Lloyd Fell, David Russell & Alan Stewart (eds) Seized by Agreement, Swamped by Understanding

An Introduction to "Maturana's" Biology

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Perhaps we can be forgiven for trying to summarise such a profound set of concepts in a few pages like this, if the reader realises how much enthusiasm we have for simply getting the conversation started.

Our Passion

Our passion for this work arose in very different histories of living, but these histories converged some years ago around the writings of Humberto Maturana1. There were other reasons for us getting together, but it was the ideas of Maturana which inspired us both to take another look at the way we were doing things in our research and education, respectively. One of us (Lloyd) was grappling with basic biological questions which arose from research on the physiology of stress. Maturana's ideas provided a new way of thinking about the relationship between living things and their environment. David, in psychology and education, sought from Maturana a more solid scientific

grounding for the extraordinary richness of the experiential learning environment in which he worked.

In the course of this article, it will become apparent that we have formed a particular kind of relationship with Humberto Maturana's work. His name appearing in the title of this paper suggests that we may be simply reviewing his ideas and referring to something that belongs to Maturana or has some particular validity outside of us, here and now. We think he would be disappointed to hear that for the same reason that he has expressed his dislike of being labelled as a philosopher when he claims to be a biologist. We have been influenced by him to regard knowledge, not as something which can be attributed to a particular book or person, or expressed as a particular principle, but as something which reveals itself in our own actions and can only be assessed in this way. This idea is at the heart of the excitement which we feel about what we have to say.

Our Knowledge

Everything that we say in the course of this conversation we have to claim as our personal knowledge even though you may recognise phrases and concepts which you may attribute to Maturana or, possibly, to someone else, like Bateson or Heidegger, *etc.* We also like to think that whatever you recognise (or know) in your interaction here with us (*i.e.* in your doing) is entirely your own stuff, too.

We are content that our knowledge (or lack of it) should be simply what we say. We cannot claim to have a particular knowledge of another person's thoughts in this situation. The only claim we can make is for the coherence of our own language, at the present time, and the only criterion that we can use to assess this is our own satisfaction in the explanation which we give. To make a satisfying explanation is the only goal for which we strive (and what an elusive goal it is!).

This means that, though we have great respect for what each of you knows now, and will know later, we take no responsibility with regard to that. We are not responsible for whatever you hear us say.

The reason we do this - and find it satisfying - lies in certain aspects of biology with which we have grappled in our thoughts and conversation for many years and for which Maturana's writing and talking has been a major trigger, amongst very many triggers, in the course of bringing forth our knowledge.

Making Distinctions

In this paper we would like to begin an explanation of this biology. Our starting point is

that each of us is a living organism or system, with the properties of being a unity and being alive. That is simply a distinction which we choose to make - as we make other distinctions, too. We are going to say a lot about matters which we will distinguish as biological **autonomy** and the process of **cognition**. These were not even respectable topics in biology until quite recent times. We note with Varela [1] that the distinction between them "is made by the hand which draws this line."

In the same way, when we say we are living unities, this is a distinction which we choose to make to bring ourselves forth as objects. We claim that this is how objects arise. They are not created in this way, of course, but this is how they are brought forth in our awareness. There is a satisfying mathematical formalism about this which Heinz von Foerster [2] was instrumental in bringing forth.



Figure 1. The distinction between cognition and autonomy is "made by the hand which draws this line."

At the same time as we specify ourselves as entities we also specify our background, *i.e.* everything else around here. The operation of making distinctions simultaneously specifies both the entity and its domain of existence. The same will be true of the entities, cognition and autonomy, as we talk about them. We are going to claim that this process of drawing distinctions, in our cognitive mechanism, is biologically constitutive - that it is both our limitation, in our living together, and our possibility.

We have found that some distinctions are easily handled and cause no great concern while other distinctions produce some sort of epistemological upheaval. It is the latter type of distinction which brings both the anguish and the delight of doing this sort of work.

Two Types of Explanation

In our daily life, we are **observers**, **observing**, the **praxis of** our **living**, or the **happening of life**, or our **experience**, and we do so in **language** - which is the basis of the operations of distinction we have mentioned. So we are always making explanations in our conversation together. The explanation, of course, is not the same as the actual living (or the biological process itself). It is in a different logical domain. Failing to realise this leads to errors of logic and a kind of incoherence which will be discussed later. However, the explanation is very important for our satisfaction; we could say, with Maturana, that it is our major tranquilliser.

We claim (simply by making a distinction) that there are two possible explanatory paths that we could follow - one that we will call **objective** reality and one that we will call **personal** reality. Maturana has used the terms "objectivity without parentheses" and "objectivity in parentheses" for these two paths. We do not claim that one of these is always better than the other - we move from one to the other according to our preference - but we are concerned that these two paths have very different consequences in our living and our possibilities for satisfaction.



Figure 2. A choice between two explanatory paths.

At the commencement of this paper we chose the explanatory path of personal satisfaction rather than objective reality, but we will be shifting between the two because it seems natural to do so; there is an emotional basis for this which we will discuss later.

We see the virtue of objective reality as being its technological convenience because it provides us with a reference point outside of ourselves. In so doing it necessitates a belief in a universal validity which is independent of the observer - some authority, perhaps an academic or religious authority - something we might call a philosophical principle. This carries with it a particular set of consequences, the characteristics of which are listed here (for consideration later): (1) some form of disagreement (or mutual negation); (2) the appropriation of knowledge; (3) hierarchies of authority based on this; and (4) a dependent manner of living together.

The idea that the observer is involved in what is observed (co-determines what is observed) has emerged strongly through quantum physics today, but nevertheless, it still is convenient, in technological matters, to behave as if there is an external reality which is independent of us. Our culture is such that we are very accustomed to this, despite its limitations.

Maturana calls that path (or ontological domain) the domain of **transcendental** ontology where the ability to know what anything is (its "isness") is considered to be an endowment - it is taken as given. This makes a stark contrast with the domain of **constitutive** ontology where the "isness" includes the observer and is very much a personal responsibility - something that we bring forth in our living. In the latter case, all our realities will automatically be different and, strictly speaking, there will be no such thing as disagreement. Instead, there will only be individual preferences, which are simply differences in culture which have been constituted through the operation of the observer. This kind of awareness can be considered as a metadomain - a second-order operation, *i.e.* knowing we are doing what we're doing and taking responsibility for it.

This personal reality is not the same as subjectivity. Subjectivity can only belong with the path of objectivity because it is a personal assessment which is made with reference to a supposedly objective perception. When we describe a particular feeling which we have about something like the weather, we make a tacit distinction between our opinion of the weather and the actual weather. However, this notion of personal reality means actually treating knowledge quite differently - taking knowledge to be only effective action. The knowing is really in the doing itself - as in our talking to you. There is no objective (or subjective) aspect to it.

The business of asking any question is quite different in these two alternative paths. In objectivity, we often find workable solutions, but the answers we get must inevitably lead to more questions because it is some ultimate truth or reality which is being

sought, whereas in personal reality we can find different kinds of solutions in our living together. One of the characteristics of these solutions which particularly appeals to us is - to use Maturana's word - tranquillity. The reason for this difference is something we will discuss further, but we think it lies in the nature of the answers (or explanations) themselves. In the latter case, the answer takes the form that we will refer to as a generative mechanism.

Trying to Define Life

As an example of how this could work, let us consider the most basic question in biology: what defines a living system - what are its essential features? These may be described in various ways - perhaps, (1) cellularity, (2) metabolism and the capability of growth, and (3) reproduction and genetic inheritance. This is a question we have been asking for a long time and, even in our most objective mode of science, do we get a satisfying answer? Speaking personally, we don't - it still seems rather vague to us, the way living things are defined.

What we want to do, now, is to make an explanation of what **constitutes** a living system, *i.e.* what operations need to happen for a living system to exist and to go on existing. This will be what we call a generative mechanism, which is more satisfying to us in this instance because it is neither symbolic nor merely descriptive - it has a particular scientific rigour. It must satisfy our particular criteria (which are described in the following paper) for a scientific explanation as distinct from any other kind of explanation.

Of course, we enjoy the symbolic explanations, too. Their beauty is far more than we can explain; all that we can do is to experience them with awe and respect. This is something which we often choose to do, as will become apparent in some later sections of this book, but, at this particular time, it is a certain degree of scientific rigour which we are seeking as our guide.

A Systems Approach

How can we make a scientific explanation which is constitutive with regard to living systems? What we have said about the knowledge which arises from our operations of distinction could be thought of as a seed which has been sown. From this seed two shoots emerge. These could be the dicotyledons of any plant you care to imagine, whose image can accompany our explanation. We think of these as two trunks of systems logic in biology which seem to provide, for no particular reason yet apparent, the twin foundations for the generative mechanism we are seeking. We will initially state (and then discuss) these two statements, drawn from the language of systems theory, which Maturana and others have used with great force in biology.

They are:

(1) complementarity of structure and organisation, and

(2) operational closure.

When we combine the two statements, we are referring to something which Maturana [3] called **autopoiesis**. The crux of autopoiesis is also a systems idea - that the organism maintains itself as a unity, not by its parts *per se*, but by virtue of the **relationship** among its parts. This is a deceptively simple idea, we find, but the profound place which it holds in all our discussion will reveal itself in different forms along the way. It is because of this idea that the need arises for a careful distinction to be made between organisation and structure [4].

The term, *complementarity*, means that organisation and structure are mutually dependent (one cannot exist without the other), but distinctly different - one cannot be reduced to the other, either. This meaning of complementarity is another of our fundaments - at times so subtle that it seems to have little importance, at other times so powerful that it seems as if everything else hinges around it.

What we call *organisation* (in biology) refers to the group identity of a living thing - the pattern of relationships among its components which must stay the same if it is to remain a member of a particular class with a certain system identity - or to remain alive, for that matter, in the case of a living system. For example, it is what enables us to tell whether something is a dog or a flower or a human being, even though there are obvious differences within each category.

The term, *structure*, refers to the particulars within a given entity, *i.e.* the physical properties of the components and the roles of the components - their actual relationships within the system. Examples of this are the expression of specific proteins from the DNA in the cell nucleus or the effect of various hormones upon the organs of the body. Obviously, these details can (and must) change continually during the lifetime of a given organisation.

A metaphor which appeals to us for explaining this relationship is that of a musical composition. The structure refers to the individual notes, each with its particular properties of tone and duration (and more subtle qualities such as staccato *etc.*) and each having a particular relationship with every other note, whether spatially as in a chord, or temporally as in a melody. The technical characteristics of a Beethoven sonata can be represented in the musical score and analysed in this way. However, the sense of melody and harmony which is the music itself arises only when the piece is being played or heard or, as in a reading of the score by an expert musician, when the music is being

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scanned as a larger whole to reveal the extraordinary, emergent, properties which were quite unrecognised in analysing the roles of the individual components. The two are not separate qualities, nor are they similar, but they are complementary.

This complementarity operates in the strict logical sense of the word. Organisation can only exist in terms of relationships amongst structures - and structure exists only in filling the roles in those relationships. Because all interactions between components in a living organism are simply due to their molecular properties, the system organisation can be said to be structure-determined *(i.e.* determined by the molecular properties of the structure) yet, at the same time, it is actually something quite different from that structure.

Whereas the structure may change all the time within a given organism, when the organisation changes it spells the end of that lifetime. Even though the organisation does not change whenever the structure changes, it can only change (in the final analysis) because of a structural change. Whereas structure is physical (or molecular), organisation is conceptual (or logical), so one cannot be reduced to the other, but both are absolutely necessary for our explanation.

The idea of *closure* is also subtle, but equally important to the whole story. Closure is a systems notion [5] referring to containment of the system operations within a system boundary; there are elegant mathematical formalisms of this recursive principle. Living things are energetically and materially open to the environment, of course (*e.g.* taking in food), but **operationally** they must be closed. The network of operations includes nothing from outside. It is entire within this boundary, which it includes in its operation.



Figure 3. A living system is autopoietic, (i.e. self-producing) and

operationally closed. In its interaction with its surrounding medium it is structure-determined, not externally controlled.

Autopoiesis is described more fully in the following paper. Simply, it refers to the construction of its own productive network - literally, self-making or self-producing. A living system is always conserving its identity by undergoing structural change. We say of life that it has to change to stay the same. It exists in molecular interactions, but the result of those molecular interactions is itself. Its *autonomy*, as we choose to represent it, arises from its organisation as a self-producing system. The nature of this self-law and its mysterious self-defining and self-referential process will be further discussed.

A Living System and its Surrounding Medium

The complement of autonomy is external control - a process with which we are much more familiar. Its characteristic element is *instruction* by specific, unambiguous signals, whereas autonomy is more like a conversation or a *construction*; something which sounds less precise (and is certainly less fashionable in science, today). By holding this new idea together with what we are more accustomed to hearing about the interaction of living things with their environment, we can progress further towards an explanation of cognition.

Because a living unity is operationally closed, it follows that any outside action upon a living system can only be a non-specific sort of trigger - it cannot specify any particular response - that response being entirely determined by the structure (the internal coherence) at that particular time. A simple example of this is the observation that the particular chemical and electrical changes in the photoreceptors of the retina and the optic nerve are not determined by the light - it is merely the trigger.

Only as we explored this, did we realise how obvious and how fundamental this kind of mechanism is. A structure-determined system like this is actually the only kind of system we could ever talk about with any degree of scientific rigour. There simply could not be instructive interactions for a structure-determined system. Such a situation would be as operationally useless as the power granted by Dionysus to King Midas of Phrygia, in Greek mythology, to turn everything he touched into gold.

The nervous system, for example, functions as an operationally closed network of neurons. There are not really inputs or outputs as suggested in the cybernetic model. The common explanation that it processes information seems to us to obscure its function rather than clarify it. Like the rest of physiology, the nervous system is observed only as a set of correlations, which do not necessarily constitute a messaging system, and there could be no possibility of it referring to the outside from the inside. We maintain that the information model in biology is a category error in systems logic,

confusing a system-internal with a system-external view [6]. Needless to say, this change in the way we think about communication has enormous implications for our living together and generates one of the major themes of this book.

What we said earlier about our knowledge was based on this. If we say that we are producing bits of information and you, the reader, are processing or representing those "facts" in some form using your nervous system, then we are employing a symbolic description which can be quite useful as a generalisation, but is inaccurate operationally. Symbolic explanations can be helpful (even powerful) shortcuts in our communication process, but such approximations are quite inadequate as scientific explanations.

A Structural Coupling

How then are we interacting with our surrounding medium - which includes one another? If it is not a process of information transfer, what does constitute our relationship at this time? Firstly, in the same way that we receive triggers, we are triggering our environment - it is being perturbed, too. A living unity simply could not exist without its surrounding medium - thus we see that there is also a complement for autonomy. An organism exists only in its connection with its medium and that connection is actually its history of interaction. This history of interaction will continue as long as the organism can maintain its organisation - then it ceases.



Figure 4. Living systems are structurally coupled by recurrent interaction.

Autonomy means that the organism subordinates all changes in the environment to the maintenance of its organisation no matter how its structure may have to change to do this. It is said to be structurally coupled in that a structural congruence must develop with its environment for it to have any history at all. Rather than an organism passively responding to the environment we have a two-way interaction where the organism and its circumstances will continually change together.



Figure 5. A history of recurrent interaction leads to structural congruence. The organism and its circumstances change together.

We can either be completely separate, *i.e.* have no relationship, or we must be structurally coupled - our structure with yours, in the reading of this book. Without congruence in this relationship we will simply separate. Given that we are structurally plastic entities (and the great plasticity of human beings is due to the intricacy of our nervous system) our histories can be seen as interlocked, mutually triggering and mutually selecting trajectories. Our history of recurrent interactions has the natural tendency to lead to some form of structural congruence.

This is not the same as talking about encoding and decoding information; we will take up Varela's point, later, that the word, information, derives from *in-formare*, meaning formed within [7]. Perception is not being explained here as the grasping of any feature of the environment. We cannot claim it to be any different from illusion; inherently there is no way we could distinguish perception from illusion. That something was an illusion will always be an *ad hoc* reflection which an observer has made.

Cognition, as we are going to distinguish it, is not the operation of neural information processing. It refers to the total biological interaction of the living organism in its domain of operation. Maturana puts it that a cognitive system is one whose organisation defines a domain of interactions in which it can act with relevance to the maintenance of itself. We say that cognition is a process whereby an organism maintains its identity in a changing world by altering its awareness through its interaction (*i.e.*

"relevating", to use a term revived by David Bohm [8]).

Being in Language

Talking about our cognition is epistemologically challenging because it is a secondorder operation - knowing how we know. It is also a point of breakthrough in our quest for a satisfying and coherent explanation of the way living things operate. To begin we will reiterate that, in our explaining, we are always observers and we are always talking to another observer (even if it is to ourselves). We are always operating in language whether we are talking or not, *i.e.* we necessarily think in language and dream in language (whether it is images or words that we use). So what is *languaging*; what is our operation of distinction in this case?

For the sake of our generative mechanism - the explanation which we are gradually piecing together - language cannot be simply a means of communicating by using symbols; we would have to know what a symbol was and it would have to be some sort of endowed ability. So we will use system logic again in our explanation of languaging. Language arises when we see that the objects we bring forth by the distinctions we make are just that - objects which arose in our awareness through our operations of distinction. It is therefore a second-order process which has the effect of expanding the domain of our coupling exponentially. This is a major step in our journey. It is the time when the plant which has grown in our mind from the seed sown earlier can suddenly burst into flower.

This interlocked conduct which we have previously mentioned, between you and us, will be seen by us observers as a coordination of our behaviours; that congruence we described earlier appears to us in that way, forming what Maturana calls a consensual domain. We see examples of coordinations of action everywhere - between our children and their dog, for example - but these coordinations move into what we call language when they become a second-order system operation. So we say that *languaging is the coordination of actions around the coordination of actions*. It is a recursion of the coordination of actions - because now we are referring to the consensual domain as the closed system and the organisms within it as being open - through language.

When we talk about the operation of an organism we are talking about its *physiology* (that is a system-internal view); when we talk about these interactions we are talking about its *behaviour* (that is a system-external view). The two are logically different - they are different categories - so we cannot reduce one to the other without compromising our scientific explanation. To say that one causes the other would be to confuse the two domains. What we can do is to propose our generative mechanism to link the two in a strict operational sense, *i.e.* when those things happen, this will also happen. That is why we need the idea of languaging - defined in this way - to take care of the behavioural aspect. It is the system-external view of the manner of realising our structural drifting

together. In language lies the mystery and fascination - and also the satisfaction - of exploring this kind of biology.

Observing Biological Phenomena

At this point, let us take stock of the ground we have covered so far. We can make some useful connections here with the more conventional biology text. We have constructed this biological explanation by focussing our attention on the living organism as an autonomous unity. It is the conservation of identity of each biological unit which we have brought forth as central, not the conservation of a population or of the genetic material which runs through a particular lineage. This contrasts sharply with the way of speaking in both population genetics and sociobiology where gene pools and species behaviour have been the focus at the expense of the individual living thing.

Although we have restored attention to the biological unit as an attempt to see basic constitutive mechanisms more clearly, we must still deal with the history of change which occurs through each lifetime and through generations. The history of interactions which occurs within one lifetime is usually referred to as an organism's ontogeny. Maturana uses the term ontogenic *drift* to denote the structural changes which occur within this lifetime *i.e.* while the organisation is kept intact. Drift can be thought of as the openness in our closure, without which the system could not survive. We will be calling our living together: co-ontogenic structural drift - which we shorten to **co-drifting.**

The phenomenon of reproduction has a prime place in biology because it is the means whereby life continues into the next generation. But this does not automatically mean that it is constitutive of the actual living process. Along with growth and development, reproduction is described in our view as one of the *biological phenomena* - observable only from the system-external view. Therefore, they are not reducible to autopoiesis which is the characteristic organisation of living things - and, therefore, they are not particularly useful as criteria of life, according to the logic we are using[9]. These phenomena arise because of a history of interaction - they are the *chrono-logical* consequences of autopoietic processes or, to put it another way, a living organism is autopoiesis with a history.

Similarly with regard to evolution and genetic inheritance: these are seen as historical epiphenomena, explainable through autopoiesis, but not part of the criteria which define the operation of living. The current preoccupation with molecular DNA arises from the discovery that nucleic acids are so universal, have been around for a long time and are unusually stable over generations. However, to describe them as life-determining, coded sets of information seems to us to obscure their role, rather than clarifying it. They can be likened to a country's constitution, which is associated with a

very stable government, but certainly does not run the country. Their role in shaping protein production is important, but no particular molecule can have the property of determining a living organism. This is where we need to take issue with what we see as a systemic illogicality in the "selfish gene" argument and neo-Darwinism.

Although reproduction and genes are not required for life itself, they certainly are required for evolution. This is a very different time-scale from living, being the consequence of many lifetimes of ontogenic drift; it is the phylogenic drift over evolutionary time. Whereas ontogeny is organisational continuity, phylogeny is a history of organisational discontinuity within a lineage - a series of identity crises with a new identity emerging again each time (if the lineage continues). The controlling thread running through this is organisational drift which results from structural change, that structural change having arisen from the history of interactions with the environment.

It follows from this that natural selection does not really cause evolution as is often claimed - it is more simply explained as a consequence of it. In Darwin's original writing, he apparently said it is **as if** there were natural selection. We will take up this point again. In our view, what we are seeing is the history of variations around what is conserved - and what is being conserved (to reappear in the next generation) is something we will call a *manner of living*. What is reproduced is the manner of living - what members of a species share is their manner of living - which Maturana calls the ontogenic phenotype. Here, the term, phenotype, is not given its conventional biological meaning as that part of the genotype which is being expressed, because we are saying that it arises in the living. Nothing ever arises that is not possible in the existing structure (*i.e.* the genes limit what range of proteins can be expressed), but the initial structure does not determine what arises. Genetic change can be expected to *follow* the drift in the ontogenic phenotype.

Our whole notion of causality [10] has been called into question in this biological explanation - which is a further epistemological challenge. We tend to think of causality in explanation as a single arrow pointing backwards to some determining event *i.e.* a *post hoc* analysis from a system-external position. Alternatively, what we are doing here, by referring to the biological system as distinct from the explanation, is to see any event as a node (or point of bifurcation) - one possibility made concrete, opening another set of possibilities. Thus it is like multiple arrows pointing forward within a broad funnel of limits. There is an important avenue for further discussion, here, leading towards von Foerster's classic statement that this kind of natural system is "synthetically deterministic, but analytically indeterminable".

Implications for Human Behaviour

This explanation of biology has great implications for our future living together - for our survival as a species - our biological satisfaction - some of which are discussed in later

papers. For now, to complete our explanation of the generative mechanism which is our biological heritage and our birthright, we only need to ask how our behaviour as human beings - operating in languaging - might be put to best use in our living together. This we regard as the fruit which our imaginative endeavour is now capable of bearing.

It follows from the structural coupling that not all domains of action - or manners of living - are open to us at any particular time. The distinctions we make are not made arbitrarily - they are constrained by the interlocked, mutually triggered, mutually selected, state of our interactions at any point in time.

The human communities in which we exist are constituted as coordinations of actions in language - which we can call networks of conversation. We are continually in conversation with others in our network - which can be large or small. We can see by now that everything that happens in this conversation is leading us onward in our living. But how is the conversation generatively linked to our living - to our physiology - to what Maturana calls our bodyhood?

We need to say that our **emotions** (or our emotioning) can be distinguished as the essence of our bodyhood in the same way as languaging is the essence of our behaviour. Emotions are the dynamics of our physiology - the flow of our molecular processes - and, because of structural coupling, emotions are also our *bodily predispositions for action*. Our emotional state (our bodyhood) limits the domain of possible actions. We know this from observing the way that anger, for example, makes it temporarily impossible to carry out certain conversations or actions. It is just as a car operating in reverse gear does not have forward motion in its domain of action.

The way in which our emotions are linked to our actions, can be seen in the contrast between what we will call love and fear. Referring back to the two possible ontological domains (or types of conversation), objectivity and objectivity in parentheses (the personal reality), we reiterate that genuine mutual acceptance is generated by the latter, but not by the former. We say that love is the action which constitutes the other living thing as a legitimate other in co-existence with you - it is a domain of action, rather than a feeling. What we call our feelings are reflections (assessments) we make of how we are and often they don't coincide with our emotion. Love is generated from the most expansive emotion, allowing the greatest range of conversation, whereas fear is a relatively narrow domain of action which goes with hierarchies of authority based on socalled objective knowledge.

We claim that what happens in conversation is never trivial. Our rational explanations are always grounded in our emotioning, although often we do not realise it. In the absence of love, the braiding together of our languaging and emotion which is our conversation *(con-versare, turning together - or dancing)* is bound to be seen as a history of separation and suffering. Conversely, the actions of love have extraordinary

powers of healing - the actions of touching, sharing and affirming are triggers toward a history of wellbeing in our living (*i.e.* our relationships). We say, with Maturana, that we are **constitutively**, not culturally, dependent on love.

Our Culture

We began this paper with our personal passion and our personal knowledge and we end our story with some remarks about our culture - about the way we make meaning together. Human culture is defined in the various networks of conversation. We can speculate that the human lineage arose when languaging arose in our manner of living and it would have arisen out of coordinations of behaviour in the context of our emotioning. It seems most likely, then, that it must have arisen out of a recursive intimacy, or love - a history of intimate, mutually supportive behaviour - because aggression and competition would only have lead, recursively, to separation.

Maturana and Gerda Verden-Zöller [11] have been examining our history to see what kind of emotional change was associated with the significant changes in our culture *e.g.* there is evidence of a nature-trusting, peaceful, sharing culture which was virtually destroyed by an appropriative, patriarchal, warlike culture about 4500 years BC. The first acts of appropriation may have been the deliberate herding of animals to keep them away from predators - leading to changes in emotions (pride, mistrust) and subsequent behaviour (hoarding, the use of killing tools as weapons, *etc*). The existence within us of vestiges of that nature-trusting emotional base would appear to come into conflict with our appropriative culture, today - and this contradiction could be what generates much of our human suffering.

The constitutive nature of our biological process of living together is also our great possibility for the future because we all have the natural ability to participate with others in consensual domains (an attribute which Maturana calls intelligence). By the laborious, but rewarding, bootstrap process of our cognition, we will continue our structural dance together and make a history for human society which will be synthetically determined, but analytically indeterminable. We cannot know what the future holds, but we can know that everything we do (or say) contributes significantly to it. This awesome responsibility is what we regard as the biological basis of our human ethics.

We are not in a position to recommend anything about human behaviour to anyone else because of our belief that each of you will bring forth your own world which is different from ours. What we choose to do - which for us brings considerable satisfaction and tranquillity - is to take responsibility for our own living according to our biologically-based ethics and, in so doing, to **invite** you to continue with this conversation. There can be no certainty about the outcome - only the invitation to continue the conversation. <u>1.</u> In Principles of Biological Autonomy.

<u>2.</u> Heinz von Foerster was a highly influential cybernetician and biomathematician at the University of Illinois and the author of numerous scientific articles and books including Principles of Self-Organisation (1984).

<u>3.</u> Maturana relates the origin of the term, in 1973, to a conversation he had with a poetfriend who said that Don Quixote had to choose between the praxis (of being a knight) and the poiesis (of creating knights) - personal communication.

<u>4.</u> Maturana and Varela's description of these concepts is most easily accessible in The Tree of Knowledge: The Biological Roots of Human Understanding.

<u>5.</u> The most comprehensive discussion of this idea, without too much formal mathematics, is contained in Varela's book, Principles of Biological Autonomy.

<u>6.</u> This is also discussed in Autopoiesis: System Logic and Origins of Life by Gail Raney Fleischaker.

<u>7.</u> In Principles of Biological Autonomy.

8. In Wholeness and the Implicate Order.

9. See also Autopoiesis: System Logic and Origins of Life by Gail Raney Fleischaker.

<u>10.</u> We are indebted to Gail Raney Fleischaker's Autopoiesis: System Logic and Origins of Life for this way of looking at causality.

<u>11.</u> Gerda Verden-Zöller is an Austrian anthropologist. Maturana spoke of this work with her during his Melbourne Workshops in 1991.