MEANING RATIONALISM AND GREGORY BATESON'S
ALGEBRA FOR AESTHETICS

Peter Harries-Jones
Dept. Anthropology, York University, Ontario.
peterhj@yorku.ca

ABSTRACT
The most distinguishing difference in approach between Biosemiotics and cognitive ethnology, our cousins in probing biocommunication is that biosemiotics centres its discussion on signs, and cognitive ethnology on consciousness and 'linguistic competence.' Biosemiotics approach has avoided the worst excesses of "meaning rationalism" in cognitive ethnology (Ruth G. Millikan), but Vehkavaara has warned us that any approach to biosemiotics based on C.S. Peirce inevitably enfolds Peirce own embedding of rationality and logic in his approach to signification. Winfried Nöth also warned us that if our interest was to develop an semiotics in ecosystems that Peircian requirements for Thirdness (interpretants) would have to be set so low that the question of which organisms be counted as 'interpreters' would become confusing indeed. Does this mean that biosemiotics should slip the collar of Peircian definitions of 'interpretants' and stick only with post-1910 years of Peirce when Peirce was writing about abduction, retroduction and conjecture or 'guessing.' Gregory Bateson's point was that perceptual processes are unknowable to consciousness in any organism but the effects of perception are tractable, including strong evidence for the relation between communication, recursiveness and intentionality in both the human and the non-human animal world. As for relating perceptual processes to the dynamics of ecosystems Bateson asked scientists to frame their enquiry in terms of aesthetic appreciation - multiplicities instead of the singularities of pain/ pleasure, utility and resource use, natural selection, and/or reproductive lust. And he promised an 'algebra' for aesthetics, which, unfortunately he did not complete. His is an algebra for a composite whole which is irreducible through its very organization to fragmentation of its parts. Recursive loops, the feedback loops of cybernetics and otherwise provide a mix of interactions which occur at an interface. Thus the leaf of a plant is an interface for photosynthesis and transpiration; but the flowers of a plant are interfaces for reproduction as well as communicative response in the whole ecosystem of which they were part (as with honeybees cf. Harries-Jones). A 'union' of complements through constraints is a natural dynamic of any ecosystem; the integration of the whole occurs through a variety of recursive loops with different reference points widely dispersed in any particular range of interaction. His 'algebra' related to its original meaning in Arabic (*al jabra*) as balance, comparison and transposition. His algebra would be a framing device for understanding pattern . For human beings, the aesthetic interest lies in the patterns of their connectivity, their entanglement or knots in the whole fabric or tapestry. The patterns which connect marks a shift of perceptual focus to an ecosemiotics that is a radical break from the conventions of energy budgets and morphological stasis in biology [and also - but not discussed in this paper - to new

conventions of representation in the topologies of complementarity and morphogenesis]. 'The Book of Restoration and Balancing' is thus an apt metaphor for an ecological aesthetics.

The most distinguishing difference in approach between Biosemiotics and cognitive ethnology, our cousins in probing biocommunication, is that Biosemiotics centres its discussion on signs and cognitive ethnology on 'consciousness' in the non-human animal world. The discussion of 'consciousness' often promotes a move from descriptive to formal language and then to some form of quantification of evidence. The differences in between cognitive ethnology and biosemiotics have appeared as a result of the fact that in and around the 1950s, when cognitive psychologists began to undertake extensive comparison of human mental processes with other animal species, the special reference given to non-human primates became the reference by which all other aspects of animal mentation were compared. The scientific discourse excluded a wide range of other living organisms such as reptiles and fishes. Reptiles and fishes were all presumed to have little or no other aspects of mentation. With their behaviour supposedly controlled by fixed predispositions, they became regarded as near-automatons .

The bias towards primates introduced a more subtle bias in the cognitive ethnology since human mental processes, with their highly developed conceptual apparatus, became the referencee norm, by which the mentation of all other organisms were compared. The philosopher-biologist Ruth Garret Millikan, has termed this bias in science *meaning rationalism*. It ensures that any analysis of the link between perception and cognition in animals, or of any examination of the intentionality of thought among animals, must proceed in accord with the same principles by which consciousness would be analyzed among human beings. Meaning rationalism, Millikan remarks, is not unique to cognitive ethnology but "permeates nearly every nook and cranny of our [western] philosophical tradition" [Millikan, 1984: 91, 92]. It is, says Millikan, a subtle yet destructive bias.

Millikan draws on several common examples of 'meaning rationalism.' These include 'game theory' in which observed predator -prey relations or mating behaviour among non-human animals, were examined in terms of human assessments of probability which in turn were based

on economic rationality. Another example was how adaptations are analysed on the basis of energy efficiencies, a third on how communicative interaction would be based on utility assumptions - cost-benefit analyses. Each of these translates events in the non-human animal realm into an explanatory format based on an array of human techniques for assessing 'rational' response.

Because mentalist interpretation of this type is so strongly related to rationality, it holds that any use of intentional (i.e. purposive) signs among non-human animals requires experimental verification. Only then can any observer assume that "meaning" has occurred. Millikan strongly disagrees with this position. The use of an intentional sign by organisms requires no verification by experimentation or use of probability calculations. For intentionality to arise it is only necessary that the sign be one that recurs. From a percipient, subjective viewpoint, feedback generates a correlation between similar signs and similar signifieds which occur within a natural domain of time and space. These are basic natural signs. So long as a *locally recurrent sign,* remains kept within its natural domain, its appropriate interpretation continues to occur, maintains Millikan [Millikan, 2004]. If there is any truth or propositional requirement here, it is simply that the same kinds of sign are connected to the same kinds of signifieds and that they recur with the same natural conditions of signification or meaning, for example specific periods of time in a specific. What 'recurs' in the way of content, aboutness, reference, propositions and satisfaction conditions i.e. intentionality, requires only that other informational aspects - indexicality if you will - of a recurrent sign also occur within the same *system* of signs within specific time and place.

I am going to call this "the recursive hypothesis" [Harries-Jones, 1995) which is composed of non-lineal recursive orders that leads to Conjectural meaning, rather than meaning rationalism. Incidentally, it is important to this paper that Millikan's discussion of recursive ordering like Gregory Bateson's is developed against standard theories of cybernetics - in Millikan's case Fred Dretske in particular, whom she indicates is a prime 'meaning rationalist' (Millikan 2004)

Biosemiotics as a whole has escaped the dilemmas of *meaning rationalism*, first by coming on to the scene at a later moment and then maintaining -along with Terrence Deacon and others - that the origins of sign-functions are *primary in evolutionary appearance to consciousness* (Deacon, 1997) Biosemiotics claims that consciousness, when it does appear in evolution, is associated with the appearance of symbolic order and that, in turn, presumes human consciousness. In other words, consciousness is specific to the evolutionary appearance of *homo sapiens*, or, perhaps, to *homo sapiens sapiens,* but is certainly related with the appearance and use of language. The biosemiotic standpoint has led to some arguments with *phenomenological semiotics* as the latter hold that consciousness must precede sign function in evolutionary sequencing and that the systematic study of 'meaning,' begins with the appearance of consciousness and not with the appearance of signs [EN 1]. I have no time to explore this discussion.

Now to pursue the recursive hypothesis and the question of how "consciousness" links to the conjectural: Bateson, always questioned the scientist's pursuit of consciousness as if it were some sort of 'holy grail.' He believed that such pursuit led to an obsessive concern with factors of 'control,' hence linking scientific enquiry to purposive action, meaning to explicit thinking and both to rationality. Yet the pursuit of 'meaning' as occurring in the form of explicit conceptions in human consciousness created systemic distortion. In its original meaning, consciousness implied that of a collective sharing namely a *con- sciousness,* so that when people engage together to plan action, they should focus in more upon con-sciousness (*sic*) i.e. upon the circumstances that, their view of action and circumstance is filtered through language and probably narrowed by their conception of the immediate goal (Bateson, 1969).

"I do not know the whole remedy" he wrote " . . . but consciousness can be a little enlarged through the arts, poetry, music and the like. And through natural history. All those sides of life which our industrial civilization tries to mock and push aside." (Bateson, 1968).

Bateson then switches the definition of "consciousness" to a frame of communication that is inter-subjective and to aesthetics as a form of consciousness in which the mind of a fixed,

supposedly objective observer is no longer the central point of reference. There is a double description required both from observer, who reports in structural terms and a different type of report and from percipients always caught in process, in the flux of change and can only conjecture. Nevertheless both observer and percipients are necessarily drawn to repetition and redundancy as context-markers for his or her aesthetic perceptions.

Now Bateson holds that aesthetics, with its indeterminate meanings, is not only of under-rated importance in human 'con-sciousness' even though much of human co-ordination of activity is non-conscious in one way or another but is also a property of all living systems. There are not many who would extend aesthetics to all living forms, including plants. In his *The Botany of Desire*, Michael Pollan (Pollan 2001) shows that while the leaf of a plant is an interface for photosynthesis and transpiration, and is therefore a physical requirement for its existence, that the flowers of a plant are interfaces for reproduction and during the course of evolution give rise to aesthetic communication. Pollan argues that a grand co-evolutionary compact occurs after the Cretaceous between insects and plants - that of nutrition in exchange for transportation of genetic material. The plants, apparently flowerless until that time, began to entice the desires of other creatures through their aesthetic creations. Thus the desires of honeybees and butterflies become paramount in the evolution of plants. To quote Pollan: "Beauty had emerged as a survival strategy," Or, to draw my own analogy, consciousness is not a template in the way that the genetic code was regarded as a template before the Human Genome Project. Nor is aesthetics to consciousness as Junk DNA to coded DNA as in those days of template genetics. [EN 2].

Pollan's analysis leads directly to Bateson's interpretation of co-evolution and of aesthetic within it. Bateson wrote quite extensively on the fact that all evolution is co-evolution and by no means a *solus ipse* affair, that is of single organisms gaining reproductive fitness over members of their own species and a truism of which western epistemology was so fond. The supposed evolution of a horse captured in its several morphological dimensions, was, in reality, a co-evolution of horse and grass. His references to aesthetics of co-evolution were more are. His most frequent references were to the way in which the actual form of a flower or an oak tree, its formal

properties of branching, for example, that we could see with our own eyes, were the same formal properties that occurred in our own bodies. This we did not see, or rather we did not see as a relation between ourselves and the external object. There was no physical visual incapacity impairing our perception of the relationship, only one of cultural limitation. And that cultural limitation largely arose from the authority of science which regarded such sort of qualitative relational evidence as anecdotal and not measurable - for during most of Bateson's lifetime such phenomena were dimensionless. Science stuck to quantitative analysis and Bateson's commentary on the qualitative aspects seemed, by comparison, to be 'mystical.'

He claimed to have disciplined his own perception in order to see the ordinary in an enlarged gestalt. "I suppose I see beauty and ugliness through my eyes. But the beauty and ugliness, for me, only exist as witnesses to the processes by which they were generated" (Bateson c.1978). Thus, such an ordinary view of the forming of buds in the axils of plants can yield some conclusions about the "massive network of premises, each of which is self-evident and necessarily true within that network of growth and ecological organization." "I am reminded of and enlightened about by my own mental and unconscious processes by the shapes etc., of the animals and plants."

Clearly Bateson did see ecological order in unconventional ways and his aesthetic response was an attempt to enable others to see ecological order differently. Not only is the dance of ecological change dimensionless, it is a process that we do not really "see" - we only perceive "the news" of it occurring. For this reason, with or without any of the epistemological blocks toward accepting the notion of a holistic ecological change, we would find it difficult to perceive changes and especially changes to those changes, a second order affair [EN. 3]. Not only are there multiple levels of connection in an ecosystem which have to be taken into account, but no observer is able to step outside an ecosystem and look back at it from above and so achieve some sort of visual look at its unity in the way that physics had always been able to resort to when deriving its metaphysical perspectives (Harries-Jones, 1995:64). So, the conjoining patterns of change that make up ecological order make it difficult for any observer to construct any *single* point of

reference and to rely upon that *single* reference in order to appraise unity and interconnection in natural order. Our perceptual apparatus only permits us to make the images of what we think we see, totally voluntarily and totally unconsciously through vast complexities of abstraction. We cannot control this process for it is entirely unconscious.

Aesthetics and the aesthetic imagination help us unravel our own classificatory paradoxes or unconscious habitual responses that create dilemmas and to "see" or perceive differently. Did Bateson develop formal language, not merely descriptive language in aid of helping others to see what he saw? Here we return to the Conjectural or "recursive hypothesis" that I introduced earlier with respect to Millikan. So far as I am aware biosemiotics has not taken Bateson's formal approach as seriously as it might have done. And so far as I can see, it is most interested in defining 'meaning' in relation to purposive action. Its interest in C.S. Peirce lies in the way that Peirce attaches meaning to logic and as Vehkavaara has pointed out to us, the truth conditions attached to Peirce semiotic logic. Not so with Bateson. In evolution, there were no syllogisms inductively relating a conventional object to perception. "[However] there were shared predicates [in their co-evolution] between the horse and the man, which zoologists call today homology. And it became evident that metaphor was not just pretty poetry, it was not either good or bad logic, but was in fact the logic upon which the biological world had been built, the main characteristic and organizing glue of the world of mental process ..." With this logic of metaphor, this 'Bateson logic,' organisms still got on all right and managed to organize themselves long before the origin of language [Bateson, 1991: 241].

Is this then why Peirce towards the end of his life began to increase his work on his notion of abduction, and even introduce a concept of Retroduction, both of which are congruent in some respects to Bateson's logic of metaphor? Let me draw you to an admission he made in 1910. He says that in writing before that time he mixed up "hypothesis and induction" and traces confusion of those interrelated types of reasoning to the logicians "narrow and formalistic conception of reference from its premises" but that there seemed to be a lack of alternatives in making a formal approach to 'guessing' (Peirce, CP 8 : 229-220). Of course information theory would provide a new logic of 'guessing' of 'news' and of 'surprise' around 1950.

Most in biosemiotics are very much aware of Bateson's initial responses to developing formal language which were to borrow what he had been working with in cybernetics and add to that what he had gained from using Russell's logical types. And they generally consider that these innovations have outlived their usefulness. They see a Russell's ladder of types. They do not see that Bateson's use of 'logical types' pointing to the *paradoxes* that arose between mathematical use of set theory as context-free abstract logic and psychological generality, which was always contextual. Nor, most importantly to liminality, the condition of betwixt and in-between – in a general sense similar to the later writings of Peirce in this respect - which arises when set theoretical statements get stuck (Neuman, 2008). Because of its abstract nature, Russell hierarchical logic of set theory could only deal with explicit references and explicit class or group membership. When this chain of explicit references breaks down then mind and sensibility – semiotic logic - had to find other means for achieving integration and differentiation; but sometimes it did not and the results were pathological.

Over the years Bateson pursued the ideas of paradox, conjecture, habit-and-breaking- habit, and conditions of betwixt and between and trial and error learning (Bateson, 2000) not merely in a descriptive sense but also in relation to different types of formal language and the way in which each made an approach to patterning, to non-linearity, to process, to betwixt and between or 'steps' in interval patterning. Let me give you a list: [see Attachment 2.]

He began with the mathematics of Lewis Fry Richardson, a very important British mathematician, and made Richardson the formal basis of what he had to say about schismogenesis - the major theoretical contribution to his very first book, *Naven,* a discussion of the life of the Iatmul people of New Guinea. From Richardson Bateson gained an understanding in formal terms of vicious circles or rapid feedforward. Next Bateson took on the study of Kurt Lewin's field theory. Then came cybernetics. His continued interest in but the cybernetics of redundancy led him to suggest that a) redundancy creates contexts for connectivity and b) mirrors that which Robert Rosen was attempting to portray in topological terms -namely that any formal description of an organic component must include itself as a "thing" plus its *contingent relations* to a larger system, for it is the latter that pertains to the "frame" "function" or 'meaning" of the component. And this enquiry conjoined him to the work on autopoiesis – the mutual corordination of mutual coordination - by Maturana and Varela.

It was to Richardson that he returned at a later time to learn about dimensionless numbers and chaos theory. Mandelbrot's book on fractals opens with a chapter on the pioneering work of Richardson in this respect. And it is here, for the first time, that mathematics is able, through fractal dimensions to point out that yes, indeed, the branching forms of trees and even whole forests are repeated within the branching forms of the human hand and the rhythms of the human heartbeat have the same fractal dimension as ridges of mountain peaks. In fact, there is now a most remarkable documentary on Mandelbrot's work showing this aspect of fractal dimension, and one quickly comes to the conclusion that Bateson's mysticism is not mysticism at all. The inner and the outer are in one important way repetitions of each other and in Bateson's cybernetic language, redundancies -the Nova documentary is entitled, appropriately "Hunting the Hidden Dimension" – Nova, 2008. Then there was Bateson's dalliance with G. Spencer-Brown in the hope of attaining a formal language expressing analogue continuities. Bateson also attempted to explore modularity. Finally came C.S. Peirce and Abduction, which led, as mentioned above, to formal issues of guesswork and conjecture. Abduction, rather than Peirce's semiotic formulation of hypothesis and induction, Bateson argued, was characteristic of animal semiotics. They were Popperians, jumping to conclusions from trial and error, not pre-1910 Piercians.

Bateson said in his posthumous publication, *Angels Fear* (Bateson and Bateson, 1987) that he was going to produce an 'algebra,' and the immediate apprehension in his reader's mind was of a notation in formal language. Yet readers looked in vain for those logical formalisms. Bateson was, by his own admission, not sufficient as a mathematician to undertake such a project. The point is, I think, that his reference was more to 'Algebra' in its original meaning in Arabic of *al jabra* that is of balance, comparison and transposition. When it came to perceptual processes of percipient organisms, his 'algebra' would be an algebra for composite wholes which are irreducible, through their very organization, to fragmentation of parts. The integration of the whole occurs through a variety of recursive loops with different reference points and interfaces widely dispersed in any particular range of interaction. Repetitive feedback develops context - subjectively interpreted through redundancy in feedback patterns .

His manuscript would present an 'algebra' aimed to capture aspects of the connectivity in feedback relations with aspects of systematics. His algebra has less to do with set theory, or network graphics than to do 'morphogenesis' as he called registered in a topological form. There is a subtle but important distinction to be considered at this point of the 'algebra' for recursive forms than in the more abstract forms of accountancy algebra. That is, when one speaks of relations and relationship in the context of morphogenesis of forms, one cannot think of them as being added to or subtracted from one another, but, as Bateson pointed out the relation held to exist between the two forms is multiplicative, especially so where any information is present. Connectivity interlinks an overall pattern of self-organization. Any living system is open to its environment to take in what it must to sustain itself and to externalize what it must to cleanse itself. But what is boundary and what is environment is, to some extent arbitrary; percipients have to reconcile is what is considered to be included in "the system" for the purposes at hand and what is to be included in the environment. This becomes a question of connectivity, and topological connectivity defining inclusion and exclusion is a somewhat different exercise to the usual ways of grouping membership or partitioning in physical systems.

His 'algebra' expressed order within the organization of circular processes; the way in which the composite whole, despite incessant change, continues and repeats itself, continuing in a systemic manner in its overall operation. Thus in systems of recursive loops, once the minimal criteria of two or more cybernations operate in a mutually complementary manner, a relation lies in these processes of interlinkage, so that there is a path, an eddy, a cycle which continues to constitute a relation or the relationship. This is suggested in one of his final metaphors, that of the axle and wheel, where the attachment of the two is neither that of a firm fastening, like a nut and bolt, nor a contingent coordination like two gears, but rather the mutual relationship of holding and being held through recursive pathways.

Another thought: Bateson was, for a time, a gestalt therapist and Gestalt Therapy works through the interconnection of percepts. It is useful to perceive Gestalt Therapy as a wheel, with each of the spokes, or percepts presented in therapy as having much the same importance and each contributing to the overall function of turning the 'hub' of habit or epistemology. Or there is a Chinese use of the metaphor of axle and wheel as a means of getting 'in touch' with situations. The wheel and the axle has long served as an example not only of 'touch' but of 'play' with the intervals between things. Without 'play' without that figure/ground and the betweeness of its interval, there is neither wheel nor axle. The space between the wheel and the axle in which the axle holds the wheel vertical and the wheel gives motion to the axle through a rotation, defines both (McLuhan and McLuhan, 1988:79).

Such an 'algebra' gives rise to comparison of formal properties undergoing transformation but whose transforms of the properties being compared would be dimensionless. Change is not measured as a fragment of time or mass, or length, or electrical charge; rather the percipient sees greater depth of vision. In my own book, I present the same image of moiré, used by both Bateson and his friend Conrad Waddington, from who he may have borrowed the original image. Moiré is a third dimension which arises from the interweaving of warp and woof in textiles made of silk. Moiré induces an aesthetic interest in the patterns of connectivity, their entanglement or knots in the whole fabric or tapestry. This is certainly the way that Bateson envisaged a greater

depth of comparison through aesthetics in his notion of 'double description'. A brilliant examination of this is made in an article by Terrence Deacon et al. in *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics* (Hui, 2008: 77-92)

Algebra as 'The Book of Restoration and Balancing' is therefore an apt metaphor for an ecological aesthetics. His recursive hypothesis had by this time enabled him to link the biological dimension of existence to those aspects of learning' and to 'knowing' that generally pertained only to cognitive representational theories of mind as talked about among philosophers and scientists. Bateson was presenting it, as an ecology of mind - to mind *and* body and to ecosystems and to co-evolution.

ENDNOTES

[EN.1] *Phenomenological semiotics* pursues the idea that appearance of consciousness is coincident with the appearance of life - and in that their discussion concerns with meaning that occurs inside the organism's individual brain perhaps we may mark this argument as another form of meaning rationalism. On the other hand, it has to be admitted that phenomenological semiotics is closer to Peirce philosophical ideas of synechism as presented in his famous 1890s lecture "Man's Glassy Essence," while biosemiotics has to adjust its Peircian upbringing quite dramatically to account for how interpretation and meaning occurs in animals - to say nothing of occurring also in free living single cells.]

[EN.2] "Instead of relying on wind and water to move genes around, a plant could enlist the help of an animal by striking a grand co-evolutionary compact : nutrition in exchange for transportation...The desires of other creatures became paramount in the evolution of plants for the simple reason that the pants succeeded at gratifying these desires would up with more offspring...[The rapidity with which they spread around the world was correlated with their beauty]... Beauty had emerged as a survival strategy." (cf. Michael Pollan. 2001:108).

[EN.3] All we know of our perceptive processes is that what we see is always related to difference and these differences are always related to change. We make think we see a world that is static, but any difference which is static is not perceptible to us. We may think we see things that standing still - but the image we produce is produced only through wiggling our eyeball, such that through microstagymous, the image moves relative to end organs of the eye. Once deprived of that ability, we do not "see" anything.

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Biographical Note.

Peter Harries-Jones was born in Oxford, England. He attended secondary school in both England

and the United States and universities in the United States, South Africa, and Oxford where he

obtained his doctorate. Subsequently he was a research officer in the Institute for Social Studies,

Zambia where he introduced together with his research group the subject of social networks into

anthropology. He taught in the University of Wales, Swansea, University of Khartoum, Sudan

and York University, Ontario Canada. Until the 1980s he was a specialist in the field of African

Studies. Subsequently he developed an interest in communication studies, systems theory and

ecology. This research culminated in an intellectual biography on Gregory Bateson's 'ecological

epistemology' drawn from the Bateson archives. He was one of the first attendees of the the

"Gatherings in Biosemiotics' and co-edited the internet journal SEED together with Edwina

Taborsky which published biosemiotics contributions. That experience introduced him to many

of the current members of that group. He is currently researching a second book on Bateson

covering his earlier years in anthropology and the necessity for enfolding the concept of culture into a broader concept of eco-culture; in effect on Bateson's 'plateaus' and Bateson's 'three ecologies' rather than Felix Guattari's borrowing of both terms.

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Ruth Garrett Millikan, Language, Thought and Other Biological Categories, Cambridge, Mass. MIT Press, 1984:91, 92].

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EXAMPLES

'Game theory'

Animal adaptations analysed on the basis of energy efficiencies

Communicative interaction based on utility assumptions

GREGORY BATESON

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In its original meaning, consciousness implied that of a collective sharing namely a *con-sciousness, (sic)*

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 (Letter 733-2 to Will Jones, 11 November 1969).

MICHAEL POLLAN

"Instead of relying on wind and water to move genes around, a

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processes by which they were generated........

I am reminded of and enlightened about by my own

mental and unconscious processes by the shapes etc., of the

animals and plants."

Thus, such an ordinary view of the forming of buds in the axils

of plants can yield some conclusions about the "massive

network of premises, each of which is self-evident and

necessarily true within that network of growth and ecological

organization."

 "A Way of Seeing," Unpublished Manuscripts folder.

GREGORY BATESON

Consultations with the mathematicians:

1940s - 1950s
Lewis Fry Richardson - arms races - vicious circles (Naven)
and later dimensionless numbers and fractals

Kurt Lewin's field theory - social networks in action fields

Bertrand Russell - logical types

Norbert Wiener - negative feedback and circular organization

Warren McCulloch - redundancy and heterarchy

W. Ross Ashby -information as variety and homeostats

1960s- 1970s
G. Spencer-Brown - the hope of attaining a formal language
expressing difference and distinction in analog continuities

René Thom - catastrophe theory: how qualitative change becomes discontinuous.

Francisco Varela - Star logic and imbrication - a Blakean approach to dialectics

C. S. Peirce - Abduction.
GREGORY BATESON: *An 'algebra' for Recursive forms*

1. Non-linear cybernetic loops are ordered heterarchically

2. Repetitive feedback develops context - subjectively interpreted through redundancy in feedback patterns

3. The integration of the whole occurs through a variety of recursive loops with different reference points and interfaces widely dispersed

4. Composite wholes are irreducible, through their very organization, to fragmentation of parts.

5. Any formal description of an organic component must include itself as a "thing" plus its *contingent relations* to a larger system, for it is the latter that pertains to the "frame" "function" or 'meaning" of the component.

6. Mutual complementarity in parts and whole: all these processes of interlinkage create relations.

7. Development occurs as in morphogenesis i.e. complexity is gained as a systemic multiplicity.

8. Topological connectivity defines inclusion and exclusion
of organisms or groups vis-a-vis environment.

9. Axle and wheel : the interconnection of percepts by percipients leads to wider gestalt as a means of learning/change.

10. Liminality: Durational timing supplants abstract notions of time-space.