

REVISITING ANGELS FEAR: RECURSION, ECOLOGY AND AESTHETICS

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ABSTRACT

In honour of the centenary of Gregory Bateson's birth, this article revisits some of the themes of his posthumous publication, *Angels Fear*. Some of the book goes over ground that Bateson had covered in prior publications, yet it contains three new themes. The first of these concerned recursion. Generally unnoticed by the reviewers of the book is that Bateson presents a reply in his discussion of 'structure' to the concepts and topology of structure-determined recursion articulated in Maturana and Varela's notion of *autopoiesis*. The second and third of these themes are those of ecology and aesthetics, and their juxtaposition as ecological aesthetics. These are viewed from his communicative perspective and in an entirely novel way he links ecological aesthetics to epistemology. For example, he argues that the science of biology required an ecological aesthetic because biology, like any self-recursive communication system, must become aware of the disruption of its own relations with the unity of nature or forever continue to conduct bad science. The final section of the article steps outside *Angels Fear* to address briefly issues raised by the introduction of two processes of recursion, the one semantic and interpretative (Bateson), the other structural (Maturana). The first exemplar raised is family therapy, the second exemplar is that of biology itself. It concludes that the world of signals and signs seem to be a universal aspect of living systems, a veritable 'semiosphere' of signification and interpretation neglected by biological science. If there are new topologies of recursion to be found, they will be found in the recursive processes of this 'semiosphere' (Hoffmeyer, 1966).

1. A SUMMARY VIEW

Gregory Bateson's posthumous publication, *Angels Fear: Towards an Epistemology of the Sacred*, authored together with Mary Catherine Bateson is, like many posthumous publications, a strange

book (Bateson and Bateson, 1987). For that reason, some reviews of this publication did not engage its themes (Marcus, 1988) and of those that did, some could not decide on its merit (Krippendorf, 1988). The idea of the book was originally set out by Bateson in his concluding sections of *Mind and Nature*. He proposed to discuss questions of unity and integration of ideas on and about the relations between mind and nature, by re-casting notions of aesthetics from the prevailing perspectives of artistic taste and/or cultural capital and join aesthetics to the ecological as a necessary part of ecological science.

Bateson did not refer to the ecological literature but had he done so he would have found a stream of writing supporting the view that aesthetics is indeed part of an ecological vision (Callicott, 1989) There is in fact a wide range of writing in the ecological field suggesting that an aesthetic vision is intrinsic to human perspective on life as is evident in religious activity, in artistic endeavour and in a variety of skilled practices, which is why books about ecology are sometimes written in terms of a spiritual quest, rather than in terms of a scientific appraisal. In some of the more influential books, like those of Arne Naess, they are conjoined (Naess, 1990).

A thumbnail summary of *Angels Fear* might be as follows: the book proposes a search for the unity of life, akin to the notion of the unity inherent in the sacred aspects of religion. The study of unity requires an epistemology, a set of procedures about how one might investigate the phenomenon of unity and derive from further understanding of holism, its order and its organization. Science has its own conventions of the sacred, but most of these lie in a scientific method dedicated to the study of 'parts.' Science rarely, if ever, deals with wholes. Those aspects of the world that scientific method cannot determine through its investigation of parts - that which is deemed to be unknown - is usually fobbed off into the realm of mystery and spirituality, and remains unexamined. This is non-science, more akin to seeking solutions in magic than in science (1987:Chapter V). It has become too easy for modern science to continue to treat the biosphere as it had treated any other mechanism since the sixteenth century. An investigation of ecology as a holistic phenomenon would be a very different sort of undertaking, not only in a switch of focus from the physical dimensions of biomass and energy to a study of ecological form, but also in the methodological path it takes. If the so-called 'mystery' of ecological unity was to be investigated, then explanations derived from quantitative examination of ecological formation would have to be reconsidered or abandoned, as would the inferences of drawn from these correlations. The major investigation would be one of how parts fit into a holistic order, and vice versa, how holistic order is contained in the development of parts. Such an investigation would also require premises very different from the premises of rationality driving modern science. An adequate epistemology of holism incorporating aesthetics was not meant to promote a return to a mediaeval realm of the sacred, nor did it mean uncritical acceptance of any

particular spirituality or world-view of peoples either inside or outside major religions. It did mean acceptance of the idea that holism, unity and beauty were coincident with each other and should be an integral part of any modern science deciding to investigate the game of life. Otherwise a science of ecology would be bad science.

Part of the book's strangeness is that Bateson's critique of the epistemology of modern science was scattered throughout the book. Marcus could not find its central focus and accused Bateson of a simple re-cycling of previous ideas. Yet Bateson's own conversational style was quite deliberately staged in order to unfold in such a way as to render it impossible for his listeners to detect any facile outline in his stories. They were also irritated by his lack of conclusiveness in his writing style. Both responses are why many people find his writings difficult to understand, and why, as Bateson himself reported, his students saw him as someone who 'knows, but won't tell you'. These elements of the Bateson style, well rehearsed in various guises over a long period of time, reappear in *Angels Fear*, Marcus is certainly correct about that. However, Marcus neglected to examine changes of context which in which the recycling of ideas appears. Thus he ignores an important aspect of the history of social sciences which Bateson's writing reflects particularly well.

In the immediate post World War II period, Bateson aimed his concerns at those social sciences, including anthropology, which seemed to be following unthinkingly in the intellectual footsteps of the physical sciences. Before the war, this follow my master procedure might have been forgiven. Bateson himself admitted in *Naven* that he too had paid unthinking attention to mechanistic views of equilibrium in society and its corresponding fictions (Bateson, 1958). The premises of natural science and the importance of these to anthropology were central to the influence of Bateson's mentor, A. R. Radcliffe-Brown, in his successful attempt to establish anthropology as a world-wide discipline. For Bateson, as for others, the Manhattan Project and the dropping of the first atomic bombs was a world changing moment for the physical sciences. Physics had produced a technology that could destroy humanity and was either unwilling or unable to place moratorium on further research. Research continued to make total destruction more efficient. It was appropriate, Bateson argued in a series of lectures in 1946, that social sciences take account of this abrupt shift of context. The Manhattan Project had altered the whole position of the science of physics in both purpose and ethical contribution. The broader challenge, as he was to develop it, was to re-cast our understanding of survival and of change in terms of the new 'king' of the physical sciences, biology.

In the years in between his initial warnings of change of context and *Angels Fear*, biology became the successor to the supreme position held by physics in the 19th century. Yet in Bateson's view biology, with its sub-division ecology, had yet to contemplate or to criticize sufficiently its in-

tellectual debt to physics, nor examine reflexively the consequences thereof. Physics had declared the separation of mind from matter, and the separation of natural science from nature, a separation first established in the 16th century. Biology still held to a tradition of natural history until the 19th century but in the 20th century began to privilege investigation of organic material, bio-energetics and biomass, leaving the study of biological form as a relative backwater of the discipline. Biological science had to become aware of the consequences of the break in natural harmony that this decision about its practices brought about. A continuing insistence on the premises of dualism, borrowed from physics, had led to increasing ignorance of the unity of biological organization. Biology, like any self-recursive communication system must become aware of disruption its own relations. This means becoming aware of the myths by which we live and the way in which these myths establish a pattern that results in our becoming that which we pretend (1987:Chapter XVI). The myths of dualism, body separate from mind, are among the most conspicuous of these myths. In contrast to the ever increasing public interest in whatever product that biological science could provide, Bateson claimed that a new conception of holism will certainly draw us toward an awareness of a larger more inclusive system than the one in which most biologists and ecologists currently work and enable us to see the beauty of its formal patterning.

To fully catch the meaning of ‘towards an epistemology of the sacred,’ the subtitle, requires background information in biology and in the relationship of biology to the social sciences through the practices of family therapy that Bateson merely alludes to and never confronts head-on in the book. The discovery by James Watson, Francis Crick and Maurice Wilkins of the structure of DNA in 1953, the genetic code, was as transformative in biology as the success of the atom bomb in physics. It could be argued, and was argued, that this knowledge was as destructive of life as the atom bomb, if used improperly, although the destructive effects would inevitably take much more time. Much depended on how molecular biologists who seemed to take over the direction of biological investigation in the wake of the Watson-Crick-Wilkins discovery felt about this accomplishment. James Watson has always been at one end of the argument since the 1950s. Commenting recently on his own role in the discovery of DNA coding and its implications for humanity, said: ‘If we don’t play God, who will?’ Watson dismisses the critics who challenge the wisdom of biology ‘playing God’ either in the past or in the future by saying that the course of biology and biotechnology since the discovery of the code has been ‘just trying to use common sense.’ He believes that the modern course of biology is no more god-like than the aggregation of a myriad of practical solutions and the continuing bold pursuit of these practical solutions with technology available (Moore, 2004). Not all biologists endorse James Watson’s position. Bateson’s argument in *Angels Fear* that when humans presume to ‘play God’ armed only with their supposed ‘common sense’ the consequences are grave.

The presumption that humans can play God tempts Fate in the same way that all acts of hubris tempt Fate and Bateson has a section of the book devoted to this particular theme. He separates this theme from other sections of the book where he Bateson speaks as a developmental biologist, a branch of biology that has generally been critical of the over-arching claims of the molecular biologists who have insisted since 1953 that they have discovered the blue-print of life. If one put the two sections together, his rebuttal to those who have the same attitude as James Watson's is 'you have no blue-print' and 'you have a wrong sense of the sacred.' The nature of sacrament is always related to increasing our awareness of interconnection with holisms

2. RECURSION: PROCESS ONE

Investigation of social and biological systems is not equivalent to investigation of physical systems, Bateson states, for all social and biological science is *participant investigation*, unlike the observer-oriented science of physical systems. Living systems are recursive systems, any substantial investigation of them will always come around to stab you in the back. This is the first rule of recursion. One may continue as both scientist and religious practitioner to indulge in the hubris of asking questions but we need humility in acceptance of our answers (1987:Chapter XIII), the humility that comes with awareness of insufficient holism which in turn stems from non-knowledge of wider dimensions of the rules of life (1987:Chapter V) . Moreover, we should bear responsibility for our non-knowledge. An ecological aesthetics at the very least gave insight into holistic patterns pertaining to the unity of life and provides a contrast to the *ad hoc* science of parts of patterns.

Bateson supplies his own analysis of Greek drama to underline the inevitable destiny of those caught up in acts of hubris and their tempting of Fate (1987:Chapter XIII). One of the original words in Greek for 'soul' was *psyche*, and Bateson illustrates the interrelation between the two in a classic tale of Greek drama.. The interrelation should not be missed. He combines his Greek tale with a short passage immediately before on a theme that appears in many other of his writings, namely that individual beliefs become self-validating in human interaction. Repeated human interaction provides the redundancy whereby beliefs, hopes and fears 'clot together' to create 'aggregates' or embodiment of themes of which the individuals may be unconscious; yet these themes shape the actions of believers. Out of the very flexible and viscous nature of the *psyche* pathology can arise . Despite the relatively abrupt introduction of this passage recounting the tale of Oedipus, Fate and hubris, it immediately precedes another passage which summarizes his approach to his book. The myths in our own society, our hubris, makes all the more necessary a perspective oriented towards

recursion in biological systems and the development of an appropriate recursive epistemology to match.

Angels Fear provides the longest discussion on the specific topic of biological recursion in Bateson's writing, although this should be qualified by acknowledging that cybernetics is a science of recursive systems and Bateson as is well known, he wrote a great deal about cybernetics in relation to biological systems in his other published work. There are also interesting passages about biological recursion in unpublished sections of *Mind and Nature* (Harries-Jones, 1995). *Angels Fear* links his discussion of recursion to the notion of 'structure,' structure being a perennial problem for both biologists and social scientists. In the original manuscript the section devoted to 'structure' is so long - a 'recensus' as Bateson expressed it - that had it been published as written, the whole book would have had an unwieldy edge to it. The reason for this is that Bateson was wrestling with two processes of recursion and attempting to resolve the two. He was also examining the processes of recursion in two different contexts, those of biology and those of pathology in human interaction. The book shifts, sometimes abruptly, between the two. but this sort of comparison of context, or abduction of thematic material in two very different realms of experience in order to draw patterns of connection between them, is very characteristic of Bateson's style.

Many regularities contribute to their own determination, he says, and this recursiveness is close to the root of the notion of structure. Information, news of its regularity, or injunctive aspect of recursiveness, is fed back recursively to control action at the next instant. In biology, there Bateson argues that recursive regularities cannot be simply read-out as if they were regularities derived from the code of a control programme, nor can information be treated solely in the context of a digital control mechanism. Those that treat DNA as a blueprint of life neglect two important aspects of biological recursion. First, biologists need knowledge of the rules for injunctive steps and second they need to know how the order of steps, the 'recipe' for any outcome is being interpreted in developmental sequences. One is a meta-control issue that arises in developmental biology and the study of evolution, the other is an order of knowledge that arises 'between the lines' of text of genetic control. Recipes for sequence are injunctions that lie *between the lines* of the commutative or distributive laws of mathematical logic. The former concerns relationships between things, their continuity or discontinuity, the latter is, in effect, an issue of participant interpretation. For example, the embryo must know the order of steps for its epigenesis, within the algorithm of its development. In a striking image, 'the developing embryo is always there to witness and critique its own development, to give the orders and control the pathways of change and response.' (1987:155). Both sets of information are different from the notion of DNA as a series of computational instructions that can be accessed through the mathematics of computational analysis. Bateson pointed towards morphogene-

sis as an exemplar, but here his arguments begin to reach a slippery edge because he held that the genesis of form is an aspect of communication rather than an aspect of substance, and in all questions of form, biological material and its manifestation and must be re- conceptualized as invoking processes of communication.

By no means do all biologists who study morphogenesis subscribe to morphogenetic development as development of a communicative form. Nevertheless, they might subscribe to the notion that morphogenesis i.e. the whole enters into the parts of the whole of the developmental process. Genes do not control; they cooperate in producing variations on generic themes produced by the dynamics of morphogenetic fields (Goodwin, 1994:41) What sort of processes of recursion may, therefore, be regarded as its typical features, and in what way does discussion of the recipe for embryonic development, the embryo interpreting the environment of that which it is part, differ from other rules of interpretation?

Krippendorff's review of *Angels Fear* is a help in this respect. He points out that for many years the processes of communication that Bateson had investigated were linked in one way or another to the forms of recursion. Bateson's particular emphasis had been with the way in which communicative order in its recursive form had an abstract underpinning in the Theory of Logical Types and in the ways in which human beings find difficulty whether as scientific observers, or in family situations from distinguishing the difference between 'maps' and 'territories.' Logical Typing distinctions give rules for establishing a hierarchy of order, in which maps can be distinguished from territories within given contexts of observation. The rules of Logical Typing essentially deny circularity at the point of re-entry in a recursive system. But the ordering rules can never work in any complete and deterministic sense in communicative systems. The context of the self attempting to observe the 'self', is a quintessential participant situation, and in this sort of situation the likely result is that maps and territories begin to mutually define each other. A mapping of the self involves humans in a constitutive, self-defining circularity, thus breaching the rules of Logical Typing. Nevertheless 'the self' habituates and justifies such breaches.

For Bateson there were evidently no 'cures' to this elemental problem of typing. One cannot in any practical sense take Logical Typing as a cure to errors of participant self-definition. This the position was justifiable for the originator of Logical Types, Bertrand Russell, in solving mathematical paradox in set theory, because he was able to be an observer outside the paradox he was trying to resolve. But for observers inside paradox of communication attempting to communicate either to themselves or to others as if they live only in an observer- defined world, would quickly end in communications that would be by most accounts pathological. A fundamental paradox occurs and

recurs again in a participant world of communication; namely, those self-definitions and circularities which can be ruled out in an observer-world by the very rules which the Theory of Logical Types employs cannot be avoided in a participant one. Communicators always live in a forked universe of being both participants and observers. The ‘cure’ is that they must be able to handle the very different perspectives that this situation engenders. In some situations communicators evidently are able to play with the difference between perspectives leading to humour, jokes, and metaphors we live by. On the other side, lies self-destructive confusion about differences in observer and participant perspectives. When, for one reason or another there is a prohibition on communication that effectively blocks the elaboration of difference in perspectives, pathology is most likely to occur. Most frequently this occurs among people who are intimate with one another.

3. RECURSION: PROCESS TWO

Krippendorff points out that a second pattern of recursiveness which Bateson discusses in *Angels Fear*, is of processes that permit rather than deny circularity at the point of re-entry. These processes ‘bootstrap’ circularity so that any ‘top’ is continuously re-cycled through a ‘bottom’ and thus all cycles in-between are able to support themselves in their own circularities. The processes are temporal.

This pattern of recursiveness permits a very different calculus for self-reference. Such a calculus was initiated by Gordon Spencer-Brown and Francisco Varela while Bateson was alive. They showed that the neither presence of re-entry nor appropriate response to circularity required the sort of prohibitions that Russell’s method of logical types had suggested. To the contrary the presence of re-entry can be regarded as a pre-condition for understanding the abstract logic of recursion. The pattern of self-reference employed by Varela was that of continuous transformation undertaken autonomously by its own participants. Further, for any calculus for self-reference to be viable, its order of ‘top’ and ‘bottom’ must be very different from the top and bottom of a hierarchy of logical types.

Maturana and Varela introduced two conceptions to comply with their conditions for their logic of recursion. The first of these, *autopoiesis* was a term that contrasted the way in which the organization of any living system was self-producing with passive production - through genetics or as reflexive response to environmental perturbations. A living system engaged in the production of its living components; and, since production was an organized procedure, and that organized procedure laid down its own path, the process of self-production gave those living components coherence. As a result the coherence in the process of self-production also recursively engaged in further self-

production. The second concept was that of 'structural determination.' Maturana and Varela held every living system existed in a medium or environment where it became co-ordinated with other living systems and that the relation between the structure of co-ordination and the organization of the living system could not be separated or reduced one to the other. The structure of such a system determines everything that occurs in it or to it, that is to say, what it might encounter in an interaction in its media, and internal changes made in order to adjust to changes in that medium as well. In effect, structural determination proposes that each living system is an irreducible whole in which there is a reciprocal generation of changes between the two phenomenal domains, autopoiesis and structural determination. There can be no longer any reports of environment acting upon organism to induce change, only reports of the structural dynamics of the living system, and of the domain in which living systems act as totality. How observers see and explain change in and among such irreducible wholes requires a big shift away from the conventions of empiricism, behaviourism and functional explanation that dominate biology and some, at least, of the social sciences.

Bateson acknowledged the importance of the newer version of recursion before he wrote *Angel's Fear*, stating that this version demonstrated how the whole of any biological structure was able to participate recursively in the development of its parts (Harries-Jones, 1995). Varela, and Maturana had accounted for the logic of coherence of any ecosystem, he said, and why self-reference, self-production and self-reproduction and self-cycling are fundamental characteristics of living systems. The main problem for Bateson was that in Maturana's explanation, the transformations undertaken autonomously by the living system clashed with his own version of recursion, its conception of process and its conception of structure. Somehow the one had to be reconciled with the other.

Bateson's position now required some defence. Bateson had argued that classification was an essential component of order in relation to mind. As befits any system of observation, logical types permit discrete jumps between levels; the classes or sets of one level are distinctive from the classes or sets of another in the next level, with classes and their classifiers, stretching away in an infinite regress of meta-levels, though the most important meta-levels were the two proximate to the level of classification. Bateson's therapeutic examples show the type of change one might expect in reclassification were movements from less inclusive systems to more inclusive systems, and that these would be marked by changes in interactive relationships corresponding to 'changes of mind.' What the reviewer, Marcus, termed a 'recycling' of Bateson's ideas in *Angels Fear* was more of an attempt to go through his ideas again in the light of the second process of recursion. In one brief section, Bateson admits error: His dialectic of mind that he had devised in *Mind and Nature* needed revision. There, he admitted, he had considered both process and structure (or form) to be discontinuous in their characteristics, and had illustrated them both as being composed of discontinuous steps.

Now, he said, 'It was surely correct to see the form or structure side as discontinuous and hierarchical, but incorrect to project that discontinuity onto the process side.' He had been too hasty in attributing to the process side of his argument characteristics derived from the form side - as if form and process, the two elements of the dialectic were in every respect isomorphic to each other in both nature and social life. (Bateson, 1987:166).

The shape of his defence follows his admission of error. Yes, of course, his analysis had been an exercise which assumed too great an isomorphism between the form of structure and process. The recursiveness that Maturana and Varela investigated is immanent in all biological phenomena - message material, injunctions and formal patterns are already there, for this is what it is to be internally organized and alive. But if forms and messages are already there - internally in a participant system of production - this does not mean that the pattern of distortions which arise in any communicative system suddenly disappear from the domain of structural dynamics nor that they are filtered out in the process of self-production. Distortions and discontinuities inherent in any scheme of observation holds true at any level of communicative order in living systems, he argues. These are their respective data. Thus discontinuity and distortion are part of the recursive process to be investigated in biological systems. 'They are to total process as the axle is to the wheel' and are necessary if we are to understand 'both the freedoms and the rigidities of living systems.' (1987:166). The metaphor of axle and wheel is striking because it is usually used as an elemental example of mechanics in relation to physical forces: momentum. Clearly Bateson did not intend a reference to the dynamics of levers, rather that if there are unnamed principles of recursion characteristic of biological systems, these will run against the oscillations of error and pathology that are always present (in the wheel of life) because both process and structure in living systems is communicative.

I do not know whether Bateson's defence was also motivated by the possibility that Maturana and Varela version, derived from biological research, would end as the definitive version of recursion which would place in some doubt his own version of recursion. For reasons that lie deep in the epistemology of dualism in the west, the chances of biological findings becoming a source of explanatory value and application in social systems is much greater than the reverse, cases where psycho-social findings become expanded to biology and ecology. Maturana and Varela created a perspective of biological networks that was a magnificent treatise on the differences between living systems and the dead hand of artificial intelligence; it decisively rebutted many of the claims that artificial intelligence was able to 'mirror' the dynamics of living systems. They also explained how dynamic transformations in living systems did not rely upon the usual import/export processes of either energy nor information applicable to artificial intelligence machines. Autopoietic, self-producing systems, need only be explained with regard to system components and their configuration, both

within the boundaries of the system, and with the way in which a system develops a recursive determinism of the whole through mutual co-ordination with other systems, i.e. mutual coordination of mutual coordination which invoked a spiral of recursive activity.

Today, Maturana and Varela are often cited as the originators of the recursive view. There is also the re-iterated belief that they won the debate with Bateson over recursion on the grounds that they were grounded in ontology, while Bateson's whole edifice remained purely 'epistemological' (Dell, 1985; Capra, 1996). This judgement misses major points of agreement between the three on the errors of functional explanations in biology. They agree that biological approaches are dominated by erroneous interpretations in which a function - standing for part- of- a- whole - is considered to be as an imputed causal mechanism in nearly all of biology. Bateson contemplated ways in which a new science might take as its subject the way in which wholes and parts relate to each other. Maturana worked systematically through the alternative proposition of whole, rather than part, as causal mechanism. In doing so he held that structure-determined systems are 'perfect' in the sense that they never make mistakes; they always behave according to their structure. It is only because a system behaves according to the autonomous dictates of its own structure that it can be out of phase with its environment and make what we call 'mistakes' in the first place (Dell, 1985:11). Bateson's appraisal of 'structure' is somewhat different. The structure we devise of any system is incomplete and conspicuously full of holes. That incompleteness which enters into the organism's relations that we are trying to describe, the structure of relations gained from outside observation, also appears in every aspect of the organism's own structural information i.e. its interrelated aggregate of messages in the media in which it participates. This is why, unlike the physical world, both error and pathology are possible: the map always differs from the territory. Yet 'structure' is all that we can know, the 'reality' of that which is (1987: Chapter XV).

4. CONTINUITY AND DISCONTINUITY

Bateson tried to incorporate both discontinuity and well as continuity in his models of recursion. This meant that the various models of cybernetic circuits, his models of a thermostat that he referred to in his major writings always had at least two levels, one representing continuity of self-adjusting circuitry, as was typical of organic homeostasis, the other representing a change in the bias of the thermostat, and adjustment of the whole adjusting mechanism to a new qualitative setting. Changes in the second circuit bias, resulting in 'second order change' (1987:Chapter IV) are injunctive; they are changes which, from the perspective of an observer observing and discussing second-order changes, i.e. descriptive information, could be called *meta-communication* (to adjustment 'inside the thermostat'). Maturana bracketed this observer perspective and de-

defined it as being relevant to the observer alone; the condition 'inside' relevant to any living system's autopoiesis was one of its own structural determinism. Bateson was wary of recursive models that only represented continuous relational adjustment, since they did not account for seeming possibility for the discontinuities of second order change. He also referred back to work done many years earlier on two forms of coding in the cybernetic ordering of communication, analog and digital, one continuous, the other discrete - arguing that in neither case could the one be reduced to the other. A specific demonstration of his wariness is evident in the 'metalogue' between himself and Paul Ryan that occurred during the time he was writing *Angels Fear* (Bateson, 1980; Ryan, 1993).

Bateson's wariness stemmed from the fact that whatever he said about communicative regularities among humans, communicative regularities in the biological world had to be true of evolutionary circumstance, for this too was part of the wheel. Bateson insisted there had to be some match between the two vastly different realms of evolutionary biology and human experience and there could be no such match of temporal process in evolution and temporal process in culture if a scientist supported the evolutionary schema of Charles Darwin. Darwin had produced a model of continuous adjustment: natural selection operated through continuous adjustment in the phenotype, to which neo-Darwinist biologists in the 1930s and 1940s had added a more jerky, but still continuous, change in genotypes brought about by the spread of mutations in a population. Both Bateson and his eminent father W. Bateson, also a developmental biologist, had very fundamental objections to Darwin. Darwin had negated the possibility of saltation, or evolution taking jumps, yet so far as developmental biology was concerned that is precisely what the evolutionary record showed had happened. Bateson was unfortunately unable to take 'punctuated equilibrium' (Eldredge and Gould 1972) into account, which incorporates discontinuity within continuity in evolutionary circumstance. Unlike the original Darwinian model punctuated equilibrium is more congruent with the idea of a Bateson-type thermostat operating in evolution, though lacks specific identification with cybernetics.

The account of recursion in *Angels Fear* follows this pattern of combining continuities and discontinuity. The following are some of the examples:

1. Plants and animals are patterned and repetitive in their shapes and responses, and repetitions of parts and repetitions of repetitions of parts, i.e. recursive modulation is typical of organic order (1987:Chapter III). The continuities of redundancy in recursive modulation is the means through which a limited supply of structural information is able to cover a complex structural order. But repetitions of repetitions introduce a further feature, that cybernetic adjustments of responsiveness to difference are not of a single kind or a single order, there are at least two levels, the level

of immediate anticipation in change and the level of structural change (change in the order of change or bias). The difference between the two must be perceived, interpreted and learned by participants.

2. A gap in communication regularities is fundamental. For example, in cultural performance there is always a need to limit or control knowledge across lines demarcating the sacred for the notion of sacred is related to knowledge of the whole. Prohibitions on continuity of communication can be compared to one another in different sorts of context. Examples of non-communication in biology are to be found in species lines. These are the basic discontinuities of natural history and the fact that stresses and vicissitudes of experience are not communicated to DNA is the main reason that Lamarckian forms of interpretation in biology and studies of evolution are so misguided. There are other examples from culture which can be compared to the demarcation of species, for instance non-communication across gender lines, where cross-sex knowledge is always 'dangerous' in cultural terms. (1987: Chapter VIII). These prohibitions on continuity of communication might compared to one another. For example, there are evident markers of non-communication as people move from the everyday world into the realm of the sacred, and since the sacred and aesthetics are so close to one another, this might help us understand difficulties of our communicating about aesthetics. Aesthetics is easier to discuss in terms of pathogenic process than in terms of 'the beautiful.' Ugliness is an example of those cases in which blockage and confusion occurs between the message and the total system that is its overall context.
3. It is necessary that we have no knowledge of the processes by which our perception images are formed since the apparent continuities of our perception are our primary link to the 'minute particulars' of difference in our visual field; in order to see visually, the process of seeing cannot be held in abeyance and examined at the same time. So there is often a refusal for humans to take discontinuity into account, despite the fact that there are gaps attached to the physiology of blinking, gaps from attempting to produce an invariant image in a visual field bombarded with multiple streams of information and gaps also in the contrasting universes of precept, thought and action. We are defended from doubt by an unawareness of these gaps. Yet errors always arise when process is treated as a state e.g. the belief that a perception is derived from a state external to the viewer. Other examples lie in the reification of consciousness (1987: Chapter IX).

5. AESTHETICS AND ECOLOGY

Bateson argued that ecological aesthetics is tied to communicational regularities in the biosphere so that any ecosystem exhibits 'Interwoven [communicative] regularities in a system so pervasive and so determinant that we might even apply the word "god" to it...the peculiarities of the god whom we might call Eco' (1987: 142). His point is correlated in various places with point three above, aesthetics, like religion, constitutes a second order bias for the supposed invariant structure of our perceptions that we manage to put together and call that which we perceive. That aesthetics is attached to perception is in agreement with all other accounts of aesthetics; and that aesthetics is attached to religious traditions is also well established. Christianity, like other religions has a vibrant aesthetic attached to its rituals performances, myths and metaphors of religious experience. The second order aspect of aesthetics is, however, a theme that is original to Bateson. He scatters throughout his examples the problem that aesthetic communication, though it is about interwoven regularities, is not the sort of communication with which we engage in our normal descriptions. Part of the difficulty in deciding what an aesthetic judgment is about is that aesthetic events often occur beyond boundaries specifically marked for 'non-communication' as if ordinary descriptive communication would be sacrilegious in that context.

The attachment of aesthetics to ecology can be read in at least two ways in *Angels Fear*. The first is that of a metaphor for unity contained in the idea of an ecosystem, an aesthetic sensibility to pattern and modulation of pattern - this is the material for dream and poetry (1991:256). The other comes about through a deep connection between epistemology and aesthetics. Bateson drew the connection in terms of a forked riddle: 'What is man that he may recognize disease or disruption or ugliness?' 'What is disease or disruption or ugliness that a man may know it?' The riddle's two aspects derive on the one side from perceptual acuity in recognizing a difference between beauty and ugliness, and on the other an observer's knowledge of pattern of disease, and disruption. The pattern of the percept does not flow easily into the pattern of the other and numerous tensions lie in the fork between the two. At the outset there are issues of perception stemming from seeming contradictions in perceiving pattern flow . Next there is the tension between appearance and descriptions of 'reality' applied to appearances. This set of tensions become a problem of epistemology. Bateson suggests that working away at the fork of contradictions, the interface between aesthetics and epistemology, will likely promote a new conception of holism, and perceptually will draw us toward an awareness of beauty in a larger more inclusive system. Then the interwoven regularities of the structure may - as in all sacred realms - become the basis for awe.

Nevertheless, he draws a contrast between a religious experience of unity and an ecological epistemology of holism and unity. An ecological epistemology lies in an immanent world, and that is where we will find its unity, whereas the world of religious belief is usually transcendental. Religious conceptions of transcendental unity are defended by faith and belief, and even differences in explanation of what ritual signifies can result in charges of heresy or sacrilege. An ecological epistemology, with its congruent ecological aesthetics must be much more critical in its examination of unity. Since any self-recursive communication system must become aware of disruption its own relations, it must acknowledge systemic discrepancies which necessarily exist between what we can say and what we are trying to describe (1987:Chapter XV). This means becoming aware of the myths by which we live and the way in which these myths help establish a pattern and habit (1987: Chapter XVI). The myths of dualism, mind separate from matter, body separate from mind, environment separate from cultural tradition are among the most conspicuous of these myths in both science and the humanities, as too, is the practice in science of separating of parts from the whole. The epistemological work attached to aesthetics must examine how mind creates its mapping of the world, and how often the map is mistaken for territory (1987:Chapter II).

He probed these issues in other writing, outside the covers of *Angels Fear* whenever he elaborated upon his ideas of an immanent rather than a transcendent holism.

Since human populations are locked in the immanent conditions of their own ecosystems the patterns of repetition and change that make up biological order makes it difficult for any observer to construct clear points of reference within them. He drew upon a striking image, that of 'free fall.' Without any register or standard of reference, ecologists are in the same situation as that of a parachutist jumping out of a plane with no instruments with which they can establish a relationship to the ground. They are floating into free fall, not knowing what their proper orientation to earth might be ...upor down . It helps to recall photos from the early days of flight one hundred years ago, as an aid to Bateson's image of the vagaries and dangers of free fall. The very early days of flying sported magnificent men in their flying machines, machines that had wings like those of a bird that the pilot pulled up and down, mimicking bird propulsion. Other machines had propellers operated by the feet, as if the flying machine was an extension of a bicycle (the Wright brothers themselves ran a bicycle shop) while other flying machines were catapulted from ramps over cliffs, as if the mere act of building wooden wings to a wooden frame would guarantee a safe glide towards earth. None of these machines succeeded because no one knew anything about aerodynamics nor did they know anything of the control relationship necessary to introduce a technical object into an aerodynamic field. In the few seconds that the pilots were off the ground and in the air above the ground, they were in risk of their lives because they were in total ignorance of the medium in which they tried to assert their con-

trol. They were in ‘free fall,’ as our civilization is in free fall because it knows little or nothing about the holism of its eco-dynamics nor the recursive processes of ecology. Hence, as Bateson reminds us, if we are unable to adjust our ideas of adaptation to the dynamics of eco-systems we will be unable to come to any judgement about the patterns of continuity and discontinuity in ecological order. (Harries-Jones, 1995)

Bateson knew about the potential for runaway in climate change, having investigated this issue in the mid 1960s and had come to the conclusion that its effects were likely to be much more grave than the ecologists of the time suggested. Industrial organization had such little conception of what non-linear eco-dynamics might be. One argument current during the 1960s which he spent some time examining was that an increase in carbon dioxide in the atmosphere will be beneficial because it will aid growth of forests! However, much better modelling of non-linear eco-dynamics was no resolution for Bateson. Instead of calling for an improvement to quantitative analysis of ecological patterns, he argued that what is required is to study holism and not part-ism. Only the generation of standards of reference about unity and integration in a holistic order would enable rigorous statements to be made about unity such as the biosphere. Needless to say, these standards of reference would be quite different from the ‘registers’ of sentience of Hume, Locke and other empiricists. Nor would they be ‘registers’ of the sublime as perceived through the artist’s depictions of nature, the Kantian path to the beautiful; nor ‘registers’ of taste - cultural capital on display - as in the case of Bourdieu.. They were to be aesthetic in the widest sense. Wherever we begin to have intimate appreciation of form, shape, pattern in nature, there we should also affirm aesthetic notions of how parts fit in relation to wholes.

Bateson’s path to the discussion of unity would take in those regions of experience where holism and its configurations already existed and examine them for clues. Christian religion, ‘fate,’ ideas about ecosystemic integration are all patterns of holism. So, too, any investigation of the realm of the sacred would yield indicators of how there had been a search for larger more inclusive pattern. Evidently, aesthetics belonged to that side of mind that dealt with metaphor, poetry, imagery and imagination and was a sort of meta-level aspect of that ordering process. Yet the abstraction that yields an aesthetic judgement, the meta-level aspect, was different in kind from any abstraction in science, or any other prose-type description. The following exchange is indicative (Bateson, 1991:300):

Q. Would it be correct to suggest that the aesthetic is this unifying glimpse that makes us aware of the unity of things which is not consciousness?

G.B: That is right; that is what I am getting at. The flash which appears in consciousness as a disturbance of consciousness is the thing that I am talking about.

It becomes a disturbance of consciousness because consciousness as a manifestation of prose or scientific description tends to focus inwards, whereas notions like the sacred and the beautiful tend to be always looking for the larger, the whole. Aesthetics, the unifying glimpse, provides a medium through which humanity can begin to communicate about how to understand wholes and thus the unity of the biosphere. The logical types of descriptive prose are disturbed with the aesthetics of symmetry and ratio, rhythms and resonance inherent in metaphor, poetry and ecosystem integration, and become conjoined aspects of our ability to understand. The two consciousness and aesthetics are not separate from each other for we should remind ourselves that all action in a recursive system lies at the interface of its sub-systems.

Bateson did from time to time wonder out aloud whether aesthetic sensibility might, like consciousness itself, contain its own pathologies. After all he had worked on German propaganda films during part of World War II and knew all too well about that theatre of blood. But he never investigated his own lingering concerns about this possibility of aesthetics as something other than a self-corrective to consciousness. It is an unfortunate lapse because there has been an undercurrent of concern since the days of fascism in Europe that an ecological aesthetics can be so easily folded into a pathological sensibility of humanity using nature to toughen itself, and instilling an aesthetic sensibility of toughness, as was the case in the Nazi Youth movements and Nazi films about athletic prowess. Bateson's greater concern was with the fact that western science explicitly removes aesthetics from scientific thinking, regarding it as something other than science, and in so doing limiting its ability to comprehend change. Without forms of comparison, reflecting part-whole relations, we will scarcely be able to undertake observation of an ecosystem at all. The edges or the boundaries between subsystems of aesthetics and consciousness, aesthetics and morality, unconsciousness and consciousness, are where both gaps and interconnections occur. Here 'difference' is to be found and the differences that make a difference lie at the interface of sub-systems. Only here can the pattern of differences - together with change in this pattern - be perceived (Harries-Jones, 1995:232).

6. INFORMATION PROCESSING, FAMILY THERAPY AND BIOLOGY

In this final section I propose to step outside *Angles Fear* in order to address briefly issues in the history of science raised by the two processes of recursion, the first in that of family therapy, the second in biology itself. I have already mentioned that the debates on Bateson versus Maturana, epistemology versus ontology, created contortions in an argument that should have been much more enlivening, namely in what ways is a structure-determined system interpretative and to what extent is an

interpretative system structure- determined. Rather than engaging family therapists in self-examination, the debates on epistemology versus ontology in the early 1980s gave rise to confusion and, in the end, either to total intimidation or to disillusion in the two constructs (Held and Pols, 1985: 516). Family therapists had long complained bitterly about the difficulties of understanding Bateson's recursive hierarchy of Logical Types, and were often in despair as to how they would put this idea to practical use. Bateson replied to his complainants that he never meant his discussion of Logical Types and double binds to be practical tools.. They complained again about the second process of recursion discussed in Maturana and Varela. From the outset there were challenges to the rationale of *autopoiesis*, critiques suggesting that a transposition from the world to biology or machines to human beings and their complex relational networks was a risky venture at the best of times. As with Bateson's recursive hierarchy, complaints about Maturana and Varela surrounded transposition of their ideas from theory to practice.

Bateson had argued that the therapists' ability to undertake family re-organization had more to do with family member's history, meaning systems, relationships and relationship rules and myths than with the specific content of the therapist's action and message. However, Maturana had seemed to change the rules of the game one more time. He argued that an *autopoietic* system will determine whether a change in the medium will become significant for it, and that changes will only become significant information for it, if those changes help preserve its stability. That is, nothing external to a structure determined system can specify changes that it undergoes as a consequence of an interaction because external instructive interaction is impossible in living systems. Family therapists took his argument to be much more than person A cannot unilaterally determine what person B will do, a position which Bateson himself took. He seemed to argue that the therapist's ability to undertake any form of intervention in re-organizing family dynamics is very limited indeed since there is no transfer of data from one individual and another. Therapists began to feel that Maturana's recursive bootstrapping approach gave too much emphasis to the autonomy of the structure determined system and too little to the family therapist's own sense of responsibility in initiating any intervention with his patients or clients. Thus a structure determined stance privileged the autonomy of the client's self-knowledge; it also seemed to permit an 'anything goes' type approach to family therapy which made therapists discomforted (Jones, 1993:25).

There was still one more looming question. Maturana wrote of the closure of cognitive systems to information. So-called information transfer does not and cannot instruct the behaviour of the living system, he said, and what we typically label as information transfer is that which we observe to be recursive interactions with the system.(Dell, 1985:6). Instead, the therapist undertakes 'language' with his client for the purposes of consensual coordination of consensual coordinations of be-

haviours. Language lies less therefore in the domain of instruction than in the domain of the operation of the organism as a whole, in the living together of a languaging community. This domain between therapist and client is primarily a domain of the dynamics of emotion and not information. Change is possible only if the patient changes his or her emotionally accepted premises through the emotioning entailed in the interactions with the therapist during the rational and logical conversation (Ruiz).

There were some benefits to this participant paradigm of recursion. Bateson's approach had certainly addressed limitation of control of therapists over their clients. But generally this had been in the context of opening up the practice of family therapy to a totally different realm than that operating in psychiatric departments of hospitals and other medical institutions. The Maturana scheme applied to family systems therapy, allowed the therapist to become an even more integral part of an inter-subjective field. Control of the therapist became minimal, in a way that contrasted with the control of therapist interaction typical of the earlier ideas of systemic family therapy, where the therapist was deliberately attempting to inducing change of family interaction towards some form of homeostasis.

But did Maturana mean that no semantic information was present in the recursion of autopoietic systems? Maturana even suggests that an *autopoietic* system is closed to the sort of information from stimuli that common experience suggests that it is open towards (see Endnote). Bateson was willing to admit that there was pre-given conditions of communication as the Maturana group suggested. As he wrote in *Angels Fear*, a preinstructed state of the recipient of every message is a necessary condition of all communication and this too must enter into our notion of structure. Yet Maturana's virtual erasure of the idea of semantic information rubbed out much of his own approach to learning. In Bateson's view, learning in any context, whether therapeutic or not, is subject to a triad of 'stimulus, response and reinforcement' which allows one component to be a comment upon a relation between two others. In other words, any control mechanism is subject to the variance of environmental circumstance and interpretation of context change (1987:Chapter IV). The central issues of understanding information was first, to grasp the contexts in which information exchanges took place, and how those contexts related to each other in an *interpretative as well as instructive sense*. second, to examine the variety of ways in which coded information - analog- digital- iconic - became transformed at their interface.

Francisco Varela recognized the quandary, even if Maturana was hesitant to acknowledge it. In subsequent writing Varela introduced the term 'enactive' to indicate that cognition in living systems is not entirely devoid of information, nor is autopoiesis a representation of living systems in a pre-

given world which their earlier writing on had suggested. Instead, cognition in living systems requires the 'bringing forth of a world based on history and the variety of effective actions' that a person can perform (Dupuy and Varela 1992: 20). The correction seemed to come too late. The extent to which absented meaning became non-acceptable in systemic family therapy was quite rapid. Within the space of about ten years during the 1980s systemic family therapy had abandoned the structure determined stance, also known as biological constructivism, in favour of social constructivism. Moving from one to the other drew family therapy into the influence of post-structuralist post-modernism- with its very different set of assumptions (Flaskas, 2002:32).

What was unexpected was that the same sort of issues might arise within molecular biology. As time went on genetic information conceived solely as instructive information began to raise more and more quandaries. These reached a spectacular proportions soon after the announcement of the Human Genome Project that the human number of genes in a human genome was only 28-38,000, a far, far smaller number than that which biologists had believed to be the case. A project undertaken at vast expense to confirm the centrality of the gene as the very centre of the blueprint of life began to disconfirm standard assumptions of genetic information (Fox, 2000). The 28-38,000 figure clearly indicated that the idea of genetic information operating as a type of key unlocking all aspects of the machinery of life, had to be revised. Information operations were multiplicative and not additive, as Bateson had pointed out previously (Bateson, 1991: 175-184), moreover if they were multiplicative they were unlikely to be keys going around unlocking multiplicative locks like some railway junction keeping the trains on track. Keller argues, in keeping with Bateson, there are now so many findings of extensive redundancy that fall outside the genetic paradigm that there has to be a return to the sort of problems that were of central concern to many embryologists in the early part of the 20th century. Central is the problem of developmental stability and of the conspicuous robustness of developmental processes despite environmental, cellular and genetic perturbation (Keller, 2000:147). As a result of the new-found interest in redundancy and its distribution, rather than genetic stability, different definitions of 'information' have quickly emerged. In fact, attempts to define what information might mean have undergone an exponential growth in response to the Human Genome conundrum, with none of the new definitions having clear conceptual links with the standard concepts of lock-and-key instructive information (Bruni, 2002:222).

Maturana's recursive structural determinism reducing the centrality of information offers one alternative explanation. Another alternative would be to allow a semantic definition of information, so that information even at a molecular level means something in genetic processes. In which case genetic information is not merely instructive but also semantic information involving a number of processes of interpretation. At least one group of biologists, the biosemiotic group centred in Copen-

hagen, have taken up this proposal. They argue that sign or signalling relations exist in a myriad of interconnected pathways involved in the regulation of cellular processes which lead far beyond the autonomy of a genome, the chromosome or the cell. This leads them directly to Bateson and his definition of information as sensing mechanism, that is as differences which make a difference to a living system and its members or parts, wherever there is a capacity to make an interpretation.

Their view is that biology should be less a science devoted to information processing and more of a science devoted to all aspects of 'sensing,' signals and signs. The most elemental interpretation of difference essential to living organisms is the difference between 'self' and 'other.' At the level of micro-organisms upwards, examples are most noticeable in symbiosis - but not exclusive to that realm. Even at molecular level an important aspect of interpretation lies in the set of relations established between a 'self' and 'another;' examples of interpretation of 'self' vis-a-vis 'other' abound in the immune system. In plants and animals and in plant-animal interaction is the most common signalling phenomena between self and other is to be found in the abundance of pheromones released. Signification, interpretation and the world of signals and signs seem to be a universal aspect of living systems, a veritable semiosphere neglected by biological science (Hoffmeyer, 1996). If there are new topologies of recursion to be found, they will be found in the recursive processes of this 'semiosphere.'

ENDNOTE

'the semantic value of an interaction...is not a property of the interaction, but a feature of the description that the observer makes by referring to it as if the changes of state of the interacting system were determined by their mutual perturbations, and not by their respective individual structures [co-ordinating the co-ordination].' (Maturana, 1975 quoted in Dell, 1985:11)

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