties and capabilities of life". In other words, it must establish a new set of directive correlations between human abilities and the realities of the world we know.

This raises another direct correspondence between the physical and the social realms as Fuller clearly realized. The 'insideness-outsideness' or the relation between human abilities and the realities of the world we know is expressed as the relationship between affordances and effectivities, central concepts within open systems theory. Affordances are properties of the environment relative to a system, the acts or behaviours permitted by objects, places and events, ie. the physical and social realities. "It is the affordance that is perceived." (Gibson, 1967; Reed & Jones, 1982; Michaels & Carello, 1981, p42). Affordances are real and persistent properties of the world as we know it. Our abilities or capabilities are expressed as effectivities, the potential, purposive behaviours of a perceiver in the field and again are relative to that field. For perceptions to be valuable they must be manifested in effective and appropriate actions on the environment and of course, for actions to be effective and appropriate, they must be informed and constrained by accurate perceptions.

Tensegrity in Biology

From his mathematical base, Fuller built complex geodesic structures that could take highly concentrated local loads or impacts with minimum effort while swiftly distributing and inhibiting the outward waves of stress from the point of concentrated loading. Built up from the tetrahedron which has the greatest resistance of any structure to externally applied concentrated load, it is the same basic form that viruses use for their protective protein shells (Fuller, 1975, p324). As Glanz wrote "Although geodesic domes may be out of fashion now, their principles could live on in biology" (Glanz, 1997, p679).

A team at Harvard Medical School and Children's Hospital has demonstrated "that mammalian cells are densely 'hardwired' with force-carrying connections that reach all the way from the membrane through the cytoskeleton to the genome" (Glanz, 1998, p678). They have shown that the cell is an integrated entity where all the parts are connected, in other words, a system. They have shown that *chemistry is structure* and the strictly chemical and mechanical cannot be separated. "All living cells continually generate mechanical tension within their contractile cytoskeletal microfilaments and they transmit these forces to all parts of the cell. Thus, this form of signal transmission involves modulation of biochemical events by changing the level of stress[1] in the cell. For this reason, the response of the cell to an external stress may vary depending on cell extension and the initial prestress (internal

[1] It should be noted that the term 'stress' in the tensegrity literature is used in the mechanical or physical sense. It is not used in today's sense of feeling 'stressed'. This concept of ‘stress’ as it is used in common language is not particularly useful. There is a curvilinear relationship between stimulation and what is in the vernacular called ‘stress’. It has long been known in human affairs that one person’s challenge or excitement is another’s anxiety or despair because the range of individual differences in response to pressure is huge. An external stimulus or a 'local force' in the mechanical sense can then have different effects on different people. When people say they feel 'stress', they mean they either feel under pressure to do or not do something or would do it differently, or that they are feeling ‘distressed’. Distress is a basic affect and the affect system is a motivational system in its own right, one of our most powerful subsystems (Tomkins, 1962).

tension) in the cytoskeleton…much like how the quality of a musical tone varies when one tunes a guitar string" (Ingber, 1998b, p234). They have shown that cells use a tension-based system of architecture, that described above by Fuller as tensegrity. Stresses from local sources promote long range structural rearrangements through the cell and nucleus. "This dependence of the structural stability of individual molecules on internal prestress, continuous tension and local compression is characteristic of tensegrity architecture, which also guides the organization of living cells and tissues" (Ingber as above, p235).

At the phenotypical level, certain patterns appear, such as spirals, pentagons etc and these appear in both organic and inorganic building blocks. “The only difference is how the atoms are arranged in three-dimensional space” (Ingber, 1998a, p30). Tensegrity governs all scales of life from carbon atoms to viruses and the many levels of organization of the human body, from molecules which self assemble into cells which self assemble into tissues, which self assemble into organs which self assemble into a body organized hierarchically as tiers of systems within systems. “If we are to understand fully the way living creatures *form and function*, we need to uncover these basic principles that guide biological organization” (emphasis added). Ingber clearly understands the difference between generic and serial genetic concepts (Cassirer, 1923).

Tensegrity refers to a system that stabilizes itself mechanically because of the way in which tensional and compressive forces are distributed and balanced within the structure, i.e. stability is given by the balance of tension and compression (Ingber, 1998a, p30 & p38). Biological material is continuously removed and replaced but what we call life appears to be the maintenance of pattern and architecture. Therefore in Ingber’s model, illness would represent a partial breakdown of the maintenance of that pattern and architecture and death is the ultimate breakdown.

Here we see another level of convergence as Ingber has implicitly in his reference to the removal and replacement of biological material, the concept of directive correlation (Sommerhoff, 1969), the core concept of open systems thinking. “Formally, the picture that has emerged is that of a physical system whose parts and part-activities are connected by complex hierarchies of directive correlations which have the necessities of survival and reproduction as ultimate goals at the apex of the hierarchy. The existence of this all-embracing system of directive correlations with its ultimate goal of self-preservation is what makes the organism into a living, biological unit. The irreversible collapse of this system of directive correlations in the breakdown of its *animation*, is *death. Ageing* is the gradual shrinkage of the degrees of these directive correlations that precedes the final collapse (Sommerhoff, 1969, p189). Because it seems difficult in any real sense to decide where learning and becoming more coordinated with the environment ends and ‘ageing’ begins, illness would appear more useful than ageing.

This evidence creates huge problems not only for genetic engineering but also for the deterministic evolutionists. Ingber (1998b) explicitly takes an open systems view. "The same stimulus can produce an entirely different response depending on the cellular context…in other words, the cellular response is dependent on both the chemical and mechanical context in which signal transduction proceeds. Thus, the key question is not which signaling molecule is activated, as currently dominates existing approaches. Rather, it is how all these different signalling pathways are integrated inside the cell" (Ingber, 1998b, p233). The work of this team is based on the behaviour of real life cells in their real life context, not taken out of context as has been the fashion in so much biological science. They prefer to study the structural complexity in which transduction pathways must function in the living cell. As we have seen in so many fields, radically new discoveries result from considering the whole in

context, often overturning whole bodies of scientific orthodoxies. When Ingber's team discovered that in the real living cells, the chromosomes and nuceoli were always connected by flexible strings, made of DNA, Ingber described it as an 11 on a heretical scale of 1-10. The clean separation of chromosomes seen previously was probably a product of sample preparation (Glanz, 1997, p679). This work emphasizes "how we will never be able to fully understand cellular control if we only analyze individual molecules in isolation" (Ingber, 1998b, p236). He believes the future in this area lies with biomimetics rather than genomics, by structures and mechanics rather than chemistry alone. It could make functional genomics look primitive. Of course, like all new discoveries, this systemic approach has stirred the more orthodox into protest (Brookes, 1999).

Far from the genes determining the shape of life and its development, tensegrity has “allowed us to comprehend better how cellular shape and mechanical forces...influence the activities of genes”. “How living things form has less to do with chemical composition than with architecture” (Ingber, 1998a, p31), changing geometry could “even alter genes...and thus the proteins that are made” (p34). “Genes are a product of evolution, not its driving force” (p38). Indeed, in the same issue of *Sci Am* and in a spate of other recent scientific articles, there is accumulating evidence that genes and other so called fundamental building blocks are far more malleable and mobile than previously believed, shades of ‘jumping genes’. They, like all else in nature, respond to changes in their environment (Rayner, 1997).

Genotypical Patterns and the Design Principles

Figure 1 illustrates the basic modules of the structures flowing from the two genotypical design principles and a third non-structure called laissez-faire (Lippitt & White, 1943 & 1947; deGuerre, 2000). These design principles have also been discovered independently by Riane Eisler (1995, p105) who calls the systems flowing from them 'androcracy' and 'gylany'. She also recognizes they are extremely powerful and affect most aspects of organizational life as well as male-female relationships.

These design principles are not human constructs or concepts in the normal theoretical sense. They are the realities of life operating in all forms of organization including families, voluntary organizations and governments. They are also legal realities within industrial relations. The first design principle is embedded in individual job specifications, duty statements or contracts and is enforceable. The failure of a supervisor to adequately supervise, i.e. control the work and behaviour of an employee and coordinate the work of the section such that the specified goals are met is punishable.

To change the genotypical principle from the first to the second in a formal, employing organization requires an agreement signed in the Industrial Relations Commission so that the second design principle is now the legally binding reality behind the organization structure. Without a legally binding agreement, the structure is still built on DP1, whatever its superficial appearance, and everybody who works there knows it. This is the main reason that so many experiments with so called 'self managing' groups are short lived. While the results may be good for a short period, they are unsustainable because sooner or later people realize that nothing has really changed. Supervisors may have their names changed to trainers, team leaders or coaches (TLCs) or but they are still legally responsible for the coordination and control of their section. People may have been told they are 'empowered' but the power structure remains unchanged.

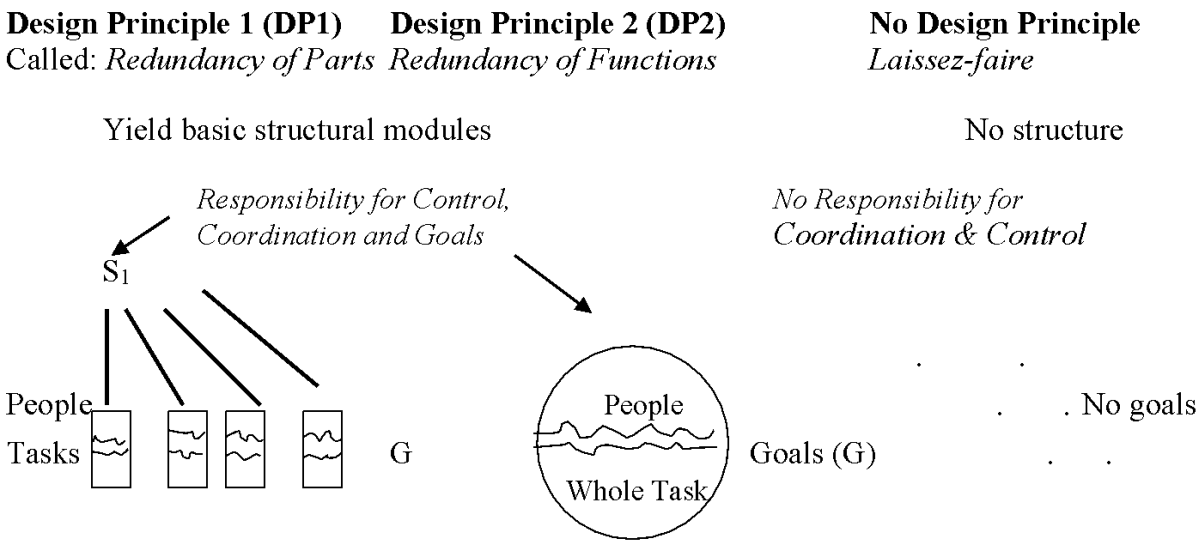

Figure 1. The Genotypical Organizational Design Principles

Figure 1 shows that the basic module flowing from the first design principle called DP1 for short, is a section of an organization with a first line supervisor (S1). The technical name of DP1 is 'redundancy of parts' because there are more parts, that is people, than are required to do the productive work at any one given time (Emery F, 1967a). DP1 yields a supervisory or dominant hierarchy. A dominant hierarchy or hierarchy of personal dominance is one where the people, at least one level above where the work is being done, have a legal right and responsibility to tell the people below them what to do and how to do it.

Its second critical feature is that responsibility for coordination and control is located at least one level above where the work, learning or planning is being done (Emery & Emery, 1974). In DP1 structures, responsibility for control, which is the vertical line, is vested in S1. It is S1's responsibility to ensure that each person does his or her job on time and up to specifications. It is also S1's responsibility to ensure that coordination, the horizontal line, is adequate, that all the outcomes of the separate jobs plus all the interdependencies between them, add up to the section's goals.

Figure 1 also shows that the basic module flowing from the second design principle, called DP2 for short, is a self managing group, without a first line supervisor. The technical name of DP2 is 'redundancy of functions' because there are more skills and functions built into each individual person than they need to do the productive work at any one given time. DP2 yields a non-dominant hierarchy of functions or a functional hierarchy. A hierarchy of functions acknowledges that different types of work need to be done at different levels of the organization, certainly in large organizations. For example, in large organizations, there is considerable productive work that needs to be done everyday at the overall organizational, strategic or policy level. Similarly, no organization can survive without having people working at the operational level, the level at which the core work or business of the organization is performed. In a DP2 structure, nobody has the right to tell others what to do and how to do it. All communications are conducted as negotiations between equals. DP2 structures are open information systems and because all staff have adequate skills and knowledge to operate in their group, there cannot be discrimination on this basis.

The second critical feature of DP2 structures is that responsibility for coordination and control is located exactly where the work, learning or planning is being done. In DP2 structures where multiskilling is possible, responsibility for both coordination and control is vested in self managing groups at different levels of the functional hierarchy. It is the group's responsibility to manage themselves as people, and to ensure that the group's goals are met on time and up to specifications. Once the goals are drafted, negotiated and agreed with whoever is the authorizing group within the organization for this, it is up to the group to decide how to allocate different pieces of the work to different people at different times.

The design principles and their basic modules form very different organizational structures with extremely different modes of operation. The overall form of DP1 structure is a larger replica of the basic module, well known and recognized. There are different forms of DP2 structures and we examine these below when we compare them with structural forms in other realms.

Before we can effectively make the comparison and judge whether there is a real parallel in biological and social arrangements, some differences must be made explicit. Obviously people are not bridges, nor are they cells or bees or dogs. Within the conceptual framework called open systems theory within which the design principles lie, people are taken to be open purposeful systems, who may under certain circumstances become ideal seeking (Emery F, 1977; 1998). They differ from the rest of the animal kingdom in so far as they have consciousness. By consciousness I do not mean the word in the sense that we have awareness, an ability we appear to share with other creatures, nor do I mean it in the sense of 'altered states of consciousness'. I use the word strictly in the sense of Chein's rigorous (1972, p95) definition which means that humans can be aware of their awareness. This definition can be expressed as a directive correlation (Emery M, 1999, pp70-77) which gives an operational definition.

Isomorphisms in the Biological, Mechanical and Social Realms

In translating from the biological and mechanical realms to the social and pyschological I will draw the parallels at two levels, the relation between individual and group within an organizational structure and the relation of intrapersonal to individual psychology. This is sufficient to suggest that tensegrity functions exactly the same way in the human and social realms as it does in the mechanical and also biological fields.

Fuller (1975, p360) stated that "compressionally dominated functions of structural systems are inherently self-diminutive in overall aspect. Tensionally dominant functions of structural systems are inherently self-enlarging in overall involvement". Self-diminutive translates into variety reducing and Emery (1977) discovered that structures built on the first design principle (DP1) are variety reducing. Those structures built on DP2 are variety enhancing. Here we see the first parallel between compression and DP1 on the one hand, and tension and DP2 on the other.

Tensegrity structures offer a maximum amount of strength for a given amount of building material. The geodesic form is one type of tensegrity structure which relies on frameworks made up of rigid struts each of which can bear tension or compression. The second type of tensegrity encompasses structures that stabilize themselves through a phenomenon called ‘prestress’. Here structural members that can bear tension are distinct from those that bear compression. “Even before one of these structures is subjected to an external force, all the structural members are already in tension or compression - that is, they are prestressed (Ingber, 1998a, p31).

These two types of tensegrity structures are contrasted with other buildings that derive their stability from continuous compression because of the force of gravity (Ingber, 1998a, p32). These do not share the critical feature of tensegrity which is that tension is continuously transmitted across all structural members. An increase in tension in one member results in increased tension in members throughout the structure, and this total increase in tension is balanced by an increase in compression within certain members spaced throughout the structure. Those that rely on continuous compression do not have the same capacity to withstand stress. Let us call the compression only structure 'type 1' while we will call these tensegrity structures 'type 2A' (geodesic) and 'type 2B' (prestressed).

The *first level* of translation involves the individual, the group and their relationships within an organizational system. The parallel is with the relation of individual nodes, hexagons and struts in a geodesic dome, or the nucleus, microfilaments and microtubules in the cytoskeleton of a cell. The overall body is the organized system.

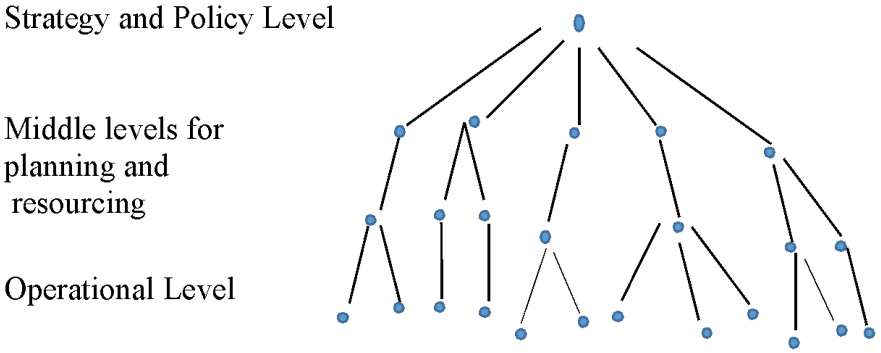

Figure 2. Small DP1 Structure

The major clue to the isomorphisms is given by the response of the structures to external forces. DP1 structures (Figure 2) are notorious for their inability to respond to external forces such as changing values in the external social field or environment. Changing customer requirements, or complaints, are either simply ignored or messengers are shot, or one or two operators are put under increased pressure to change their behaviour, which can result in increased absenteeism, turnover, accidents, etc. Unfortunately, many organizations say this continues to be true even after major efforts to introduce methods such as TQM.

As Figure 2 shows, tension in a DP1 structure is not transmitted across the whole structure as there are no lateral relationships to produce counteracting forces to the compression coming down from above. Individuals are continually compressed in their range of behaviours and purposefulness. If supervisors are doing their jobs properly, those beneath them have less than adequate levels of autonomy in decision making, goals setting and the other psychological requirements for productive work (Emery & Thorsrud, 1969; Emery & Emery, 1974). Mutual support and respect which could exert an indirect effect also often tends to be low in these structures. There are simply no other forces to bring the compression into balance with tension.

DP1 can, therefore, be described as producing a type 1 compression only structure. The relationships between different levels of the dominant hierarchy are rigid, struts, but there are no lateral structural relationships that could carry the tension across the structure.

Communication is down and up the line and because DP1 structures encourage competition, has the characteristics of asymmetry, egocentrism, and 'them and us' (Emery & Emery, 1976). While communications sent down the line are typically instructions, communications to be sent up the line may be forgotten, may contain information or may contain misinformation. External stress or force is, therefore, continuously compressed down onto individuals with the resulting breakdowns in physical and mental health that have been documented as characteristic of DP1 structures since Trist and Bamforth (1951).

In contrast, DP2 structures contain two distinct entities, individuals and groups with the individuals arranged into groups. They also can appear in three forms, two with stable self managing groups. Figures 3 and 5 show the models for stable work while Figure 4 shows the appropriate model for unstable work. In all cases, there is a lattice of both horizontal and lateral structural relationships for communicating stresses across the whole structure. In addition, these relationships or struts are under the joint control of the people, so that they also can be continuously redesigned so that they continue to be capable of bearing both tension and compression.

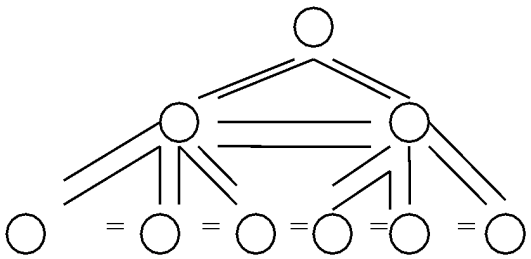

Figure 3. Medium to Large Organization where All Groups are Multiskilled

The first case with stable multiskilled groups shown in Figure 3 is the equivalent of the Type 2A (geodesic) model in which both individuals and groups can both bear tension *and* compression. In this case, individuals can bear tension because they have supporting relationships within the group, as well as the groups having supporting relationships with other groups. These supporting lateral and horizontal relationships are also flexible as they are constantly under implicit negotiation within the dynamic, responsive whole.

The double lines in Figure 3 indicate that all change is negotiated between peers throughout the organization, from its initiation at any point. We note here that purposeful, and creative, people are also a source of tension within DP2 systems as they generate ideas which result in changes, which because of the above network of relationships, are transmitted and cause change across the system. Here the group acts to compress, as the individual's bright idea must first go to the group for consideration. If the group decides to act on the idea, it will then function to increase tension within the whole system. This will then be spread up and down and across the structure as the idea is given wider consideration through the whole. Hence there is an automatic balancing of tension and compression which functions in the best interests of the whole system as no individual can act unilaterally in such a way as to introduce maladaptive change.

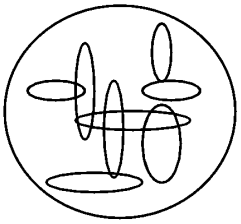

Figure 4. Small So-called 'Knowledge Work' Organization

Figure 4 shows a small one level organization where the whole is the decision making body, composed of temporary, overlapping project teams. This is the appropriate form when the work is unstable, that is, it comes in as projects where every project is different and needs to be addressed by different mixtures of skills and knowledge. It is a highly flexible dynamic form with extremely high responsiveness. As with the full multiskilled model, there are forces acting both to compress and spread tension, keeping them in equilibrium.

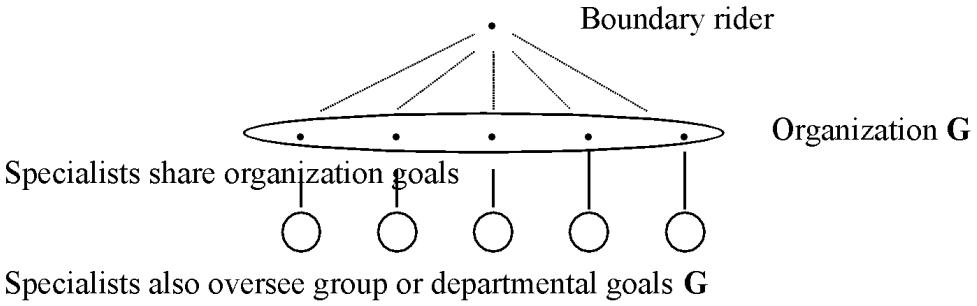

Figure 5. Small to Medium-sized Organization with Specialists at the Strategic Level

In the variation of DP2 shown in Figure 5, there is a mixture of individual and group responsibilities depending on whether control can be practically shared by a group. This is a preferred model when specialists are present and when there are legal or other demarcations operating within the organization. In Figure 5 the specialists are at the senior level of the organization but the model may be used at any level. There is also a 'boundary rider' who works across the boundary of the organization and the environment but is not a supervisor. The boundary rider and the senior team work together when required. In these cases, control and coordination are split with control remaining with the individual specialist while the specialists still share responsibility for coordination and goals. This model is appropriate for transdisciplinary research and some long-lived, stable project teams.

This model of DP2 is the equivalent of the Type 2B (prestressed) model where the tension bearing components are the groups and individual specialists with control have the compression function. The counteracting forces of tension and compression are present but we would expect that the specialist individuals who carry responsibility for controlling some

functions or particular aspects of the work would be more subject to forces originating from inside or outside the system. This would be the case because their network of supporting relations is somewhat reduced by their partial individual responsibility.

We can see that "tensegrity structures are mechanically stable not because of the strength of individual members but because of the way the entire structure distributes and balances mechanical stresses (Ingber, 1998a, p31). Now substitute 'DP2' for 'tensegrity' and 'psychological' for 'mechanical' and we can see immediately how DP2 structures achieve greater stability and adaptation than do DP1 structures (Emery F, 1977; Emery M, 1999). Because DP2 structures better produce the six psychological requirements for productive activity, the intrinsic motivators, (Emery & Thorsrud, 1969; Emery & Emery, 1974) they have shown much better organizational statistics from the birth of socio-technical systems (Trist & Bamforth, 1951) through the experimentation that followed (Rice, 1953, 1993; Trist et al, 1963, 1993) to the Norwegian Industrial Democracy Project (Emery & Thorsrud, 1976) to such ongoing sites as Syncrude Canada Ltd (deGuerre, 2000). Australia has also produced notable statistics from sites such as ICI Botany, CIG (Roberts, 1995), Karadoc Winery (Roberts, 1996a) and J Robbins & Sons shoes (Amerin, 2000; Aughton 2006) but unfortunately, few of these have been formally published. Apart from the six psychological requirements, DP2 structures also provide better possible conditions for their people as one of the changes involved is a shift from positional based pay to pay for skills and knowledge held. This allows employees to choose their rate of increased skilling and pay without the inflexibility of having to move from chosen areas to administration or management.

One of the implications of these improvements in motivation and conditions is that the massive amount of time and money spent attempting to select the right people for various positions in organizations is mostly a waste as DP2 structures do not rely on having the very 'best' people. Individual 'strength' or resilience as measured by psychological tests is not a fixed entity in any person. Like other behavioural characteristics, it varies depending on the ecosystem within which the person is embedded. What bothers one person will be very different from what bothers another and as we know from using the six requirements, individuals will rate their scores on the same criterion differently from day to day according to variations in other aspects of their life inside and outside the workplace (Emery & Emery, 1974).

More recently, a study in three organizations has shown that the design principles affect human health and also mental health (Emery & Aughton, 2006). Results of a follow-up study about nine months after the third organization underwent a total systemic change from the first to the second design principle has been published as deGuerre et al, 2008.

At the level of the whole organizational system the analogy works well with complex structures such as the human body. As Ingber describes it, the body is a non dominant hierarchy of functions with systems within systems. As we know from the work of Edelman (1992), that appears to be the nature of the organization of the human brain and central nervous system more generally. At the social organizational level, we have purposeful systems within groups that act as purposeful systems within a purposeful organization. And the more complex the organization, the more it relies on the counterbalancing forces of tension bearing and compression bearing components for coordinating production and marketing as the body relies on these for the coordination of the systemic functions of digestion, intellectual activity etc.

Tensegrity also informs us about the possibilities of other functions within DP2 structures. Researchers have experimentally modified the shape of cells. When cells were spread flat, they became more likely to divide. When round cells were prevented from spreading, they

self activated apoptosis - a cell death or suicide program. When cells were neither too extended nor too retracted, they neither divided nor died. Instead they merely got on with their work with whatever normal skills they possessed, i.e. “differentiated themselves in a tissue-specific manner: capillary cells formed hollow capillary tubes, liver cells secreted proteins that the liver normally supplies to the blood” etc (Ingber, 1998a, p34). [The analogy is not complete here because the cells with which they experimented were more specialized than most people.]

“Very flat cells with their cytoskeletons stretched, sense that more cells are needed to cover the surrounding substrate - as in wound repair - and that cell division is needed” (Ingber, 1998a, p34). When a group of people is stretched to the limit, they too realize that they need either more members or need to set up another group to better get the work done. “Rounding indicates that too many cells are competing for space...and some must die” (Ingber as above, p35). We can translate this into groups or individuals who are so restricted or constrained in their scope or abilities that they finally self destruct, either organizationally, in terms of group dynamics (Bion, 1952, 1961; Emery M, 1999, pp115-1230) or psychologically as individuals. This would indicate that they were not part of a genuinely DP2 structure where they could exercise judgement over the matters of numbers and scope. Pseudo-teams or the attempt to graft teams onto the DP1 structure have been all the rage for some time now but constantly fail over time (Roberts, 1996b).

We can also make the translation at a *second level* and this involves the relation of intrapersonal to individual psychology rather than individual to group. Here we take autonomy and homonomy as an example of our counterbalancing forces. Autonomy, meaning governed from the inside (Angyal, 1965), if allowed to run wild results in highly disturbed people who can play out their disturbances in the community arena with random violence and other dissociated and antisocial acts. This can be seen as the result of excessive levels or surges of high voltage tension. Homonomy, the need to belong (Angyal, 1965), if overdominant, results in highly conformist behaviours and levels of psychic death as measured by affectual flatness and lack of creativity. It can be seen as over-compression and it also has transfer effects to the broader community. However, it is the individual who firstly and predominantly suffers from the intrapersonal imbalance of these countervailing forces. We know that the balance of these forces and personal behaviour does change through a person’s life as their ecosystems and panoramas of social ties change (Greco, 1950). There is no need to labour this analogy further. The point has been made.

“The geodesic structure found within the cytoskeleton is a classic example of a pattern that is found everywhere in nature (Ingber, 1998a, p36). “It is visual evidence of the existence of common rules for self-assembly” (as above, p37). Is there any good reason to assume that we are not intrinsically adapted to organize ourselves by these common rules? As Fuller put it (1975, p408) "We thus discover that tensegrity structuring and its omnirationally constituted regularities are cosmically *a priori*, disclosing that Universe is not redundant", i.e. is not built on redundant parts, not DP1. It is only humanity's being born ignorant that has delayed all of humanity's escape from the self-annihilating effect of the omniredundance now characterizing most of humanity's activities". Ingber (as above, p38) restated this as “tensegrity is clearly nature’s preferred building system”. He then continued to explain it “as a local force (that) can change the shape of an entire tensegrity structure” and “these conformational changes...trigger a cascade of molecular restructuring (reorganization of which individuals are primarily doing what) inside that cell (group)”. The isomorphism is clearly the rebalancing of autonomy and homonomy within the individual. Given this, why should DP2 not be the preferred genotype for social organization? It is documented to be the “most

economical and efficient way to build", both at the level of tensegrity (Fuller, 1975, p533; Ingber, 1999. p38) and at the social level.

While our experience, and particularly our consciousness of it, gives us a choice of genotype for organizing our social structures, perhaps we would be wise to firmly make the decision to go with nature's preferred form. When Volk (1995) recognized that DP2 did appear to be Nature's major preference, he began to reflect on human history. Have we as *homo sapiens*, the "planetary brain species" become the center? "Indeed, we have taken the icosahedron of dispersed nature and molded it into a centered vector equilibrium...this act has entailed our removal of a number of original relations, expanding the parts into an unstable, new geometry, then stabilizing them in this position by our own radiating relations to all" (Volk, 1995, p119).

But have we really achieved stability, and if so, to what end? I think only in our imagination or hubris, as everyday new evidence comes to light that our dominance over the Earth is a myth. Bacterial, viral and insect resistance to our amoury of weapons has been growing apace. We cannot control the myriad of subsystems from weather to viruses and we know not what we have done. The planetary pollution by accumulating and persistent chemical groups such as PCBs, dioxins and nonyphenols is taking its toll on human reproductive and central nervous system functioning to the point where it may threaten our long term survival (Colborn et al, 1996). Where is the new stability?

We are not queen bees and our consciousness does not change our status as biological creatures embedded in the Earth. It does not confer dominance or the right of dominance. We have proved we cannot escape from the hierarchy of directive correlations in which we find ourselves. All our consciousness can validly do is to help us understand and exercise our responsibilities towards the Earth. Our experiment with DP1 appears to have failed badly. As we are only one species and there is only one Earth, it is time to design a DP2 system where responsibility for coordination and control is located where the action and the actors are, at each appropriate level of system, from our smaller local units up to the planetary wide governance system. Then we may start moving towards a genuine active adaptation that includes ourselves.

The Problems with Phenotypes

We have looked at these isomorphisms at the genotypical level. Let us now look at the confusions that are engendered when the phenotypical approach is taken. Volk (1995, pix) follows Bateson in defining a 'metapattern' as a pattern of patterns, "functional universals for forms in space, processes in time, and concepts in mind". He includes in these metapatterns many forms such as calendars and arrows as well as spheres, borders, layers, cycles, etc. His chapter on centers is most relevant to my purposes here.

Volk as does Ingber, begins from the analogy between many biological forms and the structures of Buckminster Fuller, namely the icosahedron which is 'leaderless' as are bacteria because they do not have nuclei or centers, and those stabilized forms in the 'vector equilibrium' model. These latter forms have centers and Volk compares them with atoms, cells and monarchies. From this taxonomy into 'dispersed' and 'centered', Volk derives some features of centers. These include:

- a center is singular

- in physical systems such as cells and the solar system, “the centre is of unique substance” (1995, p105)
- “center is often particularly resistant to change” (Volk, as above, p105) as for example, when cells rapidly repair DNA damage, or the sun remains after planets change
- centers affect the whole system and are most directly tied to the nature of the whole, radiating relations

This seems clear enough as a description of what we call a dominant hierarchy or DP1 system with instructions down affecting relations between the centre and the parts and between the parts themselves. The fact that there is no known evidence that people who hold center (or top) positions in a dominant hierarchy are any different from anybody else and are certainly not composed of unique substances, although as Volk points out some kings and emperors have claimed different coloured blood or partial divinity, the lack of correspondence would lead us to believe that such centered systems may not be appropriate for people.

On his first point of singularity, he then goes on to say that “Systems with a multitude of essential parts could be called multi-centered systems, implying the possibility of a dispersed systems of centers and thus going beyond the probably too rigid binary of dispersed and centered” (Volk, 1995, p104). This is where we begin to see that simply describing systems with semantics and without clear operational definitions such as those given by the genotypical design principles is not going to work, as a multi-centered dispersed system is no longer a system with a center.

This confusion worsens after he says “it is to life that the search must turn...[because] only in adaptive systems - those in which evolutionary processes channel design possibilities towards utility - can we look for wide-ranging patterns...as design attractors” (Volk, 1995, p106). When he does this he finds mainly the dispersed pattern but he seems to want to find centers. He acknowledges that plants are complex organisms but seem to lack a center, sponges also have no centre but these creatures are immobile. Hence, “mobility called for a global network of communication and control. A new center was born: the nervous system” (Volk as above, p107). However, plants do have nervous systems and they communicate through chemical messages, for example when warning of advancing predators. And describing the nervous system of plants and animals as central, flies in the face of much evidence that the nervous system merely takes its place in the whole as do other systems such as the endocrine system etc. Such subsystems are mutually influential whereby damage to the endocrine system can change the nervous system and learning potential (Colborn et al, 1996).

Taking this further, he finds that organisms with nerves as centers made possible the novelty of *social systems* but again the evidence for centers is elusive. “Flocks of birds, schools of fish, and migrating herds of wildebeest or caribou consist of a large number of nearly identical beings. They are dispersed systems” (Volk, 1995, p109). He explores the phenomenon of ‘alpha’ individuals in some mammalian species but “in some ways the case for the mammalian centers is weaker than for many of the other examples presented thus far...the alpha mammalian center is not a specialized individual [such as a queen bee] but a role. Perhaps because this role embodies a greater degree of whatever metaphysical substance makes up the network of dominance and cooperation, mammal societies with dominance hierarchies should be considered more dispersed than centered” (Volk as above, pp111-112).

With the precision given by the design principles, we can clearly differentiate between DP1 structures such as those allegedly found in bee hives and ants nests, and the DP2 structures found in mammalian structures. Also we know that DP2 structures contain the possibility of DP1 structures for certain functions and in certain circumstances. However, DP1 does not contain the possibility of DP2 within it for short periods of time. The design principles are asymmetrical (Herbst 1990). We do not need to revert to non scientific speculation about metaphysical substances.

To escape from this problem of metaphysics, Volk speculates that "the DNA, the code, is perhaps echoed in human society in the laws of the land" (Volk, 1995, p114) but again this level of argument is far removed from the observable distinct arrangements between individuals that constitute structures. When finally he arrives at the ecological level he again forces the argument for centers beyond the evidence. "The closest ecology gets to a centered system is the concept of key-stone species" and the example he uses of 'key-stone species' is that of a cow in USA where the cow is key-stone only from the economic, not the ecological perspective. Finally he acknowledges that 'Nature breathes freedom as an ideal dispersed projection - no bosses" (Volk as above, p119).

Throughout this fascinating but confused book, we see that the confusion arrives because Volk lacks the precision of concept afforded by the genotypical organizational design principles. Only at the genotypical level can there be precise validation of these principles in other realms of life and greater confidence in their power to explain and predict human behaviour.

Conclusion.

In this paper we have looked at multiple instances of structural corroboration (Pepper, 1942) of not only open systems but also of the genotypical design principles. Over and over again, we see that people have recognized them all in different areas of life and given them different names. There would appear from this brief survey to be sufficient structural corroboration of the occurrence of these design principles for them to be viewed as fundamental and ubiquitous principles producing building blocks in mechanics, in biology and in human and social affairs.

This paper was cited as: Emery, Merrelyn, (2003). Are there universal principles governing architecture in the mechanical, biological and social realms? The evidence so far. In *Conference Proceedings, 9th ANZSYS Conference, Systems in Action,* 18-20 November, ANZSYS 2003. Monash University Conference Managing Office, Melbourne.

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3. Economics

This chapter on economics is brief but it contains the basic reasons the discipline, while so touted by some of our elites such as politicians, has failed dismally to help produce a healthier planet or happier people. Indeed, not only have planet and people not improved their conditions, they have gone backward as many politicians have become captured by economics and it has come to be the major concern of governments. Believe it or not, the economy was once the concern and preserve of private enterprise, not of governments.

The major turning point in the whole field of economics was the advent of what is now known as neoliberalism, the brainchild of a small group of economists, particularly Friedrich Hayek and Milton Friedman. Centring on the prioritization of the market, it favoured replacing all human and environmental values with the single goal of increasing material riches. As a necessary precondition of success in this venture, neoliberalism tightened up organizational hierarchies. We had long been burdened with dominant hierarchies but until the middle 1970s, people had been successfully working their way around these structures, with their strictures, to ensure they not only made their organizations work reasonably well, they also managed to enjoy good relationships at work and in general, experience a good quality of work life. There were of course exceptions to that where supervisors and foremen laid down the law and enforced it, but these previous exceptions suddenly became the flavour of the month – and a lot of people did not know what had hit them.

This is now all pretty much ancient history and the dreadful results including reduced productivity and escalating mental illness (deGuerre et al, 2008), have convinced many to backtrack on it. However despite all this with many organizations eschewing the practice, many politicians still continue to build it into their policies. This can be seen particularly in policies for climate change where making money is still put above reducing emissions despite their long term ecocidal and suicidal outcomes.

This brief description at once marks neoliberalism as a major deviation from the many variants found in the past for making a little profit from the transformation of capital. It can be pinpointed as the predominant determinant of the rapid worsening of human and ecological health and happiness.

The last global financial crisis?

While many causes of the global recession (GFC) have become clear as it has received detailed scrutiny, far less attention has been paid to some of its more underlying and fundamental dimensions. For example, while there has been extensive discussion of reduced and/or inadequate regulation of the USA financial institutions in particular, and the global financial industry more generally, there has been no discussion of the alternative to relying solely on external regulation. It has merely been assumed that the way this regulation has been executed in the past is the only way in which effective regulation can be achieved. As I show below, this is not the case. The past and current forms of external regulation are not the only, and are far from being the most effective, forms.

The point of this article is that although it is now obvious just how serious these crises can be, they will keep on recurring until we change the fundamentals, not just solve the immediate presenting problems. We simply do not need to accept that ‘capitalism’ has an inbuilt boom and bust cycle. There is a solid practical alternative to the current fundamentals, a theoretical framework based on reality and tested in reality for nearly sixty years.

That framework is, of course, open systems, one of the main planks of which is the concepts of the two genotypical design principles surveyed above in chapter 2. The other major plank, the relationship of system and environment is discussed below. Most variants of economics today are built on closed systems and seem quite comfortable with the widespread use of the first design principle, DP1 which is the bane of humanity, equality and a desirable future. As we shall see, economics primarily fits comfortably within the world hypothesis of mechanism (Pepper, 1942).

Open systems not closed systems

Most people would disagree that people are machines. Most people would also disagree that the world is a machine. Yet many of the sciences and particularly many current academic economists take it as axiomatic that mechanistic people live in a world that runs like a machine. If the fundamental assumptions and concepts underlying a science are at odds with reality, it is certain that any answers that science provides are going to be wrong. And so it has been. Academic economists have misled policy makers and helped create the GFC, amongst other misadventures.

That is only one example of how much of our 'informed' or 'expert' guidance has landed us in the mess we are in today, battling the GFC on the one hand and climate change on the other. While we are not discussing climate change in this article, these two crises spring from the one source – a mistake in our choice of basic orientation towards the world, what Steven Pepper called a 'world hypothesis' (1942). This section discusses some of the ways in which our weddedness to the world hypothesis of mechanism has led to today's mess.

Academic economists have so far escaped much blame for the GFC as public anger has focused on the more obvious culprits such as greed bankers and CEOs but why did the greedy bankers take the "risks which, with hindsight, were obviously suicidal" (Kaletsky, 2009, p6)? The answer is the banker's belief in "rational investors and efficient markets", a belief sold to them by academic economists who have erected "an enormous scaffolding of theoretical models, regulatory prescriptions and computer simulations that allowed the practical bankers and politicians to build the towers of bad debt and bad policy" (Kaletsky, 2009, p6).

The reckless property lending triggered the crisis because rational investors assumed that the probability of a fall in house prices was near zero. Therefore, lending 100% mortgages "with 50-1 leverage was safe" (Kaletsky, 2009, p6). Regulators too "took it as axiomatic that markets would automatically generate the best possible information and create the right incentives for managing risks" (Kaletsky, 2009, p6). Kaletsky describes the two false theories of the rational expectations hypothesis (REH) and efficient markets as "misleading" and "highly ideological" and powerful.

The economists who developed the REH asserted "that a market economy should be viewed as a mechanical system that is governed like a physical system, by clearly defined economic laws that are immutable and universally understood. Despite its obvious implausibility…REH has continued to be regarded by universities and funding bodies as the most acceptable foundation for serious academic research" (Kaletsky, 2009, p6).

"Although there was never any empirical evidence for REH,…the assumptions of clearly defined laws and identical expectations were easily translated into simple mathematical models" (Kaletsky, 2009, p7). Mathematical tractability soon became more important than "correspondence to reality or predictive power". When models could be checked against

reality, they usually failed "but this was not a deterrent to the economics profession. In other words, if the theory doesn't fit the facts, ignore the facts. How could the world have allowed such crassly unscientific attitudes to dominate a serious academic discipline" (Kaletsky, 2009, p7)?

REH became entwined with the monetarist political ideology that claimed that government spending would produce inflation and it gradually merged with the related theory of efficient financial markets. Problems for the theory such as price fluctuations were washed away by the assumption that they were meaningless random movements that probably conformed to a normal curve and could, therefore, be ignored. But as we see below, these fluctuations are extremely meaningful and can be tracked to illuminate global social value shifts that have immense predictive power.

Mechanism writ large pervaded economics and the world has suffered from "the 'sharp' predictions of rational expectations models, which are precise but invariable precisely wrong" (Kaletsky, 2009, p7).

Acknowledging that systems have environments

A few minute's observation and thought will confirm that the world consists of open systems, systems that have permeable boundaries. For example, the captains of the automobile industry, particularly in the USA but not limited to it, have been of the opinion that 'we build them and they will come'. While arrogance is never recommended as a solid foundation for prosperity, the arrogance hides a deeper malaise. That malaise is a deep seated reluctance or refusal to acknowledge that any entity is not solely in charge of its own fate. It is the expression of an extreme and irrational individualism born of a belief in closed systems.

It is now over 60 years since it was shown that systems have boundaries open to their environments and that systems and environments codetermine each other as in Figure 1 (Emery & Trist, 1965).

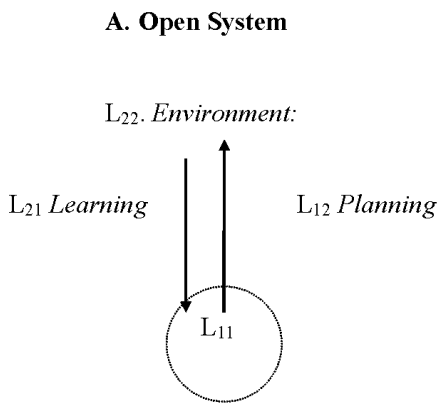


Figure 1. The Basic Model of Open System

In Figure 1, system and environment are co-implicated in any current state of affairs and act jointly to produce a new one.

What the open system shows is that people actively create the social field at the same time as they are affected by it. This means that within limits, we can track social change through the changing actions of people. These changes are called the 'embryos of social change'. By monitoring these embryos as they appear, it is possible to get to grips with the major changes that are occurring in the global social field. See for example *Did 9/11 change the world?* (Emery M, 2021).

By 1977 it was clear that there was a global social field that was constantly changing and, therefore, constantly affecting the fortunes of organizations and communities (Emery F, 1977). Since the period 1945-53, the major feature of this social field has been *relevant uncertainty* as people have been changing their minds about what they value. It is this that creates the dynamism of the field (Emery F, 1978). Any system ignores this social field at their peril.

Let us look now at the data, not only available but also highly visible, that the USA auto makers steadfastly ignored, and as we have seen, it was at their peril. Gasoline prices began to rise in the USA in February 2002 and despite fluctuations held a steady course upwards. Given that there has been a significant inverse correlation between gasoline price and consumption over at least the last thirty years (Hughes et al), it beggars belief that the big auto makers persisted in their strategy, particularly given the trend towards smaller, more fuel efficient cars around the rest of the world.

There was also data available from the USA Census Bureau that showed that for the first time, the rise in sales of SUV's dropped between 1997 and 2002. That is, there was a still an increase in sales but the increase was slowing. To any body with an eye on the L_{22} and, therefore, the market, this would have been a wake up call. As in 'uh oh, perhaps the party is over! We should keep an eye on that.' But the US auto industry bosses totally ignored the market, in fact they have been out of touch with the market since the 1970s (Sargis, 2006).

By 2005, Helmore could write "The US automotive industry is experiencing the moment it hoped would never come. Americans are turning their backs on SUVs and other gas guzzlers. Compared with a year ago, the big three Detroit car makers have seen sales of full-size SUVs…fall by more than a quarter. US consumers, battered by high petrol prices, are newly receptive to climate change warnings following hurricanes Katrina and Rita." Detroit did "not anticipate a growing interest in less environment-damaging, more economic cars". Sales of the Chevrolet Tahoe, a large SUV for 7 passengers reached a peak of 209,767 in 2002 but sold only 161,491 in 2006 (Fontanelle, 2007). That is a drop of 23% in only four years. At the same time, midsize and small cars fetched higher used prices (Abelson, 2008).

At the same time, Japanese sales experienced increases of between 14 to 23 percent. A Toyota president stated that even if petrol prices decline, habits were changing. Some in the USA saw the decline in SUV sales as a permanent change but US carmakers asked the president to take more aggressive action to reduce dependence on petrol (Helmore, 2005). Nothing to do with them!

However, it wasn't only SUVs that were causing the auto maker's woes.

As Table shows, the rate of growth in the new car market began to slow in 2003. The rate of change then became negative and accelerated. In the years 2003- 2004, the used vehicle market took up the slack but this market too then began a downhill run.

Table. Rate of Change in Vehicle Sales from 2002-2008 in Maryland (MVA, 2009)						
% rate of change for	*2002-2003*	*2003-2004*	*2004-2005*	*2005-2006*	*2006-2007*	*2007-2008*
New vehicles	6.49	0.06	-1.56	-5.35	-5.3	-18.25
Used vehicles	2.94	3.60	0.59	-0.98	-2.64	-8.94

Of course oil price and travel are closely intertwined but there were other factors affecting confidence such as "the housing recession, the costly and un-winnable war in Iraq, record federal debt and a weak dollar" (Erbe, 2008). Oil price also permeates every consumer good and service and inevitably, consumers saw the writing on the wall before the auto makers. "Now…it's all about green. There has been a tipping point in terms of people's consciousness" (Brennan, 2008). The two major factors in that tipping point are a political climate with popular concepts about climate change and an emphasis on national energy security. In progressive countries such as Norway, EVs are now a common sight. In 2025, 97% of all car sales were EVs.

Another major factor in the auto decline was the collapse of the housing market. All indices showed a severe drop in prices in 2002 from which there was a recovery until the middle of 2004 when the 10 and 20-city indices showed a steep drop followed by the national index towards the end of 2006 (Vlasenko, 2009).

Systems are defined by their system principle (Angyal, 1941), a unique relationship between a system and the environment. All the parts are interconnected within the system defined by this principle. For example, each person has a unique relation to the extended social field and, therefore, all parts of a person's life are interconnected. If a person loses their job, they will have a problem paying the mortgage, will probably attempt to sell their car or trade in their gas guzzler for a smaller, more efficient vehicle and suspend spending on household goods and services, buy cheaper food, avoiding eating out or buying take away, swapping at-home entertainment for attending movies while at some later time defaulting on a debt.

As we have seen, consequences cascade from such an event: the sale of new automobiles declines and the second hand market is flooded by vehicles nobody wants. Assembly workers and dealers lose their jobs. Restaurants and corner stores close and are vandalized. People avoid the community space increasing dissociation and distrust. Not only do the economic repercussions of such an event spread far and wide, they also deeply affect the cohesion and mental health of families and communities.

Figure 2 shows the sequence of activities known as the two stage model of active adaptation (Emery M, 2000b). The first dimension of active adaptation between the L_{22} and the L_{11} is achieved through the Search Conference (SC) (Emery & Emery, 1978; Emery M, 1982; Emery M, 1999a), the first of which was held in 1959 (Trist & Emery, 1960). The SC is a translation of the open system into a method (Emery M, 1999a, p172). Literally thousands of SCs have been held by organizations and communities around the world. Then the genotypical design principle is changed through the Participative Design Workshop to complete the second dimension which consists of active adaptive relationships between the people in the system.

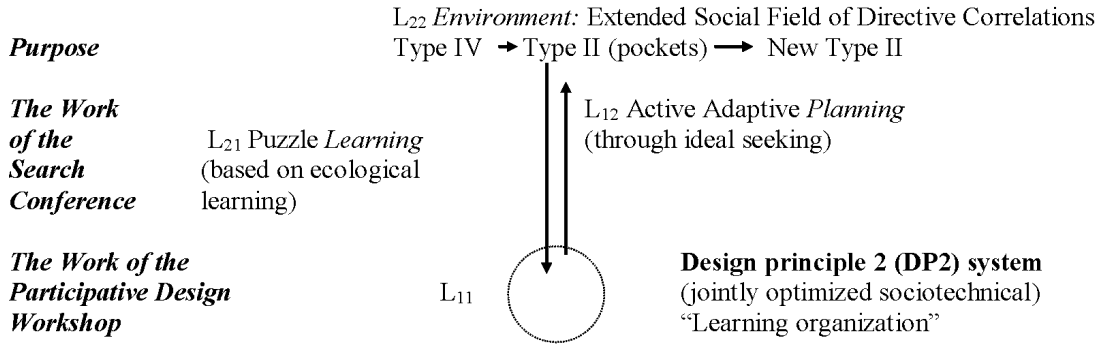


Figure 2. The 2 Stage Model for Active Socioecological Adaptation (Emery M, 1999a, p29)

The various sectors of the economy are also closely interconnected as is now well documented (Sachs, 2008) because the economy itself is a system. And yet as we see below, few economists and certainly those who designed the complex derivatives and 'securities' behind the crash denied the existence of systems by assuming lack of connectedness, even between banks who lend to each other and between today and tomorrow.

A simple Search Conference for members of the various parts of the industry could have rapidly illustrated the nature of the system and provided a way forward but of course, these captains of industry were wedded to their mechanistic beliefs. Economics in the main ignores these facts of connectedness and continues to assume individuality in all things is the rule.

As if we needed more proof, the continuing mantra from most economics and politicians is the need for growth. Regardless of the gathering storm of disasters, nothing has changed.

Many people appear to have forgotten that everything we consume comes from the Earth and the atmosphere, the biosphere. To champion continuous growth is to champion greater resource use of a finite planet. This knowledge is far from new but it is still not informing our decisions.

"You can't eat money"

Sachs (2008) makes the point well by referring to "the commercial paper market". Hitchens (2009, p3) refers to "insane speculation in worthless paper derivatives". There has been a total disjunction between use value and exchange value to the point that the use value is zero. This is why Korten subtitled his 2009 book "*From phantom wealth to real wealth"*.

Chief Seattle has reason to feel vindicated but he's probably just sad.

Two forms of control system

There was an external control system operating in the USA until investment bankers in 2004 successfully convinced the Securities and Exchange Commission to lift a rule specifying debt limits and capital reserves needed for a rainy day. Thus so easily was one of the major controls on the financial system removed leaving a hole through which the 'quants' could gallop to disaster. 'Quants' is the name Wall Street gave to the "lapsed physicists and mathematical virtuosos" who invented both the oblique securities and the software models that allegedly measured the risks attached to these securities (Editors, 2008).

These software models assumed falsely “that radically large market shifts are unlikely and that all price changes are statistically independent: today’s fluctuations have nothing to do with tomorrow’s – and one bank’s portfolio is unrelated to the next’s” (as above). That is, not only was the ultimate control over the system removed, the assumptions on which the financial system progressed on its ‘self regulatory’ path rejected both the reality of change in the external social field and its frequent discontinuities, and the interconnected and systemic nature of the financial system itself.

The editors of *Scientific American* concluded that safety nets should never ever be slashed again but as we see, there are alternative and much more powerful forms of control than relying on an external control system.

You need external control systems when you have DP1 structures such as are ubiquitous today but much more effective than any external control system is *an **internal control system***. These inbuilt control systems result from the fact that in DP2 structures, responsibility is located with a self managing group of equals. In these groups, people can exercise their full potentials as human beings, all well equipped to explore, work things out and make decisions. When they are behaving as humans, they experience high levels of positive emotion, 'job satisfaction' – and productivity goes up.

While it is easy to get away with blue murder in a DP1 structure where responsibility is forever being pushed up the line, it is almost impossible when all members of a self managing group are simply going about their tasks, meeting their agreed set of measurable goals – every member wants to get there so there is no slipping between the cracks.

All normally functioning people are perfectly capable of these behaviours but again economics has made a fundamental mistake in its conceptualization, and it is again born of mechanism. It has assumed that people are rational economic beings, putting money first and foremost. However, that is far from reality.

The assumption that we are rational

Far from being 'rational' creatures, economic or otherwise, the evidence is that Sylvan Tomkins was right when he concluded that our affect or emotional system is the primary motivational system governing our behaviour (Tomkins, 1962). New evidence about the affect of disgust provides yet more confirmation that Tomkins was right and assumptions about the primacy of rationality are wide of the mark. Experiments with foul smelling substances have shown how the disgust these smells induced influenced judgements (George, 2012). It can also influence our notions of right or wrong and morality. Many believe that we weigh up the pros and cons to arrive at a balanced judgement but the experiments showed that this as simply not the case.

Some are more prone to disgust than others and they are more likely to be politically conservative. Similarly, the more conservative people are, the harsher their moral judgements become in the presence of disgust stimuli. As the researchers point out, this raises troubling questions about the manipulation of jury and political judgements and there are examples of just how this has been done in the past. Once people feel a sense of disgust about a particular crime for example, it is difficult for them to take into account mitigating factors such as the intentions of the people involved. Disgust also clouds a juror's judgement more than feelings of anger.

Disgust has also shown to be involved in financial decisions such as the correct buying and selling prices. While we become less prone to disgust as we age, it would seem that it has

not lost its powerful influence on our behaviour. However, we have learnt how to moderate it in many ways, not the least of which are cultural conventions and practices such as the enjoyment of stinky cheese.

We also know from Tomkins that people are highly motivated by positive affect, emotions. What's more, these emotions function as a virtuous circle and are also highly contagious. Systems which encourage and produce positive feeling are far more likely to yield desirable results than any amount of punishment.

A summary of OST's *conceptualization of people* is found in Emery M (1999a, pp12-17). People are open purposeful systems, active responsible agents with needs for both autonomy and homonomy and a potential for ideal-seeking. Other significant features include consciousness (Emery M, 1999a, p70-103) and ecological learning (Emery F, 1980).

It is easily demonstrated that people make decisions on the basis of four parameters (Ackoff & Emery, 1972). The *first* is probability of choice which expresses the individuality of the person in the decision, individual preferences that are separate from the efficiency or effectiveness of the decision. Two people may choose the same model vehicle but one chooses a white one while the other chooses blue.

The *second* parameter is probability of effectiveness and this expresses knowledge. This is practical 'know how' knowledge that relates to the efficiency of the decision. If the aim is to travel with the most ecologically friendly way but with the least time wasted, the probability of effectiveness will lead to a decision to buy a small car rather than base one's travel on taking public transport.

The *third* parameter is probability of outcome and expresses understanding. Understanding is the ability to efficiently adjust one's behaviour to changes in the conditions that affect its efficiency. A person who understands a situation can explain the effect of changes in the environment on the efficient of their choices. In the decision about how to travel, probability of outcome will lead a person to choose not only a small car but the most efficient small car because they understand the importance of minimizing their carbon emissions.

The *fourth* parameter is called relative intention or relative value and expresses the degree of motivation involved in making the decision. It is shown by perseverance to make the choice indicated by the preceding three parameters despite any obstacles that may be encountered.

Economics totally ignores both the probability of choice and relative intention. Its model of decision making again inherently demonstrates its mechanistic origins by concentrating entirely on the probabilities of efficiency and outcome. It is then no wonder that when economists work with developers to bulldoze old neighbourhoods in order to rebuild flash modern apartments, people scream blue murder. All their previous decisions and values made during their whole lives, all the familiarity, the richness of long relationships and understandings are being bulldozed, ripped apart, often without as much a phony consultation.

Why many do not understand economics

For all these various reasons, there is a huge gap about economic matters between the views of most economists and ordinary people, what Boyer (2018) refers to as a "chasm in thinking" between the two. But the views of the people in the street are not just a random selection of ignorant perspectives but a coherent approach labelled 'folk economics'.

Boyer argues that this folk economics is the result of our human evolution, our intuitions about production and exchange adaptations to the particular context in which our species developed. As a result, they are unsuited to the economy of the modern world, which appeared very recently in evolutionary terms.

"The key factor is that humans,...evolved to be highly cooperative. Hunting, foraging, community defence and even parenting were done in groups" (p40). Resources were shared and trading was mainly done between people who knew each other, or between groups that shared repeated exchanges. Verbal communication was sufficient to provide adequate information on others and it was easy to track how much efforts was required for production. People could be confident they were selecting the most cooperative partners with whom to exchange or do business.

Hence our views about exchange have been shaped by eons of living in these conditions and by the other dimensions of our preference for cooperation rather than competition. "We have a strong sense of fairness, and intuitively expect and prefer that the proceeds of a joint effort be shared in proportion to each participant's contribution" (p42). Free loading or 'bludging' produces anger.

We also prefer to trade with known partners and tend to avoid purely anonymous transactions. Furthermore, we consider it beneficial to give our trading partners small favours rather than attempt to try and exploit any weaknesses because we have expectations of long term transactions.

The further we get from these small scale communities, the more difficult it becomes to fulfil the conditions we need to establish trustworthiness and understand the nature of the transactions taking place. Modern communications can provide oceans of information but does not necessarily satisfy our need for certainty about or even probable conviction about trust or value.

Increasingly it is difficult for individuals or groups to see aggregate effects or the combined effect of consumer power. We tend to overestimate the power of large corporations and their degree of control over the market. Boyer also puts our belief in regulation to control prices for example and down plays its efficacy. He also appears to regard our moral 'intuitions' about such matters as buying cheap and selling expensive as the result of lack of information about the transactions and those making them. However, he does admit that sometimes our fears may be justified (p43), and it may just be that he is a little over enthused about the 'market'. Well, he wouldn't be along there, even today.

Conclusion

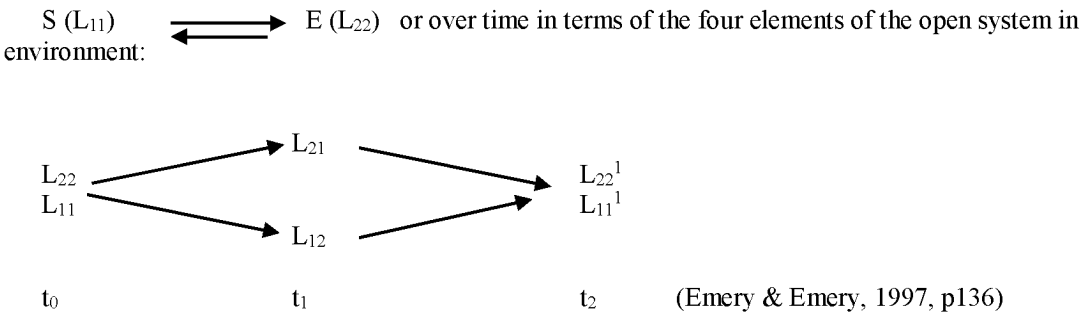
As we have seen “the causes of this fiasco are multifold” and there are many lessons to be learnt (Editors, 2008). Most are lessons “that were never learned during previous smashups” (Editors, 2008).

While the lessons were many and various they all revolve around one single factor – the neglect and indeed denial of clear simple observations of people and social realities. Each and every one of the causes underlying this global tragedy could have been avoided by the practice of a science with its feet on the ground rather than the 27th floor of an ivory tower, its eyes open to the world around them rather than the squiggles in textbooks, and its mind intent on improving the human condition rather than the bank balance of its owner.

4. Biology

Biologists Discover Coevolution

As students of Open Systems Theory (OST) would know, the original definition of an open system as given by Emery & Trist (1965) and elaborated in various ways since (Emery F, 1977; Emery & Emery, 1997; Emery M, 1999), provides for coevolution rather than evolution. As system (S or L_{11}) and environment (E or L_{22}) are mutually determining, change, novelty and 'progress' must be a joint product of S and E. This is expressed as:



(Emery & Emery, 1997, p136)

This has been in marked contrast with biology and its subdisciplines of evolutionary biology, ecology and genetics. The conventional view of evolution has been that natural selection acts on animals over ages of time to produce changes in the animal so that they adapt to their environment and thus survive. "Environment shapes living things: it rarely works the other way around" (Laland & Odling-Smee, 2003, p43).

The closest the discipline of evolutionary biology has come to co-evolution was when Richard Dawkins acknowledged that genes build environmental states, which he called 'extended phenotypes', to their own ends. By building webs or building dams, genes could lever themselves into the next generation (Laland & Odling-Smee, as above). But as they point out, Dawkins viewed niche construction not as a part of the evolutionary process but only as a product of naturally selected genes, with the evolutionary feedback only to the genes that caused the extended phenotype. In other words, when beavers build dams, they ensure the propagation of genes for dam building, nothing more.

Despite the fact of constant human observation over thousands of years that the activities of all species make changes, and often dramatic changes, to their environments, biology continued to see only a linear process, evolution, not co-evolution. Once again, it remained wedded to a linear, mechanistic theory rather than change the theory to fit the observations (Emery M. 2003).

Finally, that is now changing. Biology is in the process of catching up with the concept of directive correlation (Sommerhoff, 1969) and open systems. However, Laland & Odling-Smee confirm that niche construction conceptualized as a part of the evolutionary process is radical if not heretical, by saying they have been grappling for years with the *conundrum* that plants and animals do appear to make the sort of changes that influence evolution. The sort of evidence they quote is the everyday observations made by us all, the modification of the atmosphere by plants, the decomposition of organic matter by bacteria, the creation of soil by earthworms and so on.

They propose that niche construction is "a significant cause of evolution, on a par with natural selection" (Laland & Odling-Smee, 2003, p43). They recognize that "by accepting that organisms shape environments as surely as environments shape organisms, evolution is transformed from a linear to a cyclic process" (as above). Indeed, evolution genuinely

becomes coevolution. Cyclic loops allow successive generations of organisms to influence their own and each other's evolution. Dam building creates wetlands that are long lasting and change the nature of the diversity of species that inhabit the area. It modifies natural selection not only for the genes associated with dam building but also for other beaver genes, those associated with teeth, feeding behaviour, susceptibility to predators and disease etc (as above, p44). Today's beavers (and earthworms) inhabit environments that have been radically changed by their ancestors.

That means that extended phenotypes can be inherited. "Through niche construction, organisms not only acquire genes from their ancestors but also an 'ecological inheritance' - a legacy of natural selection pressures that have been modified by ancestors and that, in turn, shape subsequent generations" (Laland & Odling-Smee, 2003, p44). No less does it apply to humans as children are born into environments that have been continually changed by our own niche construction.

Should niche construction be accepted in biology as a complementary process to natural selection, it has definite implications for many theories about human evolution as the authors recognize. One theory they mention is the notion argued by evolutionary psychologists that we are adapted only to an ancestral environment that existed millions of years ago on the African savannah. If this theory is in fact, incorrect, then we may have to take more responsibility for our eating habits and other phenomena such as fight/flight responses. We may even have to look more seriously at alternative explanations of the prevalence of fight/flight responses in organizations (Emery M, 1999).

Because they knew there would be resistance to the idea of co-evolution by other biologists, Laland & Odling-Smee carried out mathematical analyses using population genetics models. Models obviously carry more clout than repeated, detailed observations of reality. They found that niche construction forges new evolutionary pathways for species, sometimes allowing mutations to enter a population, sometimes removing characteristics that appeared well adapted, or creating new equilibria between alternative genetic forms (p44). They also found the models showed 'time lags' in evolution, momentum or inertia effects and also unpredictable or catastrophic responses to selection. "In other words, niche construction can dramatically change the evolutionary dynamic" (Laland & Odling-Smee, 2003, p44). Niche construction creates evolutionary pressures in its own right.

One benefit the authors can see is the unification of evolution and ecology studies. Because of the previous linear theory, ecologists had difficulty incorporating non living, non evolving components, such as carbon and nitrogen, into their studies. Niche construction or co-evolution more generally makes the choices available to ecologists today more realistic by broadening their studies to include non living components. They can now link species directly to the full spectrum of dimensions of an ecosystem.

Laland & Odling-Smee also explore the implications of co-evolution for the Gaia hypothesis. As they say, "understanding niche construction allows you to see ecosystems not as mysterious super-organisms, but rather as super-constructions created by the collective activities of their constituent organisms. The impacts of niche construction thread entire ecosystems, binding them together - which explains their impressive structural and functional integration and underlies the illusion that they are alive. Yet, since not all niche construction imposes order, it also explains why other ecosystems are not functionally integrated but are the messy, uncoordinated outcomes of several species pulling in different directions" (Laland & Odling-Smee, 2003, p45).

It is clear at this point that Laland & Odling-Smee could usefully use the concept of directive correlation to more precisely investigate the results of their modeling. The picture of an evolution of an organization shown as Figure 3, *The Codetermination of Cultural Change over Time* (de Guerre, 2000, p648) depicts exactly the phenomena of different species

(human groups) pulling in different directions over three periods of time in the life of that organization. A longitudinal study of a physical, biological ecosystem could obtain precise measures of the species either pulling together or pulling in different directions, and measure the outcomes in terms of functional integration with the ecosystem (direction correlation) or the lack of it.

The coevolution of animate and inanimate forms on Earth

One of the points raised above by Laland and Odling-Smee is that ecologists had particular difficulty incorporating life and inanimate matter such as rocks or carbon into their models of change. We now have a study that has tackled just that.

Reported in *The Conversation* (19.12.18), Dosseto et al make the very simple point that Earth's history "shows that geological processes have been key to the evolution of life in Earth. Geology has shaped biology by creating favourable conditions, and indeed the basic 'ingredients', for life's emergence and evolution.

And now there is growing evidence that this also works in reverse: life has shaped our planet's atmosphere, oceans and landscapes in many ways." Dosseto et al argue that life started shaping the planet from the very beginning as bacteria producing methane warmed it when it was frozen. There is also evidence for the reverse process whereby life prevented runaway warming by trapping CO2 in skeletons which sank to the bottom of the ocean.

These processes took various forms at different times in the evolution of Earth, over and over, involving plate tectonics, weathering, oxidation, photosynthesis and the multitude of physical and chemical dimensions of our living planet.

Today we know that life forms themselves, us, share our origins and our materials with the rock and other inanimate matter; we know we are all of a one, the so called 'star dust'. The series of processes Dosseto et al describe involve a diverse range of animate and inanimate forms which have mutually determined the Earth as an open system. "Cyanobacteria, vascular plants and plankton have also modified the whole chemistry of Earth's atmosphere well before humankind, over much longer time scales."

A major part of our problem today as many people are rapidly becoming aware is the speed with which we are changing the atmosphere – much faster than most life forms, including ourselves, can be expected to adapt. It is wonderful that we now have a full scale picture of the coevolution of all the major dimensions of the planet: Let us hope it is better late than never!

Laland & Odling-Smee are aware that adopting coevolution may influence the ways in which we study and intervene in conservation projects of physical ecosystems, perhaps by preserving the niche construction activities of particular species rather than simply the species themselves. However, they spend less time speculating about the direct effects of coevolution on people. What for example, is the effect of bringing children up in an environment so heavily dominated by visual media? What are the long term effects of adults spending about 16 hours a day in a light rich environment?

What are the long term effects of people spending their entire working lives in asymmetrical, dominant hierarchies? We know the short term behavioural effects (Wilkinson, 1996; Marmot & Wilkinson, 1999) but will there be deeper, physiological or even genetic effects over generations? Who knows? But as Peirce (1878, quoted as 5.172, Feibleman, 1946, p406) pointed out, change happens faster than can be explained by evolution operating solely through natural selection. There is no reason to expect that human evolution has ceased and it may be happening faster rather than slower. Coevolution meets Peirce's point (Emery

& Emery, 1977, p123) and if it becomes an accepted concept in biology, we could hope for some studies that look directly at how our modifications of our natural world are changing ourselves.

Same econiche scenario, same evolution

Twelve different rove beetles have all evolved independently to adapt to army ant colonies, changing shape and smell, and even going marching with them on raids. This is all so they can prey on the ants by eating their young (In Brief, 2017). Pretty devious eh?

However, the moral of this story is that the nature of the adaptation depends on the nature of the environment – it is a straight out case of open systems.

Evolution: The third way

Surviving in "potentially lethal" environments has shown evolution has more tricks up its sleeve as studies of yeast have shown. Yeasts adapt to these environments not by genetic nor epigenetic changes to DNA but by converting a special type of protein into a prion. Described as "near-instant evolution", the yeast generates a "hotchpotch of brand new proteins without changing its DNA in any way" (Coghlan, 2012, p34). The prions are then passed down to daughter cells.

Nor is evolution confined to intra class processes. A silver leaf whitefly has been found to contain a plant gene which is found in numerous plants (Lu, 2021).

More on this subject is presented with an article by Brahic (2021). A side column called *Protein-based inheritance*, explains that prion proteins are characterised by the ability to take different forms. Both yeasts and mushrooms can have cells with a trait due to a protein that can turn into a prion, so altering that trait. If those cells are then crossed with others with the original trait, the progeny will contain some prions. These prion proteins then change the regular proteins into the prion form with the result that eventually all the new progeny will exhibit the new trait. *DNA is not the only molecule responsible for heredity. Protein-based inheritance has now been shown in all domains of life* (p50).

The Design Principles in the Animal World

The more one delves into this world of other than humans, the more extensive and inescapable becomes the discovery that the design principles are deeply embedded in nature. As many such as Fuller discovered, mathematical forms and 'new technologies' already exist in the natural world. "The principle of the jet was invented by the squid and the jelly fish long ago" (Fuller, 1975, p6). Moreover, even a superficial or anecdotal study of the animal world reveals that the design principles may operate in different situations in the same species. There are plenty of species that use a DP1 structure when mating (Alpha males and females) but a DP2 structure when hunting (the cooperative pack). The major difference between these animals and humans is that humans always have a choice - if they know about the design principles. Otherwise they may assume, as many appear to assume today, that organizations must be structured on DP1.

When Raphael Sagarin turned his mind to the subject of terrorism, he realized that the USA response of creating a huge centralized Department of Homeland Security was exactly the opposite response to that of the most successfully adapted species. These species “have a structure of fairly limited central control, with a lot of autonomy. They have agents out there sensing and responding to the environment” (Whitfield, 2008, p46). The current USA

structure for security in all areas is actually slowing timely and adequate responses as was seen when hurricane Katrina hit. Remember also that the many clues that 9/11 was about to happen were ignored by the people in the previous security organizations, a common failing in DP1 structures.

However, even in the animal kingdom, there appear to be vast misunderstandings. As Gordon (1999, p25) points out, stories about totalitarian societies and inexorable armies abound in relation to ants but "ants have no dictators, no generals, no evil masterminds. In fact, there are no leaders at all." Gordon spent seventeen summers studying harvester ants in a small patch of the Arizona desert and makes it clear that rather than structured on DP1, the ants work strictly within a DP2 structure with specialization of function in some cases and multiskilling in others.

The tasks in a harvester colony are many and varied and change in importance depending on what is happening in the environment. "Task allocation is a process that operates without any central or hierarchical control to direct individual ants into particular tasks. The queen exercises no authority; she merely lays eggs and is fed and cared for by the workers. No ant can assess the global needs of the colony, or count how many workers are engaged in each task and decide how many should be allocated differently. Yet there is abundant evidence throughout physics, the social sciences and biology, that simple behavior by individuals can lead to predictable patterns in the behavior of groups" (Gordon, 1999, p26).

Gordon conducted a series of simple experiments to determine the dynamics of task allocation in these ants. She discovered that the ants changed task in response to environmental demand. When for example, toothpicks were placed near the entrance, more ants went on nest maintenance rather than foraging. This finding that ants switched tasks was "in contrast to earlier work which had postulated that an individual ant would carry out a single task throughout its life" (Gordon, 1999, p27). In other words, the previous postulate had been an extrapolation from the researchers' beliefs and views of the nature of DP1 structures, e.g. one person-one task. But while an ant may specialize for a short time, it often does several tasks. The number of ant workers that perform a task is not a simple function of the number of ants of that task group.

Which ant does what appears to be determined by the patterns of interaction and simple rules. Meeting too few successful foragers returning leads to fewer ants leaving to forage. The rate as well as the number of contacts is important. While colonies must respond to changing environmental conditions, task allocation does not need to be perfect. But there is nothing clockwork about these operations. It is not "an army, each unit snapping into place so that the entire system ticks on without a hitch" (Gordon, 1999, p28) - although it is extremely doubtful that this is what actually happens in a human army. "*The most difficult thing to grasp about task allocation is that it is not a deterministic process* even at the individual level. An ant does not respond the same way every time to the same stimulus; nor do colonies. Some events influence the probabilities that certain ants will carry on certain tasks, but those regularities lead to predictable tendencies rather than to perfectly deterministic outcomes" (Gordon, 1999, p28, my emphasis). The allocation process results in approximately the right number of ants engaged in the appropriate task.

Other species of ants show the same sort of behaviour. Turtle ants are extremely sensitive to changes in the environment, assess the degree of risk present and change their strategies as the risk profile varies. "The ants make these decisions despite not having leaders" (New Scientist, 2018).

Eciton army ants have been studied to discover how they build bridges over gaps in their foraging tracks. Again, it was discovered that the ants are responding to ever changing environmental condition, in this case, the degree of contact between each ant. When traffic flow becomes interrupted, bodies pile up and this increases the chance that an ant will stop and become part of the structure of the bridge. If traffic intensifies, more ants will add their bodies to increase the capacity of the bridge. Eventually the traffic jam clears, decreasing contact which raises the chance that an ant will unhook from the others and the bridge will slowly dissolve. Computer modelling also discovered that the way the ants worked to do this achieved the best possible cost-benefit trade-off between building the bridge and foraging, the ants' collective behaviour is simply continuous adaptation to its immediate environment (Hess, 2016).

I have emphasized the above because it illustrates the belief of many, however implicit, that DP1 is the only principle for organizational structuring. It also illustrates how this has affected our assumptions of determinism everywhere and how, as she says, it creates difficulties when one is confronted with DP2 although she does not use this term. Resistance to accepting the efficacy, or even workability, of DP2 is often the visible result of this difficulty.

Gordon has conquered her difficulty after seventeen years of empirical results and makes the implications of them very clear. After stressing that it is the *pattern of interaction*, not a signal in the interaction itself, not a bit of chemical information, nor any other of the reductionist guesses about the causes of such effects, she speculates that "such a process might operate in brains, immune systems, or anyplace where the rate of flow of a certain kind of unit, or the activity level of a certain kind of unit, is related to the need for a change in the rate of flow. Perhaps ants have something general to teach us…about how nature works…Ants…show how simple parts make complex living systems, and how those systems connect to the outside world. By looking at ants in colonies, and looking at colonies in populations, one can begin to see how the layers of a natural system fit together" (Gordon, 1999, p28).

Indeed. Perhaps we can go further in realizing the implications of this dedicated piece of research. Perhaps we need to rethink the statement above that plenty of species use different design principles when organizing themselves for different functions such as mating and hunting. Dingoes and dogs are good examples. Clearly they are organized on DP2 when hunting, that seems indisputable. But perhaps, when mating, they are simply exercising specialization for good evolutionary reasons. It is simply a temporary episode of DP1embedded within the dominant DP2 structure. At a particular time, a particular male or female may have the best or required characteristics to produce the next year's offspring. Remember that at various times within human DP2 groups, seemingly DP1 structures may exist temporarily. In extreme or dangerous circumstances, e.g. when a fire breaks out in a chemical plant and few have experience of how to deal with it, the most experienced person will be called upon to give orders. The others follow the orders for good evolutionary reasons: they want to survive. In this case, we have an illustration of a temporary episode of DP1 and specialization, embedded within a long term DP2 structure. When the fire is out, the group returns to its normal operating mode.

The extension of this knowledge of the asymmetricality of the design principles to animal organization has not been fully explored. Frequently the research assumes that the dominant organizational form is that seen in the mating patterns (DP1) and that a special case is made for hunting (DP2). That assumption could, as we have seen above in the words of Gordon, be culturally determined. It may just as well be the case that the basic unit is based on DP2 and

that for reasons of specialization, intimate family, group, pack or troupe life takes on DP1. Apart from the research data, I have watched a dominant male dingo bring food to a (non pregnant) female when she was too sick to get her own share. This is actually a common observation in 'pack animals'. This also argues for the view that cooperation for the good of all may be dominant, not competition or the 'boss or strongest takes all' syndrome.

Further evidence for the primacy of DP2 in the ant world comes from Wong (2017) who describes a species of soldier any in sub-Saharan Africa who carry their wounded home after raiding termite nests. They can recover when home and quickly return to duties. Attempting to return home alone results in about a third casualties. The view that individual ants are unimportant because there are so many of them is not one that is shared by the ants themselves.

Another example comes from vampire bats which live in female dominated groups, grooming and sharing food with each other "without regard for social status" (Leste-Lasserre, 2021, p21). This is because they don't have a dominant hierarchy. They obviously operate on DP2.

The phrase above is put in quotes because it is a quote, illustrating shows just how closed minded we have become about the necessity of hierarchy. The whole study assumed there must be a hierarchy in every species under the microscope and so for species which operate on DP2 rather than DP1 we find such little gems as the "bats' hierarchy was so weak that it was less clearly defined than for 90 per cent of these other species". If the researchers had had the slightest clue that social organizations are defined by a design principle they may have recognized that "the 'egalitarian' social life of vampire bats suggests individuals do well when their group mates are doing well" was a well known feature of DP2 structures (Emery & Emery, 1974).

Forests are systems which work on DP2

Suzanne Simard grew up in forestry followed by a career researching how forests work. She discovered forest trees share and trade food via fungal networks that connect their roots. Called the "wood wide web" it consists of 'mother trees', their offspring and other species who cooperate to ensure the health of the whole. While competition through natural selection has hit the headlines, Darwin also wrote about the importance of collaboration of communities. "Natural selection results from more than competition. It involves a lot of different interactions and relationships between species and with the environment" (Hooper, 2021).

Mother trees are the mature, majestic trees in a forest which function as hubs of communication, protection and sentience. They nurture their own offspring by transferring carbon from their roots to them but not stranger seedlings and they provide information to help generations of trees to survive (p42). Mother trees protect seedlings from frost and very hot dry days. Her research has shown that the more mother trees loggers leave in the forest, the more diverse and abundant the natural regeneration is.

Simard blames our increasing separation from nature for the resistance to her research in the same way that Lovelock and Margulis were ridiculed for the concept of Gaia and systemic cooperation. She has shown that the architecture of the mycorrhizal networks follows a biological neural network. Neurotransmitters move through areas of the brain in the same way that chemical carrying information and resources move through these networks for the health of the full community. "Not only that, but the chemicals that are moving in those networks include glutamate which is one of the dominant neurotransmitters in brains" (p42).

Edelman discovered that our brains are organized on the second design principle (DP2) in 19xxRef and there is no reason to believe other systems would be differently organized. Mother Nature is economical with her designs particularly when they are the most efficient and effective.

When she was asked Simard replied: "Even from a purely biological, physical analysis, it looked like it had the hallmarks of intelligence. Not just the communication of information and changes in behaviour as a result, but just the pure, evolved, biological chemistry and the shape of the networks themselves spoke to the idea that they were wired and designed for wisdom" (p42). Plants are aware of every disturbance or injury and we can measure the responses to that. They are as aware of us as we are aware of them and this is ancient knowledge that has always informed the world view of the original peoples all over the world. Once again as Knudtson & Susuki (1992) found, science is validating this age old understanding.

NB, there is no implication in this that trees or any other plant have consciousness. Because the language used in most of the biological sciences, and in general, is so sloppy when it comes to these matters, it is necessary to make the distinction following Chein (1972) that we can define awareness and then human consciousness as the awareness of awareness. Given that Simard has definitive evidence that trees have awareness, this puts them in the same category as most animals including dolphins who are accorded high intelligence. However, there is no evidence that cetaceans in general are conscious.

We see similar confusions when it comes to 'intelligence' (Robson, 2021). Of course animals vary in 'intelligence' in the same way that humans do. We should expect variations both within and between species on such a dimension but this similarity should not cause any conclusions about equivalence. Our whole behavioural patterns encompass intelligence, awareness and awareness of awareness, i.e. consciousness as above, and much more such as emotions. There is still no evidence that any animals other than humans possess consciousness. This is despite accumulating evidence that nervous systems and brains in particular also show great similarity across many species, including those which have been rated as more intelligent.

Forests are also open systems

In what was called "unconventional research" (Spaceweather, 2025), it was found that trees respond as a forest to a solar eclipse: it was an "electric forest". Electrical signals inside spruce trees began to pulse in unison, with older trees seeming to anticipate the eclipse before it happened.

The trees were aged 20 to 70 years old and had electrodes attached. "As the eclipse approached, electrical signals from different trees began to align, their waveforms became more similar in shape and timing. This synchronization peaked during the eclipse and gradually diminished afterward. The older trees started showing electrical changes earlier, hours before the eclipse began, while the youngest tree responded later and more weakly. The tree stumps also exhibited a bioelectrical response, albeit less pronounced than in the standing trees."

The researchers interpreted this as a coordinated "organism-like" response to a large scale environmental event which could involve communication or shared signalling pathways. They acknowledge the work of Simard: "Basically, we are watching the famous Wood Wide Web in action." They also acknowledge that they do not speak the 'language' of arboreal electricity so do not know what the trees said, if anything, but are hoping repeating this type of research will cast further light on all the unanswered questions.

DP2 in bacteria

Adaptation and survival can take many forms but one which can be found in many harsh environments such as deserts is dormancy or latency. It is also found in bacteria and their colonies called biofilms which cause havoc with our antibiotics. The bacteria which use this trick have a lot of redundancy which seem to be multifunctional as you can knock out almost every gene and all the resulting mutations will still form these cells with the ability to go dormant called "persisters" (Yong, 2012, p42). It sounds very much as if the bacteria which are outwitting us and our antibiotics organize themselves on DP2. Their characteristics including persistence makes them extremely difficult to study as when in the dormant state, they do not grow or make themselves obvious in any way. It is now suspected that much of the problem with antibiotics is not just resistance but persistence requiring quite different forms of attack.

DP2 in viruses

As with bacteria, so also with viruses. Viruses are no lone wolves says Lawton (2020). They hunt in packs and can infect cells en masse, alongside other species of viruses (p34). Cooperation had been seen in many viruses including flu, measles and hepatitis B but then it was discovered that cooperation extended to other viruses. These mixed viral packs form a "collective infectious units" (p36).

Viruses have very high mutation rates and those with genetic material made with RNA have the highest error rates. A single host organism can habour thousands of different variants of the same virus creating many opportunities for competition and cooperation to evolve. Of course, this has advantages for all.

Different viruses team up and employ various strategies to survive and thrive, some quite elaborate and sophisticated, using 'altruism' or 'taking one for the team' as researchers resort to these analogies. RNS viruses do a sloppy job of copying their genomes and care called 'freeloaders'. "Cheating is common in the viral world" (p37). They churn out all sorts of "useless junk", half finished ones or with some with crucial bits missing, or mere fragments which are called "defective interfering genomes" They consume public goods such as enzymes without contributing any themselves and can't cause an infection on their own (p38).

Virologists have established that Covid-19 is unusual for an RNA virus because its genome is pretty stable. However, it does produce swarms of defective genomes and is a cooperating virus so we can get multiple infections with the potential for novel mutations. There is much more to be learn about our latest pandemic and it is to be hoped that our researchers respect that it conforms to the second design principle and the open system.

And DP2 in single celled organisms

"Biologists have been baffled since the early 20th century about how single-celled creatures with no nerves can coordinate the movements of so many legs", sometimes 14 or so (Le Page, 2021, p17). To any student of OST, this is no mystery. As the report states, there is "some internal system (which) controls and coordinates leg movements" (as above). The researchers hypothesized that the organism has evolved a mechanical computer made of fibres called microtubules. This is a quite unnecessary hypothesis as we know that this is simply DP2 in action. No computer required!

And DP2 in sperm.

Sperm are usually represented as individuals racing to fertilise an egg but that view is based on flat microscopic slides and other settings which take them out of context. When they

are seen in a mock up of their natural context, the female reproductive tract with its fluids and mucus, the bull sperm which are similar to human sperm, teamed up.

"When there was no flow (in the vaginal fluid), the clustered sperm swam in a straighter line than the individual sperm. In an intermediate flow, the clusters could swim upstream, unlike individual sperm. When the flow was strong, the clustered sperm pushed through far better than the individual sperm, which usually got swept away" (Leste-Lasserre, 2022).

There was never a leader that was supported by others but a formation resembling cyclists riding together in a peleton to encounter less air resistance. This formation increases the likelihood that at least some of the sperm will make it to the oviducts.

*Ah well, there goes the myth of the magnificent, competitive sperm that survived and won the great race of his life to produce **You**.*

DP2 just about everywhere

Examples of DP2 structure and cooperation throughout the animal and plant worlds regularly arrive in New Scientist's columns as well as elsewhere. They are complemented in the chapter on humans, social science and leave little doubt that Gorney (1968) was indeed correct when he pronounced that "Cooperation is the law of life".

Sailfish that work together in groups to hunt sardines catch more fish than if they hunt alone (NS, 2016). Long finned pilot whales were followed for three years allowing researchers to definitely demonstrate that both males and females babysit each other's calves. They live in multigenerational family pods of about 2 to 4 dozen individuals which gather together with other such units for weeks at a time for socialization. The cooperative nurturing behaviour was hypothesized to aid learning how to behave socially (NS, 2016b).

Birds do it too. Species of common redstarts and black redstarts in Tuscany shared a nest both hatching chicks. "Each parent fed both its own chicks and those of the other species" (Tomma, 2023). All the chicks successful fledged. This is not like the parasitic relationship found with birds like cuckoos but was genuine cooperative living which benefited both party.

Matabele ants rescue the companions after they have lost a limb capturing termites, taking them back to the nest. The wounded ants 'ask' for help by releasing a pheromone. Back in the nest, the nurses lick them for several minutes. If the ants did not receive the treatment 80% died. Of those who received treatment, 90% survived. The ants practiced a form of triage as ants that had lost 5 legs did not receive treatment (Fox-Skelly, 2018).

Rats are a particularly sociable and cooperative lot. They need to be finely attuned to social signals so they can identify friends to cooperate with and enemies to avoid. Eight adult rats were housed with two robots, one social and the other asocial. The researchers then 'trapped' the robots in cages and the rats could work to release them by pressing a lever. Rats are known to release each other and engage in multiple forms of reciprocal help and cooperation. In these tests they were 52% more likely to release the social robot than the asocial one, showing they perceived the social robot as a social being. Human children show exactly the same qualities (Klein, 2018).

Australian magpies have now been observed cooperating to remove tracking devices from the five members of their group to whom they were attached. One was off in 10 minutes and the rest were removed either later that day or on the following days (Crampton et al, 2022).

The quest for sex and reproduction is usually represented as a pretty cutthroat or competitive affair but bottlenose dolphins off the coast of Western Australia have been

observed coordinating their calling together to attract females (Li, 2020). We know dolphins are a sexy lot so perhaps they enjoy a good orgy.

In 2018 researchers discovered that of only 76 mammalian species that exhibited 'leadership' (by which they mean were organized into hierarchies), only 7 were run by females (Whyte, 2018).

Amazing eh? But what they skate past although it is far more important for our understanding of how the world works, is the fact that only 76 out of 6399 were organized into hierarchies. That is 1.2% were organized on DP1 and 98.8% were organized on DP2. The figure of 6399 extant species was new (Burgin et al, 2018) but even if they had worked on the previous figure which was 5341, the result would still have been dramatic. It says a lot about our knowledge, and common assumptions, that it did not occur to these researchers, or the *New Scientist*, that they were missing a far larger story that the males/female angle they reported on. I wonder what they thought the other 98.8% that weren't living in hierarchies were doing? It is extremely doubtful as you will gauge from these notes that they were conscious that all these species were living in self managing groups governed by the second design principle.

So this example tells us that a fundamental lack of curiosity is one factor fuelling our lack of knowledge in this area. So many times we have seen the assumption that hierarchies are the normal way of life and apparently what the rest are doing is of no interest.

And to cap it all off, some researchers are now "acknowledging that the biggest clue to the origins of life may have been staring us in the face all along: *life is a community*. Today, all organisms depend on others for their survival" (Marshall, 2023, p39). Rather than looking for the origin of the first individual organism, we should instead look for the origins of the first ecosystem.

And sometimes, DP1.

The differences between Chimpanzees (DP1) and Bonobos (DP2) as the more publicized species, are sometimes discussed in terms of their propensities for aggression and sociability respectively but it always important to remember that these are predominant forms of behaviour, not absolute maximums. Chimpanzees have to cooperate at times and Bonobos occasionally have disagreements and quarrels. But Bonobos solve these by engaging in consensual sexual behaviours of various sorts while the Chimps slog it out.

Now we learn of another species, quite extreme, whose whole lives revolves around warmongering and naturally enough, they are organized on the first design principle. They are the banded mongoose in Western Uganda. "They are aggressively violent animals that wage war on neighbouring groups, brutally murdering and maiming their rivals. They ruthlessly expel close relatives from their group and kill them if they won't leave, commit infanticide – sometimes against their own offspring – and even engage in cannibalism" (Lawton, 2023, p44). Such violence is unusual in the animal kingdom.

They are predators, primarily carnivorous and live in groups of between 8 and 55. Their social structure is a wacky weird DP1 based on age that involves multiple dominant females and there are 2 or 3 dominant males that jealously chaperone the females when they are in oestrus and do all the mating. The rest of the males are celibate subordinates.

Unusually, all females are allowed to breed but they all give birth on the same night, 4 times a year. Pups get mixed up and don't know who their mother is, a phenomenon called 'supersynchrony'. Some pups will be born prematurely to hit the deadline and if anything goes wrong, the pups are killed and sometimes eaten. "The group is run by infanticidal females" (p45). Surviving pups are suckled collectively and babysat by males in their dens.

At 4 weeks, out of the dens, each pup gets a dedicated unrelated escort that looks after them for a month, shows them how to forage, demonstrating which millipedes need cleaning for example. This is unique to this species. While they are known for their extremely aggressive behaviour, this whole feeding, nurturing system is a brilliant example of cooperative behaviour, showing once again that no species can exist and remain viable without cooperation in some main aspect of life.

When attacking a rival group, they line up as in medieval warfare and pile into one another. Death is rare but serious injuries are common. Often the wars are started by the dominant females who can exploit the chaos to sneak off and mate with males from the other group. Cheating is common. The actual fighting is total, noisy mayhem with males predominantly forming a "screaming, roiling maul" (p46). Battles last between 10 minutes and an hour until one side backs down and both parties withdraw leaving their injured in their wakes.

The researchers busily experimenting with these mongooses are trying to determine which individuals start the fight, coordinate the action and decide when to stop, in an effort to learn something they can use to explain human warfare. They may be better off studying the design principles and apply that knowledge to redesign so people realize they have a choice of design principle.

Cooperation not competition

Increasingly, our assumptions about the ubiquity of competition based on most of our human societies are being proved wrong. We may be silly enough to structure most of our organizations on the first design principle (DP1) but other species are much smarter. More and more observations show that in a variety of species, inter- and intra-species relations are cooperative. In the latest example, dolphins and orcas cooperate to scout out, catch and eat Chinook salmon demonstrating that DP2 once again proves to be more the rule than the exception (Luhn, 2025). Observed off northern Vancouver Island, they foraged together but the salmon are often too big for the dolphins to eat. The orcas ate the salmon in their typically messy way leaving many scraps for the dolphins to scavenge, a win-win for both.

Old birds, new tricks

Tree tobacco has recently invaded South Africa from its native South America and in its wake, malachite sunbirds have changed their lifestyle (New Scientist, 2009a). Tree tobacco has tubular flowers that require birds to hover to obtain nectar and in turn, it requires hovering birds to ensure its pollination. South America is rich in hovering birds while South Africa has had none, “something that has puzzled evolutionary biologists”.

South African sunbirds are now getting most of their winter food from tobacco tree flowers and no longer migrate. The plant is also benefiting as those pollinated by sunbirds set three times as much seed as those not pollinated in this way. Ecosystems evolve through cooperative development, otherwise known as co-determination or co-evolution. Perhaps if evolutionary biologists became co-evolutionary biologists and observed the cooperative dynamics of development, they may be puzzled less often.

Selfish genes or cooperative ecosystems?

“The idea that evolution is all about genes looking out for themselves is increasingly under fire” says Bob Holmes. That genes are selfish is the brainchild of Richard Dawkins. The premise underlying his theory is that science works best at the lowest level of analysis or entity. This is of course reductionism.

When reductionism combines with natural selection and is applied to genetics, the inevitable result is the concept of a gene that competes in order to achieve an evolutionary advantage. This concept also has overtones of 'rational economic man' who strives to get ahead in the pecking order. It accepts the premise that competition is the law of life. There are instances of competition in the natural world but there are many more instances of cooperation. "Cooperation is the law of life" (Gorney, 1968, px).

Other geneticists are now demonstrating that evolution works at levels other than the genetic such as the level of species, groups of unrelated members of the same species and ecosystems. An example of species selection is body size where larger individuals out compete smaller ones so we would expect average body size to increase over time. However, in many species this has not happened. An average larger body may have triggered a reduction in numbers or even extinction if sufficient resources were not available. Therefore, cooperation between individuals for species survival replaced competition for individual advantage.

An example of group selection is "the small size of some annual plants that grow together and reduced virulence in some parasites (to keep their hosts alive)" (Holmes, p38). Evolutionary biologists do not know how common group selection is in nature because they haven't been looking for it.

Crop breeders have, however, always used it. They choose plants that get along well rather than choosing the most vigorously growing individual plants. The aggressive growers interfere with each other when grown together in a field and produce a lower yield.

Experiments have now begun on group selection and as well on selection at the level of the ecosystem. Previous research has demonstrated that multiple species "work together to produce an environment that maximizes their collective survival and reproduction" (p39). Obviously you have not got individual selection because if you look at each species separately, you couldn't predict what they would be doing. Each species must be examined in the context of the ecosystem.

Clearly this new work is acknowledging and using systems and contrasts with the Dawkins' theory. Other evolutionary biologists point out that genes rarely act alone. They act in networks where "multiple genes affect each trait and each gene affects multiple traits" (p38). "What's more, these networks usually have enough redundancy that deleting any one gene has little if any impact on an animal's form or function. If so, it's the network – not the individual gene – that is selected" (p38).

Dawkins' response to this is that only by looking at the fitness of the genes themselves, averaged over all their possible contexts, can we really understand evolution. This response shows that while the word 'context' is used, there is no understanding that genes may behave differently in different contexts and certainly not that genes and context determine each other. In other words, Dawkins' theory is essentially context free and is not an open systems theory. It is the usual closed system approach that combined with reductionism has taken us down so many dead ends.

It's the design principle stupid

The difference between chimps and bonobos in terms of social organization and behaviour has been described before: chimp society is characterized by hierarchies where aggressive males dominate females, kill infants and generally behave in a nasty bullying way. Bonobos enjoy stable groups with no dominance but "effusive sex lives and egalitarian peaceable society". Neither infanticide nor group warfare have even been observed (Roach, 2011, p53).

They clearly live in societies governed by different design principles, DP1 for chimps and DP2 for bonobos as the features outlined for these apes accords identically with what we have learnt about the design principles in human societies. The question which intrigues researchers is why two closely related species who shared a common ancestor less than 2 million years ago and inhabited very similar environments have evolved so differently. A few minor differences have been found in such matters as time spent in "oestrous-signalling fertility" but it is not sufficiently significant to affect conceptions rates. Scarcity of, and therefore, competition for food has been found not to differ so no explanation has been found for the profound differences observed.

It has long been assumed that ingroup 'love' goes together with outgroup 'hate' but researchers have recently found that amongst bonobos, ingroup cooperators are also outgroup cooperators. This makes them much more human like than chimps and also means that humans are not alone in cooperating with members of different groups (Leste-Lassarre, 2023).

None of these researchers have heard of the genotypical design principles but those referred to in Leste-Lassaree's article hypothesized that it was because chimps have social structures based on male dominance while Bonobos females have much more status. This is very close to the nature of the design principle but of course you have hierarchies or structures of equals of either or mixed sex in human cultures. Of course, we also know that when you have dominant hierarchies, it is normally the case with people that females are regarded as inferior to males and accorded lower status. The study of Chimps and Bonobos mirrors the basic question that can be asked of these species as it has been asked of human societies – why do some choose one principle rather than the other?

Heresy rises again from the ashes: And its open systems again.

This time the heretic and heresy being resuscitated is the French naturalist Jean-Baptiste Lamarck and his theory of evolution called Lamarckism. He proposed that environment can change you and/or your genes and that such changes caused by the environment can then be inherited by your offspring.

He was of course ridiculed and Lamarckism discredited as he violated 2 of the interrelated tenets of abstract universals, closed systems analysis, namely that:

- context affects or can change a thing, and
- that basic units or essences can change at all

However –"now all that is changing…it has become increasingly clear that environmental factors, such as diet or stress, can have biological consequences that are transmitted to offspring within a single change to gene sequences taking place" [p29]. …It means the demise of the selfish gene theory…the whole discourse about heredity and evolution will change" [p29]. The word **heresy** has been explicitly used!

Of course, this revival has a new long flash name – it is called *transgenerational epigenetic inheritance.* Epigenetics deals with how gene activity is regulated within a cell – which genes are switched on or off, which are dimmed and how and when all this happens.

The article discusses several old and many new, very heuristic examples of how epigenetics illustrate that Lamarck got it right.

For many scientists now, the evidence calls for a "radical rethink of how evolution works…that 'Lamarckian' mechanisms should now be integrated into evolutionary theory which should focus on mechanisms, rather than units, of inheritance…it would reintroduce

development, in a very direct and strong sense, into heredity and hence evolution" [p31, my emphasis added].

But don't expect the old guard to lie down without a fight. But its actually a pretty pathetic attempt at a fight–some examples:

- "epigenetic marks can also be viewed as part of that basic unit in a more inclusive definition of a gene". [NB the appeal to our better natures, -lets be generous here – lets just widen the definition so that everything can fit into it and our theory can stand. As in 'when is a gene not a gene?' when it's a bird, a plane, a mechanism?]
- "the transgenerational effects now being described are mildly interesting but they cast no doubt whatsoever on the theory of the selfish gene" [The old man is using the classic disparagement – 'mildly interesting' –as in 'what could be more boring?' How could such a boring thing trouble an orthodoxy?]
- Dawkins was prepared to go so far as to suggest that the word 'gene' should be replaced with the word 'replicator'. [i.e. he appears to believe that a change of name employing a change from a static noun to a verb-based noun will make the problem go away. But he can't move away from nouns.]

These examples demonstrate that the priests of the orthodoxy believe they can win the fight by staying within their own abstract methodological boundaries, perhaps just laugh it out of credibility

But epigenetics is not going away anymore than continental drift went away and the type of refutations raised by Dawkins cannot hold back the rising tide of evidence and publication. Another opinion piece (Elsdon-Baker, 2009) has queried 'the Dawkins dogma' through a review of the historical lineage of an open systems approach. Elsdon-Baker notes that Darwin himself was a "pluralist", acknowledging the role played by the environment in affecting evolution and that many since have followed suit. "Increasing numbers of biologists find it hard to doubt the environment has a powerful impact on gene expression during an organism's lifetime" (Elsdon-Baker, 2009, p24). Dawkins' claim that only selfish genes or replicators are inherited and are essentially immortal has been shown by new research to be far too simple and limiting. The concept is inadequate to either explain recent data or support new lines of research. Once again, abstract universals and the closed systems science the philosophy generates have been shown to be holding back our knowledge rather than furthering it.

Another nail in the coffin of this closed system orthodox has been hammered in by corals which can pass on mutations they have acquired during their lifetime to their offspring, and this applied not only to the germ-line cells but cells in general. Marshall (2020) states this has been observed before in plants but not previously in animals. ***NB here*** that being a property of plants is sufficient to invalidate the claim that acquired characteristics cannot be inherited but observing it in the so called 'higher' class of beings called animals makes it harder for the lovers of hierarchy to refute.

These corals which are very old in evolutionary terms have cells which can change from body to germ-line cells and back again. They live in colonies of genetically identical polyps that divide asexually. They also release both sperm and eggs into the water that were thought to need to encounter sperm or eggs from another colony to develop. The original study observation was that some eggs developed into larvae without being fertilized.

To confirm this, more larvae were collected and their genes compared with the parent colony. There were no input of foreign sperm, only genes from the parent colony were present although they had been reshuffled.

They also discovered a bigger surprise and that was not all polyps were identical. Some of the polyps had acquired mutations that were not present in the original individual and passed

them onto new larvae. The researchers ran every possible test before becoming convinced that the corals can actually do this.

They claim this is not reinstating Lamarckism because Lamarck hypothesized that mutations were driven by an animal's actions, not by random, but really, this is a minor point. The more overwhelming conclusion that mutations can indeed be passed through the generations overturns years of dogma by scientists wedded to close systems and mechanism, another confirmation of the ubiquity of open systems.

By 2024, it seems that any concerns about Lamarckism in the sense of epigenetic change affecting the genes have disappeared. Lala, himself an evolutionary biologist, (2024) has argued convincingly for it with examples from many different species have displayed the ability to adapt through the mechanism of epigenetic change. He goes further and argues that species, such as orcas who show evidence of a culture, including ourselves, have an especially strong evolvability as he calls it as we can not only learn but transmit that learning to the next generations. In essence, these species influence their own evolution. This means that once again, a system once believed to be simple, determined and unchangeable has been shown to an open system and highly flexible. It now makes you wonder if that is actually the case that applies to all species as we constantly discover that species once believed to consist of isolated individuals, like trees, have shown they communicate and cooperate around their communities and generally behave as much as a collective as discrete individuals. How long before some biologist discovers trees too influence their own evolution? And as for poor old Lamarck? Well he was obviously a brilliant observer and biologist who certainly did not deserve his fate.

It's the environment again

Coghlan (2010) reports that a single bone marrow cell grows into either bone or fat cells depending on the shape of the mould it is placed into. Shapes with corners or angles grew bone while circles or flowery shapes grew fat despite experiencing identical chemical conditions.

Now a study has shown that the belief that 'everything is connected to everything else' has proven true once again. Our new environment with galloping climate change is definitely affecting the severity of disease. Ten climate hazards including flooding and heatwaves have increased the severity of 58% of 375 transmissible diseases examined in the analysis (New Scientist, 2022e).

In another '*surprise*' finding, thankfully not as serious as that reported in the medical science chapter, researchers have discovered that mice are open systems necessitating a rethink on the design and reporting of experiments. They discovered that the sex of the experimenter makes a difference to the results – wow!

"That's something that we've all been ignoring completely because no one thought it was even remotely possible that it could matter, but it does".

In particular, "laboratory mice tend to be more stressed when they smell men, making them behave differently in experiments depending on whether they are handled by a man or a woman" (Moens, 2022). This demonstration of an open system was discovered when a simple test couldn't be replicated. One of the most profound implications of it is that recognizing we are dealing with open rather than closed systems may be a major factor in the "replication crisis" in science more generally. Taking the environment into account may make it easier to replicate findings.

However, nowhere in the article is there any apparent awareness that it is *the environment*, the world outside the subjects with its many factors, that must be taken into account, only a

few "biases" such as sex, breeding, diet or the seasons. Until science has this awareness, it is likely that there will be more surprises. One researcher said it is nearly impossible to keep things totally controlled, especially when dealing with a creature with a sophisticated sense of smell. That doesn't sound like an awareness of an open system!

A lone voice in the wilderness? Not quite

Brian Ford has made a heart felt plea for a move away from reductionism towards the study of wholes such as single cells in their environments.

In his study of single cells he has found evidence for ingenuity and intelligence, in fact problem solving. When a cell of a red algae is cut into two separate parts in a lab, “within 24 hours, the adjacent cells have made good the damage, the empty cell space has been restored to full activity, and the cell walls meticulously realigned and seamlessly repaired” (Ford, 2010, 26). As he points out, this can happen only in a lab because in nature the broken ends of the cell would nearly always be remote from each other.

“Something amazing is happening here: because the damage …is unforeseeable, the organism faces a situation for which it has not been able to adapt, and is therefore unable to call upon inbuilt responses. It has to use some sort of problem-solving ingenuity instead” (as above). Observations such as these pose important questions about cell intelligence and also about the models most biologists apply to their thinking.

Whole living cells are autonomous, (well actually interdepedent). “They are not subservient nanobots, they create and regulate activity, respond to current conditions and, crucially, take decisions to deal with unforseen difficulties” (Ford, 2010, 27). This is of course an example of DP2 and it contrasts with the “conventional wisdom” enshrined in beliefs such as everything in multicellular organisms is ultimately controlled by the brain, the DP1 model. However, Ford points out through several examples that about 90% of somatic cell activity is invisible to the brain and the cells are indifferent to its actions. The model is at odd with reality.

Conventional wisdom similarly views the neuron as little more than an organic transistor, an on/off switch. Yet if a single cell can solve problems, surely the human neuron is capable of doing more than switching. Using his DP2 model, Ford suggests that “the brain’s power will turn out to derive from data processing within the neuron rather than activity between neurons. And networks of neurons enhance the effect of those neurons ‘thinking’ between themselves” (as above).

He has recorded the action potentials of neurons cultured in the lab and found that the audio files created had “the hypnotic quality of sea birds calling.” He suggests that this is the language of the neurons and the brain. He rejects the brain as supercomputer in which neurons are transistors. Neurons process data flexibly and on disparate levels. The brain is superior to any digital signal and may be “a trillion times more capable than we imagine”.

Ford's work complements that of Edelman who I discussed in some detail in *Searching*, 1999. Edelman looks at the brain as an ecologist and sees that the basis of behaviour is the coordination of complex patterns of interconnection between neuronal groups. These are "self managing groups" correlating "without a supervisor" (Edelman, 19992, p89). As we saw with Ingber's work in the first chapter, these researchers in different fields have recognized exactly the same structures and phenomena as Emery recognized with the structure of organizations. The patterns are distinct and ubiquitous.

In a similar but different study, giant viruses have been defying all the rules and making claims to be both alive and possibly not even viruses. Some giant viruses have been generating their own energy which they are not supposed to be able to do. They can also copy DNA into RNA on their own and have a kind of immune system (Le Page, 2020).

First there were the mimiviruses and now the pandoraviruses which are the ones that generate a membrane potential, an electrical gradient, across their outer membrane. The energy to do this has been shown in isolated viruses so it must be coming from the virus itself, not from some host cell.

As we discover more about these forms of viruses, it seems our definitions of life and living must be adjusted again.

Sixth Sense

In a development exploiting our recent technological discoveries, we are learning to replace some of the old knowledge of the ancient peoples who lived closely intertwined with the natural world and studied it intently. From these intensive observations they compiled a detailed of the world around them, all species included. They were the original ecologists in all the best senses of the word.

We are attempting to replicate that knowledge now, and indeed take it to a planetary scale. The initiative is called the 'internet of animals' in a project called ICARUS, International Cooperation for Animal Research Using Space. The plan is to fit 100,000 creatures with miniaturized transmitters which supply information about them. Signals are sent to the ISS as well as Earth based receivers.

The ambitions are large for in addition to learning about particular animal behaviours, it has the potential to help us forecast environmental change, track emerging diseases, conserve endangered species and perhaps make humans more responsive to our coinhabitants.

The sensors can record a variety of data from temperature, acceleration, humidity, magnetometry. It can track wing beats in birds, energy expenditure, foraging and emotional states.

They call it the IoA, the collective of the animals because they constantly interact with each other. They claim that we now know that collective behaviour is responsible for the 'sixth sense' observed in animals. "For example, we have some early indications that animals can sense upcoming disasters like earthquakes or volcanic eruptions" (Ponsford, 2022, p44). While it will certainly be welcome to have definite proof of this, it needs to be said that people have known this for ever, it is hardly a revelation!

Similarly, other discoveries so far frequently seem to be replicating age old knowledge gathered by the old cultures and transmitted orally through the generations. Examples given include such as shorebirds in Western Mexico who tell you in spring about the harvest of anchovies in the autumn because they are already tuning into the fry production early in the season. This is the sort of data that the old people always collected because their food supply depended on it.

It is frequently forgotten just how detailed as well as extensive the ancient knowledge was, and still is in some parts of the world. It was comprehensive ecological knowledge that enabled its bearers to understand long term weather and climatic patterns, biological cycles governing animal behaviour and astronomical cycles and events. It was this exquisitely detailed understanding that enabled them to nurture their land and develop its productivity. So much of this has been lost that we must welcome this new initiative, and hope that ICARUS can not only rapidly replace much of this loss but hopefully take it much further to genuinely help with our existential problem of climate change.

Fungi do and say it all really

In what may be called a thorough expose of the secret lives of fungi, Sheldrake (2020) has provided a wealth of information about how fungi, along with all other species, are open systems with an array of intelligence and adaptive tricks. They can form networks of huge size and complexity extending over long distances.

They are now acknowledged as an additional kingdom or whole realm of life that takes its place alongside plants and animal, and provide a flexible and huge range of services to all other creatures including ourselves. Fungi are involved in so many biological processes that we take for granted that life without them would be virtually impossible. They are a ubiquitous and ingenious collection some of whose unique characteristics are still being discovered. They inhabit just about every ecosystem on the planet from the driest, hottest deserts to the most extreme 'black smokers' deep under the oceans, to you, and they exert powerful effects on them all. People have been enjoying relationships with fungi from beyond the earliest recording, transforming them and being transformed by them, such as in the fermentation of alcohol.

Like all other animate creatures, fungi absorb energy from the sun and nutriments from the environments around them but perhaps one of their most remarkable features is the sheer diversity of this realm. Different fungi have different ranges of sensitivity but that range is extensive from light and colour to heat and humidity, nutrients or toxins, to electromagnetism. One variety called Phycomyces which grows into wind speeds as low as 1 centimetre per second is able to detect the presence of nearby objects, called the 'avoidance response. It is not only their complexity or diversity which intrigues researchers but also what they refer to as their 'intelligence'. And fungi do all this without brains. However, not all intelligent species have to have particular structures known as brains, and certainly humans with only one brain are not the only intelligent species on the planet as we explore in the chapter on human hubris.

"To this day, fungi slip around the systems of classification we build for them" (Sheldrake, p232) as the Linnaean system has difficult with fungi, lichens and bacteria. "A single species of fungus can grow into forms that bear no resemblance to each other whatsoever. Many species have no distinctive characteristics that can be used to define their identity" (as above). The problem here of course is not with the fungi but with the classificatory system which depends in large part on appearances. Their genetics likewise so far confuse us with their complexity.

Similarly the range of their many differing relationship with other creatures is dizzyingly complex, ranging over competition to cooperation to symbiosis and beyond. It has inspired an almost comical range of metaphors to attempt to cope with it such as socialism, trading markets and the Wood Wide Web. None are adequate.

Despite all the fascination and all the research Sheldrake can still state "How fungi coordinate the growth of these structures remains a mystery" (p63). Biology even now with all its sophistications has still not discovered the genotypical design principles and the role they play in all forms of organizational structure. As we have seen so many times in this book alone, the second design principle is ubiquitous throughout all the realms of life on Earth, and there is every reason to believe fungi are no different. Indeed, Sheldrake himself provides many examples.

One slime mould in particular attracted particular attention and was named the 'blob' in North America when the Paris zoo issued a press release discussing some of its more unusual features. It claims Physarum polycephalum is officially not defined as a fungus (Zaugg, 2019). Amongst its more unique characteristics are its ability to split into different organisms and then fuse back again. It can heal itself back into one piece after being cut into two as each bit of protoplasm is interchangeable, meaning that every individual unit can become a vein or any other part except its organelles which appear to be fixed, unchangeable entities (Greenberg, 2020). Slime moulds are billions of years old and have evolved significant memories and problem solving abilities. Obviously this whole world of fungi and moulds is undergoing research all over the world as more of their unique natures and significance to how the world works is revealed.

The (supposed) war of the sexes (I couldn't resist it**)**

Female spiders have a reputation for eating the males attempting to mate with them, either during the act or after. Now a species of spider found in Israel has been observed attacking the female and tying them up before mating with them (Learn, 2020). The male first bites the female which startles her and she plays dead. The male then begins to bind her legs after which he mates with her before running away.

Some males were still eaten by the larger females before they could start biting and the researchers believe the females are still in control of the process. Females break free quickly but may continue with mating if the male is found to be to her liking. His silk may contain chemical hints to his suitability. While it may seem brutal that the female has little choice, she probably actually does.

Remember people, humans are not spiders. ***Equality*** is our natural way.

5. Medicine

An open immune system

If the immune system had been studied as an open system, it is probable that the terrible outcomes of an experimental trial, part of a therapeutic program in which “six men were left fighting for their life after injections with a drug designed to activate T-regs” would not have happened.

T-regs is short for regulatory T-cells. They are injected into people with autoimmune disease to dampen their immune response. Obviously in the above experiment, they didn’t dampen; the opposite happened.

The story has been unfolding slowly ever since. On the 13 March, 2006, six healthy young men showed an unprecedented reaction to the drug which had not been seen in preclinical test animals. The animals had been given much higher doses than the men (Vince, 2006). Within minutes of getting the drug, the six men were writhing in pain and suffered multiple organ failure. It was a catastrophic event and four months later, one was already showing signs of lymphatic cancer and another, signs of the “debilitating autoimmune disease of lupus” (Bhattacharya, 2006). All six had a high probability of similar ailments and reduced life expectancy.

Investigations were immediately launched. The initial belief was that the drug had caused the reaction, specifically a “super-immune reaction”. There were hints that the reaction was a consequence of the way the drug acts on immune cells (Vince, 2006). Preliminary research showed that the six men contained very low levels of T-regs (Bhattacharya, 2006). This again was the opposite of what was expected. An early judgement was that T-regs were “unstable” (Geddes, 2008).

New research has shown that “the cells that coordinate the activities of the immune system appear to change their identity *in response to environmental cues*” (Geddes, 2009, p10 with emphasis added). In other words, it is not one cell type-one function, context free: it is redundancy of function for each cell type where different functions are activated in different environments. The immune system is an open system. Not only is it an open system, it also appears to work as a DP2 structure.

It was believed for years that there were only two types of immune cells called T-helper (Th) cells. Th1 cells help evict viruses and bacteria from their host cells while Th2 fights parasites and bacteria in blood and other bodily fluids as well as taking on allergens. Then two other types were discovered, T-regs which dampen and Th17 which triggers inflammation and autoimmunity.

New research has shown that both T-regs and Th17 can function as Th1 depending on the presence or absence of various signalling molecules. Other research has also shown that T-regs might function as Th17 under certain conditions. It seems that these conditions were present in the six men who experienced the rapid exacerbation of their autoimmune responses.

A brief report published later in 2006 (New Scientist, 2006) documented that when the dramatic changes were recreated in the lab, it was discovered that the effects noted only happen; that TGN1412 only send human white blood cells berserk when 'tethered' to a physical surface such as the base of a lab dish or in a layer of cells, as you would find in the organs of the body. The antibody had previously been tested only in solution, where it failed

to produce this effect.. Crucially, when macaque cells replaced the human ones, the tethering had no effect, suggesting that the response is unique to humans.

A later and apparently unrelated study has now documented a case where “a drug used to stop immune cells from gobbling up transplanted organs and bone marrow has been caught boosting the immune response to a virus in mice and monkeys. It might now be used to enhance vaccines against cancer and other diseases” (New Scientist, 2009, In brief. p17).

“It’s the biological equivalent of a turncoat” or as the title has it, a “traitor”. Does this sound familiar? Something changing its function in a different environment and producing a totally different outcome?

It would appear that no lessons have been learnt in the field of medical research. While exactly the opposite effect was found to that hypothesized, the report states “although the team did not measure it specifically, Ahmed suspects that the drug was also suppressing parts of the immune system in the mice and monkeys, just as it does in transplant recipients.”

Alas, suspecting is not good enough.

The following quote illustrates another dimension of this refusal to acknowledge the reality of open systems. “To use rapamycin as a vaccine booster will mean finding a dose that raises memory T-cell count and quality but keeps immunosuppression to a minimum” (New Scientist, 2009, In brief. p17).

This research team when faced with these results responded with an assumption that there is a continuum of effect from suppression to enhancement. Finding a dose where the drug performs one function rather than other means they believe in the linear logic, mechanistic, closed system approach. There was no awareness that chemical and cells and all other systems change their function as their environments change.

There is no continuum: there are functional drugs and cells who switch their function depending on the nature of environment they find themselves in. We see the same problem over and over again. This point was made by Engel in 1977 when he argued that the current model of disease used in medicine and psychiatry is inadequate for the tasks involved. The dualism of somatic and psychosocial, the reductionism and closed system approach generally cannot meet either the problems demonstrated or social responsibilities.

And again, the immune system is open

As if the above was not a sufficiently convincing demonstration that the immune system is open to its environments, researchers have now discovered that “immune cells have circadian clocks, making them more active at certain times of the day” (Geddes, 2010, p6). Not only is the immune system open to the chemical nature of the environment in which it is operating, it is also open to the wider environment of the planet and its diurnal rhythms.

A similar problem set back genetic therapies when an immune response to a virus caused "unforeseen" harmful effects. Another significant problem was experienced when "in trials treating immune deficiency diseases, some children were successfully treated but then developed leukaemia. That was because of the integration of DNA from the virus into the genome of their haematopoietic stem cells – the cells that give rise to all our blood cells" (O'Callaghan, 2016, p44). Once again we see perfect demonstrations of the fact that individualism and its translation into reductionism is incompatible with the fact that the world consist of open systems, and nowhere is this more evident than in the human body. When will they ever learn?

Another drug trial went wrong (NS, 2016c), this time in the area of painkillers. It was the first human trial after animal trials and because of its subject matter was being tested on normal subjects. Fortunately only the 6 receiving the highest dose were affected but of these one has died with five in hospital.

It is obvious that much more care must be taken with trials on humans as there are never any guarantees that the environment into which the trial is introduced will replicate previous recipient environments. Rather than such large numbers or large doses, researchers must be prepared to be ultra cautious to prevent any more of these tragedies.

And again, it functions as a DP2, not DP1, structure

Geddes (2010, p6) reports on "a set if newly discovered immune cells, known as regulatory B cells (B regs)" which are "sending shockwaves through the immunology community".

Why is this community so shocked? Because they had "assumed that B cells' main role was to make antibodies at the behest of T cells" (as above). In other words, they assumed that the immune system works as a system of hierarchical dominance where T regs boss other cells around.

However, "it seems that T-cells are not the immune system's only regulators. Experiments suggest that under some circumstances, B regs regulate T-cells, providing a shadow role for B cells" (as above). Again as we saw in previous research reports, cells change their function depending on the nature of the environment and what needs to be done. This is exactly what happens in a DP2 structure – the cells best equipped to perform a task do that task and for the duration of the task, coordinate the other cells to perform the tasks they do best, e.g. "B regs seemed to work by releasing a chemical called IL-10 into the lungs drawing in regulatory T-cells (T regs) which in turn inhibited immune attacks" (as above). While most of this research has been conducted in mice, similar cells have been identified in people "but they're pretty rare" (Geddes, 2010, p7).

The rest of the article is concerned with possible experiments to boost and/or suppress B regs to enhance treatments for autoimmune diseases and cancer. It is a discussion that cannot disguise the basic lack of knowledge and uncertainly that surrounds all this research. Read the following example carefully:

"One clue that [identifying drugs] that might boost B regs…or suppress them…[might work] comes from studies of rituximab, [a drug] which kills B cells. First prescribed for the treatment of B cell lymphoma…the drug has also reduced symptoms in people with diabetes, MS and rheumatoid arthritis. Rituximab *most likely* knocked out all the B cells to start with, and then, *for some reason* only the B regs grew back, which helped suppress autoimmunity" (Geddes, 2010, p7).

This quote makes it clear that these researchers like particle physicists are concentrating on isolating small discrete entities whose functions in differing environments remains a complete mystery. They do not know why the drug killed all the B cells. Nor do they know why the B regs grew back. Nor do they know under what conditions T regs take over or B regs take over. Nor do they know if T and B regs are simply different forms of the same cell in varying environment.

As we have seen from Ingber's work, the basic architecture of cells is fundamental to their function but specialization has become so extreme that these researchers know nothing of

each others' work. Yet cell researchers in immunology probably wouldn't even recognize the relevance of Ingber's work because it didn't specifically have a key word for immunology.

Bacteria mutate in unexpected ways

Now, once again, we see that reality simply defies current scientific thinking with detrimental results for some participants. The study reviewed here employed genetic engineering so it issues an alert to the fact that the long term outcomes of that engineering can be unpredictable, not necessarily in the best interests of patients.

The central concern here is not mainly that researchers ignored the context although that is also present, but that *they assumed a reliability in the bacterium as if it was a mechanical entity rather than a living creature*. Assuming reliability or stability is just another feature of the world hypothesis of mechanism and constitutes as serious an error as does ignoring context. Mechanism is still bedevilling our science in 2025.

The study developed a genetically modified bacterium in an attempt to break down a common cause of kidney stones in the gut (Bowler & Phiddian, 2025). After testing on rats and mice, the researchers ran two human trials, one with 39 healthy volunteers and another with 20 volunteers with a condition where the body absorbs too much oxalate, causing frequent kidney stones. Participants were given either the bacterium or a placebo.

The bacterium engineered is one of the most prevalent and abundant in the gut and it was modified to have two new abilities, to break up a compound called oxalate which can cause kidney stones, and eating a compound called porphyran which is found in seaweed. This meant it would be easy to get rid of the bacterium as the participants could just stop taking the porphyran supplement – "or at least, that was the theory".

"The bacterium was considered safe in human tests but it mutated and remained in the gut of originally 4 participants. These 4 were treated with antibiotics but they worked in only 2 cases. Two participants are still walking around with the engineered bacterium operating within their gut.

"The team knew it was possible the modified microbe could mutate but were 'surprised it occurred' in the way it did, because *it had been less of an issue with lab studies or healthy volunteers".* Obviously the team assumed that how it behaved in one setting would be the same in other settings. Here we see echoes of the immune studies above where context determined the function of the components, something completely unimagined by the scientists.

Engineered bacteria that stuck around in the gut of the healthy participants were successful because they mutated to eat foods other than porphyran. So when they stopped taking the porphyran supplement, the bacterium started eating something else. However, it mutated to become less effective at degrading oxalate in some participants who suffered from kidney stones. Therefore, the therapy was mostly successful in healthy volunteers but "it didn't treat the underlying cause of kidney stones in people who suffered from the condition".

The chief researcher acknowledged it was disappointing from the therapeutic point of view but believed there was no reason to be concerned despite the unexpected nature of the mutation. He claimed that as "genes, bacteria and activities are commonly found in a healthy gut, so we consider this a relatively safe initial application". This may well be true for this particularly study but the underlying belief system based on mechanism rather than the reality of open systems is a concern for all future research employing the same methods. A rethink and adjustment in method is required – otherwise, they may not be so luck next time.

Several things are clear: The search for abstract universals reveals a complex syndrome of closed systems, mechanism and specialization. While these researchers continue to use this approach, they are essentially engaging in a trial and error process better known as hit or miss which risks the health of their volunteers and their subsequent patients

Why won't they ever learn?

The skin too is an open system

Well of course I hear you say, of course the skin is open, it's the barrier keeping us in one piece and separate from the noxious substances floating around us, it must be open to the external environment. But not only can the sun or the biting insects dry it out the skin or irritate it, there is now growing evidence that the skin as the largest organ of the body can have significant effects on the rest of the body and the mind. Damage to the skin can drive "inflammation, muscle and bone loss and possibly even cognitive decline" (Marshall, 2024, p32). Your skin just doesn't shows signs of aging with its wrinkles but may be contributing to it.

Atopic dermatitis is associated with a small but significant increase in the risk of heart attacks, stoke, angina and heart failure. Psoriasis indicate a higher risk of cardiovascular disease. Some skin conditions are also associated with sarcopenia or muscles loss. Work is currently trying to discover the actual mechanisms that determine how these damages occur. For example, both psoriasis and atopic dermatitis lead to problems with the skin's barrier function and in the attempt to repair the barrier, skin cells release chemical signals called cytokines that trigger inflammation.

Inflammation also plays a role in aging and researchers have discovered a phenomenon called "inflammaging" in which older people show chronic, low level inflammation with blood which constantly contains more elevated levels of cytokines than young people. This continuing low grade inflammation is linked to dementia, arthritis and type 2 diabetes which are more prevalent as aging progresses.

Experiments have confirmed the link between damaging the skin and aging but it is not only acute damage but such conditions as increased dehydration can raise the level of cytokines in the blood. These conditions can also lead to bone loss. Inflammatory skin diseases also show an association with cognitive impairment and dementia and may play a play in their development.

It has long been know that systemic health shows up in the skin, whether good or bad so it is no surprise to open system thinkers that skin as an open system in its own right would enjoy a two way flow of effects not only with the external environment but also with the body it contains. We just haven't known about the detailed causes and effects that are emerging from intensive research now.

In another experiment, this time on mice, but designed to help human health, the skin of the experimental mice was cut to see if the skin-gut connection was one way or two way (Khedkar, 2024). The control mice were not injured. Both groups were isolated and their gut microbes later examined. The wounded mice had fewer beneficial microbes and more disease causing ones.

The experiment was repeated using gene manipulation to vary the skin's water content. This damages a molecule called hyaluronan which maintains the skin's water content. As in the first experiment, it was found that there was disruption to the gut microbiome, specifically that the mice were more susceptible to the digestive disorder colitis than the control mice.

The experiments showed conclusively that there was a flow of effects from skin to gut confirming that the flow is indeed two way, another open system.

Cancer as an open system

Our prevailing approach to cancer is the crash or crash through strategy, known to older Australians as the Gough Whitlam strategy (he crashed), the strategy of the direct approach. Here we say 'there is the enemy, go get 'em'. This current strategy revolves around curing the cancer, ridding our bodies of it or at the least, bullying it into a state where we can manage it, keep it under control. As many know, the result is variable depending on which one you cop and even if you do survive, the process is a long drawn out one of pain, suffering and uncertainty.

Finally, some intelligence has surfaced in this all out assault on cancer; a group of scientists are trying a radically different approach, one based in open systems and the strategy of the indirect approach. Rather than declaring war on cancer, researchers are building on its known malleability to turn it into a different and benign state, "persuading them to adopt a new identity" (Ainsworth, 2025, p41).

Other strategies involve changing the abnormal environment surrounding the cancer – "this is all the system in its entirety, that is changing" (p43). This is tricky because the system and environment are constantly determining each other as the tumour is known to be changing the surrounding tissue so it better supports the growth of the cancer. All our interventions will be met by counter moves by the cancer so a more effective approach is to change its nature so it cannot act in those ways.

As early as 1959, pathologist Barry Pierce and his team discovered that embryonic tumour cells grafted into adult mice could differentiate into benign cell types to aid healthy tissue growth. This supported observations of cancers spontaneously regressing in some patients. They realized that ***the tissue environment surrounding the cancer cells seemed to influence their behaviour*** so they began looking for the mechanisms responsible. They learnt that cancer cells could be retrained through exposure to tissue environments in which closely related cell types were generated.

However it was not until much later that two Chinese doctors Zhen-Yi Wang and Zhu Chen applied this idea in the clinic, following Confucius' advice to educate rather than punish. Now cells from varieties of aggressive cancers are being treated some directly but others on their surrounding tissue.

Examples are several: acute promyelocytic leukemia (APL), a blood cancer which can be quickly fatal is treated by administering retinoic acid, a derivative of vitamin A, to immature APL cells. This "beneficially alters the shape of a protein involved in causing APL" (p42), causes decisions that progressively restrict their ability to form different cell types. This is essentially an epigenetic process and can be reversed as the cells retain their the plasticity. Just four proteins known as the Yamanaka factors can push cells all the way back to pluripotency.

This knowledge and techniques are being exploited to turn breast cancer cells into harmless fat cells and glioblastoma cells are being turned into neurons and microglia. In this latter case, the original drug used, cAMP, is not suitable but forskolin which boosts cAMP in cells can be used in combination with radiation.

Cancer as we now understand it is a combination of genetic and epigenetic factors at many levels of biological organization. It is a crafty enemy necessitating a full bag of approaches employing far more intelligence and strategy than the 'war on cancer'. Hopefully, soon more of these advances will be available for clinical application.

Genes are also open systems

Described as "a fundamental shift in our understanding of how genes function" (Mackenzie, 2007), all our genes have been found to oscillate according to our circadian rhythm. Those with the clearest circadian rhythm seemed to be those that control energy metabolism.

The findings suggest that interfering with the body's circadian rhythm could have profound effects, particularly on multi-gene traits such as mood, growth and immunity. This of course implicates artificial lighting which we have only had for about 100 years so it could be having unexpected effects, e.g. on obesity as eating is also regulated by the circadian rhythm.

This is an area with far reaching ramifications. Even genes which were thought to be silent showed slight activity over a 24 hour period meaning researchers need to monitor activity over prolonged periods, snapshots will not reveal their function.

Human guinea pigs

Two reports have commented on the hazards of volunteering for clinical trials, exploring the motives of volunteers and detailing the ethical quandaries that such trials create. Two major motives are getting money and being cured of pre-existing maladies. The mixture of poverty and illness is a potent cocktail for potential damage on top of the already existing risk involved in applying closed rather than open systems theory. As Shetty says “Desperation – for money or medicine – is never a solid foundation for unbiased decision-making.”

Clinical trials are big business and increasingly drug companies are moving their trials to developing countries although the diseases they are attempting to cure are primarily those of the rich. At the same time, the number of subcontractors is growing while the number of non-profit organizations undertaking trials is declining. The US Food and Drug Administration inspects less than 1 percent of its 350,000 registered trial sites. Unethical practices have been recorded and despite safeguards on paper, “in reality, poor, largely illiterate populations are being exploited.” The scene is set for further disasters.

In the developed countries there is another worrisome development, a variant of the poor enrolling in trials purely for the money. We now have a growing number of ‘professional’ guinea pigs or lab rats, people who do it as a full time occupation (Motluk, 2009). These people consider themselves to be ‘employed’.

Not only is this an extraordinarily dangerous occupation as most trials are ‘phase 1’ trials, the first testing on humans after previous testing only on animals. It is in phase 1 trials that the risks of unexpected side effects and serious systemic damage such as that in the T-regs experiment discussed above are most likely to occur.

The need to earn money can cause volunteers to flout the rules in various ways and ignore the rules for reporting. There are several ways in which the use of these ‘professionals’ can distort the experimental results and, therefore, increase the risk attached to the subsequent drugs and treatments. If a drug is passed as safe because the subjects chose not to report any

negative effects because they were would be removed from the trial, future patients who are more sensitive to the drug can be at serious risk. There is evidence that side effects are dramatically under reported (Motluk, 2009, p42).

If the subjects ignore the requirement for a 30 day drug free period before a test, any side effects reported can make a promising drug look dangerous and will change the procedures for a second trial. The side effects may result from the mixture of drugs inside the subject's body rather than the experimental drug itself. All deviations from accurate data have the potential to distort the conclusions with deleterious effects on future medications and treatments.

The range of ethical problems involved in clinical trials, particularly those that rely on people from low SES or otherwise disadvantaged backgrounds urgently require solution. At the moment the situation is out of control as even the institutional review boards that are relied upon to provide the ethical oversight of clinical trials in the USA are mostly commercial, for profit organizations, often paid by the drug companies they are supposed to be regulating. Not only is this conflict of interest legal at the moment, there are "no stringent educational requirements for members, no formal government approval process for setting up an ethics board and limited oversight by government regulatory authorities" (p43).

However these ethical dilemmas are resolved, it is obvious that the most important matter at the moment is to render such trials a lot safer by substituting open systems theory for closed, in other words, by rejecting reductionism which lies at the heart of most of these problems.

Function depends on context

Other studies have found that contrary to all mechanistic theories about the human body, it functions as a whole, open, system with different parts distributed throughout the body performing different functions depending on where they are located.

Many will still find it hard to believe we have neurons in our hearts as well as our nervous system and will probably have more difficulty understanding why we have taste receptors in many parts of our bodies including our testicles (if present) and in heart, brain, bladder, lungs and body fat (Simms, 2024).

Receptors in the gut detect sweet, umami and bitter flavours which perhaps is not too surprising as the mouth and the tongue are part of the gastrointestinal tract but these sensors are not tasting but detecting nutrients. They are involved in regulating nutrient uptake which aids efficiency. They are also involved in the release of molecules such as hormones and neurotransmitters that keep organs in peak physical condition.

In the heart, sweet and umami sensors make the heart beat more strongly in the presence of nutrients while bitter sensors in the testicles enable sperm to develop more strongly. Clearly these cells perform quite differently depending on exactly which part of the body they inhabit. They are an excellent example of redundancy of function, the second design principle, DP2, in action.

Reductionism in diagnosis

Diagnoses multiply like rabbits particularly in the field of mental health. Categories of diagnoses in the DSM, the 'Diagnostic and Statistical Manual of mental disorders' rose from 102, to 182 to 265 to 297 in DSM-IV.

Supporters argue that 'specialization' is necessary and a function of increasing knowledge but it would appear that the critics have reality on their side. Diagnoses for mental health conditions "morph into each other, suggesting psychiatry's reliance on specific diagnoses may be misguided" (Jones, 2020). A longitudinal study in Dunedin, NZ, found that over time most people's diagnoses shifted into a different category showing that more of an emphasis should be placed on building basic skills for mental health rather than responding to a specific diagnosis. This was of course disputed by others who said some specific conditions responded better to some specific treatments than others, a benefit which could be lost.

The placebo effect becomes 'contextual healing'

One of the major subheadings in this article is "The findings threaten the very credibility of modern medicine" (Brooks, 2008, p39). What it means is that the efficacy of every drug tested by even the most rigorous double blind randomized controlled trials is in doubt because of the placebo effect. The placebo effect has been shown to be far more powerful and complex than ever imagined by these scientists.

- Does the placebo effect work when people know they are being deceived? Yes, when its in the form of conditioning.
- An active drug is not better than a placebo in a standard trial, even when the researchers are confident the active drug does work.

Brooks (2008) reports on an experiment by Fabrizio Benedetti in which he conducted a standard double-blind randomized controlled trial with a painkiller called a CCK antagonist. The CCK antagonist performed better than the placebo. However, he repeated the experiment without telling the volunteers what he was doing and the CCK antagonist had no effect. Diazepam also does not reduce anxiety if patients don't know they are getting it.

While it has been known since 1978 that placebos can stimulate the production of pain killing endorphins, Benedetti now believes that we can never be sure about the real action of a drug because the very act of administering a drug, and the subject's expectations "activates a complex cascade of biochemical events in the patient's brain" (Brooks, 2008, p38).

In another series of experiments which involved no treatment at all, Kaptchuk found that the improvement reported by the group that received sham acupuncture plus lots of attention was equal to the improvement reported in the 'positive' trial results after taking drugs commonly used to treat irritable bowel syndrome (Brooks, 2008).

What follows is a longer list of the various forms of, and circumstances in which, the placebo effect has been found to operate (Goldacre, 2009).

- Surgical operations without anaesthesia where the patient did not suffer and was fine afterwards
- Four sugar pills work better than two in healing gastric ulcers
- Pink sugar tablets were better at maintaining concentration than blue ones
- Capsules placebos work better than pill placebos [look more scientific]

- Injections work better than pills for blood pressure, headaches and post-operative pain [an injection is a more dramatic intervention]
- Rituals such as a sham acupuncture treatment work better than pills for arm pain
- Flashy brand name packaging work better than blank, neutral packaging
- Expensive pills work better than cheap pills for pain relief
- Sham ultrasound is beneficial for dental pain
- Placebo operations are beneficial for knee pain and even angina
- Patients who had pacemakers installed but not switched on did better than before
- Sham or placebo 'angioplasty' treatments are almost as effective as the full procedure
- Simply being told you are doing something healthy such as cleaning causes decreases in weight, body fat, waist-to-hip ratio and body mass index without any change in activity
- Sugar pills that doctors talked up before a dental injection caused less fear, anxiety and pain than those the doctors did not talk up
- Patients who received pills from doctors who believed they were handing out pain relievers experienced significantly less pain than patients who received pills from doctors who believed they were handing out either placebos or pain enhancers. This was a complex experiment with placebos, pain relievers and enhancers and where half the doctors were told the truth and half were lied to about what they were administering. The doctors were forbidden to tell the patients what they believed the pills to be so the effect was purely the result of the doctors' beliefs. The other major finding in this experiment is that people are superb communicators, that is, the doctors accurately conveyed their beliefs and the patients accurately understand them.
- Simply making a diagnosis, even a fake or placebo diagnosis improved outcomes. Only 39% of those told the diagnosis was uncertain got better while 64% of those given a firm diagnosis and told they would get better, did get better
- Warm, friendly and reassuring doctors are more effective than those who keep consultations formal and do not offer reassurance. It would appear that this experiment confounded personal style and reassurance and given all the evidence above, it is more likely that it is the reassurance that makes the difference.
- 'Neurotic' patients who were told a pink sugar pill contained no medicine but would help them "as it has helped so many others" (p67) also improved
- The gastric contractions causing nausea and vomiting reduced in two women who were told their symptoms would improve after they were given ipecac that actually

induces nausea and vomiting. In other words, the placebo effect was stronger than the drug.

- The human immune system has been shown to reduce its function after an association of a flavoured drink with an immune suppressing drug was established.

As some of these experiments make clear, the placebo effect cannot be written off as 'all in the mind'. It isn't: it affects physical systems such as the immune system. Not does it apply to any class or group of people. All people are susceptible to the placebo effect. Goldacre states "You, dear reader are a placebo responder. Your body plays tricks on your mind" (p69). But as we know, a person is a system and cannot be validly separated into body and mind. Using a systemic theory is Daniel Moerman who reframes the placebo effect as the "meaning response", "the psychological and physiological effects of meaning in the treatment of illness" (Goldacre, 2009, p69). Moerman found that the success rate of the drug cimetidine used to eradicate stomach ulcers reduced from 80% in 1975 to 50% five years later. The deterioration in success rate occurred after a competing drug believed to be superior entered the market. It is believed that the reduction in the success of cimetidine followed the deteriorating medical belief in its relative effectiveness.

Moerman's study like many others demonstrates changes with context. Miller & Kaptchuk have now suggested that the term 'placebo' is now so baggage laden that doctors and researchers should think instead of "'*contextual healing'* – the aspect of healing that is produced, activated or enhanced by the context of the clinical encounter, rather than by the specific treatment given" (Brooks, 2008, p39).

Once again we see how much confusion, at least, has been caused by the refusal to acknowledge that systems exist in environments and that both system and environment contribute to a new state of affairs.

And we need to consider the converse of this - given the unscientific (unreal) assumptions built into the medical testing model, it should come as no surprise that many drugs have side effects that show up only after clinical trials have 'proven' the drugs are safe. Drug trials are studied out of context but patients take their drugs in a context. Obviously we should expect differences between the experimental and day-to-day experiences and effects. How many more people have to become ill or die before medical research falls out of love with abstract universals and shows some responsibility to the human race by adopting practices based on material universals. Is the ethic of medicine still "do no harm?"

There is another dimension to this work on placebo. As noted above, the placebo effect is now considered to be carrying much baggage but the problem is more fundamental than this. A placebo was once considered to be just a harmless substance that would have no effect on a condition. The term has now been broadened to include conditioning and even includes word of mouth from others, "such as learning that a treatment has worked for others" (Brooks, 2008, p38). These broadenings of the term make it clear that the placebo effect is no more than a particularly influential or persuasive human transaction, people influencing each other.

If it had been recognized as this and called this from the beginning, there would have been no mystery about the 'placebo effect'. It would have been acknowledged as a fact of human life and drug trials would have taken it into account and would have evolved into totally different practices to establish drug effects.

And now science validates voodoo.

Described as "placebo's evil twin", the *nocebo* (I will harm) effect has been investigated with an open mind. The effect is well known around the world and goes by several names and has many variations but includes the 'evil eye' and 'being sung to death'. As with the placebo

effect, the nocebo effect has worrying implications for medical practice. Cases have now been documented of patients dying from the diagnosis per se, not the disease that was diagnosed. In other words, the patient did not die from cancer but from believing they were dying of cancer.

Comparable proportions of experimental and control groups in clinical trials report the same side effects and about 60% of people undergoing chemotherapy start feeling sick before their treatment even starts. One man nearly died because he believed he had overdosed on antidepressants and recovered only after being informed that the pills were harmless.

Not only is the nocebo effect widespread, it is also catching. Students who watched a woman inhale a supposedly toxic air sample and develop the expected symptoms were more likely to develop the symptoms themselves and the effect was more pronounced in women. This is a bias seen in other cases of mass psychogenic illness.

"It appears that, as with the placebo response, nocebo effects vary widely, and may depend heavily on context. Placebo effects in clinical settings are often more potent that those induced in the laboratory…which suggests the nocebo problem may have profound effects in the real world" (Pilcher, 2009, p33).

As Pilcher points out, most of us today would laugh at the idea of dying after "a strangely attired man leapt about waving a bone and told us we were going to die. But imagine how you would feel if you were told the same thing by a smartly dressed doctor with a wallful of medical degrees and a computerful of your scans and test results. The social and cultural background is crucial" (Pilcher, 2009, p33).

While these phenomena appear to be "psychological", they have "very real consequences in the brain…Nocebo effects were linked with a decrease in dopamine and opioid activity. This would explain how nocebos can increase pain. Placebos, unsurprisingly, produced the opposite response" (Pilcher, 2009, p33). These neurochemical effects like the rapidly dropping blood pressure of the man who thought he had overdosed, are the consequences of a belief, a "psychological" phenomenon. These physical effects demonstrate that people are not aggregations of bits and pieces or bodies and minds. They are *open systems* and until science acknowledges this in its theory and practice, it is going to continue not only to be surprised by its results but also to run risks in its experimental and treatment regimes.

For those who are particularly vulnerable to persuasion and influential communication, how does the doctor warn you of the possible side effects of your treatment? Perhaps the doctor doesn't do that, perhaps some user's group process is substituted. This replaces the unhealthy 'expert' top down instruction with a healthy discussion between equals. Such a forum is more likely to lead the new user to be well informed of the range of possible side effects and their probabilities and a radically lower risk of nocebo effect.

Now if you were the slightest worried about the role of nocebos, it is time to avoid social media like the plague – as it may well be, a modern plague. It has been established beyond reasonable doubt that social media is serving the same ancient purpose as witches and shamans uttering curses with the intention of spreading illness (Robson, 2025).

Through the power of suggestion, social media can trigger real symptoms ranging from Tourette's-like tics to headaches, muscle pain, fainting fits and even cognitive impairment, by pronouncing on threats to our health. It has long been known that negative expectations, nocebos, can affect our health and that they are highly transmissible. Now it has been shown that it is not only face to face conversations as a powerful vehicle but also social media.

Given the number of people consulting Dr Googles and his mates, this is a real worry indeed.

A nocebo is not as some may imagine, all in your mind, its effects are changes in actual bodily function. The body can ramp up the production of cholecystokinin as a reaction to feeling under threat, or it can activate our autonomic nervous system which controls involuntary responses in respiration, blood circulation and bowel movements. We may feel breathless or dizzy or faint.

In one experiment half the men given finasteride, a drug administered for an enlarged prostate, were told it could cause erectile dysfunction, half weren't. Of those so informed 30% experienced the side effect, only 10% of the uninformed didn't.

Moreover, it has been established that each time a particular issue or risk is discussed, the pain or other symptom increases. As social media has the power to transmit to high numbers, the rate of contagion can be huge. It could explain modern mass outbreaks of mysterious symptoms not caused by any infection or environmental toxin. We have seen the case of TikTok Tourette's in the early 202s when an increasing number of the platform's users began to upload videos of facial and bodily tics, resulting in a surge in people reporting these symptoms to their doctors. These are reminiscent of outbreaks of 'mass psychogenic illness' such as the dancing mania in the Middle Ages (p40).

Nocebos are though to lie behind the "wind turbine syndrome" and also some at least of "non-coeliac gluten sensitivity" although the latter is disputed as the same symptoms may be caused by other agents. However, in our modern world where 'connectivity' is thought to be desirable, it is obvious that the nocebo can be the source of a host of quite unnecessary problems.

Is there a way out? Some studies have found that the placebo still works even though the recipient knew it was fake. However, some are hopeful that educating people about the nocebo effect may reduce the symptoms. From my own personal viewpoint, it would seem to be more efficacious to stay away from Dr Google and his afictionados and if you must use social media for medical information, desist from discussing it with others.

Time to listen to the ancients?

Long scorned by modern medicine, acupuncture has been shown to improve sensory and motor functions in people with spinal cord injuries. Now it has been shown to reduce nerve death in rats with induced spinal damage (New Scientist, 2010.Why acupuncture aids spinal recovery. 24 April, p15.)

The article is at pains to point out that “it’s not due to improvements in their energy flow or ‘chi’: acupuncture seems to stop nerve death by reducing inflammation”. The researchers hypothesized that “sharp needles – but not toothpicks – prompt a stress response that dampens down inflammation.” In other words, they do not know how it works.

Exactly how does a “stress response” differ in status from an “energy flow”? The medical profession has ridiculed acupuncture as quackery while continuing to use anaesthesia without any idea of how or why it works (ScienceDaily. 1998. Understanding the mystery of anesthesia. www.sciencedaily.com. July 3. Retrieved 16.5.20100.) A case of double standards?

Electromagnetic systems in an electromagnetic universe

As with the segment on acupuncture above, the idea of electrical or electromagnetic bodies is ages old but constantly overlooked again if it momentarily surfaces from its long slumber in medicine land. It is well established that we actually live in an electromagnetic universe although you would not know it by immersing yourself in much of today's physics

so it is quite fitting that you would find living systems in such a universe mirroring the nature of the world they inhabit.

The latest surfacing of this old but neglected aspect of life on Earth, itself an electromagnetic entity, lies in an article "You are electric" (Adee. 2023). She documents how every cell in our bodies is a tiny battery, providing electricity with immense power to shape, heal and harm. She calls it the 'electrome'.

Researchers have now documented with film exactly how electrical patterns provide a blueprint that shapes a developing body, coordinating where to put its face and grow its other features. The experiment began with a camera running as a frog embryo turned into a tadpole. At an early point in the sequence, light began to flash in a series of patterns in the shape of two ears, eyes, jaws and a nose. Two to three hours later, the real things appeared just as the images had showed.

However, this is just one of the many roles electricity plays in biology. Everything in our lives from healing to cancer is touched by it and by mapping this electrome, it is hoped to learn more of its secrets in areas other than the brain where it is more understood and accepted. Genetics has occupied much of the exploration in recent years and while it is vitally important, it cannot tell you how many eyes or where to put them.

That is the role of electricity but it is much more difficult to investigate as development occurs in whole open systems over long time frames. This makes if difficult for reductionist and other non-wholistic methods. In the initial experiment as above, it was discovered that it is was the exact voltage of each cell that was the cue for it to assume its particular identity, e.g. 70 millivolts for nerve cells, 90 millivolts for skeletal cells. These functioned as instructions and later experiments discovered that they turned on the genes "that got to work to create an animal's physical template" (Adee, p40). Fiddling with the voltages created abnormalities which could be corrected by correcting the voltages.

They have also reproduced a finding first documented in the 19th C but ignored for 150 years – that injury creates an electric pulse which generates an electric field of around 120 millivolts per millimetre. This field acts as a beacon for the various cells that move in to repair the damage and rebuild tissues.

People with stronger pulses heal faster that people who generate a weaker field and in all people the current weakens with age, half the strength at 65 that you had at 25. Tracking currents from healthy cells to cancer can be dramatic, the voltage can shift to around zero, "similar to the voltage stem cells display" (p41). But the voltage of cancer cells can also oscillate just like electricity in a nerve call as they need these currents to communicate with each other about their environment – in order to metastasize. Researchers are now hoping to put all this new knowledge to work to drastically effect healing if not some reversals in injuries and diseases that afflict us all.

6. Genetics

Selfish genes or cooperative ecosystems?

"The idea that evolution is all about genes looking out for themselves is increasingly under fire" says Bob Holmes (2009). That genes are selfish is the brainchild of Richard Dawkins. The premise underlying his theory is that science works best at the lowest level of analysis or entity. This is of course reductionism.

When reductionism combines with natural selection and is applied to genetics, the inevitable result is the concept of a gene that competes in order to achieve an evolutionary advantage. This concept also has overtones of 'rational economic man' who strives to get ahead in the pecking order. It accepts the premise that competition is the law of life. There are instances of competition in the natural world but there are many more instances of cooperation. "Cooperation is the law of life" (Gorney, 1968, px).

Other geneticists are now demonstrating that evolution works at levels other than the genetic such as the level of species, groups of unrelated members of the same species and ecosystems. An example of species selection is body size where larger individuals out compete smaller ones so we would expect average body size to increase over time. However, in many species this has not happened. An average larger body may have triggered a reduction in numbers or even extinction if sufficient resources were not available. Therefore, cooperation between individuals for species survival replaced competition for individual advantage.

An example of group selection is "the small size of some annual plants that grow together and reduced virulence in some parasites (to keep their hosts alive)" (Holmes, p38). Evolutionary biologists do not know how common group selection is in nature because they haven't been looking for it.

Crop breeders have, however, always used it. They choose plants that get along well rather than choosing the most vigorously growing individual plants. The aggressive growers interfere with each other when grown together in a field and produce a lower yield.

Experiments have now begun on group selection and as well on selection at the level of the ecosystem. Previous research has demonstrated that multiple species "work together to produce an environment that maximizes their collective survival and reproduction" (p39). Obviously you have not got individual selection because if you look at each species separately, you couldn't predict what they would be doing. Each species must be examined in the context of the ecosystem.

Clearly this new work is acknowledging and using systems and contrasts with the Dawkins' theory. Other evolutionary biologists point out that genes rarely act alone. They act in networks where "multiple genes affect each trait and each gene affects multiple traits" (p38). "What's more, these networks usually have enough redundancy that deleting any one gene has little if any impact on an animal's form or function. If so, it's the network – not the individual gene – that is selected" (p38).

Dawkins' response to this is that only by looking at the fitness of the genes themselves, averaged over all their possible contexts, can we really understand evolution. This response shows that while the word 'context' is used, there is no understanding that genes may behave differently in different contexts and certainly not that genes and context determine each other. In other words, Dawkins' theory is essentially context free and is not an open systems theory. It is the usual closed system approach that combined with reductionism has taken us down so many dead ends.

While this article concentrates only on selection, we now know that adaptation occurs in several ways.

The lengths to which researchers go to explain the discrepancies between their theories and reality as it is consistently found are considerable. Evolution theory has always had a serious problem with cooperation or Good Samaritans as Barras (2020) puts it. Cooperation is widespread in nature as it is in humans but traditional evolution has been built on individualism and the primacy of competition. One by one hypotheses such as kin selection to explain this discrepancy have proved inadequate. The latest contender is called cultural group selection but is disputed by others.

Rather than endlessly chasing inadequate explanations, it would be a lot more satisfactory if these scientists simply accepted that their underlying basic assumptions that:

1. the individual is the basic unit of a system is wrong, that
2. there are two genotypical design principles and,
3. most species, and indeed genetics in general, appear to be governed by the second principle, DP2.

Heresy rises again from the ashes

This time the heretic and heresy being resuscitated is the French naturalist Jean-Baptiste Lamarck and his theory of evolution called Lamarckism (Young, 2008). He proposed that environment can change you and/or your genes and that such changes caused by the environment can then be inherited by your offspring.

He was of course ridiculed in the normal manner as he violated two of the interrelated tenets of abstract universals, namely that:

- context affects or can change a thing, and
- that basic units or essences can change at all (Emery M, 2000).

However –"now all that is changing…it has become increasingly clear that environmental factors, such as diet or stress, can have biological consequences that are transmitted to offspring within a single change to gene sequences taking place" [p29]. …It means the demise of the selfish gene theory…the whole discourse about heredity and evolution will change" [p29]. The word **heresy** has been explicitly used!

Of course, this revival has a new long flash name – it is called *transgenerational epigenetic inheritance.* Epigenetics deals with how gene activity is regulated within a cell – which genes are switched on or off, which are dimmed and how and when all this happens.

The article discusses several old and many new, very heuristic examples of how epigenetics illustrate that Lamarck got it right.

For many scientists now, the evidence calls for a "radical rethink of how evolution works…that 'Lamarkian' mechanisms should now be integrated into evolutionary theory which should focus on mechanisms, rather than units, of inheritance…it would reintroduce **development**, in a very direct and strong sense, into heredity and hence evolution" [p31, my emphasis added].

But don't expect the old guard to lie down without a fight. But it's actually a pretty pathetic attempt at a fight–some examples:

- "epigenetic marks can also be viewed as part of that basic unit in a more inclusive definition of a gene". [NB the appeal to our better natures, -let's be generous here –

let's just widen the definition so that everything can fit into it and our theory can stand. As in ‘when is a gene not a gene?’ when it’s a bird, a plane, a mechanism?]

- “the transgenerational effects now being described are mildly interesting but they cast no doubt whatsoever on the theory of the selfish gene” [The old man is using the classic disparagement – ‘mildly interesting’ –what could be more boring? How could such a boring thing trouble an orthodoxy?]
- Dawkins was prepared to go so far as to suggest that the word ‘gene’ should be replaced with the word ‘replicator’. [i.e. he appears to believe that a change of name employing a change from a static noun to a verb-based noun will make the problem go away. But he can’t move away from nouns.]

But epigenetics is not going away any more than continental drift went away and the type of refutations raised by Dawkins cannot hold back the rising tide of evidence and publication. Another opinion piece (Elsdon-Baker, 2009) has queried ‘the Dawkins dogma’ through a review of the historical lineage of an open systems approach. Elsdon-Baker notes that Darwin himself was a “pluralist”, acknowledging the role played by the environment in affecting evolution and that many since have followed suit. “Increasing numbers of biologists find it hard to doubt the environment has a powerful impact on gene expression during an organism’s lifetime” (Elsdon-Baker, 2009, p24). Dawkin’s claim that only selfish genes or replicators are inherited and are essentially immortal has been shown by new research to be far too simple and limiting. The concept is inadequate to either explain recent data or support new lines of research. Once again, abstract universals and the closed systems science the philosophy generates have been shown to be holding back our knowledge rather than furthering it.

These epigenetic or Lamarkian phenomena continue to be discovered, some with serious repercussions for people. Such a one came to light in 2018 when a study of 28 men found that those who had difficult childhoods carry chemical clues to their past in their sperm which may be passed down to their sons (Yasinski, 2018).

It was already known that stress in mice could be handed down to their offspring and now it has been shown in people. Those who have experienced four or more well known stressors such as physical abuse are known to be more at risk from health problems such as heart disease and depression. The analysis of sperm from men who had experienced at least four stressors showed they had less of two certain micro RNAs in it. These are believed to play a crucial role in foetal development. It is a reminder that father as well as mothers play a significant role in the health of their children.

And there is evidence that fathers who have children later in life may pass on changes acquired from their environment in another stunning example of how poor old Lamarck may have been wrongly reviled. A study of 3000 grandparents, their children and grandchildren showed that the length of a child's telomeres correlates with the age at which its father and grandfather reproduced. Several studies have shown that sperm from older men have longer telomeres than average, contradicting accepted theory. If telomeres shorten with age, we would expect that these children should have shorter telomeres but they don't. The researchers hypothesized this was because an enzyme called telomerase which extends telomeres by adding DNA to them, is very active in the testes.

It all suggests that older fathers are adapting their children's DNA for an environment in which it may be possible to live a longer life (Wilson, 2019).

Arnold (2020a) relates a similar example from WWII when the Nazis cut off food and fuel supplies to the Netherlands. During this Hunger Winter adults were subsisting on 580 calories a day on average and children born after this experience were smaller with lower

birth rates than normal. Later in life, these people had higher than normal levels of obesity, diabetes and schizophrenia, *and so too did their children.*

Examples are found throughout the natural world (Arnold, 2020b). Epigenetic inheritance is more common than anyone expected and has great advantages. Environmental changes can be rapid and dramatic allowing for almost immediate adjustment whereas genetic mutations being random can take ages.

Genetics is tricky, just don't tell the mechanists!

The structure and function of the human genome

In 2012 the results of the study of the entire genome, begun 2003, were released. It is fair to say that almost nothing about it satisfied any of the hypotheses, theories or predictions. The way different cells work is vastly more complicated than thought and the whole thing is similarly more complex than anybody ever suspected. Geddes called her article 'Unfathomable' which is a good summary of the surprising findings and highlights just how inadequate our previous research approaches to the genome have been.

Taking just the switching function which some cells perform, the study found that individual switches interact with many genes. Moreover, most genes are being influence by numerous switches at the same time. Almost every gene studies physically touches multiples other pieces of DNA, up to 10, and each site in turn has RNAs on it, proteins on it, histones on it (p42).

Geddes suggests that this helps explain the "missing heritability" problem as while we know that there is a big genetic component to height or diabetes, the genetic variants found so far typically account for only a tiny percentage of this heritability. Some geneticists and biologists agree that the missing heritability is due to the complex interactions between multiple genes, multiple non-coding variants and multiple environmental factors.

Of course, the field of genetics has also been subjected to reductionism where the assumption was that genetic variants worked in isolation so their effects are additive. Obviously Ingber's work (1998) (in chapter 1) has not filtered through to genetics. If the researchers in this field had even contemplated for a moment that groups of multifunctional genes worked together at different times to perform different tasks required by changing conditions initiated either externally with the environment or internally, they would have asked radically different questions. Geneticists do recognize that there is a lot of redundancy in the genome but they don't realize that there are two types of redundancy and that the one they are faced with is redundancy of function rather than redundancy of parts. As we know that other cells and neurons work in structures governed by the second design principle (DP2), it would be a good bet that the genome is similarly structured.

A few years on and if anything the picture has become more complex. Singh reports (2021) that they have found three advances that doctors need educating about:

- Many combinations of genes can lead to the same disease, implying that there is a considerable amount of redundancy in the molecular structure of the organism (cf. Ingber).
- Genes do not work alone: gene-gene and gene-environmental interactions are a major part of any organism's functional biology. This explains for example, why only some women with breast cancer genes develop breast or ovarian cancer.
- Since males fight for mates and early reproduction, this would lead to an evolution of mutations that benefit males even at the cost of them being harmful later on, making them vulnerable to disease later in life. Mutations that benefit males but harm to females would trigger a female driven response leading to evolution of

increased female immunity and possibly evolution of higher thresholds for complex diseases and mental disorders – could explain e.g. why more males have autism.

It used to be thought that there would be one gene for one characteristic, a typical piece of mechanistic thinking, but nothing could be further from the truth. Genes account for just 1% of our DNA: the rest is so called junk. In toto we have only 20,000 genes – far too few for a one to one gene to feature equation (Brown, 2018).

The reality is far from mechanistic as discussed immediately above:

1. genes do different things depending on factors such as when and where they are expressed
2. different chunks of a gene can be encoded into different proteins
3. it is all regulated by non-gene DNA, RNA molecules and other proteins, further diluting a gene's autonomy in determining a protein
4. a single gene is comprised of segments of DNA, but one segment can contribute to more than one gene, meaning that genes can have overlapping boundaries (Brown, 2018), in other words, genes cooperate to produce an outcome.
5. and not all genes contribute to proteins, many simply code for a variety of RNA molecules, and as we have seen, epigenetics is complicating the picture even more.

As time goes on and we learn more about the complexity of our whole genetic system, it becomes even more clear that the underlying structure of the genome in its various environments is governed by DP2 where coordination and control leading to an outcome at any time is a shared function of the units involved – a long way from any possible conception of a DP1 model in any sort of mechanistic or deterministic system.

This hypothesis that genes are governed by DP2 is strengthened by work showing that gene activity is regulated by other genes to create a network of connections. Genes "are team players" (Douglas, 2020, p41). Gene networks work and learn just like networks of brain cells, combining and recombining in various ways to achieve inductive learning. This explains how entire ecosystems evolve to be well adapted despite natural selection favouring fit individuals, not fit communities (p41). Ecosystems can't be adapted by natural selection but they can be by natural induction.

"Maybe, evolution is less about outcompeting others and more to do with co-creating knowledge" Watson quoted in Douglas, (2020, p41).

Complicating evolution even further are

2. genetic drift (Barras, 2020c) where a gene may become dominant in a population simply by chance, and
3. horizontal gene transfer whereby genes are pinched from a neighbouring entity, or swapped, and some even snatch free floating DNA from the environment (Arnold, 2020c)

From mechanism to Darwinian evolution to today, we are starting to better understand the real complexities of life as it evolves, and it looks today as if life is quite happy to do pretty much as is required for adaptation and beyond. Certainly, there are several mechanisms involved in the dynamic processes we call evolution and as we have seen, some simply exploit whatever is going.

7. Neurophysiology

The Human Brain

“Your brain is like a pile of sand” (Robson, 2009, p34)? I don’t think so.

Your brain is also a constantly changing array of many dimensional ephemeral structures (Ananthaswamy, 2017). Again, I don't think so.

Years after Ingber's (1998) work on the tensegrity structure of cells, documented in the first chapter, and Edelman's work, similarly and clearly documenting how the brain works as a DP2 structure discussed in Emery M (1999), there seems to be still no diffusion of either of these bodies of research into the broader field of neuroscience research.

Using algebraic topology, the Blue Brain Project for example is attempting to simulate a brain inside a computer which seems like a terrible waste when the critical principles are already known. The multidimensional, mathematical temporary structures this project has so far observed are easily explained when researchers have an understanding of how DP2 structures work.

The impermeable blood-brain barrier isn't

For ages we have all been taught that the blood-brain barrier is impermeable making the brain one of the few parts of the human body that is not a fully open system. However, over the last few years, increasingly we have seen that there is communication across this barrier and while it appears to keep out all sorts of "unwanted interlopers", it is in constant dialogue with the immune system and even allows some foreign agents in. As we have learnt more about the brain's border control, we have also been forced to confront long held assumptions that the immune system and in particular molecules that promote inflammation are unwelcome in the brain. (Crow, 2017).

The normal blood-brain barrier rules don't apply at a structure called the choroid plexus. Here a different kind of cellular seal separates blood from brain – one which macrophages can cross, a process controlled by a cytokine called interferon gamma. As we age, the cytokine signalling here tends to weaken, reducing the number of macrophages that get into the brain. When mice are bred to have a condition equivalent to Alzheimer's, communication across this border was shut down completely. When researchers blocked the signals that suppress interferon gamma, there was a surge of macrophages crossing into the brain with a reduction in the number of amyloid plaques and improvements in symptoms. Human trials are underway.

The researchers then discovered another whole network of vessels directly linking the brain with the immune system via the lymphatic system. It appears that the brain really is not that different in this regard from the rest of the body. T-cells actually release the key cytokine interferon gamma which neurons require for normal learning behaviour. Moreover, the adaptive immune system's access to the brain might be involved in how we behave towards other people. Mice without proper immune cells are socially abnormal. All this has huge implications for human behaviour including autism and schizophrenia as it seems the immune systems is a normal part of healthy rain function.

As Crow says "this suggests a whole new approach" but neuroscience research today is still 90% oriented to neurons. All other cells are neglected. Considering that that most brain disorders are of neurovascular origin, we need to start targeting more than just neurons. OST

would say you start targeting whole open systems rather than just adding to a list of individual targets.

Methods and technologies

Our understanding of the brain and its connections to our experiential life has always been constrained by the methods used to investigate it. Long governed by various forms of reductionism, studying the cells or the synapses for example, methods have gradually become more systemic. We have never had a full picture or roadmap of the brain or its functioning but this is slowly being addressed by using more adventurous approaches. Williams (2017) has described how scientists are now using graph theory and more recently topology to obtain more systemic overviews.

Building on the knowledge that the brain is basically a network, topology has started to show that it may be the spaces or 'holes' between the clusters of neurons that are critical to functioning along with long loops or 'cycles' that link different areas of the brain. "The old view was that each brain area worked separately, without much crosstalk between them". This work suggests that they are connected by long loops (Williams, 2017, 31). This perspective better explains conditions like synaesthesia and could play a significant role in untangling depression and schizophrenia. "It is at least time we ditched our focus on pulling at its wires" and also started examining the holes (p31).

DP2 and coordination

A new technology has finally paid off with a major breakthrough in understanding brain function. Years ago I wrote *Are there universal principles governing architecture in the mechanical, biological and social realms? The evidence so far* (Chapter 1 herein). It built on the work of Ingber, (1998), Fuller (1975), Volk (1995) and many others, presenting the convergence of principles discovered in so many different disciplines and the genotypical design principles discovered by Fred Emery back in 1967.

Now Munn (2024), using advances in calcium imaging, has discovered a *universal principle* in brain function and yes indeed, it is a rule of DP2 functioning. Moreover, it is an amazingly precise quantitative one.

Munn recorded signals from tens of thousands of cells simultaneously. This allows researchers to watch neural, activity in real time by using fluorescent sensors that light up according to calcium levels in the cell. Previously, they could only record the activity of a few cells or of several millions, the middle ground was missing. It is precisely this middle ground which allow them to discern coordination, the more powerful of the two dimensions of organizational structure where the other one is control. His work is taking that of Edelman to a level of greater detail.

All the way through this article, Munn makes the comparison back to the human organization and so it is quite clear that there is only one principle involved, DP2 simply operates in both the neural and social structures. In describing how cells coordinate their activity, Munn says "it's a bit like being a worker in a high-performing business. Balancing individual skills with teamwork is key to success, but how do you achieve the balance?"

Simple! ***Devote no more than half (and no less than 40%) of each cell's effort to individual tasks. The rest goes to scalable teamwork.***

His claim of universality derives from the fact that in every species they tested, they found exactly the same organizational structure, from fruit flies, nematodes, zebrafish, mice and monkeys, chosen because they "come from different branches of the tree of life that are separated by more than billion years of evolution." This explains why the brain is "a marvel of efficiency, honed by thousands of years of evolution so it can adapt and thrive in a rapidly changing world". Munn is direct: his discovery offers "powerful lessons for any complex system today".

The researchers ran other tests revealing that there is a fractal coordination of neuron activity which produces unique advantages allowing the brain to operate efficiently, and adapt to change. It ensures the brain accomplishes tasks with minimal resources while staying resilient, maintaining function even when neurons misfire. The evolutionary persistence of this structure from vertebrates to invertebrates "hints that *we've uncovered a fundamental design principle".*

This resilience is something people in DP2 organizations notice all the time, it doesn't matter if one or two of your people are having a bad day, the show goes on exactly the same as others automatically collaborate to complete the group's tasks.

"The best businesses operate in the same way – when a challenge arises, individuals can react without waiting for instructions from their manager, allowing them to solve the problem while remaining supported by the organization". The brain balances individuality and teamwork as the cells collaborate to build increasingly larger networks.

Want to grow your business? Follow the basic rule – within your whole organization, ensure that it is structured such that the individuals in each self managing group can exercise their own expertise as well as cooperating to achieve the group goals. This means they must be structured on DP2 as no other structure can meet the requirement of no more than half and no less than 40% of each individual efforts to their individual tasks. Teams described as 'self managing' but having team leaders or coaches cannot achieve this as it is the team leader or coach who actually holds responsibility for coordination. The team may be expected to coordinate but the reality is that they act as individuals. Unless the group as group, holds responsibility for coordination and control, they are unable to properly or adequately coordinate. These so called self managing teams are still a con job as they were when Weisbord first proposed them as a substitute for the real thing.

The import of this new discovery, this new universal principle, reinforces what every OST practitioner understands well – coordination is as central to good organizational function as control, if not more so. The reason new ideas like Agile foundered was exactly because they put all the emphasis on individual autonomy and control, and neglected coordination. Obviously without adequate and reliable coordination, you don't have an organization, just a collection of individuals doing various tasks with varying degrees of cooperation depending more on whim and inclination than organizational requirement. Fly in, fly out coaches or various other varieties of quasi manager, can never substitute for the responsibility for coordination inherent in DP2 structures. That is why Agile, now with all its now variants and derivatives, has proven a disappointment to so many of its original enthusiasts, and still fails to reliably create the 6 criteria for productive work. Until these organizations move to fully DP2 structures, they will continue failing to meet their original objectives (Emery M, 2023).

There are some corollaries to this rule at the human level such as there should be no forced rotations of tasks around the group in the same way as there should be no specialized roles without the responsibility to coordinate. In the Buurtzorg model for example, in the self

managing groups, each individual practitioner is required to do administration on a roster regardless of skills, talents or inclination. This is an extremely wasteful approach to say nothing about industrial justice and general union rules about being paid for duties performed – the care teams are paid for their nursing skills and qualifications but not their administration. It has proven far better to have a couple of trained, skilled people doing administration with backs ups with required. Needless to say, they should get paid for the administrative skills they hold.

There are also large organizations at the moment where only the operational units are granted a degree of autonomy. The management levels retain their hierarchies and the individualism and individual functioning that goes with it. This is a travesty of DP2 in two ways: first, it is not a DP2 organization and conveys a message that hierarchies are still required for the higher status or more prestigious of the organization's people. Second, since hierarchies are inherently unstable, these management structures are putting the whole organization at risk as they do not contain adequate controls on the quality of decisions made about the business in general. As we have shown for years and years, there is no reason why the groups operating at the organizational level should not be self managing, and indeed, the organization blossoms when they are.

The universal finding in cells and their organization that individual function and group work are both required in roughly equal quantities echoes the age old wisdom which has been constantly rediscovered throughout history. It is simply that individuals only flourish when they are embedded in cohesive, supportive groups. It is a balance between autonomy and homonomy where mental health is "the capacity both for autonomous expansion and for homonomous integration" (Angyal, 1965, p254). We all need to be in harmony with units much larger than ourselves as only then can we grow and develop. This is colloquially knows it as 'no man is an island' which expresses the common knowledge that people experiencing aloneness or loneliness wither and die.

We currently have no measure of how much time self managing groups spend functioning as individuals or at group work because nobody has thought to measure them. At this level, I would expect that the ratios would vary from hour to hour or day to day as tasks and demands on the group vary. On top of this, in dangerous organizations when an emergency arise or when for example, a patient goes critical in intensive care, there will be periods when it appears there is a reversion to DP1 as the most experienced member of the group may be expected to issue instructions. As soon as the emergency is over, the group returns to its normal DP2 mode demonstrating that DP1 can temporarily exist within DP2. We can't speculate here in the absence of data so it would be useful if somebody in a DP2 organization could start systematically making those measures. I would not be at all surprised if over a reasonable period of time, the ratio of individual to group work may average out to roughly half and half, confirming once again the ubiquity of this newly discovered rule of DP2 functioning.

8. Social Science

Human Behaviour

In her review of the book *What's Next?* By Max Brockman, Amanda Geftner states "Throughout Brockman's collection, one idea crops up time and again: when we examine the human race, the whole is greater than the sum of the parts. We owe our evolutionary success to our unique modes of social behaviour" (Geftner, 2009, p45).

Various specializations such as anthropology and neuroscience converge to suggest that it wasn't intelligence that led to social behaviour, but social behaviour that paved the way for intelligence to evolve. The great innovation was not the prowess of the individual mind but the ability to harness that power across many individuals.

Now compare all that historically validated evidence with the newest and best that mainstream marketing and psychology can offer. Two articles in New Scientist of 22 August 2009 suggest ways in which people can be manipulated or tricked into doing their bit to combat climate change (Aldhous, 2009; van Vugt, 2009). For years marketers have been working on ways to persuade people to buy certain goods or services, vote for a particular political party or these days, just believe what an organization, individual or interest group wants you to believe. They have become exceptionally good at it.

I explored many of their tricks and devices in my PhD (Emery M, 1986) because the TV, digital medium, is their best friend. That role is now also shared by our mobile phones which have proven equally if not more compelling and addictive than the TV.

Individual vs individual-in-group

One of the craziest ideas going around which has probably found its most concerted support base in the USA is that we are individuals, heroes, strong in ourselves, looking out to conquer the world we see and dream about. The social science equivalent is that the basic unit of humanity and society is the individual, lone and complete in themselves.

Of course it is a total myth as has been known for ever by people through history who have actually observed the human condition. Nothing could be further from the truth. Reality and OST tell us that healthy people are immersed in socially cohesive and supportive groups and communities: the basic unit is the individual in community. The isolated individual is much more likely to be dissociated and mentally ill.

Now new data is accumulating as to just how serious loneliness can be, when people feel isolated although they may be surrounded by other people, that is when they feel they have no connections, even when not physically isolated. It is important to note here that the data shows that rather than alleviating the condition, "the use of social media to bridge the gap seems to compound the problem" (p32).

The researchers investigated whether social media use provoked loneliness or whether lonely people use social media more. Feeling bad does not lead to more Facebook use but the more you use Facebook, the worse you feel.

The more passive users evoked the worst feelings but they also found that the more 'friends' you have in your online life that you have never met in person, the higher the risk for emotional problems. Another of the findings was that it is the quality of the relationships rather than the quantity of them with the key criteria of quality being closeness. A core group

of about 5 close relationships appears to be consistent across all primates, including humans (p32).

The list of effects from feeling lonely is long and extensive including anxiety, depression and eating disorders, and in terms of destructiveness and risk of mortality, is equivalent to smoking, alcohol abuse, inactivity and obesity. Other serious effects include on the genes controlling the immune system where it can generate high levels of inflammation. This in turn leads to a range of other conditions and diseases including changes in the brain triggering behaviours that prime for threats. Lonely people can overestimate the threat in a situation and gradually become more and more suspicious. Twin studies have suggested a genetic component in the degree to which people strong social bonds but the environment obviously plays a major role.

Living in committed relationships is a foundation for a healthy life but American data showed that a rise in the uncommitted from 52% to 64% in the 10 years to 2014. That is going to make it harder going and likely to be a contributing factor to the general level of suspicion and hostility in evidence in the US population, making it easy prey for people like Trump. The researchers suggest that helping others become engaged, trying to make the world a better place, changing their personalities back to more wholesome is an oblique approach to the problem. To achieve this, however, is going to require a well established method such as the Search Conference if this approach is not to flounder on the pitfalls built into more individualistic methods that can easily fall foul of paranoia and latent hostility.

In the unremitting search for an alternative to our sick society as the vacuum created by ignorance of the design principles continues, we have a never ending parade of attempts to fill that vacuum. In the industrial sphere we have such examples as the Buurtzorg model, Teal and Agile, all of which are at best, half way houses and all ultimately fail over the long term as without understanding of the design principles, essentially people are continuing with the first principle, just trying to make it work or correct some of its most obvious failings.

The same applies in the social and health fields. An example comes in a rambling interview Clare Wilson (2020) conducted with Ruby Wax, a comedian who has suffered from depression. She has set up community groups who meet and chat, online since the advent of Covid-19. She has also searched the world looking for alternatives to our privatized, unhealthy societies discovering such things as intentional communities and community oriented transport options in Denmark, initiatives she calls 'green shoots' of a brighter future. One example the article mentions is a school with team teaching where they teach empathy and have various methods to relieve and reduce stress. But of course, there is no need for these schools to generate stress at all as if designed for learning in DP2 structures as I showed in *The Future of Schools* (2006), kids can be highly motivated to learn and find it fun, not stressful.

Her own designed groups are obviously attempts at DP2 structures as she describes them as having rules, not 'a free-for-all', 'melting pots of people' feeling empathy and 'being honest with each other', 'steadying each other'. However, they have facilitators who run the groups which have 'real structure' which is always American language for DP1.

One can conclude from all such examples, and the short life expectancy of so many of them, that while the desire to create a more productive and healthy life is stronger than ever, the absence of the design principles and the denial of them by some, is causing a tragic waste of time and resources.

A new large study, 11,235 kids aged 9-13, has confirmed that playing team sports affords protection against anxiety, depression, social withdrawal and problems with attention. It also found that kids who played individual sports were more likely to experience mental health problems. It also found that people who were "exposed to adverse childhood experiences reported better mental health as adults", if they had played team sports as children (Elder, 2022).

The researchers' expectation that children who played individual sports would experience better mental health than playing no sport were disappointed and of course, if one understands the design principles, that was to be expected. Individual sports pit a solitary individual against another with all the competition and negative dynamics associated with that. It is DP1 in action on the sports field.

In team sports, the element of competition is replaced by cooperation with all the other benefits of DP2 including particularly the mutual support and respect experienced in well functioning teams. Competition is present obviously as they are competitive sports but cooperation takes primacy if the team is to win.

Once again, we see that the choice of design principle has serious effects on individual health in a series of demonstrations from the birth of sociotechnical systems (Trist & Bamforth, 1951) to Australian industry (deGuerre et al, 2008).

Lost Abilities

Berdik (2009) has reviewed the apparently poor ability of humans to navigate in space. Neuroscience has confirmed that people have specialized neurons dedicated to sense of direction, similar to those found in the hippocampus of rats, mice, monkeys and goldfish. Countless species are expert at keeping track of where they are and returning home. There also appears to be a genetic component but this cannot explain why the great majority of people get lost so easily and have so little sense of direction.

Berdik speculates that we may have lost this ability at some point in our evolution but as we see below, people from the old cultures who know their land still have the ability. People who “live closest to the land such as the Bedouin in the Sahara, Arctic Inuit and Australian Aborigines show that reasoning and experience can be very useful for finding your way. Such people can navigate perfectly well using subtle, learned directional cues from the landscape, even in what looks like the most barren expanse of snow or desert” (Berdik, 2009, p32-33).

However, this connection to the landscape is easily lost. Young Inuit hunters who have been using GPS “have found themselves hopelessly lost for days when the technology fails, leading to several fatal and near fatal incidents…This was unheard of among the elders – until recently, the Inuit didn’t even have a term for lost” (Berdik, 2009, p33). In the past it was just a matter of time before the weather cleared or they recognized a feature and could find their way.

The complex skills involved in having a sense of direction and navigating which include memory of surroundings, sensing speed and changes in direction over time are obviously rooted in direct perception, first hand knowledge of the physical environment. This is the bedrock upon which the further detailed skills, awarenesses and judgements can develop.

Here we see yet another example of how a basic human ability, essential for survival or at least for effective movement, has been destroyed by another technology that claims to make live easier and safer, make us smarter and generally improve our lives. GPS has not made the

lives of Inuit hunters safer but more dangerous. Technology is not always just an extension of a human characteristic or ability, it can be a replacement.

Having an intimate knowledge and understanding of our environments is vital to many aspects of life. The more we substitute technology for the environment and thus second hand or virtual or abstract knowledge for direct extracted, first hand knowledge of the environment, the more we lose in terms of fundamental capabilities. As we have seen with the effects of television, computers and the CRT, we diminish ourselves in many ways. So now we see with the simple, seemingly useful GPS device that yet again, we are further diminished.

Mechanism and reductionism fail again

"Genetics and neuroscience have revealed the depths of our radical ignorance about what it means to be human. We need something else" (LeFanu, 2009, p45). LeFanu is a general practitioner and has reviewed progress in the fields of genetics and neuroscience. Far from resolving "the fundamental questions of 'being human", the results so far seem "perplexing" and "quite contrary" to those anticipated.

While LeFanu sees these fields and their discoveries as posing "the most searching challenge to prevailing theories of how things are", the major research institutions maintain direction, sure that "the ever accelerating juggernaut of data" might somehow release some understanding. In other words, the prevailing theories, and the methods used to test them, have become orthodoxies and beyond criticism even as they continue to fail to answer the questions they were designed to answer.

Genetics was supposed to tell us who we really are and reveal the source of the diversity of form and attributes that so readily distinguish the species. However, our genome is virtually indistinguishable from mice and chimps. But the assumptions die hard. While LeFanu recognizes that "the source of the near infinite variety of forms of life now seems more elusive than ever," he concludes that "the genetic instructions [to distinguish mice and humans] must be there of course, condensed within the simple elegant spirals of the double helix."

The same picture emerges with the neurosciences which were supposed to clarify the physical basis of the human mind and its activities such as thinking and memorizing. Again we see how difficult it is for people to put away their assumptions and beliefs. The example LeFanu uses is as follows: "The simplest of mental tasks (linking the noun 'chair' with the verb 'sit'), it merges, activates the brain virtually in its entirety, while the sights and sounds of every transient moment are fragmented into a myriad of different components – *with no compensatory mechanism to reintegrated them back* into my single coherent stream of conscious awareness" (my emphasis added).

The belief in this case is the need for DP1. LeFanu cannot conceive of the brain being a DP2 system where the parts coordinate themselves: he needs to see a part or mechanism that coordinates the other parts. It is this need that seems to propel his overall suggestion of a "hypothetical entity that might conjure the elusive richness of 'form' and 'mind' from the bare bones of the genes and brain respectively."

These examples illuminate the multiple problems with attempting to do science through abstract universals. We have the division of science into narrower and narrower specializations all of which manage to lose the whole human being and certainly the human mind. Once again we see that reductionism has failed to deliver on its promises and once

again, we have the suggestion that we must postulate some additional entity in order to make progress. We also see the assumption of mechanism, that human beings and our brains must work like a machine.

This latter assumption is quite strange – why should a human being or any of its parts work like a machine? On the face of it, human behaviour is so un-machine like that it would be most improbable that we should work like a machine. But our dominant form of organizational structure has so influenced our beliefs that many assume DP1 is the only model.

Another area in which abstract universals have led us astray is the whole field of taxonomy – what is a species? Historically, the mechanists have had us believe that there are a finite numbers of distinct life forms each existing in a "clearly defined pigeon hole" (Barras, 2020b).

But the rapidly unfolding and exploding fields of genetics and epigenetics have blown this mechanistic myth to smithereens. The whole notion of evolution means that species change and blur into one another over time, creating "a problem with the machinery in our heads we use for classifying" (Barras, 2020b). But it is not only evolution, species break the rules by breeding with closely related other species when they are not supposed to, and apparently it is quite common as our own species interbred with other hominins extant at the same time.

'Doing science' by labelling things rather than by describing what they do, their primary functions have proven to be a battle ground of conflicting taxonomies, 'taxonomic anarchy' and the graveyard of 'species'.

Solving the ultra processed food puzzle

For some time now the hunt has been on for the reason the stuff that is called 'ultra processed food' (UPF) doesn't appear to be nutritious. In fact it appears quite bad for us and apart from other problems, is contributing significantly to the obesity epidemic.

UPFs are ubiquitous and form a large part of some people's diets, unfortunately most likely those who are less well off and already at risk of health problems. They are often quick to prepare, easy and cheap. Needless to say as they are industrially designed to appeal, they are delicious. Previous studies have shown it wasn't the fat, the salt, the sugar, the lack of fibre or anything in particular that was causing the problems. Researchers just couldn't isolate the factor or factors that *were* causing them. ***Turns out it could be an open systems problem!***

Nutritional psychiatry is a new specialty dealing with the role of diet in brain and mental health. It has shown for example that the brains of those who indulge in UPF have a smaller hippocampus and reduced cognitive functioning**.** They have also shown connections between mothers eating UPFs and neurodevelopmental disorders in their children (Bains, 2023).

The most recent studies suggest that when nutrients such as vitamins, minerals or proteins are added to UPFs to bring them up to nutritional scratch, the body does not recognize them. It does not, therefore, process them as it would when they are present in whole foods. Therefore, UPF for all its credentials as containing all the components necessary for nutritious food, is leaving us essentially hungry so the body tells us to eat more. So even when we are overweight, we may be malnourished.

It looks as if our brains only recognize these components when they are in their correct, normal ***context,*** as part of real natural food. When they are isolated and re-entered into a new

chemical mixture, we ignore them with all the consequences we see in epidemiological studies of nutritional deficit.

The researchers say more studies are required to confirm these findings but they are more than a little suggestive and can solve what is now a long standing and urgent problem. Could be that industrialized food is a failure.

Free will

And again, it has been shown that the seemingly endless debate about whether we actually have 'free will' revolves around two opposing versions of how to approach the subject. Many believe that repeated demonstrations, using technologies such as MRI scans, that our brains show signs of a decision before we become consciously aware of it prove that we do not have free will.

Tom Stafford, a cognitive scientist who studies decision making argues the so called lack of free will is an artefact of mechanism and its corollary, one to one cause and effect, A causes B. In reality Stafford says, "it is always a set of things happening (or not happening) that causes another set of things to happen (or not happen) (Stafford, 2019, p35).

Everything from our genetics, to our history, brains and the environment we are in all contribute to a decision but the influence of those factors does not diminish the fact of free will. At every moment this complex mixture is unique to you making human behaviour difficult to predict. Once again we see that the choice of world hypothesis, in this case mechanism vs contextualism, lies at the very heart of this disagreement about a basic human behaviour.

In addition I would argue that separating your brain from the person, the self is a very crude act, again born of mechanism - your brain ***is*** you.

Specialization: the road to the loss of the human being

In the issue of 18 November, 2006 New Scientist explored ‘the biggest breakthroughs in the next 50 years’. I discovered that Robert May believes we have made little progress in understanding cooperative behaviour since Darwin recognized its importance [p49].

However, competitive and cooperative behaviours have been shown to be primarily the consequences of organizational structures where the structures are given by the first and second genotypical, organizational design principles respectively. These two principles underlie all forms of organization from the structure of representative and participative democracies to temporary structures such as conferences.

The design principles were discovered by Fred Emery during the Norwegian Industrial Democracy program, published first in *Human Relations* in 1967, reprinted in 1997. Since that time they have spawned much research. This research has found that these design principles are extremely powerful with effects on many other aspects of human behaviour including motivation, communication and creativity. We are currently researching their effects on mental health.

We have also developed an efficient and effective method for changing structures from the first to the second design principle called the Participative Design Workshop (Emery & Emery, 1974). It works well in all countries and cultures tried so far. With a change of design principle, organizations experience increased performance and productivity in all areas.

The design principles have also been shown to apply to animal organization and behaviour and have their equivalents in Ingber's work on cell architecture and function, see chapter 1 on architecture. It is possible as Fuller and Ingber have speculated that there are a small number of simple principles governing architecture and function (structure and behaviour) across the biological, mechanical and social realms that we usually see as separate and distinct.

While there is much more to do in this field, particularly in overcoming some entrenched beliefs about 'human nature', understanding the genotypical design principles represent a major advance from Darwin's knowledge and a hope for the future where cooperation may be more vital than ever before.

Why would May be unaware of this body of work? Because he specializes in *Cooperation Theory* which has a certain set of instruments and methods such as game theory, deduction, simulation etc. It can be highly mathematical as in 'deterministic chaos'. Social science like its physical and biological cousins has also become split into a mass of little fragments such as this which have long lost track of the fact that they are part f a body of knowledge about human behaviour. The little fragments have also long lost any intention of communicating and learning from each other. Specialization has become the road to fame and fortune – and loss of relevant, meaningful knowledge about people.

Morals and expectations of support and cooperation

Babies as young as 4 months have been shown to expect adults to comfort and help crying babies. This suggests moral behaviour is innate rather than learnt and if it isn't innate, it is clear that human babies arrive prepared to very quickly acquire a moral sense and expectations of cooperation (Ananthaswamy, 2018). It is yet more evidence that we are intrinsically social or group creatures reliant on each other, where cooperation is a species characteristic rather than a feature appearing in a few isolated individuals.

Ecological learning

A science built on abstract universals takes a more analytic form than a science built on material universals which leans more towards synthesis. Like linear logic, the consequences are often unfortunate, leading to wrong answers or non-existent puzzles. Several examples are given below.

One of the most unfortunate results of the mechanistic theory of learning is the current education system which treats children as machines. It is built on the assumption that people are born tabula rasas, empty slates on which knowledge must be written. Behind this assumption lies another; that information enters the brain through discrete pieces of sensory apparatus such as eyes and ears. Once in the brain, these fragmented and inadequate pieces of sensory information must be somehow associated in order for us to gain meaningful knowledge about the world. But our knowledge always remains inadequate. Clearly in order to bring it up to scratch, we must receive transmissions of additional information from the great warehouses of knowledge we have accumulated over the ages. In other words, we must be taught.

Most of the knowledge stored in our warehouses is abstract knowledge, knowledge which has been abstracted from the real concrete world around us. Schools teach abstract knowledge.

The theory of ecological learning stands in direct contrast to the sensory theory above. It states that the world consists of a field of information from which we, as a species adapted to live on this planet, can immediately and directly extract. What we extract are invariants, pieces of meaningful knowledge about the world and how it works. They are invariants because they do not vary regardless of where and when they are observed. All this and more has been spelt out by Fred Emery in *Educational Paradigms*, 1980.

In 1999 I devoted many pages to a detailed exploration of ecological learning including a section on 'babies as ecological learners'. The following is an extract:

> "Experiments by Meltzoff & Moore have demonstrated the "infant's very early capacity for...'intermodal perception' -to combine the brain's perception of two activities" (Friedrich as above: 55). In addition, using infants six to eight months old, Starkey et al (1983: 181) showed they could extract information about number across two very different kinds of display, or perceptual modes. They in fact had to disregard the modality, visual or auditory, in order to detect invariance In other words, meaning is extracted by a **single, organized, perceptual system.** People are perceptual systems" Emery M, 1999, 59-60).

Now we have another example which causes difficulties for our kids as they try to learn mathematics.

"Fractions tend to be taught as ratios of whole numbers, but Neider [the researcher] says this may not tap our neural machinery in the most constructive way, making fractions harder to grasp than they need to be" (New Scientist, 2009b, 15). It seems we respond to fractions directly, without processing whole numbers along the way. Specific groups of neurons respond to different whole numbers and it has now been discovered that we also have fraction-specific neurons. In an experiment that compared responses to fractions either as a numerical ratio or expressed in words, it was found that people did not calculate from the ratio but reacted to the fraction itself.

This confirms once again that people practice ecological learning, the ability to directly extract meaningful knowledge from their environment, without mediation or in other words, without being taught (Emery F, 1980). This experiment demonstrates again that people learn from meaningful wholes and do not have to analyze in order to obtain knowledge. Kids could be introduced to fractions "more intuitively", facilitating their understanding of their world without putting the obstacle of unnecessary analysis in their way. We are adapted to our world including the mathematical dimension of it. Let us take mechanism right out of our understanding of how people and the world work.

But unfortunately, the mechanistic notion that we have separate sense organs that deliver separate sensory information has become so ubiquitous and deep seated that even when evidence shows that a person receives meaningful information about the world from a unitary perceptual system, the evidence is written up in such a way as to preserve the old mechanistic theory. A classic example of this is provided in a book and a review of it: Rosenblum, Lawrence D. 2010. *See what I'm saying: the extraordinary powers of our five senses.* NY. W. W. Norton & Co. Review by Cytowic, 2010.

Here are some quotes from the preface to the book:

> "Brain regions once thought dedicated to particular perceptual functions have the potential to rededicate themselves to different functions both within and across the senses". "Areas of your brain once assumed to be dedicated to a single sense actually help out with multiple senses".

> "In some ways the brain doesn't much care which sense organ provides information. This fact is even true of the supposed 'visual' and 'auditory' brain centers that, we now know, incorporate multisensory input…many of our implicit perceptual skills involve sensitivity and reactivity to *human* actions. Extraordinary sensitivity to what others are *doing* is consistent with evidence for brain cells that have the dual role of *recognizing* and *producing* an action". "You perceive the world in terms of what you can do with it".

What actions you can take in the world are known as affordances, the possibilities that the world affords to you (Gibson, 1967).

Rosenblum discusses "entire perceptual skills" and "*implicit perpetual abilities*" that occur unconsciously, and he describes his work as an "ecological approach".

Throughout these quotes it is clear that there is *a perceptual* system designed to extract, and act on, meaningful knowledge about the world, particularly those aspects of it that involve other people. The individual senses are barely relevant. Why then does he call it a book about the five senses?

The review also includes such statements as "it shows how the scope of everyone's perception is greater than we think, thanks to the ways that senses reinforce one another, giving us *a unified picture of everyday reality* taken from multiple perspectives" (emphasis added).

Again in the final paragraph, the reviewer states: "*See what I'm Saying* demonstrates that the five senses do ***not travel along separate channels***, but interact to a degree few scientists would have believed only a decade ago" (Emphasis added).

This book and its review merely adds to accumulated knowledge that a person is a mobile perceptual system inherently adapted to our world to directly extract meaningful knowledge about it regardless of whether all our sensory apparatuses are working or not. But neither the author nor the reviewer can escape their mechanistic assumptions.

As Starkey et al showed above, attempting to work from the senses one by one inhibited understanding of how children learn. "Perception is…not reducible to sensations" (Gibson, 1966, 237). Rosenblum and Cytowic have also inhibited their own learning and that of others by attempting to explain our remarkable perceptual system by reverting to the reductionism of a sensory analysis.

Additional evidence of a unitary perceptual system comes from a group at Duke university who showed that our eardrums coordinate with our eyes to shift our hearing in the direction we are looking (New Scientist, 2017).

Yet another problem with the old mechanistic theory of learning has now been observed with kids with ADHD. These children were found to be more likely to succeed in cognitive tasks when they fidget (New Scientists, 2015c). Other researchers have found a link between ADHD fidgeting and improved working memory. The conclusion was that top priority should be given to helping kids finish tasks rather than sitting still.

Of course, as many observant teachers can tell you, even 'normal' kids move around and make more noise when they are learning. Learning is exciting and when kids are immersed in some learning and discovery, they show it in their whole bodies. The last thing you would ever want to do is tell them to sit up straight and be quiet.

Exceeding our capacity

Along with ignoring ecological perception is another whole set of problems caused by ignoring the results of our machines, specifically our communications technology. The problem was first isolated in 1975 when the signal from a functioning TV set was shown to exceed our adaptive capacities by both its speed and its use of radiant rather reflected light. We lack the ability to extract meaningful information from radiant light.

My PhD thesis entitled *The Social and Neurophysiological Effects of Television and their Implications for Marketing Practice* has a whole section devoted to the effects of television on learning and education or rather, the non effects. Part II including Chapter 7 documents in detail the failure of television to inform or educate, children and adults, despite the desperate efforts of many to sell it as the answer to all our educational problems. It actually created more than it solved.

Over time, knowledge of the woeful results of ETV faded while the hype lived on. Today, most people would believe that their kids need computers for their education and they are certainly ubiquitous.

However, the reality is as it was before 1986: "growing evidence suggests that computer technology in schools is of no educational benefit" (Spitzer, 2015). Again, vested interests are spruiking the opposite: "the IT industry and educational policy makers repeatedly assert that computers are good for learning" while numerous studies have failed to identify any positive impact and have found negative effects. The latest study by OECD showed that educational systems investing the most in IT saw no appreciable improvements in exam results used in international comparisons (PISA). Worse than that, results of 250,000 PISA students showed that they performed worse at school if they had a computer in their bedroom. This cannot be put down to lack of sleep as the original analysis by Emery & Emery (1976) showed that the deleterious effects increase with time spent in front of the screens.

In Israel, performance declined in elementary and middle schools with computers and in Romania, poorer children whose families received money to buy computers performed worse at school than children with no computers. And on it goes: other studies showed that laptops in classrooms are linked to poorer performance in tests and assignments. They also do not close the achievement gap between socioeconomic groups.

Similarly, US researchers have concluded that taking notes by hand during a lecture leads to better learning than typing them straight into a laptop. Moreover, most students are engaged in distracting activities found on the technology such as the internet.

"Digital media pose serious risks and side effects in educational settings, causing marked levels of internet addiction, insomnia and inattention, especially when used for non-course-related activities. They also take time away from more valuable learning processes" (Spitzer, p29).

So why all this? Spitzer must be given credit for avoiding the ignorant explanations blaming some aspect of the content which normally accompany articles like this despite the fact that they were well and truly debunked during the 1970s and 1980s. Instead he goes immediately to the processing problem which is at the heart of the crisis with the screens. Arguing from experimental psychology and neuroscience, he writes "the deeper content is processed mentally, the better the learning. IT seems to result in shallower processing. A study in *Science* showed that online information is less likely to be encoded in memory than that obtained from books or journals" (Spitzer, p29).

The results from all the studies documented in my thesis (Chapter 11), none of which have even been refuted, on top of the wealth of material in the 1976 study, demonstrated that these screens have a neurophysiological effect called cortical slowing – they ***reverse*** the normal pattern of brain wave activity seen when viewing the world around us or a book, which is a *majority of fast wave and a minority of slow waves*.

This means the information carried in the light to the viewer is not being processed as normal, plus it has a series of flow on effects. For a full range of these effects such as addiction, hyperactivity, reduced attention spans which are constantly reported, see the relevant chapters in *A Choice of Futures* (1976).

In 1986, there was no resolution to the question of whether it was the signal from the Cathode Ray Tube behind the TV or the fact that the screens emit radiant light. These days it is questionable if it even matters if it is one or the other or both. As the signals from modern screens are different to that from the CRT, radiant light to which we have no adaptation is certain to be a major factor. Testing could determine if the signals from various screens exceed our capacity to process but more important is simply to once again ***raise awareness that it is these screens that are causing the multiple problems – and then get this problem fixed.***

It really is time that researchers gave up the all but useless pursuit of trying to blame the content of the programming, for example or the social media, or whatever, for all the deficits when it has been shown time after time that is it is the medium, the technology itself, that is the culprit. Until this basic research from nearly 40 years ago is taken seriously, we are going to continue to hold our people back and do untold damage to the brains of our kids.

The evidence never stops rolling in. A new report from France (Willsher, 2025) documents the fact that our screens, whether they be TV, tablets or smartphones are hindering and altering brain development, causing permanent damage. The experts from the societies of paediatrics, public health, ophthalmology, child and adolescent psychiatry, and health and environment, wrote an open letter calling for an 'urgent rethink' of public policies to protect future generations. "Screens in whatever form do not meet children's needs. Worse, they hinder and alter brain development" causing "a lasting alteration to their health and their intellectual capacities."

They observe that every day, health professionals and infant school teachers see the damage caused by regular exposure to screens before children enter elementary school: "delayed language, attention deficit, memory problems and motor agitation." There are exactly the problems that Emery & Emery predicted in 1976 as above.

But these experts do not stop there, they report that exposure to screens, no matter how brief also has a negative effect on children's social and emotional development which affects all social groups but especially the disadvantaged, leading to greater social inequalities. Their recommendation was that children under 6 years of age should not be exposed to screens. They list activities which can be substituted for screen time which is the old range of activities for kids before we were hit with this technology.

Problems caused by not knowing about the design principles

- **Self interest and environmental destruction**

In a classic example of just how badly we can misunderstand ourselves, van Vugt and Griskevicius (2012) have given us a double bunger: not only do they assume self interest is innate, an instinct, they also get their description of, or assumptions about our hunter gatherer societies totally upside down.

Anybody who understands the design principles (see chapter 1) knows that behaviours such as self interest and short-termism are determined by the person living or working in organizational structures designed on the first design principle (DP1). Not everybody exhibits

these behaviours which should have been enough on its own to convince the authors that they are not innate, nevertheless, these behaviours are easily reversed by placing the same person in a structure designed in the second principle (DP2). In this second structure, the person exhibits cooperation and care for the goals of the group, the common good.

van Vugt & Griskevicius group self interest and short termism with relative status, social imitation and ability to ignore novel threats, all of which are well known features of life in bureaucracies. Their prominence also disappears when structures are redesigned on the basis of DP2.

As if this put down of our instincts wasn't bad enough, they assume our ancestors all showed the same behaviours, i.e. lived in a world governed by DP1 despite the fact that these cultures, common around the ancient, world lasted for thousands of years in peace and harmony with their environment (Graeber & Wengrow, 2021) - until they were invaded and almost destroyed by our aggressive hierarchical cultures, those with a shocking record of environment disregard and destruction. It is ironic that this very serious mistake appears in an article purporting to help turn us 'green'.

The accumulating evidence shows that contrary to most of today's societies, these ancient cultures were governed by DP2 with their most prominent features being their respect for all life and cooperation with it and the laws of nature (Emery M, 2020). It was those characteristics that permitted their flourishing over such long periods of time and their ability to survive catastrophic change over the millennia.

Such ignorant and misleading views are only going to be corrected when the design principles become common knowledge so we may attain a more accurate and useful picture of ourselves and our species.

Let us look at another aspect of this ignorance. There has been much debate since the publication of *The Spirit Level* (Wilkinson & Pickett, 2009) as to whether there is a genuinely causal link between income inequality and a range of social and health afflictions. As part answer to this question, there has been speculation that the problems may be caused by anxiety about status, derived from the competition people are forced into by way of the inequality (Joseph Rowntree Foundation, 2014).

This whole rolling discussion just happens to ignore the fact that we all live and work in organizational structures which are inherently unequal as the whole notion of DP1 is that people are ranked in status which inevitably leads to competition with all its well established deleterious effects on human health and well being. Income inequality is a side effect of this fundamental status inequality and so does little more than exacerbate these already serious and widespread effects on the individual and society.

To provide another striking example of how ignorance of the design principles can affect our understanding of ourselves along comes McCarthy-Jones, 2021. As any student of OST, and particularly the design principles can tell you, spiteful behaviour is simply one of a clutch of negative emotions that flow from being immersed in a DP2 structure. All these negative affects play out in various ways as people either fight to gain or maintain position in the dominant hierarchy, fighting to win, or just survive, spite can be used as payback for an attack or a perceived slight. Sometimes it seems pointless but is being used as a reminder that one is above or more powerful than one below on the slippery pole.

Yet here we have a psychologist airing a range of theories about spite and what explains it and why we indulge in it. Apparently the major theory has been that spite evolved to make unfair people behave better, behave more cooperatively. However, "cracks have appeared" in

this theory (p41). Spite doesn't seem to work as a way of persuading others to treat you better. No, of course it doesn't!

All these theories apparently are derived from various game playing methodologies as if there was no real world experience to learn from. Amongst the far from the world shattering insights aired is that "It is clear that the human desire for dominance has deep evolutionary roots, but so, it appears, does our counter-dominant drive. Anthropologists argue that our hunter-gatherer ancestors evolved an egalitarian instinct to pull others down when they threatened to pull ahead" (p41). Well, well!

Yes, we are perfectly capable of being spiteful as well as a plethora of positively oriented behaviours but these behaviours are tied to the organizational realities in our lives. Some small clue about this is provided in a mention of a study which found that 'spiteful people' may experience poor mental health and social inequality (p42). And yes, DP1 structures are a determinant of poor mental health (deGuerre et al, 2008).

Other researchers have gotten closer to the mark perceiving that being spiteful is less about restoring cooperation and more about retaliation, coercing individuals into submission or inflicting harm and gaining status (p42). Then there is also the "uncomfortable finding" that being spiteful can be pleasurable, particularly when we find ourselves in a highly competitive environment. I imagine they would be extremely uncomfortable if they realized how just closely spite is tied to the everyday structures we live and work in.

To illustrate just how confused and useless this whole area of research has become, McCarthy-Jones argues that rather than trying to avoid spite we could use it better, employing it as a tool to improve society. "Spite, done with the aim of wrathful compassion, could prove to be a force for good" (p43).

Overall, these multiple efforts to explain spite are a tremendous waste of time and energy.

Our adoption of the first design principle (DP1) was a wholehearted one as we adopted it not only for our dealings with each other but unfortunately as the basis for our relation to the natural world. It shows up dramatically in a global study rating each of 151 country's sustainability by totting up how it used, produced or affected seven things. These were "water, phosphorous, nitrogen, carbon dioxide emissions, land-use change, ecological footprint and material consumption. The team also used 11 measures to assess whether citizens had good lives. Some were basic needs or expectations like nutrition, sanitation, access to energy and long life expectancy. The others reflected social stability, income, education, equality, social support, employment prospects, quality of democracy and overall life satisfaction" (Coghlan, 2018).

If a country was using DP2 for its relationships, we would expect that following the laws of nature and cooperation would ensure that the country was achieving a reasonable standard of sustainability and well being. Not one country achieved "the Goldilocks feat of doing it just right: creating a good life for its inhabitants without overusing natural resources" (Coghlan as above).

The worst plunderers of nature were the rich countries like the USA and Australia while poorer countries such as Vietnam overuse fewer resources but fail to provide adequately for their citizens. When it comes to life satisfaction, important measures such as good health, strong family and community relationships all depend more on the design principle than outright financial wealth. Many forms of improvement on the scales could be achieved while moving to reduce material wealth in the richest nations. The study recommends scrapping measures such as GDP in favour of measures of things that actually matter to people like "health, happiness, employment and equality".

- **Tribalism**

In what appears to be a large study, Whitehouse (2024) builds a whole case around 'tribalism', "one of our most powerful evolved psychological biases" (p37) without ever attempting to definite it. As such, it is one of those foibles of modern work in the social sciences that just assume that so much of our behaviour can be put down to human nature. The reality of course as every anthropologist should know, and Whitehouse is an anthropologist, is that human behaviour is so diverse and flexible that very little can actually be put down to an invariable human nature. Additionally, those characteristics which can be so ascribed are not at all the sorts of things people normally attend to.

Tribalism is blamed for many things: for example, the expansion over the last 10,000 years whereby people have gone from living in small groups of familiars to nations of strangers numbering millions. It has also been responsible for "some of the cruelest acts in human history" (as well as motivating) "tremendous feats of cooperation" (p37). This leads Whitehouse to propose that what we need now is a global tribe of billions, and of course, he can help achieve it.

Whitehouse also follows the linear theory of social evolution from hunting gathering to agriculture which evolved into larger political structures into today's huge nation states. "Today out tribal instincts are the basis of nation states – but they tend not to extend to the feeling that we belong to a single tribe of humanity" (p37). This theory has been comprehensively and conclusively debunked by Graeber & Wengrow (2021). They have documented in massive detail the various ways in which people consciously decided to live their lives, choosing one or other of the principles right through the span of history until today. There was no linear social evolution.

Apart from the assumption about human nature, I take exception to 'tribalism' used this way as its very use makes other (usually) hidden assumptions about the behaviour of our old, and present, hunting and gathering cultures with their tribes. As the quote above shows, tribalism is used to explain conflicts and aggressive behaviour with the assumption that the hunting gathering culture was an aggressive or warlike one. The exact opposite is true. The ancient cultures were predominantly peaceful and nurturing, of the land, its people and all species –they were cultures which lived in harmony with the planet.

What Whitehouse throws together as tribalism is actually none other than the old concepts of in group and out group as has been used in social psychology for generations. He claims the sense of oneness with the group is called "identity fusion" (p37) which is obviously a trendy new name for the same idea.

And what none of this confused grab bag of tribalism comes even close to is knowledge of the design principles. Different cultures have used one or other of the principles through history with most of the ancient cultures using the second principle (DP2) which produces cooperation while today's predominantly white Western cultures are governed by the first which produces competition, and ultimately violence.

If Whitehouse understood the design principles, he would never have been able to write the following: "Tribalism, the psychological bias that enabled our ancestors to stand united in small warrior groups and hunting parties, has been harnessed to foment interstate conflicts and forms of modern warfare capable of engulfing the entire planet" (p37).

Similarly, he makes much of the case of people identifying with Cecil the lion who was shot by trophy hunters, claiming it as a case of identity fusion based on shared suffering. He writes: "This was the first time anyone had shown that people can bond in this way with an entirely different species" (p38). Of course, that is nonsense as people from cultures governed by DP2 frequently have totem animals. It also ignores the fact that many people from diverse cultures regularly fall in love with animals and treat them as family or equals. The case of Cecil was a good example of our fundamental or default nature as social creatures, a probably subconscious awareness that we are actually part of the ecosystem, not above it. At heart, we are all bound by DP2.

As an example of just how confused all this really is, we have "Although some forms of tribalism entail a competitive attitude towards other groups, competition isn't required to achieve identity fusion. This suggests it is possible to be fused with all other humans – potentially even all forms of life – without feelings of rivalry, fear or hatred towards out-groups" (p38).

Whitehouse and his team are hot on the track of how to create this fusion to solve the world's problems and the wonder if it could heal divisions between rival or conflicted groups. What a terrible waste of energy when it is so easy to create DP2 structures in which people can come together in peace and cooperation to do whatever they want or need to. Not only do we have an efficient method to redesign DP1 organizational structures, we also have the Search Conference which has a proven record of successful rationalization of conflict for conflicted groups plus Unique Designs for other forms such as problem solving.

Contrary to Whitehouse's contention, it has nothing to do with maturing into a 'global tribe' and everything to do with learning about the design principles and their applications.

Real tribalism features cooperation

When a Maasai herder runs into trouble, they know what to do – they ask for help. And guess what? They get it, from a tradition called *osotua* (Homes, 2o16, p26). Osotua literally means umbilical cord, anyone in need can request aid from their network of friends.

There is no expectation of reciprocity which runs contrary to our Western view of cooperation which is much more utilitarian. But such forms of generosity are quite common around the world, just not for us. Some anthropologists think it is one of the earliest forms of generosity in human society and sources such as *The Beginning of Everything* leave little doubt about this.

However, even in our often nasty mean Western cultures, it is possible to generate such supportive networks as American cattle ranchers are one of the examples researchers found of this type of generosity. This marks the example of osotua out as a case of humans turning to DP2 when the going gets rough. There is much discussion of the reasoning behind this form of cooperation as many researchers insist there must be some 'rational' reason for it. Consequently, the article calls it 'needs based giving' as you never know when catastrophe may also strike you, requiring help from others.

Why can't we just admit however, that the major variable determining generosity as well as a host of other behaviours is simply the design principle, and on top of that, an explanation which is never put forward is just it is its own reward. All such supportive and related behaviours generate positive affect and enhance the wellbeing of the supporter and giver. Giving is a life affirming behaviour.

Ridding us of patriarchy

All the evidence points to the fact that no one benefits from patriarchy and yet we can't seem to get rid of it. Over and over Ananthaswamy & Douglas (2018) come close to identifying the hidden factor maintaining patriarchy but it evades them because they are not aware of the design principles that lie behind the symptoms that regularly pop up in discussions of this topic. The closest they come is to identifying 'gender inequality' but this label itself is a combination of age old sexism and misogyny and inequality of status flowing from DP1. Their evidence includes studies of people such as the matriarchal Minangkabau of West Sumatra which shows them that matriarchy is not the inverse of patriarchy, it is egalitarian (p36). Women and men cooperate and there is no sexual abuse as that is basically about power. The Minangkabau share power.

They visit the now well known stark differences between chimps and bonobos and specifically mention the social structure of chimps which is strictly hierarchical but do not tumble to its influence on the vicious behaviour of male chimps towards their females. Similarly, they describe bonobo females as being successful because they cooperate and form alliances without realizing that all bonobos cooperate and live in flexible group structures which determine their cooperative nature.

They review many authors who conclude that sexual harassment and abuse are always about power and that, therefore, the only way to eliminate them is to tackle inequality. However, nowhere is there a clear identification of social or organizational structures as a determinant of the inequality. Once again, we see how widespread the utter blindness of so many in our cultures are as to the power of the design principles in our lives.

Perhaps one of the most insidious bulwarks for the patriarchy is the assumption that all 'leadership' roles in the past must have been male – because so many of ours today are. Knowledge of the widespread matriarchal and equal societies that existed in the past (Emery M, 2020) is unfortunately few and far between and modern beliefs in our 'progress' tend to crowd out opportunities to learn about them. A small snippet (Ly, 2023b) illustrates the biases in our interpretations of the past: one of the most prominent figures in an ancient Iberian society was female, not males as thought. The tomb, about 4-5000 years old was lavishly decorated and provisioned. The deduction at the time of discovery (2008) was that it was a male, however, an analysis of tooth enamel showed it was a female.

The evidence that in previous times, people were more equal and often more matriarchal keeps coming in with the latest report from Urquhart (2025). This discusses the genetic analysis of people in a 2000 year old cemetery in southern England. It further confirms data that Celtic communities placed women at centre stage, staying in their ancestral homes while the men moved elsewhere, a practice that lasted centuries.

This is evidence that the women had high status in Celtic societies right across Europe, something observed by the Roman which had been discounted by moderns. There is pattern emerging here as we constantly see with modern commentators downplaying, if not rubbishing, reports of more equal societies in the past.

But the evidence doesn't stop there, the Durotriges who buried their people, left their women with valuable items which is a sign of high status. There were also clear signs of matrilocality as more than thirds of the individuals were descended from a common female ancestor. The researchers found this was a common pattern across Britain and Europe and left no doubt that in this period, women were genuinely empowered.

Impact of the extended social field

It isn't just the power of the extended social field (L22) to influence our thinking and beliefs, external events such as the political can affect our sleep and our heart rates (Stokel-Walker, 2018).

Using data from devices such as smartwatches, researchers found that our biorhythms shift during and after monumental political moments including the election of Donald Trump and the Brexit vote. After the election of Trump, heart rates rose from an average of 66 beats per minutes before his election to 70 afterwards. They still had not returned to normal after 4 months.

After the Brexit vote over 12 % showed a reduction in sleeping time of about 10%. Both movement and heart rates also deviated from normal. The hypothesis is that these events are experienced as stressful so in the short term, it is a normal biological reaction.

In a review of a book about Schrodinger and the quantum revolution, Purcell (2012) delivers another reminder of the importance of the powerful influence of the external social field on us all: "Yet what sets Gribbin's book apart is the elegance with which it delivers a *simple but neglected truth*: that each of us is a product of our times. Gribbin addresses the myriad forces which shape both the process of scientific discovery and those making the discoveries. From the fortunes of nations to the work of peers, political ideologies to romantic affairs and religious convictions, he deftly identifies the influences that sculpted Schrodinger and his pivotal role in the quantum revolution" (p48 my emphasis).

The power of external influences on our behaviour, conscious and unconscious, is accentuated once again in a study of births during the Covid-19 pandemic. There were fewer male babies born in England and Wales in mid 2020 than expected. Between 2012 and 2020, 1054 boys were born for every 1000 girls on average.

"Several studies suggest there can be a sudden drop in the proportion of male births around 3 to 5 months after a stressful event that affects a whole population. This occurred in New York City after the September 11 attacks, in the UK after the death of Diana, Princess of Wales, and in Norway after the Breivik mass shooting" (Klein, 2022c).

Scientists believe this happens because the male fetus is more likely to be frail than the female triggering a non-conscious evolved response in pregnant women to spontaneously abort fetuses that have less chance of surviving in a tough environment. By August 2020, the ratio of male to female births had returned to pre-pandemic levels because people had become habituated to the pandemic and the acute stress had passed.

Still want to bet we aren't open electromagnetic systems?

We know that many, including unfortunately many social scientists, deny humans are open systems, continuing to use close systems theories that seriously distort their findings. This is despite so many truck loads of evidence that basically everything in our environments, both physical and social, affects us and our behaviour.

Now another convincing piece of evidence adds to the latest truck load, this time concerning our intrinsic nature as electromagnetic systems. Solar activity that disrupts Earth's magnet field may cause up to 5500 heart related deaths in the USA alone (Klein, 2022b). Solar storms associated with the 11 year solar cycle disrupt circadian rhythms which play a role in regulating our heart rate .

Other species are similarly affected as in for example more frequent whale strandings and homing pigeons getting lost which further strengthens an argument that every creature on planet Earth is an open electromagnetic system in an electromagnetic universe. We definitely need to pay more attention to the impacts of the wider environment on health and well being and finally put worn out old mechanistic notions behind us.

Now comes news that having Zika or dengue virus increases your chances of being bitten by another mosquito. The virus secretes a chemical that makes these people more appetising to mosquitos meaning they are more likely to transmit the virus to others. It is not only the large visible things but the very smart little invisible ones in your environment that affect you (New Scientist, 2022c).

Feeling part of the whole

It has been known for a long time now that losing touch with the natural world is a recipe for many of our psychological ills but apart from a few research reports emanating mainly from Indigenous or religious studies, there are been less evidence for the positive side of the equation – the benefits that flow from the experience of awe, the awareness that we are part of the greater scheme of things, part of the whole.

This is of course the feeling that accompanies awareness of the reality of the primary importance of the second design principle (DP2) in our lives. It is also associated with the experience of the set of ideals that people can feel while working in a Search Conference, something that some people say they will never forget. Feeling awestruck can dissolve our very sense of self, bringing a host of benefits from lowering stress and boosting creativity to (make) us nicer people" (Marchant, 2017, p33). It is the feeling we get when confronted with something vast, that transcends our frame of reference and that we struggle to understand. It knocks out part of our identity making us more connected to bigger collectives and groups.

One of the most publicized examples of this experience which traditionally has been called 'at-one-ment', atonement, has been viewing space and the Earth, the little blue dot, from space and the moon. Some of the effects of this overwhelming feeling of awe include tranquillity, elation, increased altruism and feeling small. Less religious people felt more awe.

The positive benefits for the individual of experiencing awe include improved health and quality of life, calming the fight/flight response and reducing the production of cytokines which promote inflammation, even weeks later. Awe also improves memory, curiosity and creativity. It also makes us feel more humble and charitable (p34). Studies showed it didn't have to be mind blowing instances of awe such as seeing Earth from space; it can be much lower level experiences such as wandering in the vastness of the desert or among tall forests. Some have called it being awestruck by *beauty*. They remind us that once again the ancient people of the planet were correct in their understanding of our place in the world, our immersion in the whole, recognized or not, and also correct in emphasizing that we respect it for our wellbeing.

Placebos, nocebos and their implications

Working with a computer model, researchers have proposed that our immune system has an on-off switch controlled by the mind. Others have observed that we are not the only species in which placebos work and whether the immune system responds to an infection is a function of the conditions they find themselves in. These conditions may include such factors as whether it is summer or winter.

The theory is that because the immune system is costly to run, so costly that a strong, sustained response can drain an animal's energy reserves. The role of the placebo in humans seems to be an assurance that it will weaken the infection without risking the dangerous over expenditure of energy, it is tricking the mind into thinking it is time to safely turn on the immune switch (Barras, 2012).

The great communicators

Today we are suffering from having been swamped by a lot of trendy rubbish about communication and our ability to do it, much of which appears to be motivated not only by sheer ignorance but also by the desire to make money by 'teaching people to communicate'. The trend started to become obvious in the 1960s when interest in groups first sparked up with the invention of the T-group and a rash of similar methods. See for example Emery M, 1978.

The results of an Italian study constitute the "first real-world evidence that chemical signals in our body odour can betray our emotions and influence the behaviour of those around us" (Hamzelou, 2018). Using dentistry rather than experiments in a lab, the research team found that dentists made more mistakes when their patients were experiencing anxiety or fear although they were not conscious of these emotions. This finding is an additional confirmation of our powerful communicative abilities with, and without, language.

Another example of our powerful communications comes from Leste-lasserre (2021c) discussing a study from Israel. Previous studies had shown that that hexadecanal, which is a chemical emitted from human skin, breath and faeces, triggers different brain activity in men and women but it wasn't known how that activity would result in behaviour. The new study showed that it makes men calmer and women more aggressive. The chemical has no detectable scent but it is clear that humans communicate subconsciously via body odours.

Old wives tales and folk lore

Old waves tales and other expressions for beliefs that have been passed down through the generations often get a bad press. However, many of these long held views have been shown through scientific study to have validity and contain a kernel of fact. It stands to reason that if something important was once seen or something continues to be useful, knowledge of it will be discussed and passed along to the next generation. Our ancestors were not stupid and accumulated a wealth of knowledge and understanding of how the world works and naturally passed that understanding on. This section could just as well have put under the heading of *Ecological Learning* as once again, it demonstrates how veridical our direct perceptions of our world actually are. Beliefs that were discovered not to hold over time would have dropped out of the knowledge store and disappeared over time. Occasionally some of those ancient beliefs get tested in modern studies and we review them here as that happens.

Long hailed as an ***aphrodisiac***, oysters and other seafood have been found to boost sexual desire and increase fertility as 92% of those couples who ate more than two portions of seafood a week conceived within a year compared to 79% of those eating less. Having more sex did not account for all the success so seafood acts to increase fertility separately. It is important to note that it was the male diet as well as the female that contributed to the difference (New Scientist, 2018b).

Gigantic or ***freak waves*** have long been part of our wealth of accumulated mariners' tales and just as long have been treated with the sort of scepticism accompanying stories of the

'one that got away'. However, modern recording techniques and science have now caught up with these 'monsters of the seas' (Kotze, 2021) and it turns out they are by no means unusual. They are commonly described as walls of water up to 30 metres high that can seemingly arise from nowhere and spell doom. Such rogue waves are very high concentrations of energy, with a crest to trough height roughly more than twice the average height of the tallest third of the surrounding waves (p42). They do appear unexpectedly making them difficult to study and predict but progress is being made using the physics of wave energy. This is being subject to non linear methods used to predict instances in systems such as weather patterns. These studies suggest these rogues are not so rare at all as first hand observations through history have confirmed.

Because the old people were acute observers of all around them, humankind has long believed that the moon and its changes relative to the Earth has effects on human behaviour. The word menstruation comes from the Greek *mene* for moon as the cycle is 29.5 days, same as the length of time between full moons. And we could go not go past the word 'lunatic' based on the ancient belief that lunar cycles influence madness.

However until recently, these beliefs were dismissed as unscientific and 'paranormal'. The work of one Frank Brown, a biologist in the 1950s, convinced him that not only oysters but also humans and all forms of life are plugged into subtle cosmic cues, continuously sensing both lunar and solar movements to coordinate biological processes from metabolism to reproduction. Poor old Brown was given the Velikovsky and Wegener treatment and his work was called 'outlandish' (Marchant, 2020, p41).

However, these days such enquiries are known as chronobiology and it is in the process of vindicating Brown and the ancient peoples before him. Many species have been found to work on lunar cycles acting partly on genes involved in key functions such as cell signalling and division. Some have been shown to have both solar and lunar clocks. Research in humans is more difficult because we have cut ourselves off from raw nature by using vast quantities of artificial light but despite this results are coming in. A study of suicides found that the rate increased at full moon but only in premenopausal women. The researchers suggested this could be caused by lunar effects on the menstrual cycle as its hormonal changes correlate with feeling of depression (p44). This latter finding has been confirmed and also linked to sleep cycles. These in turn have been linked to bipolar disorders and schizophrenia. One patient had his sleep cycle on the lunar cycle of 24.8 hours so he ranged from almost no sleep to sleeping most of the day.

Other mechanisms suggested include magnetism which Brown also investigated, suggesting we have an ability to sense changes despite the fact that the Earth's magnetic field is very weak. However, many creatures have been shown to have this sense and some experiments have shown we do too. The mechanism may be cryptochromes, light sensing molecules or magnetite crystals. Other experiments have shown that electrical activity in volunteer's brains responded to changes in the magnetic field. "Brown described living creatures, including humans, as an inseparable part of an electromagnetic cosmos. Organisms and their environment, he said, 'merge intimately for timing of life'" (Marchant, 2020, p45). He was undoubtedly correct.

A story from folklore in Hawaii, a mo'olelo, has led scientists to the discovery of a 8 metre high tsunami about 380 years ago (Urquhart, 2024). The story is of two gods who became enraged by a home owner who denied them food and hospitality. They then destroyed the owner's large fishpond. Tracking down the geological record in the relevant area, the researchers found all the evidence of the tsunami and by modelling the data plus radiometric dating of the coral rocks at the site, were able to determine when the tsunamic happened.

Understanding this tsunami has helped design a forested bio-shield to protect the area's nature reserve. This mo'olelo has enabled our ancestors to speak to us warning us of our vulnerability.

And what was that ridiculous new age nonsense about some people having ***an aura***? Or some people being sufficiently sensitive to detect people's ***auras***?

Well it just so happens that every living creature including us constantly emits a faint glow which vanishes soon after death (Wilkins, 2025). This glow consists of 'biophotons', the result of a process called ultraweak photon emission. As mitochondria and other energy producing machines in our cells create our metabolisms, molecules gain and lose energy. This in turn emits the equivalent of a few particles of light a second per square centimetre of skin tissue.

The effect was isolated by using digital cameras which are capable of detecting single photon to produce two, hour long exposure images of four hairless mice, one before and one after death. All other sources were tightly controlled. The experiment showed the emissions decreased significantly after death. This is what you would expect as metabolism stops with death.

They also injured an umbrella tree and found that the plant's repair mechanism increased bio[photon emission. The application of a numbing drug did the same. While similar results had been seen with individual cells and smaller body parts before, with these results from whole creatures, we can be confident that we really are seeing biophotons.

Now the article does not say that this discovery could be the basis for the age old theory of people having an aura but it seems to me that it is an excellent candidate for such a perception. People with very powerful metabolisms could be producing sufficient biophotons for sensitive people to detect them. If a camera can see them, surely there are eyes capable of such a feat.

Still in search of ideals

In a long article Kate Douglas (2021) explores all the various explanations that have been given for why simply being in nature, rather than for example a beautifully designed built environment reduces negative affects such as anxiety and depression restoring calm and joy and improving abilities in just about every area of life. The list of benefits is long and growing. Greening our urban environments have been documented to have additional benefits including redressing social inequality and improving biological diversity.

The links to our wellbeing, general and mental health are "complex and not fully understood" (p37). Some of the reasons put forward are simplistic in the extreme while others such as less pollution, more exercise and socializing make sense in terms of increasing physical and mental health, but "Intriguingly, some well-being effects do seem to be entirely psychological" (p38)

In our commonly mechanistic way, this line of research has led some to ask questions such as 'how much nature do we need?' This may be a practical question that urban planners need to consider when working on severely deprived built environments at their drawing boards but it really misses the point. That point is that we just need to be connected to our natural environment, the planet, not disconnected. Connection may lie in one tree or perhaps a small pond with some water weeds and insects depending on the individual. Others may require immersion in a dense forest or access to the never ending spaces of a desert.

The reason the links are not well understood is I believe we have been approaching the whole question from the standpoint of our separation from the environment. Yet everywhere we look at ourselves and our behaviour we see that it cannot be separate from its environment: there is no escaping the fact that we are adapted to this planet, are a part of it bound to it in the most basic ways from the very composition of our bodies and their physiology to the fact that we cannot extract information from radiant light.

When we are removed from our environment, we begin to weaken and sicken as has been thoroughly documented by our first excursions into space, just outside the atmosphere and onto the moon. We see much the same with our food: as so much of our food has become divorced from the natural products of the Earth to its ultra processed forms, so we fatten and sicken although the processed products can contain exactly the correct mixes of minerals, vitamins and other essentials. Exactly why this is so and what is doing the damage have so far evaded the scientists as once again, all the usual suspects thrown up by a mechanistic approach have failed the test (Wilson, 2021).

It is only when we accept that we are a part of planet Earth and inextricably linked to it in the most fundamental ways that we can see the only way to stay sane and healthy is to stay connected in every possible way. The reason the natural environment is necessary as a part of our everyday experience is as Emery (1977) explained, the ideal of beauty is one of the set of four intrinsic ideals.

The ideal of *Beauty* expresses that which is aesthetically ordered and intrinsically attractive; moving within the social and physical environments so that they become increasingly desirable, more dynamically balanced. It is the antithesis of ugliness (Emery F, 1977; Emery, M, 1999). Similarly, eating food which is close to the Earth so that is nurtures us and in fact arises from our nurturing of the flora and fauna of the planet, is an expression of the ideal of *Nurturance*: cultivating and using those means which contribute to the health and beauty of the whole and all its parts. It is the opposite of exploitation.

And let us never forget we are open systems

Many experiments have established just how our bodies with their various rhythms work without constant sensory experiences, stimuli from the world outside of us, and also how they go wrong when we defy those rhythms by for example, working night shift.

Now other experiments have established exactly what happens when we experience life without time. A French researcher Siffre spent 6 months in 1962 in a cave during which his circadian rhythm stretched out to 48 hours, his sense of time passing slowed and he also became depressed, like the shift workers. He also experienced an intense feeling of being in the present.

All these experiences have now been replicated in more modern settings such as sleep labs. They have established that the brain is essentially a prediction machine, making sense of what happened in order to effectively anticipate what comes next. "Without sensory inputs from the around us, whether in a cave or a tank, this system breaks down. Without time, it seems, we may quite literally lose ourselves in the moment. You lose your sense of self" (Delange, 2022, p48).

Some may see this as a good thing in an era when ego and 'me, me, me' worry many but as the researchers point out, being able to track time also helps bring people together. It is also time that helps establish the reality of the world we all live in as in the first phase of the Search Conference. In this first phase, a recent certain period of time is examined as people

perceive the same events occurring around the world and can, therefore, confirm that indeed, *we all do share an objective reality*. When this reality is denied or ignored, we humans who are adapted to our planet get ourselves into terrible trouble, collectively as well as individually.

9. Human Hubris

Put away the hubris, i.e. the assumption that the world works on dominant hierarchy and we are on top. This assumption shows itself in many ways. Here we document a few, clarifying in the process some of the concepts built into OST.

They are not as intelligent as us

Mental maps have long been thought the province of mammals but it has now seems many are constantly surprised to discover just how 'intelligent' our fellow inhabitants of the planet are. Why are we surprised? Old Ma Nature has contrived to ensure every creature evolves to be able to live a rich productive life span filling every possible little econiche with life.

Scientists are not immune from this form of mechanistic thinking which seems in this particular case to be based on associations with 'simplicity'. Common house spiders catch cockroaches up to 50 times more massive than themselves by using their webs as pulleys to lift the cockroaches off the ground. "This behaviour is interesting because you might not expect such a relatively simply animal to know how to catch its prey in such a sophisticated way" said one of the researchers (New Scientist, 2021, p21).

It has also been discovered that this ability is not confined to mammals but is possessed by rodents, bats, and the tufted titmouse which walks but does not fly. Now it seems that flying birds also possess this ability as they have 'place cells' which activate as the barn owls flew between two perches. His activity indicates the presence of mental maps that the owls use to navigate their surroundings (Arunn Murugesu, 2021).

This comes on top of the earlier findings that rooks can perform feats once thought to be the domain of only humans or great apes, including planning for the future and understanding the minds of others. Rooks can also use tools and work cooperatively to pull strings to obtain a treat. They engage in mental time travel, showing an ability to remember the past and use this to plan for the future. They recall which other birds were watching when they stash away food and use this information to imaging and plan how to protect their cache for future recovery (George, 2022).

Penguins modify their vocal calls to become more similar to their partners and colony. This ability to modify calls in response to the social environment is a key part of vocal learning, a complex set of skills and an ability that was previously known in only a few species including humans (Wilkins, 2022). Sounds exactly like the processes involved in adapting to ones "panorama of social ties" (Greco, 1950).

It would seem that we are definitely making progress in dealing with our hubris problem in the area of intelligence. Eberle writes that "If you have ever concluded that intelligence is in short supply in the modern world, perhaps you are looking in the wrong place. Humanity may seem to be suffering from collective stupidity, but there are still plenty of smarts to be found elsewhere" (Eberle, 2022, p43). The article documents the ways in which many wildly diverse species display their intelligence.

We now have a proposal by a group of researchers to create a periodic table of intelligence akin to the one used to categorize the chemical elements in a project called *Diverse Intelligence*. It could radically change the way we see ourselves and others and that is desperately needed throughout the white Western industrialized world. Defining intelligence as "an organism's ability to flexibly respond to a changing environment" (p43) the search is on for the criterion or criteria, the structural properties, that can organize the table.

Even if the project fails, the researchers know there will be a lot of learning including "a deeper appreciation and sense of wonder for the multitudes of intelligence around us" (p45). We are constantly learning that many species are far smarter than we have ever given them

credit for in our assumption that we are the most clever species on the planet. "Humans don't outperform other species as much as you might think (p45). However researchers consider there is something different about human intelligence and hope the new table may help us understand exactly what that difference is.

Some people can sniff out cancer while dogs and mice routinely do it. Now it has been shown that roundworms can also it. The worms were attracted to the cancer samples taken form 24 people, identifying them out of a total sample of 242 people, 96% of the time. This is actually a higher success rate than any cancer blood test we have so far devised (NS, 2015).

Now we are informed that rats can judge the passage of time and can even assess how accurate they were. Rats were put through a series of tests that added a "whole new richness to the way that rats represent time [in their minds]" (Wong, 2022, p10). Another area in which we no longer hold superiority!

And two species of mosquitos learn to avoid pesticides after just one exposure to a non lethal dose (New Scientist, 2022). If only some humans could learn how to avoid nasties after one non lethal exposure.

Orangutans may be closer to us than we think

Orangutans also use stone tools for both hammering and cutting despite living in trees and having no natural use of them. They were given no training for this but did it spontaneously. However, they did not learn how to make the tools despite being shown how the researchers said (Marshall, 2022). Perhaps they just couldn't see the point?

However, a male orangutan has been observed selecting, chewing and then applying a known efficacious plant to heal a cut on his face. He repeatedly put the chewed up plant precisely onto the wound and no other part of his body. The wound closed up in 4 days which is really fast. It is the first time on the scientific record that a non-human animal has used a plant with proven therapeutic properties (New Scientist, 2024). There have been previous examples of great apes of various types attempting to self medicate in other ways, for example, swallowing leaves from plants to get rid of intestinal parasites. This specific preparation and application is however, considered to be in a different class of behaviour.

In another surprising discovery, researchers have found chimpanzees can consider mutually exclusive outcomes, that is prepare for alternative futures. "It was thought that other animals couldn't manage the feat, including our closest living relatives, chimpanzees" (Ly, 2023). Human children can demonstrate this ability between 1 and 2.5 years although some researchers limit this ability to around 4 years when the children can talk about multiple possibilities. The finding for chimps suggests the ability is not dependent on (human) language.

Orangutans have also displayed predictive abilities equal to humans (NS, 2016d). After trying a few cocktails as well as cider apple vinegar, Naong the orangutan could predict whether combinations he had never tried before would taste pleasant or not and remember the flavour of each one. He was able to do this as well as human subjects. We are not the only species who can use prior experience to predict whether a new situation will be pleasurable or not which the researchers say makes evolutionary sense because having to use trial and error for every new experience would be costly as well as risky. So why do we keep presuming we are uniquely good at these levels of advanced cognition?

And Holy Cow! Even cows do it.

Veronika, a Swiss Brown cow in Austria excited scientists when they discovered she was adept at using sticks to scratch herself. They tested her extensively with a broom and she showed them how she could pick up and use it. If it was at an awkward angle, she repositioned it with her tongue and clamped it into place with her teeth. She used the bristle

end to scratch tough skin but switched to the smooth handle for more delicate parts like her udder (Sample, 2026).

Ants recognize and deal effectively with infections

Then again, the Matabele ant seems to be the only species, apart from humans, that can diagnose infected wounds and treat them with antimicrobial medicine. These ants raid termite nests for food with 1/5 suffering loss of legs or other injuries. Injured ants are carried home to be licked clean by 'nurses'. In 10% of cases, the nurses also applied a substance collected from glands in their backs or the backs of the injured ants. Chemical analysis showed this substance contains "several proteins and organic compounds with structures similar to known antibiotics and antifungals" (Klein, 2022, p19). Subsequent experimentation showed that the substance inhibited the growth of a bacterium that commonly infects ant wounds confirming its antimicrobial properties. When the researchers separated the injured ants from their nurses, only 5% survived compared to 90% of those treated by their nurses.

Infected ants produce a profile of chemicals, cuticular hydrocarbons, in their outer shells used to communicate with other ants. In this way, they let the others know they need the appropriate chemical treatment. Other entomologists were not surprised by the study because "insects are full of ingenious tricks" (Klein, 2022, p19).

The Matabele ants in the intelligence stakes have now been joined by the Carpenter ants. They are the first non-human animal performing amputation operations to treat leg wounds to prevent the onset or spread of infection (Davis, 2024)

They tailor the treatment to the location of the injury displaying an ability to diagnose, to some extent, the wounds and treat them accordingly to maximize the likelihood of survival. Nest mates first licked the wounds before moving up the injured limb until they reached the trochanter, the joint with the hip bone. They repeatedly bit the injured leg until it was cut off.

When the injury was on the tibia or lower leg, there was only licking, no amputations. There was definite evidence that the treatments were beneficial. The researchers also discovered that the thigh wounds were associated with damage to structures that pumped a blood like substance around the body. This meant infections of the lower legs spread much faster so that amputations would do little to improve the chances of survival.

We have reviewed several new discoveries in this area as they have come to light but now (Lawton, 2025) has published an interview with Japp de Roode who has just written a whole book on the subject *Doctors by Nature: How ants, apes, and other animals heal themselves*.

The examples covered are wildly comprehensive leaving us in little doubt that this is an ability of just about every species on the planet. They range from the more expected such as chimps to monarch butterflies to wooly bear caterpillars to sheep to porcupines to cats to elephants to house finches. The last are particularly interesting as they have been observed not just using substances in their natural world but have also adapted to use man made products. They have started using cigarette butts in their nests as fumigation – where there were more butts in the nests, there were fewer lice, mites and ticks (p36). Outside of urbanization, in their natural environment, the finches collect nicotiana plants which contain the same chemical.

Cats roll in catnip and dogs roll in the grass and eat dirt. De Roode's advice is to leave your animals be as they are self medicating and we should first allow them to be themselves instead of filling them up with antibiotics and anthelmintics to kill worms. The benefits are not only financial but include greater resistance and preventing drug resistance. Animals more generally also indicate to us which plants can be used for which purposes.

In a similar study (Davis, 2025), the researchers found that chimps have a range of cleaning and caring behaviours for themselves and others. These include wiping bottoms, cleaning up after sex and treating wounds of self and others. This replicates those behaviours

seen previously in orangutans, indicating that these health care procedures are more widespread amongst the primates than previously thought.

The specific plants the chimps used for treating wounds have known wound healing properties and also have known bioactive properties including preventing infections.

The study also throws more light on the question of primate empathy and altruism with these researchers firming on the belief that these features are not as uniquely human as we once thought.

The many examples surveyed in this review make it quite clear that our hubris in supposing that animals were dumb and we had little to learn from them has been put to bed once and for all. Once again, as our ancient ancestors learnt many moons ago, we should be learning from them in the quest to help ourselves to better health and well being.

They also use social distancing to prevent infection

As we learnt in the Covid19 pandemic, social distancing is a powerful way of preventing infection of such species. It turns out we are not the only species to realize the efficacy of this strategy. When ants are exposed to a pathogen, they change their nests to cut the risks of an epidemic. Nests built by ants where an infection was present were more compartmentalized and less densely connected. The ants also worked faster, making more tunnels with more distant entrances than ants not exposed to the infection. This distancing cut the likelihood of catching the infection by 10% (Le Page, 2024).

Now mice have been observed trying to revive others discovered unconscious. "They start with sniffing, and then grooming, and then with a very intensive or physical interaction....They really open the mouth of this animal and pull out its tongue" (Simms, 2025). Some also licked the eyes and biting the mouth area. After concentrating on the mouth area, the mice pulled on the tongue in more than 50% of the cases. In another test, researchers placed a plastic ball in the mouth of the unconscious mice and the helping mice successfully removed the ball in 80% of the times. Mice that were helped in these ways woke up again faster and also walked fasted than the uncared for mice, These results have also been observed by other research teams.

Animals do arithmetic

Then we learn that fish, two species tested apparently, know how to add and subtract (New Scientist, 2022b). It has also been established that pigeons understand probability, exactly the same as humans, apes and some monkeys (Barras, 2018).

Sharks also have a well established sense of numbers and quantities as do also black bears, guppies, rhesus monkeys and wolves although dogs could only distinguish two groups if one had substantially more objects than the other.

Some shark species are social learners and can perform a task in a tank more quickly if they watch another shark doing it, thereby contradicting the image of sharks as mindless, solitary creatures. They also learn from their own experiences and failures same as we do. Bamboo sharks can also discern categories such as snails or fish although the pictures may look similar. This is the same ability as humans being able to recognize that goldfish and salmon are in the same category of creature despite the obvious differences (Prosser Scully, 2019).

Llamas are also better at performing tasks after seeing a human or another llama do it first (Wetzel, 2023b). As the data rolls in, it suggests that imitation or 'social' learning is just something that we all do.

Spiders apparently show multiple indices of intelligence rivalling those of mammals and birds including foresight and planning, complex learning and "even the capacity to be

surprised" (Robson, 2020, p43). Taken together with what we have leant of octopuses, it may be a feature of creatures with eight legs – two legs good, eight legs good too!

Octopus have indeed proved so intelligent and ingenious, every effort so far at farming them has failed (Hamilton, 2023). A new venture is proceeding with new ideas and technologies, we shall see how it goes. Any bets on the octopus?

Spiders tailor their webs to adapt to the available shape and size of econiche which is achieved by reconnoitering the space via silk threads. Orb spiders ability to form a mental representation of space seems present but limited. They are also sensitive to weather and adapt webs to avoid the cold and trap prey most efficiently. Spiders in the genus Portia hunt like "tiny cats" (p44), employing premeditation and careful route planning. They also seem to have a basic sense of numbers. They are "able to 'think' about what they are doing before actually doing it " (p45).

Spiders behave more flexibly than we have previously believed but of course, that is the way of our hubris about our intelligence and place in the world. Why would we ever doubt that all creatures are equipped for the most high quality and adaptable life for reproduction and survival?

There is one point in this article that I disagree with – it is the suggestion that webs form an "extended cognition", i.e. are a part of their minds. This is one of those totally unwarranted speculations that become so irritating when the basic facts about this animal are so fascinating anyway. The web is no more part of the spider's mind than a wearable sensor is part of mine. Extended cognition sounds very exotic but ranks alongside the thoughtless way that the word 'consciousness' is thrown about without any attempt to define or clarify it. Spiders use their webs as tools just as many animals use tools. This should no longer come as a surprise.

Bees have also proven to be little surprise packets for "astounded biologists, who once assumed that bees resembled genetically programmed bots driven by instinct and incapable of solving problems or learning new skills" (Schiffman, 2018, p40).

Instead they have found, and confirmed, that bees have individual personalities that enable them to solve problems, make choices and react in ways that look suspiciously like human emotions. With a brain the size of a mustard seed, they rival small mammals using the symbolic language of the waggle dance, following intricate rules, distinguishing patterns, sorting sensory stimuli by shape and colour, having a rudimentary sense of mathematics, using tools hitherto believed confined to vertebrates, particularly primates. They have also established that bees will only attempt a task when they have all requisite information about it. They demonstrate they are constantly learning and adapting.

Most surprising was that the inner life of bees is "governed by complex feelings, mental states that are in some ways similar to emotions like discouragement and contentment" (p41). Sugar syrup gave the bees a more positive attitude showing up in increased neurotransmitter dopamine, being more adventurous and brave. When the bees were threatened, they became "more pessimistic" and less likely to take risks (p41). Wasps differ from bees in several regards but are cognitively similar, confirming that bees as insects are not unique (Simms, 2022).

Bumblebees have also demonstrated they not only learn and feel complex mental states, they also pass on their learning. Bees taught a trick to get sugar by humans passed it onto to their colony mates more than 98% of the time. This suggests that behaviour can be spread by social learning and can be maintained over time in exactly the same way that humans disseminate and preserve their cultures (Quaglia, 2023a). This was confirmed when bumblebees, taught to solve a puzzle they could not work out on their own, were put back into their colony and passed their new skill back onto five others (Quaglia, 2024).

Wasps use logic, showing logical reasoning, something we believed could be handled only by creatures with complex nervous systems. If you know that A is larger than B and B is larger than C, people can easily deduce that A is larger than C. This type of logic called transitive inference was tested in paper wasps who got the right answer 65% of the time, much high than chance (Whyte, 2019). They can learn to distinguish between pairs of stimuli that are the same or different demonstrating a grasp of abstract concepts, something believed to be the prerogative of only some birds, dolphins and bees (New Scientist, 2022d), and of course us.

To give them their due, some of the scientists involved recognized that perhaps it was only to be expected that such features such as emotions would be found in other species simply because they would be an aid to survival. Each species evolves emotions for their own specific purposes one said. While that is a slightly more thoughtful response to the bees capabilities, it doesn't come close to acknowledging that the reason so many biologists were surprised is that they practice closed systems thinking, totally ignoring the questions of how species survive and reproduce in an every changing dynamic world, just assuming it is a static unchanging one fitting for a biological robot.

Some scientists following in the behaviourist tradition have long claimed that various forms of animal actions do not really indicate emotion as we know it but the evidence against them is building. A recent study shows that pigs experience empathy which leads them to free trapped companions (Wong, 2023).

Previously, researchers found that domestic pigs become stressed when they see other pigs in a fearful state. So the aim of this experiment was to see if they would take action to relieve the distress of those others. In 75 trials with a variety of different pigs, the group member in the main pen released the confined pig 85% of the time. This does certainly indicate pigs experience empathy but of course, this conclusion could not be accepted without a proviso – that the pigs were acting selfishly because they enjoyed solving the puzzle.

I know from personal experience that this behaviour extends to dogs. My dog, a female kelpie mongrel from the RSPCA, came across another dog with whom she sometimes played. This dog had been tied up and was very distressed. My dog came to get me and took me to the tied up dog, entreating me to release her. I had to explain that I couldn't do that. My dog remained very unhappy and did not want to leave the tied up dog. There was no puzzle solving or anything else in this case that could possibly explain my dog's behaviour except the obvious one that she was experiencing empathy and wished to relieve the other dog's suffering.

However, such seemingly sophisticated behaviour is not confined to animals well up the IQ scale such as pigs or dogs. Both rats and budgerigars have been observed showing empathy. The rats freed distressed neighbours trapped in a wet chamber and did so even faster if they had already suffered a soaking themselves. "This suggests knowing that soaking is distressing enhances the rats' motivation to help their cage mates" (Sarchet, 2015). The rats were tested extensively to determine that the motivation was indeed empathy, and it was. Originally empathy was believed to be confined to maternal care but these experiments show it is more widely practiced. It could be considered just another aspect of the more general tendency towards cooperative behaviour.

Very few species apart from humans have so far been observed finding yawning contagious: budgies have joined them. They also yawned after watching others yawning in a video (NS, 2015b).

Having 'theory of mind'

Perhaps surpassing all these achievements is what has come to be called having 'theory of mind' which means the animal in question realizes other species have thoughts and feelings just like they do, and as a consequence, will appreciate certain behaviours in the same as the other animal does. This has been observed in some birds, non-human apes and marine animals such as dolphins.

Now orcas have displayed theory of mind by giving gifts to humans. In several documented cases the gifts were dead prey. This behaviour is believed to indicate that they engage in altruism and can recognize sentience in other species. Not only do the orcas deliver the gifts, they hang around to watch what the humans would do (Yang, 2025).

This behaviour has previously been seen within orca pods which are very close, complex social units in which members cooperate and share their prey. They are now taking something they do amongst themselves and spreading the goodwill to another species. Not only does this indicate altruism in a fellow species but also are bold and curious enough to experiment across species.

So another plank of human exceptionalism hits the dust!

Ecological perception and learning

Apparently there are still some scientists who do not believe in direct perception or ecological learning as the dominant mode of learning across most if not all species. Or perhaps they think it is only humans who have this facility. Earlier theories asserted that we obtain sensory information one sense at a time and that learning takes place after these sensory inputs are integrated inside the black box through various vague processes. That theory was well and truly been put to bed with the work of Heider and Gibson (Emery F, 1980). They established that rather than experiencing individual sensory inputs, we directly gain immediate understanding of the world around us through our perceptual system. We do not require mediators of any sort, including teachers.

Following these pioneers, researchers established that babies learn through an integrated perceptual system rather than individual sensory inputs as they showed what 'intermodal perception'. "Virtually from birth, our abilities to immediately understand what is happening in our human environment are acute and extensive" (Emery M, 1999, p61).

This facility is acknowledged by Forster & Middleton (2023) who write: Bees "can integrate sensory information independently of the specific sense involved. This is something human babies do when developing, and how we learn to read and write". They sound slightly surprised that bees practice 'cross-modal' learning, recognizing an object they have experienced in one sense when it has been presented in another, forgetting that nature is particularly parsimonious in this respect. Once having found an efficient process, she tends to use it just about everywhere.

They also present evidence that bees also learn by imitation and are 'active' not just 'passive' learners, as they will learn to push balls into holes to gain a reward. They can also recognize different styles of art and different human faces. Finally, they play voluntarily for pleasure and not for any value to the ability to mate, reproduce or feed. As the researchers acknowledge, play is a critical component of human learning.

Far from being some sort of inferior species in the learning department, bees seem quite the little humans in their own right as we already know that they also communicate quite complex information. Slowly but surely we are overcoming decades, if not hundreds of years, of ignorance and arrogance about our fellow species on this planet. May the learning continue.

Plants communicate

Similarly many are surprised when we discover that yet another plant communicates with others of its species to warn of predators or of damage being done. It seems we have become so blinded by our own capacity for language that it comes as a surprise that other animals share communication skills without the benefit of words. And they do it in much the same ways as we so - tomatoes that are being eaten by insects use electrical signals to send an alert to the rest of the plant, similar to the way our nervous systems warn of damage. Those signals help the plant muster defences such as releasing hydrogen peroxide, a chemical which combats microbial infections of damaged tissues. Instead of neurons, plants have long thin tubes called xylem and phloem which move sap between roots, leaves and fruits. This carries charged ions which propagate electrical signals around the plant in a similar way to neurons (Wilson, 2021, p23).

But plants do not only communicate. They have been shown to have a sophisticated awareness of their environment and of each other. They also have both short and long term memories, and can integrate massive amounts of information.

The speed of response in plants led researchers to hypothesize that electrical activity must be involved, not only chemical and this was indeed found to be the case. It appears that the roots are the key to this behaviour: "a root is a complex assemblage" with a particular structure called a "transition zone" believed to be the nerve centre of the plant (Ananthaswamy, 2014, p36). It is electrically active and its activities including being a major consumer of oxygen, form "a curious analogy to the human brain" (p36). Every cell in the root is electrically active and it produces chemicals that are the plant equivalent of human hormones and neurotransmitters such as serotonin, GABA and melatonin. In the pea plant memories are decentralized – the whole plant is a total brain and show exactly the same set of characteristics as discussed here (Howgego, 2018).

Some argue that plants are more environmentally aware than animals because they can't move to run away but must sense and adapt. Indeed, while animals have a handful of photoreceptors to sense light, plants have about 15. They are aware of the direction and quality of the light. They also know when they are being touched and integrate all this information without a neural system. They have also been shown to have memories that last at least a month.

Plants have also demonstrated how cleverly they manipulate pollinators for their own ends. They control what goes into their nectar and how much. Nectar includes a range of ingredients including "an array of potentially harmful compounds" such as alkaloids, terpenes, phenol based molecules and more. They are linked to defences and are found in roots, stems leaves and seeds. They are good for good reasons and not just for defence (Pain, 2015, p42).

Some plants produce caffeine which can taste bitter to insects but in doses too small to taste, it is an attractant so pollinators return for more as it has the same effects on a bee's mind as it does on ours. Flowers with caffeine laced nectar received significantly more pollen (p44).

Some plants spike their nectar with both an attractive molecule such as benzylacetone and a repellent such as nicotine so the pollinators return frequently but for short visits. This strategy results in more seeds and greater movement between plants meaning a much more healthy mixing of genes and a greater capacity to survive challenges. We are only beginning to understand the world of these creatures.

Now another study has found that bees also communicate. They release "a rallying call for collective defence" which shares acoustic traits with alarm shrieks, fear screams and panic calls by primates, birds and meerkats (Young, 2021). They produce it by vibrating their wings or thorax, elevating their abdomens and exposing a gland to release a pheromone. The call is

characterized by rapid bursts of high pitched sounds that change unpredictably in frequency. It is harsh and noisy, alarming to hear. It is joined by a number of other defences the bees produce to deter enemies and protect their hives or nests.

New research on plants suggests plants may enjoy a form of consciousness, an idea which is strenuously disputed in some quarters (Lawrence, 2022). Among the many special abilities plants have now been shown to possess such as being able to distinguish relative from non-relatives and firing up nectar production when they hear pollinators nearby, is the newly discovered one of reacting to anaesthetics in exactly the same way as human beings. This reaction immediately raises the question of whether there is a state of awareness that is shut down by the anaesthetic.

Researchers are now enlisting many technologies such as time lapse photography to learn more about how plants actually behave. Plants such as beans show goal directed behaviour, not simply rigid reflexes, by for example, lunging towards a pole when it appears suitable to grow up. These behaviours are accompanied by spikes in electrical activity which is the hallmark of nervous system activity and learning in sentient, animate creatures. They also employ many of the same signalling molecules such as GABA, acetylcholine and serotonin. It has been shown that they have all the correct architecture for awareness.

The idea that plants communicate "has taken a scientific hammering recently with suggestions that the evidence for some claims is lacking" but even more confirming data comes from research on orchids (Hooper, 2024). Young orchid seedlings don't have chlorophyll so are unable to make their own food through photosynthesis so it was not known where they got their nutrition from. Now it has been shown that their parents share resources with them which seems to be a form of nurturance or care by plants.

The researchers have shown that the adult orchids send parental care packages of food to seedling through mycorrhizal networks with which they have a relationship. (Most plants have links with soil fungi).

Not relying on observations in the wild, these researchers demonstrated in the lab that radioactive material fed to the adults was present in the seedlings as letting them grow for 48 hours. The adults had used the labelled carbon to make sugars by photosynthesis which were then supplied to the juveniles. This is direct confirmation of 'mother tree' and 'wood wide web' concepts, (see the chapter on biology) with further evidence of the importance of plant and fungal cooperation.

Dolphin's baby talk

We have long known how intelligent and communicative dolphins are but now a study has shown just how similar to human behaviour, these creatures really get. In a 30 year study which in itself is a marvellous achievement in this day and age, 19 wild bottlenose dolphins were recorded in a variety of situations. When talking to their calves, they adapted their vocalizations, the whistling is pitched higher and has a greater range. "They coo to their babies" just like human mums do (Associated Press, 20123).

Zebra finches are also known to adapt their vocalizations in specific ways when communicating to their chicks so perhaps this is just another feature of mother-child behaviour that is widespread throughout the natural world but we have ignored until relatively recently. Another way in which we are definitely not superior.

Elephants invent and use individual names

Elephants from two herds in Kenya were recorded from 1986 to 2022. Researchers identified 469 distinct calls which included 101 elephants sending a call and 117 receiving one. It became clear that that the elephants were using individual names that did not involve

imitation. These names are invented. They also recognize and react to a call addressed to them while ignoring those addressed to others. This is the first case of non human animals giving each other names and using them (Agence France-Presse, 2024).

When names were used, it was often over long differences when adults were addressing young elephants. In general adults used names more often than young ones, suggesting it could take years to learn this particularly behaviour. When the researchers played a recording to an elephants of their friend or family member calling out their names, the animal responded positively and energetically. They were less enthusiastic when played the names of others. This suggests they have the ability for abstract thought, the researchers believe.

Again, should we really be surprised? As the study noted, elephants share many similarities with humans; living in "extended family units with rich social lives, underpinned by highly developed brains".

This behaviour has now been observed in marmosets along with some parrots, bottlenose dolphins as well as the elephants above. "Many animals are a lot more cognitively sophisticated and have much richer social lives than has historically been recognized" (Quaglia, 2024b).

Parrots carve tools

Many definitions of human intelligence have centred on tool making, innovation and improvisation as a way to distinguish us from other animals. Yet as many observers have known, we are far from being the only smart tool makers.

Bumblebees have learned to push a ball into a hole to get a reward, stretching what small-brained creatures were thought capable of (NS, 2017a). A researcher showed them how to do it by using a plastic bee on a stick to push the ball. The bees imitated the action and even minimized the effort required by choosing the ball closest to the hole, not just learning but improving on what they learnt. This put bees in the same tool using class as primates and crows.

Yet another example: Wild and Goffin's cockatoos in Indonesia eat sea mangos with hard pits. The birds strip wood from branches with their beaks which they then craft into differently shaped tools. Some were sharp like knives which allowed the cockies to pierce the pit's parchment like coating. More middle sized ones functioned as spoons with which the birds dug into the pits and extracted nutritious seeds. Sometimes they used the thickest as wedges to pry the seeds apart making it easier for them to use their other cutlery (Leste –Lassirre, 2021b).

Goffin's cockatoos have now demonstrated that they understand they need to bring a two-piece 'toolkit' to retrieve a cashew nut (Wilson, 2023). That is, they did not simply use the tools one at a time as need arose. When a box containing the nuts was placed up high so the birds needed to fly vertically to it, they took the required tools with them in one trip.

White or sulphur crested cockatoos, Cockies, and people are waging a war in Sydney Australia as the Cockies have learnt to raid the rubbish bins. As fast as the people come up with new ways to stop the Cockies, they respond by working out ways to defeat the humans. "It is a classic example of an arms race in cultural evolution" (Wilson, 2022b) as the original trick of prying the lid open at the front, gripping the lid in their beak while walking around the rim towards the hinge, then flipping the lid, was seen in only three suburbs in 2018 but by 2019, it has spread to 44 suburbs. Early efforts by the people such as putting heavy items such as bricks on the lids was quickly defeated by the birds as they simply nudged them off with their beaks and similarly spread. The next move was to wedge a stick or pair of trainers between the hinges and the bin to stop the lids from flipping open. We await the Cockie's response but in the meantime, the researchers have found the human protection tactics tended

to cluster among neighbouring houses and then spread, with the people learning in exactly the same way as the Cockies learnt. Both species are using imitation learning.

Even insects do it. Australian assassin bugs utilize gooey plant resin to help them catch prey. Spinifex grass produces a sticky resin that is useful for human tool making but has now been shown to also be used by the bugs. While they rest on the spinifex they scrape the resin off the leaves and "meticulously" apply it all over their bodies and particularly their forelegs. In an experiment which deprived some of their resin, the researchers found that the resin produced a 26% increase in the success of capture (Sagar, 2023).

Ants also use tools, in this case it is funnel ants in Hungary using tools to transport liquid into their nest, and selecting the most appropriate one (New Scientist, 2017d). The ants were offered a range of liquids containing water and honey along with a range of potential tools. They experimented with the tools choosing those with better ease of handling and soaking capacity, including bits of sponge and paper although these were not found in their natural environment. The ants showed they take into account the properties of both the tool and the liquids they are transporting, and additionally, they can learn to use new tools.

Revenge of the Orcas

As discussed in the chapter on biology, countless species use DP2 rather than DP1 and yet another species has displayed this along with seriously high levels of intelligence. A third recent boat sinking by orcas off the Iberian coast has speculation about motivation running wild. The last attack was conducted by a large orcas and two smaller ones who imitated her.

Theories start from "some form of education, teaching going on", not malicious (Bakan, 2023). Apparently they all take the same form, grabbing or eating the rudder and ramming the sides. One observer thought they were playing. Still others suspect it is an increase in traffic through the strait. Others think it is a short term fad as orcas have been observed to indulge in fads before such as carrying dead salmon around on their heads. (This bears a distinct resemblance to some of the sillier fads some humans have been observed to follow).

Other believe it began when an orca called White Gladis (Gladis Bianca) was injured and traumatized by illegal fishers in 2020 and has been attacking sailing boats since with others copying her. Orcas are matriarchal with post menopausal females being the most important members of the pod. (This is a characteristic they share with the Iroquois Federation where grandmothers are the most powerful members.) It is believed only 15/50 of the orcas in this area are involved and that they are reacting to the damage done to White Gladis. Hoare who was present at a ramming which he found terrifying said "I felt I'd given up all notion of being a 'superior' animal...Orcas, not us, are probably the most successful mammal on Earth. They've been around in their evolved state for 6m years, and are present in every ocean. They have no known predator, except us" (Hoare, 2023).

Speculation will continue no doubt but when the scientist in Hoare's boat pulled up his underwater microphone, he found they had bitten it off.

Economic animals

Many including Adam Smith of economics fame believed economics was the preserve purely of humans, having been observed, or so they believed, in "no other race of animals" (Cossins, 2018, p49). This belief was based on the assumption that responding to changes in supply and demand could only be achieved by a species with a brain hefty enough to think through decisions rationally.

Of course our Indigenous people would have been able to correct them but nobody asked them. Eventually biologists began noticing that many different species make trades, engaging in economic behaviour and diverse it is, just like ours. Indeed, some are "surprisingly savvy wheeler-dealers capable of manipulating the market in their own selfish interests. From frisky baboons to fish offering spa treatments on the reef, pretty much everywhere we look in nature we find evidence of surprisingly sophisticated economic decision-making. Even fungi are at it, and according to the latest studies, these brainless soil dwellers give the impression of being more rational than us" (p49).

Attempts to explain common examples of cooperation in nature such as the game theory never bothered to consult empirical evidence and when this was done, it became quite clear that much of the cooperative behaviour was based on economics. When it comes to the exchange of services in pursuit of mating in baboons, individuals shop around for the best deal from potential collaborators.

Cleaner fish employ two types of client called visitors and residents where visitors have an advantage as they can shop around. They get much better service, were treated more gently with the cleaners less likely to take a bite of them. Clients can switch partners to enforce a good service.

After devastating cyclones killed off many cleaner Wrasse in Australia, researchers noticed that visitors were no longer given priority. It had suddenly become a restricted market and the cleaners knew it. There was nothing to stop them making visitors wait. The sophistication extends to these fish constantly adjusting to market conditions and updating their strategies accordingly (p50). Needless to say there are tiny brains involved.

In the "underground marketplace in which mycorrhizal fungi trade phosphorous for carbon with the roots of plants" there are no brains at all!

A fungal network can be connected to many plants and can shifts between trading partners rapidly while the plants can choose between different fungal networks. The fungi avoid poor trading partners and have been observed "hoarding their phosphorous in a form that is inaccessible to the plants" so as to 'inflate the price', thereby getting more carbon in return from the plants, "a brilliant strategy" (p51).

The researchers believe this is pure economic behaviour, economic decisions uncontaminated by cognition but here we must disagree. They say it is nothing to do with "resentment or hope" but these are emotions which contaminate all human decision making, if not dominating it. From other examples in this chapter, it would be unwise to assume or believe that fungi have no brains, no cognition. Indeed, these very example of economic behaviour demonstrate just such a thing. The language used to communicate our hypotheses and theories is critical here and rather than 'cognition' it may be wiser to assume fungi have a nervous system which functions to help them function and adapt to their environment.

And indeed as we explore in the economics chapter, our theories about human economics have much to be desired.

Economic behaviour also extends to birds. A range of different macaws tested with tokens associated with rewards of varying value demonstrated that they were prepared to forgo an immediate reward for a better snack later on. Over a range of different tests, the parrots consistently chose to delay their reward but only when the later reward was of higher value. They make deliberate profit maximizing decisions in just the same way and as well as chimpanzees in exactly the same tests (New Scientist, 2018c).

Understanding probability is a critical skill, statistical inference, in successful general economic behaviour and carrion crows have demonstrated that they are well and truly on top of this skill (Quaglia, 2023b). In hundreds of trials, the crows consistently chose the option with the higher probability of yielding a reward, when the probabilities were reasonably high, round 70 and 90%, and also when the probabilities were much lower. They proved they could

apply their knowledge in a new situation, not just the one in which they had been trained. Even more incredibly, for those who still harbour a little hubris, the crows still chose the shapes with the higher probabilities a month later, contributing even more to the reputation of corvids as a pretty brainy lot, showing complex numerical abilities previously thought limited to primates.

Understanding the intentions of others has long been seen primarily as a human feature although it was discovered that some of our primate cousins also showed that ability. Now researchers have demonstrated that dogs also can clearly distinguish between people making genuine mistakes and teasing them. There were 96 trials with 48 dogs with every movement being recorded on camera. In the accident condition, the dogs were more patient, made more eye contact and tails wagged more. They obviously still expected to get the sausage. When teased, the dogs sat or lay down, and backed away from the barrier more frequently. Age, se and breed played no role in the results (Wetzel, 2023). I expect they understand a lot more about us than that. It just hasn't been written up yet!

Altruistic animals?

Surely humans have the edge when it comes to altruism, well so we have been led to believe. That too has now been thrown into doubt by observations of whale behaviour that indicates what in humans would certainly be called altruistic. Repeated observations of humpback whales saving seals from orcas has ignited a long standing debate about the reality of altruism in other than humans. In one incident, just after the orcas had washed the seal off the ice, two humpbacks came over and just as they reached the seal, one rolls onto its back and the water washes the seal onto the whale's chest. The whale then lifts its chest up out of the water with the seal on it. It proved to be no accident but quite deliberate as when the seal started to slide off the Whale's chest, "it used a 5-metre long, 1-tonne flipper to gently nudge the seal back onto its chest" (Howgego, 2016).

There have been previous observations of dolphins helping other animals in distress including humans, but this was different in that these humpbacks were rescuing another smaller animal from attack. When this researcher checked around and in the literature, he discovered that there were many reports of similar behaviour by humpbacks, often by non scientists such as whale watchers on tourist boats which makes sense as there are many more of them than there are professional whale researchers.

However, many remain unconvinced that these incidents represent altruism: it seems to be a step many can't take. Whether this is blind prejudice or problems with definitions is an open question. Pitman, the marine ecologist making the original observation, defines altruism as "a behaviour that increases the recipient's fitness at the cost of the performer's"(Howgego, p43). This makes the behaviour undeniably altruistic.

But there are further complications – is there anyway this behaviour is in the humpback's best interest, i.e. is it self interest rather than altruism? Humpbacks when mature have nothing to fear from orcas but their calves do. Orcas regularly try to kill calves.

Detailed observations show that the humpbacks charge in when the orcas start vocalizing, they have been known to come from two kilometers away when they hear what could be an attack, without knowing what the victim is. The hypothesis then is the humpbacks have a simple instinct, when orcas attack, go in to try and stop it. Pitman, therefore concluded that it was a case of "inadvertent altruism" (p43).

Then the question becomes 'does this apply to people too? Personally I think the conclusion of inadvertent altruism is simply a way of avoiding the controversy with the hardliners in the scientific community. Why not just admit that highly intelligent, and highly social species like whales, dolphins and human show altruism as one in a complex profile of

behaviours. We do not find it strange that we have a sense of morality and care for others unlike our own, why can't other species share that as well. We will just leave the hardcore behaviourists to their own devices.

It appears, however, that it is not only the 'advanced' species like whales and dolphins that help each out but also mice. In a supposed first sighting of altruism among nonhuman primates, mice have been observed helping when others are having trouble giving birth (Wade, 2025). The midwife mice very carefully used their mouths and paws to pull out the pups stuck in the birth canal. They also broke open the sacs encasing the pups so they could breathe. It seems from this series of experiments that the midwife mice need to have had their own experience of at least one litter for them to effectively assist the mouse having difficulties.

Ant farmers

And just in case anybody thought that agriculture was a distinctive human activity, it isn't. Hundreds of ant species around the world farm plants or fungi for either food or shelter or both. They have evolved to do on at least 15 separate occasions and as long ago as 45-65 million years so they beat us to by a wide margin.

There are 4 criteria for identifying an activity as agriculture: the ants must plant it, care for it, harvest it and depend on it for either food or shelter. The number of species classified as farmers depends on whether shelter is included in the criteria (Le Page, 2022).

Nor it is only ants, bees also farm for their food. A Brazilian stingless bee has been found to farm fungus inside the cells which house their growing larvae. When researchers tried to grow the bees without the fungus, the survival rate of the larvae dropped from 72 percent to just 8 percent. The fungus also profits from this arrangement because it has a protected environment, the food inside larval cells while the bees also disperse it to new colonies. It is likely there are other types of bees who farm but it is important that the use of fungicides is stopped if we are to retain the benefits of bees pollinating our food (NS, 2015d).

Ants and bees are also joined by worms. "Worms have been spotted growing sprouts in their burrows, a type of cultivation never seen before in non-humans" (NS, 2016e). The worms bury the seeds of cordgrass which has a very tough husk, too tough for the worms, and then wait for them to germinate – they then feed on the juicy sprouting shoots. The sprouts are more nutritious than the raw seeds and more easily digestible. Worms fed on other foods grew more slowly. The researchers suspect earthworms also sprout seeds which is the "beginning of agriculture".

The sniff test (with thanks to Elder (2022b)

And for those of you who though we were a cut above our canine friends – we are not!

In a series of carefully designed and rigorous tests with both human and electronic noses, researchers have shown humans also sniff each other for exactly the same purposes as dogs.

They used same sex and non romantic dyads or couples that had rapidly formed close friendships, i.e. had immediately 'clicked', half male and half female and harvested body odour. The study established that friends do smell similar and that those who smelled more similarly enjoyed more positive interactions. Overall they found they could predict social bonding to 71%accuracy.

The study confirms previous research that "humans like other mammals are capable of discriminating between kin and non-kin by olfactory cues alone" (Elder, 2022) although the authors were quick to stress that human judgements involved many other factors including SES and genetics, not merely smell. However, all these studies confirm that it is not primarily how we look that determines these relationships. This emphasis on appearance is probably a

product of our reluctance to acknowledge sniffing plus the increasing dominance placed on our visual sense.

While some cultures are open about our use of smell in relation to others, Western culture has treated it primarily as a taboo. This means many of us use this olfactory capacity subconsciously leading to the growth of the myth that smell is not involved in relationships, a myth this research has well and truly put to bed.

And now for the complete opposite

We should be sure that while human hubris, the reflection of DP1 in action, is widespread across the Western world, it is not universal. There are still plenty of people around the planet who understand the reality of the open system and our place in it, i.e. they understand we are but a part and are completely interdependent with the whole of the world. This should, of course, be screamingly obviously even to the most dedicated arrogant Westerner as we are increasingly suffering from the effects of climate change and the decline of life on Earth. It isn't.

However, let us rejoice that the old knowledge and ideals are alive and well in some parts. In one African village, the people held a funeral for its baobab tree when it died. They addressed it as 'the mother of us all' thanking it for protecting them in times of drought (LePage, 2018). Large trees provide shelter, food and water and people traditionally use almost every part of it from the edible fruit and leaves to the bark and roots containing fibres that are used to make ropes, baskets and clothes.

That ceremony, and the spirituality behind it, is the core of ages old culture of the ancient peoples that was once found all around the globe. Its remnants survive on many continents where it goes by different names such as Pachamama, the Earth Mother in South America and a constellation of slight variations on a theme in Australia where there may be one Earth Mother or she may be two sisters for example. Despite all the variegated appearances, the core set of beliefs and practices are the reflection of DP2 in action as the basis of a very practical spiritual culture.

Ancient medicine

Most people have heard of trepanning, the ancient art of drilling a hole in the head to relieve pressure on the brain or to cure various diseases. There is evidence of this medical practice going back well into prehistoric times and it was an obviously successful technique as it was used extensively around the world to treat a variety of problems. However despite that, most people assume that the ancient cultures had little knowledge of medical science or physical or surgical healing. What knowledge there was, was assumed to have started developing after we started farming about 12,000 years ago as evidence of a successful amputation on an old farmer was found in France (Wilson, 2022).

Now an example of a successful amputation 31,000 years ago on a 10-14 year old has been found in East Kalimantan in Borneo. The child had his left leg cut off just above the foot, showed healing with no evidence of infection and lived until they were about 19-20. This was no farming but a hunter gatherer community demonstrating they already had sophisticated medical and surgical knowledge and techniques. First they understood that removing the limb was necessary for survival and the lack of infection means the wound was regularly cleaned and disinfected, probably using antiseptic plant extracts.

We have massively underestimated the knowledge and understanding of all the ancient peoples as we are slowly discovering to our cost as for example, our land suffers from monstrous hot burns in the summer, accelerating extinctions. *Wisdom of the Elders* (Knudtson

& Suzuki, 1992) documents some of the accumulated and detailed knowledge the ancients had of their world, knowledge that some of our scientists are only slowly learning today.

Faecal transplants, surely a new tool in modern medicine? Alas no. Apparently the first known faecal transplant took place in China in the 4th century AD (Whyte, 2022).

Our culture is a regression not the pinnacle

There are so many today who believe we represent some pinnacle of civilization simply because they have no idea of the deleterious effects of the shift from DP2 to DP1 for individuals and society as a whole, not the mention the health of the planet. We have another example of this ignorance and hubris in a brief note from George (2018). "Researchers tend to think such large structures were the work of stable, complex hierarchical societies with surplus resources, arguing that they were often a way for a chief to advertise their power" (p6).

The structure is question here is the oldest and largest cemetery in east Africa, at Lake Turkana, Kenya, a communal cemetery built about 5000 years ago. It was built by herders. There are 9 stone circles with 1.5m tall pillars and a vast 700 square metre raised platform along with the remains of at least 580 people. The dead include people of all ages and sexes with no evidence that anyone was treated differently, meaning that nobody was more important than anybody else. This finding accords with all the other accumulated evidence that the ancient cultures right around the world were predominantly build on the second design principle which conferred the adaptivity to persist and thrive for literally thousands of years before they were invaded and taken over. All that evidence for example in Cultural Contexts (Emery 2020) points to much healthier, and happier, societies and individuals than be found anywhere in our slowly degrading ones. Anyone who assumes other cultures can be measured by their distance from our dizzy heights is in need of some anthropology and a solid grounding in the design principles.

There is also incontrovertible evidence that the people who built the Menga dolmen in Southern Spain had a sophisticated understanding of at least physics and geology as these were employed in the design and construction of this structure, built between 3600 and 3800 BC (Leslie, 2024). The heaviest of these stone weighs more than three times as much as the heaviest stone at Stonehenge built 1000 years later. The stones while built of fragile sandstone were shaped so they would fit into stable structures reducing the risk of fragmenting. The structure produces distinct patterns of light during the summer solstice suggesting an astronomical purpose and its stones have been protected from water damage by several layers of carefully beaten clay. The builders also, therefore, had knowledge of architecture as well as physics, geometry, geology, astronomy which adds up to a fairly sophisticated understanding of science.

In what must be one of the most comprehensive put downs of modern science, *The Dawn of Everything* (Graeber & Wengrow, 2021) is a riveting read through human history around the planet. It leaves absolutely no doubt that our ancestors regardless of where they lived were just as clever as us and in many ways much more resourceful, and above all much more free. See Chapter 10, Graeber & Wengrow provide another major excursion into both our modern forms of hubris and the often dismal performance of our social sciences.

A fitting conclusion to this chapter has come from the *New Scientist* 17 January, 2026. Entitled **A cultural awakening**, it is a heartfelt pleas to do just what we headed this chapter with, a plea to put away our hubris, our belief in our exceptionalism which Brakes and Bekoff describe as a "folly" and realize that we part of this planet, not above any of the other inhabitants.

They see the interval since Jane Goodall "stunned the scientific community by reporting that chimpanzees in Tanzania were using tools" as an opportunity to recalibrate our whole position on this planet and definitely with respect to its wildlife. This is because "the evidence that many other species learn from each other and have cultural ways of behaving is overwhelming". There is also evidence that some of the longest living animals have not only developed extraordinary genetic adaptations to cope with an extended lifetime, but some are also the keepers of ecological knowledge shared culturally between generations. They can hold knowledge critical to fluctuating environments.

They acknowledge the fact that our Indigenous peoples have long understood this as they listened "deeply to nature". Now that we know we live among a multiplicity of other cultural life forms, we can no longer go about our lives damaging if not destroying the world around us but must acknowledge our "responsibilities as guardians of this rich bio-cultural diversity".

10. The Ancient World

Book Review: *The dawn of everything: A new history of humanity*[2]

The reader here may question why I include a book review in this collection about science but it illustrates in its own way, many of the dilemmas science has gotten itself into, even in the fields of archaeology and anthropology. Or actually, because these disciplines are so concerned with humans, it renders them even more vulnerable to the foibles of a science chasing abstract universals. Most branches of the social sciences have been, and continues to be, very serious casualties of closed systems science.

This book on its own, has done more to expose the pitfalls and outright blatant mistakes (I am being polite) many of their colleagues have published than a dozen little reports of disparate errors could do. It is a worthy follow up to the chapters on social science and human hubris.

The dawn of everything is a monument rather than a book but I enjoyed reading every page of it. It is full of elaborations and diversions, everyone a little gem conveying understanding of some wonderful or stunningly unexpected fact about our past societies. It winds its way round every contour of our past like a lazy river so confident that it will reach the sea, it doesn't have to hurry and can even slow down occasionally to admire the scenery. Little asides pop up at various times and some of these are no less than fascinating elaborations of the huge diversity of social arrangements uncovered. They put meat on the bones of the descriptions of social structures and explain for example, why my Mohawk friends were so delighted with the book, more on that later.

The book takes its name from "the *illo tempore*, the dawn of everything, when animals could talk or turn into humans, sky and earth were not yet separated and it was possible to create genuinely new things (marriage, or cooking, or war)" (p497). It was the mythic time, the basic for traditional societies as held by theorists such as Eliade. Eliade was one of those who believed a linear sense of time was a recent innovation, one aspect of the modern appreciation of ancient history which this book specifically debunks.

The purpose of the book was not immediately obvious to me and is still somewhat fuzzy in my mind as the authors at several different points discuss its purpose and also its non purposes which are equally compelling as subject matters. I find on reflection that it really doesn't matter very much. That is because the whole tome is in one sense, a collection of powerful subject matters or themes, a key one of which is a devastating condemnation of contemporary social science, certainly the anthropological and archeological divisions of it but also including those fields more centrally concerned with recent and contemporary human affairs. That non purpose in itself enlivens many of the asides and clarifies the conceits and other inadequacies of those pursuing the basic disciplines in this field.

Today's theories alternate or involve in some way the alternatives springing from Rousseau or Hobbes, what most would know from the 'noble savage' or a selfish, war like creature whose life was 'solitary, poor, nasty, brutish and short'. The book tells another story altogether, one based on a dizzying amount of evidence. Far from humans being innately hierarchical or egalitarian, doomed to be Hobbes' hawks or Rousseau's doves, we have the ability to determine how we want to behave (p86). However, we should note that there are

[2] David Graeber & David Wengrow, 2021, Farrar, Straus and Giroux, NY.

limits on this ability as the social structures in which we find ourselves have a powerful effect on our behaviour, and when people have no knowledge of the design principles, they have no easy way of negating that effect.

There are many themes and subthemes, purposes, running through it so we will examine some of these in more detail, as in other contexts, they can form whole subject areas. In this massive book, they are no more than fascinating subthemes.

One of the themes which emerge is the whole complicated question of our current woeful circumstances - "If something did go terribly wrong in human history – and given the current state of the world, it's hard to deny something did – then perhaps it went wrong precisely when people started losing that freedom to imagine and enact other forms of social existence" (p504).[3]

Freedom, practical forms of social liberty, as a concept is researched in detail with the final distillation of:

6. The freedom to move away from one's surroundings
7. The freedom to ignore disobey commands issued by others
8. The freedom to shape entirely new social realities, or shift back and forth between different ones (p503)

One of the big themes which emerges from the huge range and diversity of material is that these freedoms have diminished to the point where many cannot even comprehend how humans could live so freely so the questions become how did that happen? How did we get stuck without basic freedoms, and just how stuck are we really? (p503) Is there a way out?

I don't think they really answer any of these questions in any convincing matter. They review various theories and analyse how the loss of one freedom leads to the loss of others. However, none of it explains the ease with which societies in the past have thrown off dominant hierarchies and the difficulties we are experiencing doing the same thing.

Similarly, Graeber &Wengrow theorize about three forms of domination, namely:

4. Control of violence
5. Control of knowledge
6. Charismatic power

but their development of these types is fuzzy with poor delineation. In these classifications, they came nowhere close to the design principles as the bedrock of the diversity they discover. Even their use of the term bureaucracy is vague as in places they seem to equate it with the power of an established strata of administrators in what OST would refer to as a top down or DP1 structure while in others such as at Tell Sabi Abyad, it refers only to record keeping and not to any sign of personal status (p421). In others again, bureaucratized meant when promises became impersonal, transferable (p427).

Not much material comes from Australia but I constantly noted similarities as I read through it. While the Aboriginal or Torres Strait/Papua New Guinea extended systems, as the

[3] OST (Emery F, 1977) suggests that the breakpoint may have come at the beginning of the Industrial Revolution when the great mass of the population was forced into hierarchies (DP1) as the governing principle of the new factory system. Prior to this, people had been largely left to their own devices to organize themselves and they almost without exception chose the second design principle (DP2) – see below. G & W agree as they hypothesize that it was the model of the discipline on ancient Egyptian boats turned the crews into clock like machines that was picked up for the factory floor (p407).

people in this region are one ethnographic subsystem of Melanesian origin, often use different structures and practices, there were commonalities with others from far flung points on the globe.

The overwhelming impression I got from the book was the huge, seemingly never ending ***diversity of the human experiences in the past*****,** the ways in which the genotypical social structures and essential functions were mixed and matched with just about every possible variation on their phenotypes. And that brings us to the critical point I need to make about this book.

The genotypical design principles

As much as I loved reading the book, a lot of it is an attempt to discover that which has already been discovered, the genotypical design principles. These two principles called have been thoroughly discussed in Chapter 2 so we shall only take those understandings a little further, particularly into the cultural realm.

The dominant hierarchy is in total contradiction to our nature as purposeful creatures who want, and need to make their own decisions, both individual and collective. The structure sets off a sequence of dynamics which begins with competition, progresses through the need for self interest to survive or win and ends up with physical conflict and warfare. In cultures or societies where dominant hierarchies are the predominant form and/or lie behind the governance system, that culture or society gradually succumbs to various forms of destructiveness such as class warfare and/or mental illness. There may be a debilitating sense of hopelessness and depression as people unaware of these principles affecting their lives cannot see their way out the mess.

In cultures or societies governed by the second principle, both ancient and contemporaneous, we find greater stability and peace as people go about their lives, cooperating to further the welfare of the group by looking after the land, building technologies such as fish traps, trading with others and finding ample time for creative crafts and artistic pursuits. There are generally no bosses in the sense of people making decisions on behalf of others, as people naturally arrange themselves into variously sized self managing groups or communities. These group or communities are self determining and devise rules and conventions for larger groups to come together in peace and harmony. Wealth in its various forms is more equally distributed and the overwhelming affects are those of energy and joy with widespread participation in music, dancing and ceremonies performed for the common good. The sexes are much more likely to enjoy equal status and power in these cultures as well and some have clearly become predominantly female oriented (Emery M, 2021).

While Graeber & Wengrow are not aware of the design principles, they provide some excellent portraits of them. As we would expect from our knowledge of the effects of the design principles and the way people perceive them, it should not be surprising that the authors find that DP2 societies "represent the vast majority of human social experience (p523). Throughout, they show that they know in their bones, the reality and meaning of these principles: for example, they say the ultimate question about human history is not about our equal access to material resources but "our equal capacity to contribute to decisions about how to live together" (p8).

Had Graeber &Wengrow known of these principles, the organizational structures they produce and their powerful effects, they would have been able to make more sense of the huge historical diversity they discovered. As it is, they really struggled to classify it into brief

but comprehensive sets of categories. Their final classifications are not particularly convincing nor really clearly delineated. They are certainly more useful than the totally inaccurate orthodox theories with their sequences built on false assumptions and modern arrogance and vanities they critique. However, they still lack the crystal clear explanatory power the design principles provide.

Such an example is their effort to define and come to grips with various types of state. For today's 'state', they identify sovereignty, bureaucracy and a competitive political field. They showed "how those elements map directly onto basic forms of social power which can operate at any scale of human interaction, from family or household all the way up the Roman Empire or the super-kingdom of Tawantinsuya" (p507).

Some societies appear to have been built on one, or two of these three elements but these elements alone cannot account for the wild diversity found in the past, nor can they explain our current dilemmas or degree of lack of freedom.

Graeber &Wengrow ask for example, what is equalized in egalitarian societies and hypothesize that it may refer to some sort of homogeneity as an ideal. Similarly, some confuse status with wealth. However, there is little to no evidence to support these hypotheses while the book is stacked with evidence that egalitarian refers to equality of social status. That is what the many discussions of e.g. chiefs with no power, the right not to be commanded and the right to easily move, amount to – there were no social strata.

People around the world from Greece to old Mexico had tumbled to the fact that elections have a nasty habit of throwing up leaders with tyrannical ambitions. Elections were therefore, considered an aristocratic mode of appointment, at odds with democracy, so the truly democratic way was by lottery, sortition (p356).

Graeber &Wengrow see democracy today, i.e. representative democracy (rep dem) as "a game of winners and losers, played out among larger-than-life individuals, with the rest of us reduced largely to onlookers" (p367), a far cry from the collective deliberations on common problems employed by the egalitarian societies. This is an accurate perception as we know now that rep dem is DP1 with elections, autocracy at the governance level, nothing to do with the DP2 form of participative democracy (Emery F, 1974, 1976, 1982).

Not only did the old egalitarian societies share their material wealth, they also enjoyed wealth of another sort in that they spent much less time working, working hours have increased over time, and much more time creating, celebrating with ceremonies to both maintain the culture and enjoy social relationships. Significant amounts of time were consumed with playing games, gossiping, arguing and travelling for pleasure. Arts of various sorts flourished throughout the old societies.

But the design principles are not the only component of Open Systems Thinking (OST) to pop up in this review of the past. Some societies employed the basic formulation of the open system itself as the basis for their arrangements. These two 'coincidences' vindicates the OST view that it is an age old approach that has been with us since the mists of antiquity.

The Open System

In the Osage, a nation from the Great Plains in the USA, the elders after lengthy investigations determined that life and motion was produced by the interaction of two principles – sky and earth – and therefore, they divided their own society in the same way, arranging it so men from one division could only take wives from the other. Here we see two related features from OST, indeed its theoretical foundation. Firstly, sky and Earth are the

direct equivalents of the L_{22}, external social field, and L_{11}, system, dimensions of the formulation of the open system with their interrelations given as the L_{21} and L_{12}. (See Note 2). Elaborations of the dimensions in this model account for an infinite variety of conditions and situations. Secondly, it provides further confirmation that the premise of the Type II, the clustered placid environment inhabited by the ancient peoples, was indeed isomorphically designed to mirror the structure of the natural world they saw around them. It was this that gave this environmental type its great stability and longevity until they were invaded by the warlike hierarchical people after the Industrial Revolution.

The Osaga elaborated the basic model to arrive at a desirable structure for their typical summer village. It is an extremely intricate pattern (diagram on p477) based on a circle divided into two exogamous moieties, sky and earth with 24 clans in all, each of which had to be represented in any settlement or camp, and in every ritual. This was regarded as something not given from on high but the result of a series of legal and intellectual discoveries or breakthroughs. Again we see that this was a people self consciously creating their own institutional arrangements, "well before European settlers appeared on the scene" (p481). It turns out that this sort of thinking was commonplace in North America.

Ostensible purpose – asking the right questions

On p25 Graeber &Wengrow say the book is simply trying to lay down foundations for a new world history and as such it is uneven and incomplete. Concomitantly, it is a quest to discover the right questions given that they believe it should not be about the origins of inequality. The book began as a conversation between an anthropologist and an archaeologist about those questions and finished as an expression of the evolution of their ideas, rejecting the 'European perspective', instead considering "perspectives that derive from those indigenous thinkers who ultimately inspired them" (p26).

Ironically, it was wars of conquest and plunder that opened the eyes of the Europeans to the vast diversity of social arrangements found in the New World; predominantly egalitarian. This flood of new ideas became known as the Enlightenment (p29). But then in another twist, it was later seen that the Enlightenment was failing as rather than ushering in new forms of free society, it brought for example, the Terror, the French Revolution. This was because they did not know what was causing it – DP1.

A significant part of the book covers the cultures of the original people of the Americas, particularly those inhabiting the North of the continent. The early missionary and travel accounts from New France, around the Great Lakes, brought home to Europe knowledge of societies very different from their own. Many Enlightenment thinkers insisted their ideals of individual liberty and political equality were inspired by Native Americans, because it was true (p37).

Some of the indigenous intellectuals from these cultures such as Kandiaronk who features significantly in the book may not have isolated the design principles but he knew that the European lack of freedom and punitive laws sprang from "a form of *social organization* that encourages selfish and acquisitive behaviour" (p53). These intellectuals exercised significant influence not only on the Europeans but also the Founding Fathers of the American constitution although those advocating for an egalitarian system lost out in the end.

It is probably not recognized today that the indigenous peoples in the various new worlds were harshly critical of the invaders' society, particularly their lack of freedom, indeed their hostility to freedom. They criticized the inequality of women, their lack of generosity and cooperation with each other, a critique which was taken seriously by some Europeans. It

came to be regarded as a danger to the fabric of European society which necessitated a whole new body of theory being created to refute it. It is that evolutionary theory which forms today's orthodoxy, which is clearly at odds with the evidence. Today, the idea that American indigenous intellectuals played a leading role in this conceptual revolution is almost heresy (p35).

It is this theme running through the book, the accuracy of it and the huge effect their cultures had on their eventual conquerors that so delights my Mohawk friends – after years of fighting to recover their cultures, it certainly vindicates their belief in the superiority of their cultures and the fight itself.

There were pockets of DP1 structure in the past amongst all the great mass of egalitarian cultures but these seem quite limited. Graeber &Wengrow cite the peoples on the Northwest coast of today's America with cultures built on rank and featuring the famous *potlatch*, festivals featuring displays of excessive wealth, gluttony and sometimes destructiveness. These displays signified "contempt for the ordinary world possessions by performing magnificent feats of generosity, overwhelming their rivals" (p182).

The structures consisted of hereditary ranks of nobles, commoners and slaves. Intergroup raiding for slaves was endemic. This form of structure (DP1) is not at all what is expected of foragers by today's social science so again we see the misleading nature of that 'science'.

Not its purpose – origins of inequality

The authors state that the book began with an appeal to ask better questions than the origins of inequality. This inadequate starting point necessitates the creation of a myth, a fall from grace, the old patriarchal Garden of Eden story. Theories based on this are limited to variations on how to cope with or improve in some minor ways our condition. An alternative theory claims that inequality has no origins but is innate in the human condition which requires competition and selfish behaviour in order to achieve any measure of progress or civilization, a view they claim is popular only amongst billionaires (p495).

Neither of these theories accords with the facts.

The origins of equality/inequality may not be the purpose of the book but discussion of the dichotomy itself accounts for a sizable proportion of the book. It is in fact one of the major themes as the astounding diversity of cultural variants they discover revolve around basic governance principles of status equality or inequality as given by the two design principles as above.

While the view that the progress of Western civilization inevitably makes everyone happier, wealthier and more secure is optimistic and appealing, it cannot account for the fact that this civilization was rejected by the people on whom it was imposed, that it could be forced upon them and maintained only by the power of the gun. Similarly, it fails to account for the fact that many Westerners defected to the culture so conquered – that the conquered were miserable and unfree was simply another myth.

The social sciences began with trying to explain why the Enlightenment was failing and why so many of the attempts to fix things simply made them worse – how could "the passion for liberty, equality and fraternity end up producing the Terror?" (p494). *It was here for example that understanding the design principles really could have provided a short cut to their musings.*

But this was the era of Rousseau whose theory is still alive and well in some quarters. But today, inequality is seen just as the "inevitable result of living in any large, complex, urban, technologically sophisticated society" (p7) – and so nothing can be done! Suits the rich and famous!

Instead of the origins of social inequality, the question they propose is "*How did we get stuck?" – in such an unfree state?* (p112). How did we come to treat eminence and subservience as inescapable components of the human condition? Today, we appear to be less able to imagine, let alone design and implement an alternative social system to what we have. The irony of course is that today's dominant evolutionary theory postulates that the people of the past were subject to the forces of progress which robbed them of their ability to self determine their social arrangements in a self conscious way while the evidence documents the opposite: it is us who have been so robbed. ***Social science has been creating myths***.

Theme that emerges: current orthodoxy is wrong

Therefore, the book presents a major challenge to today's conventional wisdom that there was a linear sequence of development or progress, an evolution from an "imaginary collection of tiny hunter-gatherer bands" which ends with the "current collection of capitalist nation states" (p442). These powerful European theorists insisted on classifying societies in terms of subsistence so agriculture could be seen as a breakpoint. This was accompanied by an assumption that as societies became more larger, they became more complex and that complexity means not only greater differentiation of functions but also the reorganization of societies into hierarchical ranks governed from the top down. This theory of course has the effect of putting us and our hierarchically dominated societies at the top of the heap.

What the book discovers, over and over again, in often minute detail, is just how wrong that theory is as to maintain it, it is necessary to ignore most of the world's history. That is because that history flat out contradicts the theory. When we rip away that bandaid of a theory, we have to face the reality of our cultures.

Just how wrong is illustrated by the Nambikwara (p99-100) for example. During the rainy season they practiced horticulture while for the rest of the year they dispersed into small foraging bands. During the dry, chiefs behaved like absolute dictators (DP1) but in the rainy season, they worked with others to build houses and tend gardens (DP2). Other versions of this alternation between structure are documented throughout the book. This is in fact an example of how in a basic DP2 structure, there can be periods of DP1 for good reason but the overall structure remains DP2 as the decision to deviate into DP1 temporarily is under the control of the people themselves (Emery M, 2013).

Not only did the Nambikwara share wealth during the winter, the wet, they also shared their spouses "under the aegis of Sedna, the Goddess of the Sea" (p107). Another theme running throughout the book is the alignment of gender equality, if not female rule, with liberal social and sexual rules, and DP2.

Other examples of such oscillations include the people who built Stonehenge as they had been cereal farmers but had returned to gathering hazelnuts as their staple around 3300BC. Incidentally, there are many point in the book which roughly coincide with the various critical points in time which Velikovsky hypothesised to indicate planetary disruptions due to cataclysmic movements in the solar system. Not only does Stonehenge appear as an astronomical instrument, there was also a highly coordinated social and communications structure across large parts of the British Isles as there was in the Americas. This enabled

people to travel safely for whatever purposes and again indicate a highly sophisticated and cooperative series of social units (DP2). There were similar trade routes across Australia.

A close significant date is given as 3500BC when the first cities started emerging in Eurasia: it was also where the hunters and fishers of now Louisiana constructed Poverty Point, a huge piece of ceremonial infrastructure, public architecture featuring the shapes of huge birds. This tradition of public architecture going back to around 1600BC appears to have been a place for exchange of knowledge of esoteric types probably featuring astronomy amongst other specialities such as mathematics, medicine, ethics and social structure (p144).

But Poverty Point is only one among many around the world demonstrating how the hunting gathering people raised huge monuments and other buildings: after the Ice Age. These non agricultural peoples celebrated, played games, created art, buried their dead and led exciting complex lives in social structures of diverse shapes and sizes, but in cooperative cultures at peace. The orthodoxy would have it that hunters and gathers did no such thing. We saw the controversy, if not outrage when Pascoe documented the agriculture and structure of villages in *Black Emu* in Australia (Pascoe, 2014).

All the many objections raised about this new more accurate appraisal are deftly dealt with by the authors who clearly have little patience with the purveyors of this evolutionary theory. They simply say after hundreds of pages of proof that it, and all its variations, "didn't really work" (p446). New versions created continue to be as successful and many adherents have now fallen back on the old original version where the basic sequence is:

- *Band societies* – small, no political roles, egalitarian by default
- *Tribes* – larger, horticulturalists but technologically unsophisticated, arranged into complex lineage or totemic clan structures, featuring 'big men' but with no coercive power, egalitarian
- *Chiefdoms* – kinship system is basis of hierarchy of ranks, production leading to surplus with distribution with enforcement
- *States* – large, intensive cereal agriculture, legal monopoly on use of force, professional administration and complex division of labour.

As the sequence shows, the progression consists of roughly correlated size and complexity. This form of the theory didn't work either but seems to have become the convention. Despite this being wrong and 'deceptive' (p449), the authors point out that we find it so difficult to imagine history that does not imply that current arrangements were somehow inevitable. When we look at it from the standpoint of the design principles we see that DP1 has become so entrenched that people simply cannot imagine anything fundamentally different.

Of course, when people discover that systems based on DP2 not only exist but provide a high quality of life, they find them extremely attractive. We can assume that this is exactly the same reason the book documents that time after time, people through the ages have not followed the sequence but decided to stay with their own organizational arrangements. Having looked at or experienced forms of DP1 structure, they have found their home grown DP2 system more attractive.

"What we can say with some confidence is that the societies encountered by European invaders from the sixteenth century onwards were the product of centuries of political conflict and self conscious debate. They were, in many cases, societies in which the ability to

engage in self conscious political debate was itself considered one of the highest human values" (p452). In some places, immense effort was made and elaborate systems were devised to ensure that nobody could rise above anybody else.

Similarly, when huge earthworks were required, often employing ingenious construction technique and materials, and often for scientific astronomical observations and calculation, simple devices such as rotation systems were used instead of command structures. None of these cultural features could have occurred by chance, their coherence was obviously the product of a carefully thought through preference for egalitarianism and an aversion to dominant hierarchy.

There is also accumulated evidence that these egalitarian societies were organized into nested systems of larger and larger size, coordinated without hierarchies over areas as large as continental America. Totemic systems operated over huge areas where many different languages were spoken. Similarly rituals were organized in which the smaller units came together. Rules were devised for meetings of strangers to ensure harmony and constructive relations. These appear to have been common all over the planet as their form in Australia was the 'Welcome to Country'.

Cities first started emerging all around the world in about 4000BC but their diversity defies classification. Not just do some lack class divisions, wealth monopolies or hierarchies of administration, all the features found in today's cities, they exhibit such extreme variability as to imply "a conscious experimentation in urban form" (p285). The early cities showed harmonious beautiful patterns in built spaces, statements of self conscious civic unity as a result of municipal planning. Such spaces were used for festivals and other ceremonies cementing the cohesive unity or identity of the people of the city.

Almost overlooked are what are undeniably large cities in ancient Ukraine, dating back to the early and middle centuries of the fourth millennium, before the better known, and smaller ones in Mesopotamia. Disparagingly dismissed as "overgrown villages" (p289), or simple rather than complex, they show no sign of any centralized government, no form of ruling class. They all showed the prominent role of women, and they all featured circles rather than linear arrangements for layouts and structures. Far from simple, they organized huge structures over large distances while maintaining peaceful and cooperative relations with all they met.

It was not only in what is today Europe that huge cities flourished – Teotihuacan in Mexico, 100BC to 600AD was estimated at about 100,000 and again had found a way to govern itself without overlords but with totally different technologies and ecology.

Surprisingly few of the early cities anywhere showed any evidence of authoritarian rule and there was no uniformity of ecological surroundings – farming or legions of slaves to maintain the population were not required. This data chops off another leg of the evolutionary theory.

Graeber &Wengrow uncover a particular form of conceit amongst today's social scientists, a habit of assuming that people who have worked out to live "without overt displays of arrogance, self-abasement and cruelty – are somehow less complex than those who have not?" (p290)

One of the most stubborn misconceptions of the current orthodox view is that structures of domination are the inevitable result of increasing population. The assumption is that the larger and more densely populated groups become the more 'complex' they need to be. Here, 'complex' is a synonym for hierarchy. Graeber &Wengrow found that history does not bear

this assumption out at all, as above. it is no more inevitable in the social world that it is in the natural world.

What we also see with these societies of equals is that rather than personal dominance based on position on a hierarchy of rank, social influence flowed from esoteric forms of knowledge. Australian Indigenous cultures do not feature prominently in this book but similarities abound. Elders in Aboriginal Australia are so called not because they have reached a certain age but because of what they can do and what they know (personal communication). It is the same system of esoteric knowledge employed by many Indigenous peoples around the world documented here from the Americas. This knowledge was used to advance not the individual holder but the unit in everyday productive pursuits as well as instances of religious and other ceremonies.

For the Osaga people, initiation through the levels of understanding required for Elder status necessitated a substantial investment of time and wealth and the few who reached the top level were known collectively as *Nohozhinga*, 'Little old Men' although some were women (p478). They functioned as the intelligentsia and kept records of important discussions. They met daily to discuss affairs of state and were effectively the government although much larger assembl9ies were required to ratify decisions.

It should be noted here that while Elders among the Osage were effectively a governing body, this was not common amongst the majority of egalitarian cultures. More usually they just had some specialized roles. Decision making was a collective activity.

Similarly, the authors note many times throughout when examining different sites or cultures, that although there may have been practice sessions or playful wars, or even people identified as war chiefs, there is an almost total lack of evidence for actual warfare. In some places, conflict was played out through aggressive games. This accords with data from Australia and Papua New Guinea such as *Gardens of War* (Heider & Gardner, 1968). War games were regularly played between tribes and if somebody was injured, it was a tragedy for both sides.

The case of North America with its many different nations is dealt with in detail throughout the book and alone, convincingly illustrates that the evolutionary theory of progress plus the inevitability of statehood as the final destination is nonsense. There are examples of authoritarian or DP1 structures such as Cahokia where the backlash was so severe it reverberates till this day (p482). It leaves little doubt that the indigenous people critiquing European cultures were well aware of alternative political possibilities and that they saw their own social orders as self conscious creations, designed in part at least as a bulwark against authoritarianism and its forms as they observed it in the invaders.

Just one example demonstrates the strength of the objection to authoritarianism: "For the Haudenosaunee, the giving of orders is represented as being almost as serious an outrage as the eating human flesh" (p485). Any member of an Iroquoian society given an order would have fiercely resisted it as a threat to their personal autonomy. However, when it came to dreams which were treated as if they were commands, people had to comply. They acknowledged the subconscious mind with its desires, including the desire to dominate. By employing these rules and practices they acknowledged, realized and controlled the desire to dominate thus preserving the egalitarian structure and functions. This is but one example of the complexity and diversity of the ways in which all these different people in their various setting operationalized and maintained their DP2 structures.

Nor does farming, agriculture, automatically presage the death of egalitarianism and the rise of hierarchy as the modern theorists would have us believe. The Iroquoians began

cultivating maize around 1100AD and then added beans and squash, the 3 sisters of their diet, but were careful to balance the new crops with the traditional pursuits of hunting, fishing and foraging. New, often quite substantial settlements were set up but the old patterns were retained. Children were deliberately spaced so as to not exceed the fish and game carrying capacities, not the potential agricultural productivity. Again we see the commonality with the Australian Aborigines who similarly constrained their population growth to the health of the land.

But in other places, there was a wholescale rejection of domesticated foodstuffs although its cultivation could have been advantageous. This is even more striking when we note that many Californians and N. Coast people did cultivate tobacco and other crops for ritual purposes. As all these people travelled extensively they would have been aware of the other possibilities but simply rejected them.

Examples of this rejection of alternatives, particularly autocracy, include Cahokia, a large settlement in what is now East St Louis, with a population of around 15,000, 40,000 counting its satellite towns, one of the largest cities north of Mexico, looked like an early 'grain state' with the rise of social hierarchies. It was a centralized design built around a huge pyramid standing before an enormous plaza. It gives the impression it was planned to dismantle any of the self governing communities outside the city. "For those that fell within its orbit, there was nothing much left between domestic life – lived under constant surveillance from above – and the awesome spectacle of the city itself" (p466), which could be terrifying with mass killings, mainly young women.

Within a century of the initial urban explosion at Cahokia, a giant palisaded wall was built around parts of the city which was the beginning of the process of war, destruction and depopulation. For whatever reason, and there was probably more than one, people walked away from the city for freer lives elsewhere, leaving extremely unpleasant memories as much of its bird-man mythology was erased from oral memory along with the place itself.

This pattern was repeated elsewhere which Graeber &Wengrow describe as ideological conflict and in the place of the great authoritarian cities, communities resumed their egalitarian forms of communal life (p471). It shows unequivocally that far from being unthinking recipients of the forces of nature or inevitable social dynamics, these people were acutely aware of what they wanted and didn't want, and organized their societies to produce those desired results.

Cahokia ended up being "a place of ruins and bitter memories" (p452). The America the European invaders found was the product of centuries of political conflict and self conscious debate.

So much for these 'primitive' people or childlike natives being swept along on an inevitable tide of 'progress'.

War

There is so much bumpf written about war today, usually trying in some way to justify our belligerent, warlike cultures, that it necessitates a correction from this book. As Graeber &Wengrow note frequently throughout, they find there is no actual reason to believe that war has always existed. By war they mean not just organized violence but a kind of contest between two clearly demarcated sides. War involves two teams who employ the principles of 'social substitutability' whereby any member of one team treats all members of the other team as equal targets. For most of human history people obviously didn't see much reason to kill

others or even engage in destructive conflict at all. There are some rare scattered instances of warfare and as the examples unfold, we can see that they take place in societies governed by DP1. They struggle to explain the correlation between the patriarchal household and military might but students of OST could help them here.

There is a wealth of evidence scattered throughout the book that societies built on DP2 were generally gender equal with women governing without recourse to violence, adversarial politics or rule by command. This was sometimes limited to the more domestic area but not always. A safe rule of thumb is that where the governing principle is DP1, there is gender inequality. Inevitably there, women are treated as inferiors. And there is conflict.

Nor is there evidence that war followed the adoption of farming as there were long periods of peace in farming communities. There is no reason to believe war is "in any sense hardwired into the human psyche. On the contrary, it's almost invariably necessary to employ some combination of ritual, drugs and psychological techniques to convince people, even adolescent males, to kill and injure each other in such systematic yet indiscriminate ways" (p506).

Even in the matter of punishment, the cultures based on the two principles were found to be poles apart. For example the Wendat, from the Mississippi delta, when visiting France were appalled by the whipping, hanging and killing of their own kind. Their own ritual punishments were designed to absorb the strength of the enemy making themselves more powerful; the ritual of the Europeans revealed *a dissymmetry, an imbalance of power within the culture itself.*

This of course makes the current fad of referring to instances of aggressive behaviours which destroy or divide as 'tribal', just so much nonsense. It is yet another example of just how ignorant and conceited we have become in our beliefs that the old cultures arranged into 'tribes' were an inferior bunch compared to ourselves. Nothing could be further from the truth.

Social science

We have note above some of the almost unbelievable failures of social science as it operates today and it is indeed a sad story about these branches of social science that Graeber &Wengrow tell here. "Scholarship does not always advance. Sometimes it slips backwards" (p110). They explain that about a hundred years ago, most social scientists knew that hunters and gatherers were not confined to small bands or groups. That now orthodox evolutionary view emerged from the 1960s.

That an underlying or emerging purpose or theme in this book is the almost total failure of the social sciences to acknowledge the facts of history whereby theorists have promoted absolutely absurd perspectives of people and their societies raises questions about the origins of the social sciences. Why does it seem so odd to many to imagine or believe that people in the past made their own history in a deliberate self conscious way just like we do?

The authors explain that our modern social science has been largely a study of the ways in which human beings are not free, the ways in which our behaviours are determined by forces outside our control. In other words, they had already assumed our unfree situation was inherent, could not be changed,. Accounts showing people collectively determining their own affairs, their own futures and working towards their freedoms in free societies was therefore, always likely to have been judged as suspect, awaiting real scientific explanation.

This is also why so much of our history is categorized in terms of technologies and the basic materials involved in creating technologies, e.g. the stone and iron ages. These technologies are then seen as the primary determinants of culture and society. Not us.

However, once again we see just how far out of kilter this categorization has been as a driving force as the technologies over history made little difference to the internal organization of various cities or even their size.

What is clear from the facts is that "innovation in Neolithic societies was based on a collective body of knowledge accumulated over centuries, largely by women, in an endless series of apparently humble but in fact enormously significant discoveries" (p499). Take for example, the discovery of the role of yeast in making bread.

Wherever you look in history you see women harvesting plants and turning them into food, medicine, baskets and clothes and along with this developing knowledge you also see the development of geometry and mathematics – but most of this has been slid over by male scientists (p238). Not just plants but also animals were subjected to women's ingenuity, not a science of domination and classification but one of "bending and coaxing, nurturing and cajoling, or even tricking the forces of nature to increase the likelihood of securing a favourable outcome" (p239). Based on close observation and experimentation, this science was highly successful.

One of the better questions social scientists could ask involves precisely this: is there a correlation between gender equality or women's freedom and the degree of innovation in a society? Their answer is in the affirmative and holds even more true for social creativity than technological creativity. They state that one of the most striking patterns they discovered was that the zone of ritual play acted as the site for social experimentation and possibilities. Moreover, people did not merely imagine these possibilities, they "actually lived in them for extended periods of time" (p502). Which as they say could not be more different from today.

More directly, some archaeologists such as Gimbutas explored 'Old Europe' from about 7000 to 3500BC (that date again), societies existing under the "tutelage of a supreme goddess" (p216). Her images in the form of figurines were found everywhere from the Middle East to the Balkans and those times were peaceful. They were overrun by cattle keeping, 'kurgan' peoples. They were the opposite of the communitarian Old Europeans as they featured social stratification with aristocrats and warriors and as we would expect, were patriarchal with the radical subordination of women.

Although Gimbutas was ridiculed and vilified during her life, recent DNA analyses have vindicated her research.

Not only Old Europe but throughout the world, the equality of the sexes is found with much the same characteristics, lack of hierarchy and general political equality. In some cases such as the Iroquois and other original American people, women, and sometimes the grandmothers specifically formed the councils and made the critical societal decisions. This system is still in place to this day amongst the Mohawk (personal experience).

With examples like Minoan Crete which today's social scientists avoid like the plague, it becomes clear that not only were the great civilizations of the past based on gender equality, they were also societies in which creativity and thus innovation flowered with women taking their fair share if not more of the kudos for successful, long lasting discoveries and inventions.

Minoan Crete and its city Knossos is simply an extreme example which frustrates many modern scholars as it presents absolutely no evidence of monarchy while providing

ubiquitous evidence of women's political superiority, women holding symbols of command, performing fertility rites and meeting together in assemblies with no male presiding (p435). The so called 'throne room' in Knossos was an open space surrounded by stone benches symmetrically arranged in rows so people could sit in comfort with all visible to each other, more a council setting for female councillors or a theocracy governed by priestesses rather than a throne room. Cretan palaces were unfortified and rather than war and conflict, there was an emphasis on celebrating life, of all species, play and creature comforts.

Graeber &Wengrow uncover in monumental detail the "mythical substructure of our social science" (p525), the erroneous axioms which have underlain it. This new knowledge they contend should enable us to rediscover the meaning of their third freedom, to create new and different forms of social reality.

Criticism

Graeber &Wengrow maintain that the Middle Ages for example were socially unequal with instances of "folk egalitarianism" (p34) played out during festivals or carnivals such as May Day or Christmas where the authorities or 'carnival King' or 'May Queen' were dethroned or mocked. However, while inequality may hold true at the so called state level where there were monarchies and hierarchical court structures, had they understood the design principles, they would have realized that the great mass of people were free to organize themselves and did so on the basis of DP2 as is obvious in the cottage industries and field world. There was no hierarchy in the many cottage industries and certainly not out in the fields where small groups worked the land and it was all hands on deck from the village at times e.g. to get the harvest in.

This was the situation until the Industrial Revolution when all strata were sucked into the factory system, turning them from free to slaves to the machine.

11. Physics

Physics – can it still be considered a science?

For years now, the laws of physics have been in a bit of a mess. Are there any left that still actually work without the endless invention of mythical entities or substances such as dark matter and/or dark energy or the hugely expensive and apparently endless search for hypothesized particles. After all this time searching for the missing in action, wouldn't a genuine scientist say that the data does not fit the theory and, therefore, we should find a new theory. Yet physicists of the particle, big bang variety do not do that. From the very beginning of the search for the smallest particle through Einstein's discovery of relativity through to quantum physics, physicists have refused to throw away the basic tenets of their 'discipline'. How long does this farce continue before somebody accuses physicists of behaving unscientifically?

For many years now, physics has been on a quest for the 'theory of everything', a unified field theory. Two versions of a Grand Unified Theory (GUT) have been developed during this quest. The first "seeks to describe electromagnetism and the weak and strong nuclear forces as a single force…The more ambitious version seeks to include gravity in the unification framework (Gleiser, 2010, 29).

There are numerous examples of just how far from describing reality physics actually is. Here are just a few:

"The Milky Way should be surrounded by mini galaxies. That it isn't spells trouble for gravity as we know it" (Chown, 2009a, p37). It has been described as "the cleanest case in which we can see there is something badly wrong with our standard picture of the origin of galaxies" (as above). But not only is there a disturbing lack of mini galaxies, the few that do exist are behaving badly, so badly that they are challenging the strength of gravity as posited by Newton.

Dark matter is required to explain why the stars in spiral galaxies can orbit at "breakneck speeds without being flung off into the void" (Chown, 2009a, p38). Such is the size of the problem that 6-7 times as much dark matter than the real visible stuff is required. Dark matter is also required to explain the current theories about the shaping of the early universe. It is the dark matter hypothesis that predicts the many small companions of the Milky Way. It also predicts that these mini galaxies should be "moving on random orbits and distributed in a spherical shell around our galaxy" (as above). However, most of them are confined to a plane perpendicular to the disc of the Milky Way and orbit in the same direction. "This is completely incompatible with the dark matter model" (as above).

So now there is another scramble to explain or explain away the latest problem with modern physics. There are competing sub-theories whose proponents are fighting it out for supremacy. One competitor is prepared to modify gravity, a theory known as modified Newtonian dynamics or MOND while others see the problem of merely as a matter of time before we can construct bigger and better telescopes to detect the millions of missing galaxies.

There were attempts to revive MOND after it was discovered that there was a "tight correlation between the galaxies' rotation speeds and the distribution of the visible matter they contain" (Anderson, 2017, p30). This held across a wide range of galaxies, like a 'natural

law', showing there was clearly something up with gravity. So new hypotheses were applied to MOND.

Alas, these tend towards the more esoteric end of the scale – "gravity could be an emergent phenomenon, a consequence of interactions between entangled bits of quantum information" (Anderson, p31). From the frying pan into the fire!

In 2012 Clark reported that all the tests to reveal dark matter founded on the fact that it appeared to be different stuff to different detectors, with no two the same and if what they are seeing is truly dark matter, "then it's not what anybody thought it was" (Clark, 2012, p31).

Conflicting detections and a weight for the dark matter particle being far too light, less than a tenth of what was expected meant the WIMP was looking exceedingly wimpish. WIMPS should also be able to be created in the LHC's high-energy collisions but none have shown up. Some have suggested the axion particle as a replacement for the WIMP but they are classified as 'cold' dark matter, the existence of which is disputed.

If there is dark matter it should be able to explain the absence of small scale structures in the universe, or dwarf galaxies. Theoretically, there should be tens of thousands of these galaxies but nobody can find any sign of them. Newer hypotheses are centring on 'warm' dark matter consisting of lighter, faster moving particles such as 'sterile neutrinos', or 'dark atoms'. There are others, all of which sound equally fanciful to a laywoman, more like a fairy story of what the naughty girl found in the forest. Clark concluded "either astrophysics is wrong, or particle physics is wrong, or our whole understanding of dark matter is wrong" (p33).

One attempt to include gravity in a GUT is superstring theory. Superstring theory is prepared to abandon “the age-old paradigm that matter is made of small, indivisible blocks, substituting them with vibrating strings that live in higher-dimensional spaces (Gleiser, 2010, 29). It is mathematically elegant but like all the other attempts, “the theory is so detached from physical reality that it is exceedingly difficult to determine what a measurable string effect might be” (Gleiser, as above).

At the beginning of 2010 I wrote: “However, after all this time, all the observations that can’t be explained and all the failed demonstrations, nobody is prepared to say that perhaps the universe is not held together by gravity, that perhaps reductionist physics simply doesn’t work. The high priests and foot soldiers of the orthodoxy alike will simply not concede that their assumptions are wrong”.

Now one brave man has done exactly that. Marcelo Gleiser believes “that the very notion of a final theory is faulty…Science is full of surprises. Much better to accept that our knowledge of physical reality is necessarily incomplete. This way, science is understood as a human enterprise and the ‘mind of God’ is exorcised once and for all” (Gleiser, 2010, 29).

Now let us remember that what Newton was proposing was that the universe works like a machine. A Newtonian universe based on Euclidian space is the bedrock on which the current physicist orthodoxies rest. Newton assumed a closed system but as we see in all of our chapters, assuming a closed system has proven false in every area of enquiry we have examined and nothing works like a machine. So if none of the parts of the universe fit the Newtonian assumptions, why should the whole?

Some astronomers and cosmologists do acknowledge the reality of open systems. In his book *Heaven’s Touch*, James B Kaler “describes in detail how the moon, sun and planets

continually nudge the Earth's spin axis and orbital plane, triggering mundane effects such as the wandering of the north celestial pole, and more catastrophic effects like the ice ages" (Chown, 2009b, p44). The Earth is also subject to more distant and violent events such as supernovae and gamma ray bursters. However, Kaler also reminds us of the real nature of an open system – not only are we subject to outside influences, we are of the universe. "The iron in our blood, the oxygen that fills our lungs each time we take a breath – all were forged in the furnaces of stars that lived and died before the earth was born" (Chown, 2009b, p44).

Another closed system bites the dust: The half-life heresy

The original article is by Hazel Muir, Half-life heresy, *New Scientist*, 21 Oct, 2006, pp36-39. It concerns observations that the orthodoxy that the rate of radioactive decay and similarly, the rate of nuclear fusion, are totally independent of the environment, is false. In other words, these rates are also environmentally influenced which also means that we can exercise some control over them; i.e. these processes are open, not closed systems.

The heretic involved is Claus Rolfs who has spent his life researching the innards of stars. He heard of a strange result in a lab in Berlin and followed it up. His lab has replicated the experiments many times over with 50 different materials and has consistently found that the rates of fusion can be changed by varying temperature for example. He has verified that protons fuse more quickly in a cold metallic environment rather than an insulator.

He then wondered could a cold metallic environment also influence radioactive decay which is pretty much the opposite of the fusion process. They have been running tests with this and find that there is an effect. Rolfs has built a model that obviously needs more work as it is estimating the direction but not the size of the observed effects.

"Perhaps the most striking result to date comes from an experiment this year in which Rolfs bombarded a sliver of highly purified gold-197 – the metal's normal stable isotope – with neutrons. Some of the gold atoms absorb a neutron to create radioactive gold-198, which undergoes beta-minus decay with a half-life of 2.7 days. With the gold-198 atoms surrounded by ordinary gold, Rolfs model predicts that their half-life should increase by about 1.7 hours, even at room temperature.

Conveniently, he could now measure the half-life directly, by counting the gamma rays released during the beta decay, and timing how long the count took to halve. The results which are still to be published, amazed him. It turned out that the half-life actually increased by a whopping 5 hours" (p38).

Naturally, other physicists are deeply sceptical. Some say that while it may work for beta-decay, it cannot work for alpha-decay. However, Rolfs has some preliminary results for alpha-decay which show promise. He and physicists from CERN have planned an experiment with radium-226 that should solve the matter in a couple of years.

The results will not only affect our understanding of what we do with nuclear waste but also affect our understanding of the Earth - there is more heat produced by the core that can be predicted by the current assumption of rates of decay. Ditto, it will affect our estimates of the age of stars and the universe itself. All are based on the same assumption of a constant rate of change.

In June 2009 another article appeared documenting another puzzle regarding the lack of constancy in the rate of decay of radioactivity. This time the lack of constancy involves a periodic wobble that follows the seasons. The wobble was originally discovered in 1986. "If

we know anything about radioactivity, it's that this kind of thing just doesn't happen. Radioactivity decreases predictably over time" (Mullins, 2009, p42).

New research has now found the wobble is the result of interference from the sun. Far from being random as mechanistic theory predicts, the wobble was annual. "The closer Earth was to the sun, the higher the decay rate was" (Mullins, 2009, p44). The search is now on for exactly what is causing this wobble but it now seems accepted that radioactive decay at least, is a function of an open system.

This is helping to clarify another "curiosity", the fact that when the age of trees judged using carbon-14 dating is compared with their age gauged by counting their rings, the discrepancy between the two gets larger and smaller over a cycle of about 200 years. "Wiggles in carbon-14 data are well known as a nuisance" but the 200 year cycle suggests that the wiggles may be determined by the de Vries/Suess sunspot cycle and, therefore, the sun's rate of neutrino emission.

Note the language used around this issue. The period variation in and, therefore, inaccuracy of the carbon-14 dating has been treated as a 'curiosity' and a 'nuisance' rather than an exception to the rule of radioactive decay constancy. If these observations had been taken seriously as exceptions to the assumption of constancy, our knowledge of radioactivity and its decay would have proceeded so much faster. This neglect is typical of the dedication to an orthodoxy – '*a few facts should not be allowed to ruin a good theory'*.

The June article was followed by three letters to the editor, the first of which reported previous work in 1994 that found the radioactive decay of tritium absorbed in titanium particles could be reduced by 40 per cent at temperatures between 115C and 275C (Van Nieuwenhove, 2009). Van Nieuwenhove also reported that "the most dramatic change in radioactive decay has, however, recently been observed by Fabio Cardone and others on he decay of thorium-228 by using ultrasonic cavitation in water…In this case, the radioactive decay rate was increased by a whopping factor of 10,000." He concluded from this that "*radioactive decay constants seem not to be constant at all*." He then went on to explain that perhaps that is not really so surprising as radioactive decay is a result of "random particle interactions between the surrounding vacuum and the nucleus. Changing the vacuum state will inevitably change the radioactive decay."

The other two letters were from researchers who are now attempting to pin down the annual decay cycle and particularly the fact that there is a gap between the closest month to the sun (January) and the peak decay rate in February.

This is just another example that one by one, closed systems are being shown to be open. As NASA and many others found out long ago, it is impossible to build a closed system but the belief in their continued existence is strong. *Radioactive decay rates as constants, regardless of environment*, is one of the big sacred cows and if this particular cow carks it, there will be huge implications for our understanding of the physical world. It marks another confirmation that a fundamental change of theoretical framework from closed to open systems is required.

Another constant isn't

It would appear that it is not only the rate of radioactive decay that is not behaving as expected by mechanists. Even the speed of light, one of the most fundamental building blocks of physics is behaving badly. Bursts of energy from galaxies far away are routinely measured by physicists and recently some have shown some unusual characteristics: some lower energy

photons arrived up to 4 minutes earlier than the high energy ones. In another example, the low energy photons beat the higher energy ones by up to 20 minutes. ‘This should not happen. If an object is 500 million light years away, light from it always takes 500 million years to get to us, no more, no less. Whatever their energy, photons always travel at the same speed, the implacable cosmic speed limit: the speed of light” (Ananthaswamy, 2009, p27).

To explain this inconvenient observation, additional hypotheses must be entertained, e.g. something got in the road of the high energy photons. In other words, there are obstacles in space. While it is agreed that space is not entirely empty, there is no agreement about what it contains or how one would identify and measure these contents. The fabric of space-time remains as elusive as ever.

Perhaps, these anomalies “put us squarely on the road to a quantum theory of gravity and on towards the long elusive ‘theory of everything’ (Ananthaswamy, 2009, p27). However, as there is no agreement about any quantum theory of gravity, it seems that physics is a long way from a ‘theory of everything’ and actually receding from a theory of anything.

By 2018, Cossins could write, "lately though, particle physics as barely proceeded at all" (p31). Far from obeying natural or beautiful laws, everything they touched was full of holes or started to fall apart as soon as they examined it. Even the joy about discovering the Higgs Boson became curtailed when it turns out its mass is almost unbearably light.

So the theoreticians were off again, by inventing supersymmetry, SUSY, to restore the Higgs to its natural state. They expected 'sparticles' would start to show up at energy scales just beyond the Higgs, and "physics would roll victoriously on " (p32). Except it didn't. All tests including those with the LHC have come up empty handed, zilch. To make matters worse, we are running out of parts of the universe to look in.

This is *a story of profound failure*, from the first time a researcher refused to acknowledge the new data basically destroyed their theory through a constant series of episodes where desperation to maintain the orthodoxy by whatever means possible took precedence over the responsibility of scientists to admit their theory might be wrong. There is simply insufficient evidence to conclude we live in a gravity based universe.

OTHER EXAMPLES OF ANOMALIES ETC IN HERE – That was a note I wrote to myself but I didn't follow it up. I found the whole thing too sad and depressing to constantly document how far so many of our scientists seemed unaware that they were violating the very tenets of scientific method, the doctrine by which they should be ordering their observations, theories and experiments.

July, 2023.

I gave this chapter up some years ago as it seemed a total waste of time to constantly document the inability of the world's physicists, cosmologists and astronomers to admit that their theories were failing every known test of validity and necessitated a return to the beginning, and by that I do not mean *'The Big Bang'* which is part of the problem. Week after week, year after year, *New Scientist* documented the anomalies scientists could not understand, observations that defied all current explanations, experiments which left researchers shaking their heads and all of it costing huge amounts of money as we chased not only a gravity based universe, dark matter and dark energy but that even more elusive substance of credibility.

I left it alone; the whole scope of all the related disciplinary fields were busily cementing their own failure and I was too disheartened to document it.

Then, one cold afternoon I came across an article entitled *Our magnetic universe* (Clark, 2022) and guess what – my faith in basic science suddenly returned from the cold distant reaches of space to planet Earth.

Mind you, this article continues the mythology that our theories really are going well as the introduction states: "The cosmos is full of beautiful structures, but what created them? ***The surprising answer seems to be not just gravity***" (p35). Thirty two years after "*The Big Bang Never Happened'* (Lerner, 1991) and in which interval innumerable observations and experiments showed our now elaborate theory of gravity could simply not explain much about the universe at all? But never mind, there is renewed hope.

General relativity became the bedrock of gravity but the inconsistencies started rolling in and Clark documents one of them. Then came the hypothesis of 'dark matter' and later that of 'dark energy', both examples of what one should *not* do when confronted with failures of your theory.

Although magnetism had been considered too weak, Alfven pointed out that much of the stuff in the universe is in a state of matter called plasma, a gas made of charged particles. He reckoned magnetic fields must play an important, *if not dominant*, role in shaping the cosmos (My emphasis). Testing this hypothesis was difficult and interest faded again.

Then the discovery of another serious anomaly in late 1990s, that the plasmas inside galaxy clusters are inexplicably hot, at 10 million degrees C. According to gravitational physics, the gas should have radiated away that heat long ago. Finally, they observed the spiral galaxy NGC 1068, the core of which was known to be a source of polarised infrared light, a sign of a magnetic being present which is ordering cosmic dust to polarize the light. In NGC 1068 "they saw something extraordinary: the magnetic field was clearly following the spiral pattern of the galaxy" (p36). Gravity couldn't predict, or explain, this.

They then examined 20 nearby galaxies and every single one of them has a large scale magnetic field permeating the whole galaxy, all of which follow the shape of the spiral arms. Other researchers have now found exactly the same thing in other galaxies. But this was insufficient to confirm magnetism as a force similar in its power to gravity.

With the ever increasing power of our computers and modern simulations, they have identified 'turbulent dynamos' that can hugely boost a magnetic field's strength. Again there were problems until the emergence of large laser laboratories which can create a plasma hot enough to get close to the conditions where a turbulent dynamo can be studies (p37). They created this for the first time in 2018 and watched a turbulent dynamo in action.

A massive experiment later in 2018 had the right magnitudes to create a very hot plasma but instead got a patchwork of hot and cold spots. Replications yielded the same result. Finally the penny dropped as they realized the laser was creating such a high temperature that the magnet was capturing particles inside certain regions of the plasma. It means the magnet field created could hold plasma in place for billions of years. The magnetic field contains enough energy that it can tell matter how to move, just like gravity does, or is supposed to.

"Astronomers need to start taking magnetic fields a lot more seriously" (p37) as should we all. Is it powerful enough to banish the need for all the dark stuff and all the superfluous hypothesized entities? Time will tell, but *I've got my money on an electromagnetic universe.*

And there it all ends folks, not really a fitting end of the supposed Queen of the Sciences.

12. Conclusions

The conclusions are short and simple.

1. Many scientists seem unaware that they are the inheritors of two traditions in the history and philosophy of science, i.e. that there are basically two sciences, one a real science based on realism which acknowledges open systems and uses functional or operational definitions.

The other approach which is based on abstract rather than material universals has become the dominant type in some disciplines and is distinguished by its use of closed system assumptions and is colloquially known in some circles as 'science by noun'. It has been shown to continually run into trouble with destructive results, conclusions which are obviously contradicted by reality or perhaps results which cannot be reproduced. A range of problems like this leads to science which is one step forward and one or more backwards.

The obvious way to correct this gap in basic knowledge is to keep making scientists aware of the distinction and the mistakes they may be making. It is way past time that the history of science is taught in all science courses with due attention paid to the Thin Red Line (TRL) of material universals.

2.In terms of the specific use of open or closed systems, the documentation done here makes clear that research based on closed system is inherently flawed and this is manifested in a variety of ways. Whether it be discussions about forms of evolution or 'conventional' research involving transfers from test tube to human, there are no 'ifs and buts', it is as clear as a whistle – using closed systems is going to get you the wrong answers, and probably a heap of trouble.

3.In terms of the assumptions made about the genotypical design principles, there is one conclusion which is slowly becoming inescapable. Whether the assumption is fairly explicit as it is in the chapter on human hubris or whether it is more implicit as it is in the chapters on biology and social science, the assumption that humans are way ahead on the evolutionary scale and have a great collection of capacities denied the lesser species on the planet, is just plain wrong. As more and more unbiased research documents the capacities of our fellow species, so there is more and more evidence that what we can do, they can do too.

4. There appears to be only one capacity that has, as yet, not been documented in a non human animal and that is ***awareness of awareness***, i.e. Chein's definition of consciousness. Not the waffly, totally ephemeral and many meaning consciousness but the critical one of being able to be subject and object at the same time. That appears as our ONLY distinguishing feature. Mind you, it is big and important one – but the only one.

So if science could:

- substitute open systems thinking for closed systems thinking and reductionism
- put away our equating of common sense with linear logic, and,
- search for the genotypical features behind the myriad of phenotypical differences we see around us,

we may have a better chance of speeding up our understanding of our world.

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