CHAPTER THREE. INDIVIDUAL AND ORGANISATIONAL LEARNING: AN EVOLUTIONARY PERSPECTIVE

"The evolutionary epic is probably the best myth we will ever have"

(E.O.Wilson, 1978.)

3.1 Introduction

The aim of this chapter is to introduce an evolutionary perspective on learning that can be applied at multiple levels of analysis: individuals, organisations and populations of organisations. This will address the general problematic identified in Chapter Two and provide the framework for analysis in the remainder of the thesis. The chapter starts with an introduction of evolutionary theory in terms of how it meets some general criteria used to assess theories. This is followed by a detailed explanation of one development of evolutionary theory known as evolutionary epistemology, and related developments that can be used to extend its value. The chapter will then end with a summary of the practical implications for observing and analysing and organisational learning.

It will be argued that evolutionary theory is of value for two reasons. Firstly, it provides an explanation for the origins of diversity and the role of learning within that process. Secondly, it is able to generate concepts of learning that can be observed at the level of individuals and organisations. In subsequent chapters these will be used in the analysis of learning in NGOs in Bangladesh. They will also suggest methods of assisting organisational learning.

3.2 The Nature of Evolutionary Theory

The Darwinian theory of evolution is the most widely accepted theory of the origins of diversity (Dennet, 1995). An essential part of this theory is a theory of change over time. This theory has been successfully applied on temporal and geographic scale much larger than that covered by either development theory or theories of organisational learning. The basic

structure of this body of theory has now survived for more than 140 years.

Not only has it survived but it also continues to attract the interest of disciplines other than biology. In the last decade evolutionary theory has been applied in the fields of economics (Andersen, 1994; Delorme, 1994; Hodgson, 1992), sociology (Burns and Dietz, 1992; Hannan and Freeman, 1989), political science (Axlerod, 1984), international relations (Modelski and Poznanski, 1996), organisation theory (Baum and Singh, 1994), psychology (Cosmides et al. 1992; Edelman, 1987; Dennet, 1991), cosmology (Smolin, 1997), the philosophy of science (Hull, 1988), epistemology (Cziko and Campbell, 1990), and theories of organisational learning (March, 1991). It is increasingly an inter-disciplinary body of theory, a point that should be in its favour in an inter-disciplinary field such as Development Studies.

There have been many criticisms of the use of evolutionary theory (Sanderson, 1990; Dietz, Burns and Buttell, 1990). Many of these involve assertions about appropriate criteria of value for widely applicable theories of change. Rather than explore these criticisms in depth the remainder of this section will briefly introduce evolutionary theory in terms of some of these criteria. The sections that follow will then look at a more specific interpretation of evolutionary theory, and how it can be of use.

Evolutionary theory is not a *uni-linear* theory of history. The basic metaphor is of a branching structure. Change is seen as an open ended process involving a diversity of agents but one where the entities concerned have common historical origins. Evolutionary theory is not *teleological*. However, contrary to some interpretations (Economist, 1998), while purpose is not required for the process as a whole, it is not the case that individual agents must operate without purpose. Contemporary evolutionary theory does not embody a questionable notion of *progress*. It has been suggested that the appropriate metaphor for the shape of evolutionary change is not even a branching tree but a "moorland with lots of stunted bushes but only a few trees" (Cohen and Stewart, 1995:327). This image more accurately reflects the fact that the fate of the vast majority of lineages in the history of life has been extinction.

Evolutionary theory is not excessively *functionalist*. An over-emphasis on the concept of

adaptation fails to take into account the "inefficiencies of evolution" (March, 1994), the variations in capabilities within species which ironically is the very source of evolution's flexibility. Evolutionary theory is not inherently *conservative*. It recognises both homeostatic and chaotic relationships, but does not privilege either (Dennet, 1995). The former are more characteristic of conditions within individual organisms, and the latter best describe relationships between organisms, especially prey-predator relationships. Although originally conceived by Darwin as an *incremental* process subsequent evolutionary theory has also been able to incorporate revolutionary rates of change (Ray, 1994; Eldredge, 1985).

Darwin's own theory was not *reductionist*. It did not attempt to explain the history and diversity of organisms by their constituent chemistry or physics. His focus was on the relationships between organisms. Evolutionary theory does not require a simplistic *ontology,* centred on genes alone. There is an active discussion centred around the idea of hierarchies of entities of different scale, each subject to some form of selection pressure by their environments: cells, organisms, demes, species, etc., (Allen and Starr, 1982; Buss, 1987, Eldredge, 1985; Schull, 1990). Within this framework the notion of individuality is seen as a complex one, clearly conditioned by the scale of the observer relative to the observed and the span of time under examination (Gould, 1990).

The current debate on the *directional* nature of evolution is on the degree to which increasing diversity is intrinsic to the evolutionary process (Wilson, 1993, versus Gould, 1994) and whether species diversity contributes to ecological stability or not (Cherfas, 1994). The latter question is closely related to the management of diversity problematic introduced in Chapter Two.

When applied reflexively to the development of scientific theories (Campbell, 1986; Hull, 1988) evolutionary theory is *tolerant*. Contending theories are to be expected, as is diversity within evolutionary theory itself. The quotation from Wilson at the beginning of this chapter captures an awareness of its dual status. It is a major theory of the world, but also just another human story. Although it appears post-modernist, it will be argued in this thesis that it can be used to generate practical implications for action.

It is possible to evaluate evolutionary theory in more forward-looking terms than discussed above. Developments in computer capacity in the last twenty years have now made it possible to explore evolutionary theory on an experimental basis, in addition to the traditional method of naturalistic observation. This has dramatic consequences for the ability to explore evolution both as a theory and as a process that can be adapted into a form of technology.

Computers, with their very large memories and fast processing speeds, make it practically possible to simulate the actions of large populations of agents that react locally to each other according to particular rules, which can vary between agents. Crucially, computers also allow time to be built into models. This development has allowed the study of how stable social structures can emerge from the actions of individual agents. The best known of these is the work of Axlerod (1984) on the emergence and persistence of co-operation amongst selfish agents. Within the new field of artificial life (Langton, 1989) computer simulations of evolutionary processes are shedding light on how complex ecosystems emerge over time from simple beginnings, exhibiting complex mixes of relationships including competition, co-operation, parasitism and symbiosis (Ray, 1994). It is important to note that both Axlerod and Ray's approaches involve a *synthetic* rather than reductionist approach to the study of complex behaviour. They are based on the manipulation of *relationships*. The results generated have also re-affirmed another attraction of evolutionary theory: the creativity and open-endedness of the process of evolution, as originally identified by Darwin (1859).

A wide range of practical applications have also emerged, in association with the increased availability of sophisticated computers. Since the mid-1970's (Holland,1975) a class of software know as genetic algorithms has been under development which can be used to solve complex optimalisation problems (i.e. involving multiple conflicting requirements). These embody a process of simulated evolution, where a large population of potential solutions compete to produce the best solutions to specified problem. The fittest of these interbreed and mutate over a series of generations, until a satisfactory level of performance is achieved. Genetic algorithms have been applied in a wide range of fields: business decision making (Mathews, 1995), engineering (Holland, 1975), computer hardware design (EPLF/LSL, 1995), computer software design (Forrest 1990; Koza, 1992; Johnstone, 1995), architectural design (Frazer 1995), graphic art (Geake, 1993), and music (Johanson, 1997). An important

lesson from these developments is that the evolutionary process is not intrinsically biological in nature, but as an abstract conception, can be embodied in a variety of media.

Not only is there diversity within evolutionary theory, as suggested above, but evolutionary theory itself is undergoing change. In his appropriately titled essay, *The Evolution of Evolution* James March (1994), a significant contributor to theories of organisational learning, has summarised a number of important changes in the way the ideas of evolution have been used.

> "As ideas of evolution have developed, they have moved away from outcome conceptions of evolution to process conceptions. They have moved from conceptions of evolutionary processes as "efficient" instruments of adaptation to an appreciation of their "inefficiencies". And they have moved from an emphasis on using evolutionary theories to predict history to an emphasis on the engineering of history." (March, 1994:39-49)

It is the potential of this latter use that has led to the exploration of evolutionary perspectives developed in this thesis. The participatory monitoring system that is described in Chapter Eight is an attempt to embody the same basic evolutionary process within the structure of an NGO. The process was designed with the intention of enabling CCDB to manage a wide diversity of accounts of events taking place in the lives of its beneficiaries, in a way that was in their interests.

3.3 Evolutionary Epistemology

The particular development of evolutionary theory that will be developed below has been described as evolutionary epistemology (Cziko and Campbell, 1990). Its most well known advocates have been D.T. Campbell (1974), an eminent American psychologist, and the philosopher, Karl Popper (1979). Although the focus will be on Campbell's views some use will also be made of the recent work of Henry Plotkin (1994), a British psychologist and evolutionary epistemologist. Some potential problems with the application of evolutionary

epistemology are then managed by introducing some ideas developed by Gregory Bateson (1979), a social anthropologist. The social dimensions of the theoretical framework will then be elaborated by making use of the work of Burns and Dietz (1992), sociologists who have developed what they call a rule based conception of cultural evolution.

Evolutionary epistemology has been defined as "the biological study of knowledge...the study and understanding of knowledge through the use of evolutionary theory" (Plotkin, 1994:2). It can be distinguished from other approaches by the fact that it is naturalistic, inductive and descriptive rather than foundational, deductive and prescriptive in its approach. It argues that "evolution - even in it is biological aspects - is a knowledge [accumulation] process and that the natural selection paradigm for such knowledge increments can be generalised to other epistemic activities, such as learning, thought and science" (Campbell, 1974:413).

The nature of the process of natural selection, in its abstract form, is detailed in Campbell's 1969 paper titled "Variation and selective retention in socio-cultural evolution". There he outlines the key elements of what will be called in this thesis the evolutionary algorithm. It consists of the iteration of the following three events:

> 1. "The occurrence of *variations*: heterogenous, haphazard, "blind", "chance", "random", but in any event variable (the mutation processes in organic evolution and exploratory responses in individual learning).
>
> 2. Consistent *selection* criteria: selective elimination, selective propagation, selective retention, of certain types of variations (differential survival of certain mutants in organic evolution, differential reinforcements of certain individual responses in learning).
>
> 3. A mechanism for the *preservation, duplication, or propagation* of the positively selected variants (the rigid duplication process of the chromosome-gene system in plants and animals, memory in learning)." (Campbell, 1969: 73).

According to Campbell (1969:73) "If there are representatives of these three requirements at

the level of social forms and customs, then a socio-cultural learning process is inevitable". In this context Campbell has in effect defined learning as the *selective retention of past forms*. This definition is central to the view of organisational learning developed in this thesis. What survives is what has been learned. This view equates forms, or more correctly their selected and retained adaptations over time, as knowledge itself.

In the words of another psychologist, Plotkin (1994:xv) "…adaptations are themselves knowledge, themselves forms of "incorporation" of the world into the structure and organisation of living things. Because this seems to misappropriate a word, "knowledge" with a widely accepted meaning - knowledge usually just being something that only humans have somewhere in their heads - it makes the argument easier if the statement reads "adaptations are biological knowledge, and knowledge as we commonly understand the word is a special case of biological knowledge."

He explains with the example: "...the relationship of fit between parts of the organisation of an organism, its limb structure for instance, and some feature or features of the world in which it lives, such as the terrain or medium through which it just move, is one in which that organisation is in-formed by the environment". The environment, by favouring appropriate variations in an organisms functioning, and not favouring others, *makes a difference* to the structure of the population of those organisms. At the individual level (of learning) non-fatal experiences can similarly effect current and future behaviour.

There are two advantages of this epistemology. One is its avoidance of a form of dualism that privileges human experience: one where there is a split between a human mentalistic experience of knowledge and the rest of the world simply existing as the object of knowledge. This non-dualistic conception of knowledge is also a recognised characteristic of the ideas of Gregory Bateson (Harries-Jones, 1995:175), which will be explored below. It enables us to legitimately think about organisations learning as well as individuals. It also enables us to think about knowledge being retained in other forms than texts and speech, for example, organisational structure. The idea of structures being in-formed also implies that new learning may be at the cost of old learning, and thus need to be undertaken strategically.

The second advantage is the minimalist nature of the definition of learning. In his review of work in the field of artificial life, Belew (1991) has emphasised this feature in his claim is The dumbest smart thing you can do is stay alive". The minimalism of this definition also makes it an enabling definition. Once the requirement of survival is met further variations may take place and these lead to the emergence of further structure. For example, in architecture a column may fulfil an essential structural role, but then also be used for various aesthetic purposes.

Having outlined the evolutionary algorithm Campbell suggests that evidence should then be sought for the embodiment and co-existence of these three processes of variation, selection and retention, within human cultures. Variation is the least problematic, being evident in his view between social groups (in the form of social organisation or items of material culture), between members of specific groups (e.g. in the execution of a common custom), and between occasions (e.g. in the resolution of a particular problem). Mechanisms for the transmission of past experience can also be readily identified: writing, oral poetry and song, story telling, rituals and routines of behaviour.

Campbell's main reservations concerned the nature of the selection processes: *"The potential selective systems are so numerous and so intertwined, and the selective criteria so difficult to specify, that quite respectable intellectual grounds are provided for a denial of the existence of a socio-cultural evolutionary process*" (1969:74). A selection process can be broken down into entities that are subject to selection and criteria or rules that account for their selection. The former are described in discussions of evolutionary theory as units of selection. Within biology there are some entities, for example single organisms, that are universally recognised as units of selection, whereas the existence of others, such as species and sub-groups (demes) are still subject to continuing debate (Schull, 1990).

In human cultures there are problems with both aspects of the selection process, with identifying the units of selection as well as the criteria for their selection. As Campbell

pointed out "We know the physics of the air, water and light to which swimming, flying and seeing apparatuses of the lower animals must conform. For the study of social evolution we have no such semi-independent descriptions of the selective criteria" (1969:75).

In fact Campbell is even understating the difficulties of understanding selection processes in biological systems. It is important to recognise that much of biological fitness is to do with how an organism fits into the biosphere, i.e. the complex of other life forms in its neighbourhood, not simply the geosphere. This secondary level of fitness can emerge because there is typically more than one way for organisms to meet their basic physical requirements (a sustainable metabolism). This is especially the case in ecosystems located in environments with high rainfall and solar energy, such as the Amazon. In environments where there are high densities of species and high levels of species diversity it is the responses of many other life forms that determine its fitness and survival. These are mediated by processes of perception and communication, which themselves are subject to evolution.

Unlike the physical world and its rules, the world of the surrounding biosphere is also evolving, in addition to that of the organism of concern. In recognition of this fact Van Valen (1973) has proposed the Red Queen hypothesis, that an ecosystem is an Alice-in-Wonderland where organisms have to run as fast as they can simply to keep in the same place (i.e. survive, let alone proliferate). The process whereby one organism evolves in response to the evolution of others is known as co-evolution.

One implication of the concept of co-evolution is the possibility that environments may vary in their rate of change, and this may have implications for how organisms need to be able to adapt. Campbell (1974), Plotkin (1994) and others have argued that evolution (in species) and learning (in individuals) are methods of adapting to different rates of changes. They suggest there is a temporal hierarchy of processes of adaptation which is ordered by the speed with which the different variation-selection-retention (VSR) processes takes place. According to Plotkin and Odling-Smee (1979) the capacity for short term behavioural variation is an evolved capacity to deal with short term unpredictabilities in the environment that cannot be dealt with by variations generated during the longer cycle of reproduction.

At a higher level of abstraction Plotkin and Smee argue almost paradoxically that "environmental unpredictability must be reliably present in certain situations", in order for behavioural flexibility i.e. learning to be selected for. One general implication of this perspective is that explanations for particular learning behaviours that are observed should be sought in the nature of the changes taking place in that environment. It is this view which has led to a move in psychology, since the 1960's, away from general process theories of learning towards more ecologically situated theories (Johnston and Pietrewicz, 1985). In Chapter Seven attention will be focused on the periodicities of behaviour within an NGO, and how they relate to the frequency of events within that NGO's environment.

Another consequence of this hierarchical view of learning is that "*the learning process* [i.e. the behavioural variation within individuals] never starts de novo, but always starts on the basis of phylogenetic priming i.e. on physical adaptations that have been inherited up to that point. Those accumulated adaptations specify the range of variations possible and also the criteria by which variations in behaviour are selected as valuable or not, e.g. forms of pain and pleasure. The existence of those particular criteria themselves are simply one of many trials at the level of the species. Variations are likely to exist within the species, and even more so, between species. It seems feasible to extend this concept of constraint located within temporal hierarchies of selection processes into the realm of organisations of individuals. Within organisations the range of possible interpretations of particular roles and routines is limited by wider conceptions of the overall organisational structure which contain these roles. The job of a clerk in a Finance unit could not easily be altered into one of graphic artist. Deliberate variations in the form of those defining structures may take place much less frequently.

Campbell's and Plotkin's hierarchical conception of VSR processes does not limit itself to a one way process of causation, the results of longer cycles simply constraining the settings of shorter cycles. Campbell (1974) also describes what he calls "downward causation". At the minimum, successful learning processes [i.e. rapid VSR cycles] within individuals will support the continued existence of the longer cycle processes (e.g. of reproduction of their species) in which they are embedded. But if that learning process is able to expand the range

of conditions in which the individual can survive then changes in longer cycle processes will be possible (e.g. rates of reproduction), so long as they do not undermine the survival prospects of the individual. In biology this process is known as the "Baldwin effect" (Abercrombie, et al. 1990:54). The homology of this process can be seen in human organisations. People whose roles are located within particular structures can perform in ways which not only allow the continued survival of these roles and structures but they can also achieve significant changes in those structures, if they are consistent with their own survival.

Plotkin and Odling-Smee (1979:9) and Waddington (1969) have argued that the process of mutual or co-evolution present in the biosphere generates a positive feedback cycle "with the consequence that change itself generates change and tends to do so at ever increasing rates". However, all biological life depends on energy inputs and these are finite, even in the tropics. These act as a constraint on the continued escalation of co-evolutionary processes. The point has been made by Mayley et al. (1996) and others that learning (behavioural variability) has an energy cost that is greater than that of fixed (e.g. instinctual) behaviour. This analysis suggests there may be a particular value in investigating the highest frequency forms of learning in organisations. If they are more costly, what is so important about their contents?. In his analysis of information in organisations Stinchcombe (1990) has argued we should "analyse the structure of organisations as determined by their growth towards sources of news, news about the uncertainties that most effect their outcomes" (1990:6). In particular, "the protection against error that an organisation builds into its information systems tells us a lot about what the organisation really wants to know"(1990:15)

This temporal perspective on evolution and learning takes the focus of attention in the opposite direction to that taken in the past, by 19th century social evolutionist (Spencer, 1893) and neo-evolutionary social science in the 20th century (Parsons, 1951). These were concerned with the nature and fate of whole societies, and over long spans of time. Instead it suggests the need for much more micro-level analysis. For example, the temporal structure of information processing within individual organisations. At this stage it is appropriate to return to the question of what it is that is being selected by these selection processes, and the contribution of Gregory Bateson, a social anthropologist but the son of a biologist.

3.4 Bateson's Ecological Epistemology

The phrase "units of selection" suggests there are unambiguous, if not solid, entities out there, waiting to be selected. Bateson's view on the evolutionary process takes the opposite direction and focuses on *information* which he sees as the very opposite of what we think of as substantial matter. Information is about the relationship between things, more particularly, about differences. "Information consists of differences that make a difference" (Bateson, 1979:99). The idea of difference is a key idea in Bateson's work, and one which he has used to develop his theory on the ecologically embedded nature of mental processes, as developed in his later work (1972, 1979). In Bateson's view the units of selection are information, not objects per se. Campbell's definition of learning can now be refined: *learning is the selective retention of information* (in-formation).

Bateson argued that we do not see things, but rather differences. This is visible in the operations of the human sensory system, such as the retina, which is most sensitive to edges (spatial differences) in the centre of our vision and movement (changes over time) in our peripheral vision, and where any constant sensation quickly becomes adapted to and effectively invisible (in practice prevented by micro-movements of the eye). Current attempts to physically model visual perception are based on this recognition (Mahowald and Mead, 1991). In the process of perception the structure of differences initially perceived by sense organs such as the eye undergo an immensely complex series of transformations as a result of subsequent interconnectedness of the rest of the human nervous system. Some of those interconnections are inherited structures, the priming referred to above, developed as a result of evolution to date. Others are known to be affected by the process of epigenesis, or maturation associated with growth to adulthood. Others are thought to develop during the process of learning. Although Bateson does not go on to speculate about the nature of the processes within the human brain, though others have, such as the psychologist Edelman (1987), in his theory of Neural Darwinism.

Bateson's conception of difference, and the subsequent transforms of difference, is integrated

through the use of the idea of "logical types", an idea taken from Whitehead and Russell's Principia Mathematica (1910-13). A logical type is a class of information of the same type. Bateson suggested that information can be structured in terms of a hierarchy of different logical types (1979:127-142). At the base, notionally speaking, there are differences, above that is a different logical type of information: differences between those differences. Above that level is another logical type of information: differences between those differences between differences, and so on. An example within the field of development aid is the difference between project performance, evaluations and meta-evaluations. The latter treats evaluations as the subject of scrutiny, not project performance.

Bateson argued that this structure can be seen to exist in nature and not just as a human conceptualisation. In Bateson's word when the biosphere is examined “Instead of a hierarchy of classes we face a hierarchy of orders of recursiveness.” (1979:222). Differences at one level are subject to selection by differences at another level. This is the basis of his idea of deutero or second order learning, which has been both borrowed and re-conceived as a key idea within a number of theories of organisational learning (Argyris, 1976; Lovell and Turner, 1988; Shrivastava, 1983; Senge, 1990). Deutero-learning involves what he describes as a different logical type of learning. What is subject to variation and selective retention are the settings, or criteria which govern what is considered successful or fitting behaviour. This conception relates closely to the ideas of Campbell and Plotkin, introduced earlier.

There is an important additional dimension to this process, which complements the views of Campbell and Plotkin. In deutero learning, instead of behaviour being subject to selection, as in ordinary learning, what is being selected are “categories of contextual organisation of behaviour”, wider categories of experience (Bateson, 1979:149). For example, whether the situation is a "game" or "life and death situation", "casual" or "formal". This view relates closely to Wittgenstein's idea of different language games, that there are different rules for the use of language and their application depends on the setting, or rather the perception of the setting (Grayling 1988). Furthermore, Bateson argues that children learn more macro differences such as "play" and "not-play" earlier than they learn the specific rules of language. This is consistent with the fact that many animals distinguish between play and not-play, but do not have a language as we know it. Children are also known to learn to

develop a gender identity before they develop their identify as specific individuals. What is important about this argument is that conceptions of the world are not built up out of atoms of language (Cohen and Stewart, 1995) or "memes" as suggested by Dawkins (1976). Instead what is involved is a progressive differentiation of constructs, of key differences in the world.

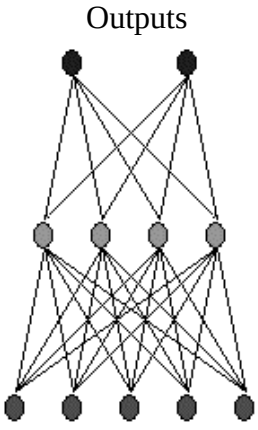
This view corresponds with our common sense idea of expertise, that a person who is a specialist in a particular field is able to differentiate entities or aspects in that field to a far greater extent than a normal person. Often this associated with a specialisation in the language being used (e.g. that of the wine enthusiast). This view of the structure of learning parallels the idea of human learning as involving differentiation of smaller units of time, referred to earlier. The process is homologous with that of speciation: "...a taxonomic tree [of biological life] tells us about the distribution of the capacity to construct organisms, with the most basic capacities being at the top [read root] of the tree while more specialised capacities exist at the bottom [read leaves]" (Benzon, 1996:2). There is also some similarity (but not an identity) with the structure of knowledge in organisations, with generic knowledge held by the CEO at the top, and different forms of specialist capacity located in each of the branches of the structure.

The argument above is at risk of suggesting an overly rigid and thus unrealistic view of human constructs of the world. This is of a hierarchical and branching structure some parts of which differentiate over time more than others, but which are otherwise independent of each other. It may be more realistic to see human constructs in terms of a heterarchy. A heterarchy is a form of structure that is in between that of a network with no overall authority and a hierarchy with a single clearly defined authority. In a heterarchy agents may participate in a number of different hierarchies, either at different times or to a different extent at the same time. A simple example would be a person who undertakes different roles in their relationships to different organisations during the same day (e.g. parent, staff member, and shareholder). The amount of attention they give to each role may vary from day to day, as may the attention that others give to them in that role.

The concept of heterarchy is embodied in the structure of a typical artificial neural network. These are typically used to learn complex discrimination tasks, such as speech recognition

(Aleksander and Morton, 1991). A simplified example is show in Figure 3.1 below. Learning in neural nets involves the tuning of the strengths of the different relationships between nodes in a heterarchy through trial and error, according to how the response of the whole network fits the task. The basic structure of a neural network can be designed or evolved using genetic algorithms. Learning then takes place within the parameters of that particular structure. The neural network metaphor is quite consistent with learning as a VSR process, and of one involving a hierarchy of logical types of information. There are multiple levels of nodes and at each level there are choices between which links will be used, and then emphasised, more than others.

Figure 3.1 A simplified artificial neural network as an example of heterarchy



Source: Neural Planner, Windows-based neural network software.

The initial structure of a given artificial neural network (e.g. above) can be described as generalist, it can be applied to a number of different circumstances. As it learns to recognise a particular set of conditions there is what could be called a process of specialisation. Some links are eliminated and some are retained, some are given more weight than others. The resulting combination is a unique representation of the conditions the neural network has adapted to. The heterarchy in effect becomes more like a hierarchy. The proviso being that more complex recognition tasks tend to require more complex structures. This is consistent with Ashby's (1958) Law of Requisite Variety: a model can only model something to the extent that it has sufficient internal variety to represent it.

In biological evolution a similar process of transition can be noted. Within one species the relationship between members of different generations is typically heterarchical. The genes of one ancestor can be inherited by many descendants. One descendant may have genes from many different ancestors. The process of speciation involves the introduction of a permanent separation between groups of these members, where there was none before. Some linkages, and thus combinations of genes, are no longer possible. There is in effect a move towards hierarchy and specialisation. Each group becomes a new branch on the larger genealogical hierarchy of organisms. As discussed above, this process of biological speciation is typically associated with greater specialisation. The origin of a diversity of species and processes of learning by individual actors in that process seem to be homologous, if not identical.

It is not difficult to find examples of heterarchy in organisations. Meetings can be organised to bring specialist staff, and their line managers, together to deal with more general issues. Ad hoc teams can be pulled together to work out strategies for dealing with new problems. The concepts of hierarchy and heterarchy will be returned to and elaborated in the discussion of other contending theories of organisational learning, in Chapter Four.

3.5 Evolutionary Processes in a Social Context

The process of learning is not something that occurs in isolated monads. Even at the level of

biological evolution interactions within populations of organisms are central to the process. Within the lives of individual human beings the ability to learn from each other, and not just their own immediate experience, is a major feature that has enabled humans to adapt effectively to their world. It is an advantage Campbell has described as an "economy of cognition" (Campbell, 1969:82). The social context is also the primary source of emergent complexity, which is possible when large numbers of similar entities have to co-evolve because they are part of each other's environment.

One way of situating the process of learning in organisations is to see that process as a form of localised cultural evolution. As Raymond Williams (1990:87) has noted "Culture is one of the two or three most complicated words in the English language". In the section below the focus is on one specific interpretation of culture, chosen because it fits closely with the epistemology that has already been outlined. However the range and overlapping of meanings noted by Williams is itself quite consistent with the view that will be elaborated below.

Burns and Dietz (1992) theory of cultural evolution can easily be linked to Bateson's views of information. Burns and Dietz base their "approach to action and social structure on the interpretation and use of rules by human actors" (1992:261). In their view "rules are viewed as the basic pieces of information on which evolutionary processes act". Their definition of rules is wide ranging including prescriptive, descriptive and evaluative rules. However, their conception of rules can be related to Bateson's definition of information as a difference that makes a difference. This is an elemental definition of a rule, an if-then statement in the most logical sense, or simply a statement of association in its simplest sense. Their views on rules can also be related to the idea of behavioural routines as the basis of embodied knowledge in organisations, used by Nelson and Winter (1982) in their evolutionary theory of economic change. Routines are fixed structures of if-then rules.

Burns and Dietz "consider the culture of a group to be the set of rules held by members of

that group. A culture includes rules that assign meaning and make what is observable interpretable". Within this perspective "Cultural change is a change in the frequency distribution of rules in the population. Cultural diversity is the variance in rule frequency in the population" (Burns and Dietz 1992:261).

More contentiously, "*cultural fitness"* is defined in terms of an increased prevalence of a rule in the population, relative to other rules. "Cultural fitness in this sense is not identified with long term-survival of individuals or social groups, or with any other normative or ethical standard" (1992:278). They are not proposing a biologically reductionist perspective on human culture. There are two arguments behind the idea of prevalence as fitness. One is historical: that proliferation to date is indicative of greater fit between the rule and the various contexts where it can be applied. The other, which is more arguable but has some basis in observation of natural ecosystems, is future oriented: that proliferation across of diversity of environments favours the longer term survival of a species because it is a way of hedging bets against unpredictable nature of future change in particular locations. Nelson and Winter (1982) have made a similar distinction between survival, which describes the fate of individual organisations, and viability, which describes the "share of the market" of a given organisational form. Burns and Dietz's conception of fitness is quite consistent with the minimalist definition of learning introduced earlier.

Burns and Dietz do not see culture as a singular integrated structure. However they do recognise the existence of structures (plural) wherein some rules are governed by meta-rules. "The complexity of life favours frequent use of meta-rules that generalise across specific contexts and thus avoids the need for a new rule for every situation and problem. Strong meta-rules that subsume larger sets of more specific lower order rules generate, indeed are, cultural structure" (Burns and Dietz, 1992:261). Examples given of meta-rules include those governing the use of language and genres of representation. In that respect their view is compatible with Campbell, Plotkin and Bateson's idea of a hierarchy of selection processes outlined above, although this conception is relatively underdeveloped in Burns and Dietz's work. Given that people in societies may participate in many different groupings it would be more realistic to see this cultural structure in terms of a heterarchy rather than a hierarchy.

Use of the term "rule", and the idea of structures of rules, does run the risks of conveying a view of people as "cultural dopes" (Jary and Jary, 1991:204) whose actions are totally determined by the structure of their culture and their location within it. Burns and Dietz compensate by emphasising that all individuals are socialised into particular local sub-sets of rules. They argue that the complexity of many social settings means choices over appropriate rules are not straightforward. There is also likely to be error in the learning of rules and in their implementation. "Rules must be interpreted to be used in a particular context, and this in turn involves defining, and even socially constructing, the context" (1992:263). While realistic this explanation appears to give a residual role for agency, being that which is left over.

The variability of actors' interpretations can be seen as more central to the process when located in a wider context, that of information transmission in biological systems. In organisms inherited (learned) information is encoded and transmitted in the form of genes, whose form is called the genotype. In the process of birth and maturation the genotype is transformed through its interaction with its immediate environment into a new living organism, whose form is known as the phenotype. It is the survival of that phenotype which governs whether the genotype also survives and proliferates. Speech, texts, ritualised and routinised behaviour can be seen as the cultural equivalent of genotypes, relatively stable and standardised entities whose meaning emerges out of their interaction with observers within particular contexts. The meaning of these events, as experienced by individuals, can be seen as their phenotypal expression. This event in turn governs the likelihood of the further reproduction of these genotypes in the future. Benzon (1996) has proposed a similar interpretation in his own exposition on cultural evolution. This view is quite consistent with phenomenological and post-modernist views which stress the equivocality of meaning in situations and the joint role of the reader and writer in the construction of meaning in texts (Cuddon, 1991:770). An additional feature, which will be explored in practice in Chapter Eight, is that when multiple actors are involved a single event can carry multiple meanings at the same time.

In this context variation is not simply an epi-phenomenon. Burns and Dietz argue that evolutionary theory *requires* the notion of agency, in the sense of activity not evidently

determined by surrounding contexts. Without that degree of freedom there simply would not be any process of evolution. "Evolutionary processes are based on variability in the rule system of a culture and in interpretation and application of rules" (Burns and Dietz, 1992:275).

Burns and Dietz make an important point that "... agency [is] a continuous rather than a categorical property of all actors" (1992:274). They argue that the degree of agency a particular actor has in a particular context is a matter to be determined empirically. However they do not specify how this could be done. One way to do so is to take forward Booth's argument that diversity can be indicative of human agency. Rather than seeking some insight into the voluntary nature of an individual's behaviour our attention should be focused instead on the level of diversity of behaviour within particular groups or populations of people who are sharing particular common conditions. For example, in the case beneficiaries of NGO credit programmes a diversity of loan use could be seen as indicative of users empowerment both in relationship to their local economy, and the aiding NGO.

3.6 Conclusions: Observing and Representing Learning Processes

The aim of this chapter is to argue the value of evolutionary theory, as: (a) an explanation for the origins of diversity and the role of learning in that process, and (b) as a source of concepts of learning which can be observed at the level of individuals and organisations.

It has been argued that there is close homology between the process of evolution and learning. This exists at the level of mechanism and tendency. Both evolution and learning can be understood in terms of the iteration of variation-selection-retention. Within evolution the process tends towards a diversity of species, and within individual and organisational learning it tends towards specialisation of knowledge.

The theory of learning explored above also offers a number of implications for how we can observe and interpret the process of learning in organisations. Firstly, information is retained over time by in-forming structures, by making a difference. We should look for evidence of this process. Bateson's concept of logical types suggests there are at least three different types of structures that may be in-formed and which we could attend to: individuals, organisations, and populations of organisations. Individuals differ in the distinctions they make about the world. Organisations differ in their organisational structure, the distinctions between people making up the organisation. Populations of organisations differ in the structure of the relationships between organisations within them. Each of these levels will be examined in the fieldwork analysed in Chapters Six, Seven and Eight.

The process of learning has been presented as one involving increasing specialisation: progressive differentiation of events taking place in particular areas and occurring at particular frequencies. That specialisation is a consequence of the fact that learning is expensive and therefore has to be rationed. At the least, this process must meet the need to survive in a particular environment. This view suggests that we should look where individuals and organisations have specialised their knowledge and relate it to the nature of their environment.

The process of learning also involves balancing the needs for the retention of past knowledge and the acquisition of new knowledge. The presence of significant variations in practice, and awareness of those variations, may signify the location of new individual learning. The distribution of heterarchies may signify the location of new learning within organisational structures. As above, that distribution should be related to the environment in which the actors are located.

Bateson's concepts of logical types of information and hierarchies of recursiveness also suggest a means of differentiating what has been learned *within* individuals and organisations. Not only will there be detailed and up to date knowledge in a particular area, but a person or organisation may be able to meta-evaluate that knowledge, identify differences of higher logical types than just the original phenomenon themselves.

In addition to suggesting features of organisations that can be observed by an outsider, the evolutionary epistemology introduced in this chapter can also provide a means for more participative interpretations of what has been learned within an organisation. In Chapters Six and Eight two accounts will be given of how the basic evolutionary algorithm (variation-selection-retention) can be used to design a social process which enables a number of people to summarise a diversity of experience into a small volume of significant information.

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