The human ecological significance of different types of knowledge

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Abstract

In this paper the widespread belief that the right answer to the ecological crisis consists in the exclusive fostering of explicit (in particular: scientific) forms of knowledge is questioned. The commonly postulated tripartition of the human psyche into three levels of consciousness, namely unconscious, practical consciousness and discursive consciousness, serves as a starting point. It is then shown that these levels can be associated with different types of knowledge: The first two with implicit or tacit, the latter with explicit or propositional knowledge. Reference is made to Michael Polanyi's notion of the indispensability of implicit knowledge and the incompleteness of explicit formulations. The three levels of consciousness can also be paralleled with the evolutionary sequence of instinct, tradition and reason, and the example of agriculture is employed to discuss the significance of traditional practices in a human ecological context. It is argued that only with a suitable combination of scientific with other types of knowledge can we hope to overcome the crisis.

> "I shall reconsider human knowledge by starting from the fact that *we can know more than we can tell*"
>
> Michael Polanyi 1967

1 Introduction

As we face an unprecedented ecological crisis the question arises as to how we shall go about solving the problems associated with it. The predominant view still seems to be that we will do this by means of scientific research and ensuing technical measures[1]. A number of influential writers such as, for example, Bell (1973) in his

[1] By this we may understand 'technical measures' in a broad sense such that 'social technology' consisting of, for example, the economic internalization of environmental goods into the market or a kind of environmental education in which explicit knowledge is

reflections on a post-industrial society, entertain such a notion. According to him theoretical knowledge will gain a central position as the basis for future planning and design. He expects the emergence of what he calls an 'intellectual technology', by which he means that decisions will be based more on algorithms and less on intuition. It is my contention that this attitude, if taken to the extreme, is itself a problem and may in fact result in a further aggravation of the situation. It overlooks the fact that human beings have access to different kinds of knowledge among which scientific arguments are just a special, and in a certain sense not even the most important, case. The purpose of this paper then is to try to shed some light on these types of knowledge and their significance in a human ecological context. I will start from a distinction of different levels of consciousness with which the types of knowledge can be associated, discuss these types themselves, and then point to their position in an evolutionary perspective. Finally I shall, by way of examples, make an attempt at evaluating their role in the relationship between humans and the environment.

2 Three levels of consciousness

Let us begin by describing the human psyche in terms of three levels of consciousness. In doing this we refer to Giddens (1984) who, when talking about agents in his theory of structuration of society, makes the following distinction: 1. Unconscious; 2. Practical consciousness; 3. Discursive consciousness. A human being operating in the last kind of consciousness is capable of verbally formulating and expressing his or her thoughts. In contrast, practical consciousness is a state of mind in which things are simply being done without agents being able to tell what exactly they are doing. Typical examples of human actions belonging here are bodily skills such as riding a bicycle or a behaviour patterned by some social norms such as giving a lecture. The notion of practical consciousness is at the core of Giddens' structuration theory as it makes a routinized character of everyday life possible which in turn can give rise to a feeling of ontological security to agents. Finally, the unconscious is the source of motives which, however, rarely impinge in a very direct way on *everyday* courses of action. Rather they "tend to have a direct purchase on action only in relatively unusual circumstances, situations which in some way break with the routine" (Giddens 1984, p. 6).[2]

being transmitted to individuals, is included. The point is that approaches such as these emanate from a belief in the adequacy of careful analysis and planning on scientific grounds to attain a necessary degree of control over the situation. This belief in turn can be seen to be a child of a mechanistic worldview [for a discussion of worldviews in a human ecological context see Steiner, Furger and Jaeger (1991)].

[2] Giddens (1984) restricts himself to a (critical) elaboration of Freud's notion of the personal unconscious. He does not consider the so-called collective unconscious as proposed by Jung. For our purposes we will have to attach some importance to the latter in the sequel. We also note that there are authors (Gustavsson 1990, for example) who speak

There is no clear-cut boundary between discursive and practical consciousness. Also, contents of the latter may be consciously raised to a level at which they can be discussed discursively and, conversely, contents of the former may sink down to a level of routine. As an example take the case of an athlete who, together with a coach, is watching a video recording of his or her performance in order to analyze it critically and to get useful hints for retraining the body movements. On the other hand, there seems to be a barrier between discursive consciousness and the unconscious. For most human beings, at least the ones living in modern society, it is impossible to access the latter actively and purposely. However, the same persons are passive receivers of messages from the unconscious in the form of dreams during their sleep. Let us note at this point that the question of possible interplay between the different levels of consciousness is presumably a very important one in a human ecological context. I shall come back to it in the last section.

Various other writers use similar tripartite schemes, and this coincidence points to the adequacy of such a distinction. For example, Harré et al. (1985) speak about the 'deep structure of mind', 'behavioural routines' and 'conscious awareness'[3], Piaget (compare with Ginsberg and Opper 1975) of 'reflexes', 'behavioural schemes' and 'thought operations'. Piaget is particularly interesting in this context as, with his researches on the psychological ontogeny of children, he sheds some light on the question of how and when a new member of society acquires these different levels of consciousness. A newborn baby does not constitute a tabula rasa. Rather it is equipped with a number of bodily reflexes such as the sucking reflex. This is not all, however. It also contains as an organizational metastructure a tendency to compose more complex out of simpler structures. Thus the sucking reflex just mentioned is gradually turned into an active business which manifests itself in thumb sucking. This then is the beginning of the acquisition of a practical consciousness. During the first one and a half to two years the child seems to be learning exclusively through doing things. Piaget and Inhelder (1969) call it the 'sensi-motor' period which includes the development of perception as a special case. The development of 'concrete' (logical) operations of thought only sets in at age seven or eight. In between there is a transitional period in which the child acquires a faculty of abstraction (a 'symbolic or semiotic function', Piaget and Inhelder 1969) including the use of language. As a phenomenon which would seem to be important for the following discussion we wish to note that a child is capable of distinguishing something living from something inanimate at an

about a 'collective consciousness', a concept that reaches beyond the idea of a collective unconscious. It "rests on the notion that all people are united through a transcendental field of consciousness, and that influence from this field is not dependent on contact between the people ..." (p.5). This speculative idea may be akin to Rupert Sheldrake's (1981) concept of 'morphogenetic fields'.

[3] More precisely, Harré et al. (1985) make a further distinction with their notion of 'social orders', the internalized rules of the society one is living in, which they put on the same level as the 'deep structure of mind'. In my understanding the 'social orders' rather belong to the level of practical consciousness and thus are companions of the 'behavioural routines'. Thus the latter relate to sensory-motor, the former to mental aspects of practical knowledge.

early age. Compare this with the difficulties academically trained biologists have in defining what life is.

Presumably these levels of psychological functioning can, with some degree of plausibility, also be paralleled with components of the brain as material substrate. Thus we can associate the unconscious with older parts of the brain, the practical consciousness with the right hemisphere and the discursive consciousness with the left hemisphere of the neocortex. As we know the right half of the brain is responsible for such capabilities as spatial orientation, pattern recognition and activities in arts, handicrafts and sports, while the left half contains modules for language expression and mathematical and logical thinking.[4] This becomes quite clear from experiments done with 'split brain' patients[5], as can be illustrated with the following example: A patient is shown the word 'ring' in the right half and the word 'key' in the left half of the visual field. (We remember that the right half of the visual field is connected to the left brain, the left half to the right brain.) At the same time the person is also presented with a number of objects, among them a ring and a key, to choose from. The individual in question can tell that it has recognized the word 'ring', whereas it cannot make a verbal statement about the word 'key'. On the other hand, it can pick out the corresponding object with the left hand. If asked what it is, however, the person answers: a ring (after Schmidt 1979, from Kastenholz 1987).

Finally we may point to a tripartite metaphor used by Pestalozzi, the Swiss pioneer in school education, to indicate the necessity of combining all three states of mind in a fruitful way: He used to say that head, hands and heart of children should be educated in equal parts.[6]

3 Types of knowledge

In philosophical discussion the term 'knowledge' is often used in a rather strict sense and in contrast to 'belief', meaning the result of an act of cognition for which reasons

[4] For a detailed account of the different capabilities of the two hemispheres see Springer and Deutsch (1985).

[5] A 'split brain' patient is a person who previously suffered from severe untreatable attacks of epilepsy and who, in order to avoid a transmission of seizures from one hemisphere to the other, had the connection between the two hemispheres, the corpus callosum, cut. Much of our present knowledge about the functioning of the left and the right brain is due to the brain researcher Roger Sperry, who in 1981 obtained the Nobel prize in medicine for his work with split brain patients.

[6] Going further back in time we find, as so often, also a forerunner of modern thinking in some notions of Aristotle. His distinction of a vital soul (containing the principle of life, keeping the bodily functions going), an animal soul (instrumental in perceiving, feeling and desiring) and a soul of reason (in which feeling and desiring turn into will, perceiving into cognition) resembles the three types of consciousness made in the text, if indeed, considering the state of scientific knowledge at the time, one can speak of a similarity at all.

can be given and which is based on experience and insight. This would restrict the existence of knowledge to discursive consciousness. In opposition to this usage I will use the term in a rather broad sense making it possible to say that the contents of any of the levels of consciousness constitutes knowledge and therefore that types of knowledge can be paralleled to these levels. This incurs the cost of a blending of 'belief' and 'knowledge', but such a blending is closer to the reality of human existence and also corresponds to the continuity of the emergence of forms of knowledge during evolution. It also means that the claim that knowledge refers to things we know 'correctly' has to be taken as a proposition that is valid in a relative sense only: It may be true if it refers to the logic of a closed system, it may no longer be if the system is opened. As will be elaborated later, this will become important for the consideration of human cultures which have a tendency to create their own world, a world which may be far detached from the fundamental biophysical reality of planet Earth.

Also, we wish to emphasize the relational aspects of knowledge: a member of a system, even though it may be intelligent, cannot make any statements about the system from a detached vantage point. Consequently, truth is not something that I can find separate from myself as a distanced observer, but something that comes to the fore only in my participatory relations within the system. For Pratt (1990) 'relationship' is a key concept in his thoughts about the 'ecology of knowing'. He puts it this way: "... knowing is participation. We know things by participating in them, and participation entails relationship. Relationships are *particular*, *involving* and both *create and limit* possibilities, according to what we bring to them. The participation they entail changes both ourselves and the thing known" (p. 17). We note at once that with notions such as this one we are in opposition to the (still) usual views of science in this respect.[7] To be somewhat malicious we could in fact say that modern scientific knowledge, which has fostered the ecological disaster rather than prevented it, is closer to being a 'belief' and further from the truth than a primordial animistic religion which results in a respectful attitude towards nature.

To have knowledge, then, means to know something about the world we live in, be it the biophysical environment or the societal context. Going back to the previously mentioned levels of consciousness we now associate with each of them a particular kind of knowledge. As we know there are two aspects of the unconscious, the personal unconscious detected by Freud and the collective unconscious as elaborated upon by Jung. The former may be regarded as containing ontogenetically acquired but stowed away and suppressed 'knowledge' referring to traumatic experiences and the like, while the latter can be interpreted as the psychological aspects of genetic structures, i. e., phylogenetically acquired knowledge. It is the latter we are particularly interested in here. Presumably we can say that the unconscious is the source of (genuine) feelings. What is their truth value? For most of us this is difficult to say because in our Western culture we tend to suppress them most of the time. Originally, emotions were associated with the basic existential experiences of human

[7] This, I think, is largely true despite the findings about the role of the observer in particle physics, which do not seem to have had a great impact in other disciplines.

beings. Once a human culture has developed, however, human existence tends to be experienced in a culture-specific way (Hillmann 1989). When feelings come to us in an uncensored fashion such as in dreams, we have a problem of interpretation as the messages we get are largely in the form of pictorial scenes happening in a fantasy world[8], which can be translated into words only in a very unsatisfactory way. We remember the saying that a picture is worth one thousand words. The fact that archaic religions presumably can be understood as the result of experiences rooted in practical consciousness that are heavily laced with emanations of the unconscious and that cultures with such religions by and large were based on ecologically sensible rules may let us attach some importance to Meyer-Abich's (1988) notion that feelings are guides to cognition.[9] 'Mythic knowing' as expressed in stories, art, and poetry is definitely of importance (Pratt 1990).[10]

Knowledge that resides in a state of practical consciousness is called 'knowledge by experience', 'knowledge by familiarity' or 'tacit knowledge'. With these designations the fact is expressed that this is a kind of knowledge that is neither available readily in preprogrammed form (as knowledge embedded in genetic structures) nor easily transmittable by verbal communication. It is acquired through a process of individual learning, which presumably is based on elements of social interaction, such as the observation and imitation of others, as well as on direct personal experiences of the environment. Surely even the higher animals have the capacity for this kind of learning which transcends purely instinctual behaviour. Hence, one can say that much of what they do happens in a state of practical consciousness. As we will point out later, there is a connection between an existence based on tacit knowledge and what is called a tradition. And inasmuch as the evolution of traditions, which involves a transmission of knowledge from one generation to the next, can be recognized as the basis of culture, one can, as Bonner (1980) does, talk about the occurrence of culture with animals. Well-known by now is the story about the monkeys (macaques) on a Japanese island who, based on an individual innovation, started a 'culture' of washing the sand off the sweet potatoes they used as food (Wilson 1977).

A useful aid in understanding how animals relate to their environment in a state of practical consciousness is a brand of ecological psychology based on the work by James Gibson and further developed by Claudia Carello and others (Michaels and Carello 1981; Carello 1991). Its basic theory is realist in character as it asserts that terrestrial objects and events, not mental representations of them, are perceived. Perception is not something that happens inside animals. In the words of Gibson, "it is a keeping-in-touch with the world, an experiencing of things rather than a having of ex-

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[8] It is typical that it is the right hemisphere of the brain only that seems to be involved in dreaming (Springer and Deutsch 1985).

[9] In German the term he uses is *erkenntnisleitende Gefühle*.

[10] We may note at this point that Pratt (1990) makes use of a bipartition into 'mythic knowing' and 'paradigmatic knowing'. As pointed out by the example of archaic religions, the former refers to a combination of contents of the unconscious and of practical consciousness, whereas the latter would seem to correspond to a mix of elements derived from practical and discursive consciousness.

periences. It involves awareness-of instead of just awareness". To understand a problem in perception, therefore, it must be addressed at the level of an active animal-environment system. This means using ecological units of analysis which makes it possible to identify ecological laws of perceiving and acting. There is a perceiving-acting cycle such that perception constrains action by detecting the information by which activities are guided and action constrains perception by altering the animal-environment system and thereby the available information.[11]

With the emergence of human beings, of course, the capability of learning and the possibility of the evolution of culture is greatly intensified. The development of (verbal) language plays a decisive role in this process. Language is a phenomenon which makes an existence in a state of discursive consciousness possible, but first of all it develops as a means of communication which helps to speed up learning by experience. To be sure, language cannot replace this experience (for example, I cannot ride a bicycle immediately upon being told how to do it), but it can assist the learner by guiding his or her awareness. The acquisition of tacit knowledge would seem to rely always on a social dimension, already in a pre-language state of existence, but even more so with the availability of human language. Beyond the basic human faculties which a child acquires and develops first at home and later at school during what is called 'primary socialization' (see, e.g., Berger and Luckmann 1989) it is mainly the acquisition of bodily and/or mental skills in connection with the learning of a profession (to be understood in its widest sense, i. e., including such things as handicrafts, sports, instrument playing and so on) during a phase of 'secondary socialization' that make part of the stock of tacit knowledge of a human in today's society. Regarding the question of 'truth values' we have here a situation of direct control so to speak: As tacit knowledge of the type mentioned is applied in direct contact with some aspects of the biophysical environment, the question of truth is simply answered by the consequences of action: Either it works in the desired way or it doesn't. What it may mean if a practical art falls into disuse and becomes forgotten is illustrated by Polanyi (1962) with the following example: "It is pathetic to watch the endless efforts, equipped with microscopy and chemistry, with mathematics and electronics - to reproduce a single violin of the kind the half-literate Stradivari turned out as a matter of routine more than 200 years ago" (p. 53).

'Truth' in relation to skills means for human beings something which is still close to the situation of animals in a Gibsonian setting. Polanyi (1962) refers to this fact when he points out that there is a continuity between the inarticulate faculties of animals and the ineffable domain of skilful knowing of humans. "What I understand in this manner has a meaning for me, and it has this meaning in itself, and not as a sign has a meaning when denoting an object. I have called this ... existential meaning" (p.

11 There is an interesting link here to the much earlier notion of a 'functional circle' (in German: *Funktionskreis)* of the biologist von Uexküll (1928). This circle is to be understood as a recursive system between an organism and environmental objects involving a 'perceived world' *(Merkwelt)* on the one hand, and an 'effected world' *(Wirkwelt)* on the other. More recently Knötig (1986) has taken up this concept and developed it further.

90). There is, however, another type of knowledge which presumably must also be regarded as part of a human's practical consciousness. What we mean is the mental internalization (the expression is typical for a process which involves practical consciousness) of values and norms, views and ideas that are predominant in a particular type of culture, in short of the world a society lives in, and will affect the attitudes and actual actions of individuals living in that culture (compare with Berger and Luckmann 1989). In contrast to skills we are concerned here with 'images', perspectives or states of mind founded in cultural rules and such rules can be more or less detached from a reference to the biophysical environment. Knowing those rules means adhering to a 'truth' which reproduces the logic according to which the particular society functions. As soon as we consider a social system within a wider bio-ecological context, however, what is true socially and culturally may not make any sense at all environmentally. Certainly this state of affairs applies to our modern society. We may find, on the other hand, that rules which are still close to knowledge residing in the lower levels of the psyche as those associated with archaic types of religion may be 'more true' than rules of more 'advanced' societies that have started to construct their own types of worlds.

The construction of separate worlds becomes possible because of the availability of language. As pointed out by Sayer (1984), the words of a language have, in that they refer to each other, on the one hand abstract relationships between themselves. On the other hand some of the words refer to concrete entities of the environment. Relationships of the first type will establish sense and meaning, i. e., members of a language community can establish their own reality. How far this reality can be attributed a lesser or greater degree of truth with respect to the larger encompassing environment is dependent on the way the relationships of the second type, i. e., the referential relations between words and environmental entities, work. In a more primitve stage of societal development properties of the environment which may be crucial for survival may make themselves felt on the linguistic side, such as when the Inuit use different words for different kinds of ice (Montagu 1962). On the other hand, as the cultural evolution advances, the way the environment is seen is more and more guided by environmentally detached sense relations within a language community. The environment not only becomes socially interpreted but finally, as humans actively change it, also socially constructed. The philosophical thinking about this problem is nicely reflected in the writings of Wittgenstein (see, e.g., the short description in Störig 1985). In his early work, the *Tractatus logico-philosophicus*, he was of the opinion that there should exist the possibility of a 1:1 mapping between the world around us and our language, and that this relationship could be logically analyzed by reducing entities on both sides to a level of fundamental 'atoms'. Later, in his 'Philosophical Investigations', he changed his mind completely and developed his notion of language games: He now maintained that the meaning of words could be understood only by observing the situations and contexts within which they were spoken. We will come back to this problem further on in the context of traditions.

Whether the unreflected use of language in everyday situations should be regarded as something that happens in discursive or rather in practical consciousness can be deba-

ted. This uncertainty shows the dual position of language in this respect.[12] There can be no doubt, however, that, given a certain degree of critical self-reflection, enabling one to question everything that has become routinized and perhaps unfounded, there is a higher, truly discursive level on which theoretical knowledge can be formulated. It is the type of knowledge which supposedly enables human beings to take action on the basis of a careful process of thinking involving calculation, foresight and design. It makes them rational agents who can define a goal and find the necessary tools to reach that goal. For our present culture the prototype of rationality is, of course, represented by science in which knowledge is presented in a systematic, logical fashion and in which the ideal of being able to condensate it to statements in a concise formal language is still very much alive. It is what is called 'explicit knowledge', 'propositional knowledge' or 'expert knowledge'. The belief that the way human reasoning functions on the material basis of the brain can be imitated by computers finds its expression in an explosive development of a branch of cognitive sciences known as 'artificial intelligence' (AI). This label clearly suggests that only the manipulation of explicit knowledge in a state of discursive consciousness is regarded as 'intelligence' by the AI people, hence their attempt to imitate this intelligence in expert systems, robots and the like.[13] Josefson (1991) sees the problems inherent in this trend: "The systems are based on experts' detailed descriptions of their professional knowledge; their knowledge is then reformulated in the uniform rules of logic and transferred to the machine. This has proved to be a much more difficult process than hitherto imagined. It is difficult to 'tap' experts of their entire pool of professional knowledge" (p. 1). The neglect of or rather the negation of the existence of other types of 'intelligence' may lead to perversities. Josefson provides an example: Discussing present efforts to make the training of hospital nurses more formal and theoretical, she quotes one instance in which a demand arose for the description of a thing like 'tender loving care' in exact scientific terms. It is a purpose of this paper to challenge such one-sided attitudes.

[12] Related to this situation is the following interesting question: do we have to assume a mutual depencence of thinking and spoken language or is it possible that some kind of language-free thinking or thinking in an 'inner language' exists? Recent investigations regarding the cognition of deaf people seem to point to the existence of language-free operations as a component of thought processes (Müller 1987).

[13] That there may be a conflict between what these people think as scientists and what they believe as 'normal' human beings is reflected by the following anecdote: a professor in neurobiology was asked whether or not he thought that the human brain worked in the same way as a computer. He answered: yes, I think it does when I observe my colleagues, but definitely no with respect to my own. For detailed critical evaluations of the benefits and the shortcomings or even dangers of information processing by computer see, for example, Roszak (1986) and Weizenbaum (1975).

4 An evolutionary perspective

When reflecting on the development of the cultural out of the biological evolution it seems to be a common error to illustrate the difference between 'nature' and 'culture' with contrasting terms such as 'natural' and 'artificial' or 'instinct' and 'reason'. In fact, much of what constitutes cultural evolution is neither purely artificial nor the result of designs by reasoning human beings. Rather it consists of 'phenomena of the third kind', a term used by Keller (1990), in his treatise on the change of human language, or phenomena 'between instinct and reason', the expression employed by Hayek (1988) in his study on the evolutionary position of the market mechanism. Such phenomena are at the basis of a society and a culture: they relate to human actions guided neither by genetic programs nor by a reasoning mind but come about rather as the result of learning during a process of socialization. In short, we are dealing here with traditions. The theory of structuration of society by Giddens (1984) is useful at this point: we can envisage a social system as a recursive system in which socio-cultural structures enable but also constrain particular actions of human beings such that these actions reproduce (and possibly slowly transform) the socio-cultural structures.[14] The reproduction of structures is thereby an unintended consequence of human actions. It is as if, in the sense of Adam Smith, an 'invisible hand' were at work.

Hence we again have a tripartition and, with some degree of caution, we can parallel the evolutionary sequence of instinct, tradition and reason with our previous three levels of consciousness, namely the unconscious, the practical and the discursive consciousness, and related types of knowledge. The caution is in order because of the practical-discursive duality of natural language referred to earlier. Such a language is a component of the socio-cultural structures of a particular social system which enables and constrains communicative actions of the members of the system and is being reproduced (and slowly transformed) by these actions. In other words, a language is first of all a tradition.[15] It is clear that a child learns a language by imitation.[16] The physical process of speaking (the movements of the vocal chords, the tongue etc.) is cer-

[14] For Giddens (1984) 'structures' are 'rules and resources'. Limiting ourselves to the rule aspect, the following clarification can be given: structures can be roughly divided into social and cultural structures. The former concern the forms of social organization which decide about possible positions of and relationships between people. The latter refers to cultural paradigms expressed in the form of values and norms which will decide about the quality of relationships between humans (and humans and the environment). This usage of terms reproduces the distinction made by some sociologicst between 'society' and 'culture'.

[15] This becomes very obvious if, for example, we think of the present feminist critique of the 'maleness' of language.

[16] This does not exclude the possibility that language has also deep-structural aspects. For example, the linguist Chomsky (1965) thinks that there is a commonality to all human languages in the form of a 'universal grammar'. If this is true then presumably it would presumably point to the existence of a genetically anchored basis to language.

tainly something that happens in practical consciousness. But also the content of speech may be grounded in traditional unquestioned beliefs, values and norms that have been internalized by the speaker as a member of the social system in question. 'Reasoning' in this sense, i. e., as a practice of 'reason-giving', is itself something that is governed by social rules (Coulter 1989). On the other hand, of course, language can be employed by free thinkers in an emancipatory fashion, in which case 'reason' can be understood to comprise reflecting, questioning, planning and designing operations of the mind.

As may have become clear already, the evolutionary sequence of instinct, tradition and reason does not mean that one replaces the other. On the contrary the development of a later phenomenon is dependent on the previous existence of the earlier phenomenon. Therefore for traditions to emerge the existence of instinctual patterns is a prerequisite. We can interpret the situation as one in which genetically anchored dispositions increasingly leave room for ontogenetic individual learning to be integrated into overall behavioural patterns. There is no way that we can 'date' the emergence of such new capabilities. As indicated earlier they reach far back into the animal kingdom. We can say more in this respect about the time when human reason started to emerge as a sort of culminating condensation of discursive consciousness. It seems obvious that it could develop only within the context of a social system with traditions. The upstart of a philosophy in the time of the Old Greeks, which more or less consciously began to emancipate itself from religion, can be seen as a turning point in this respect. Typically, however, the first philosophers were people with practical skills, and wisdom was seen by them as something that can produce a creativity of practical significance (Josefson 1991). A real acceleration in the development of reason then set in with the foundations to rationalistic thinking set by Descartes in the first half of the 17th century.[17] Emphasizing the fundamental principle of doubt it was probably the most important building block for the ensuing project of enlightenment. Paradoxically, what started with a particular philosophical orientation culminated in this century with a concept of a science being regarded as the only cognitive human undertaking that ensures the possibility of a sensible discourse. As a consequence, philosophy did not seem to have a right of existence anymore. At any rate it is possible to see connections between the phenomenal sequence of instinct, tradition and reason and that of religion, philosophy and science. Also we can see the conservative role played by both instinct and tradition. The latter can be understood as a kind of cultural continuation of the biological evolution, whereby Lamarckian principles of inheritance become superimposed on the original Darwinian ones, so to speak. This is in line with the frequent notion that human cultures have grown in an 'organismic' way. In contrast, reason can take on a prospective function and upset the conservative patterns of development completely.

Extremely important for an evolutionary perspective, I think, is the notion of a contrast between implicit and explicit knowledge by Polanyi (1962, 1974, also Polanyi and Prosch 1977). It would seem that we are allowed to equate the former

[17] Interestingly enough, Descartes is reported to have been inspired to his philosophical thinking by an angel of truth who appeared in several of his dreams! (Roszak 1986).

with unconscious and tacit knowledge, the latter with propositional knowledge. Some of the aspects of this notion which are relevant for our discussion are the following. Any kind of knowledge has roots in the bodily existence of human persons and in this sense is always 'personal knowledge'. Described slightly differently one could say that knowledge cannot exist without some kind of personal involvement. Anything that can be formulated explicitly is so to speak only the tip of the iceberg in that explicit knowledge cannot come about without a foundation of implicit knowledge. Human knowledge has the same structure as the world: we have a stratification into parts forming wholes, whereby the wholes appear only if the parts merge into the background. In terms of knowledge it more precisely means that if the attention is focussed on the parts, there can be no comprehension of the whole. Only if a defocussing away from the parts takes place can the whole take shape. In consequence, Polanyi speaks about 'from-to knowledge'. Take the example of reading a text: by concentrating on individual words I cannot grasp the meaning of a sentence; to get it I have to sort of read 'over' the words. Seen this way we can equate explicit knowledge with formal statements about parts and relations between parts, whereas implicit knowledge goes beyond that level, it involves the way these parts and their relations relate to each other to form a whole. Comparing this statement with the by now classical notion of a whole, which says that a whole is more than simply the sum of its parts we would have to correct it by saying that a whole is more than the sum of its parts and the sum of the relations between the parts. What is the more? It is something that relates to sense and meaning. In other words it also means that a description of some aspect of the world in explicit terms always constitutes incomplete 'information': It misses the most important, the meaning it has. In cases where knowledge is of the practical kind involving, for example, a manual skill, a concentration on the parts may virtually destroy the whole. As an example consider the situation of the piano player who starts to focus his or her attention on the individual movements of the fingers and by doing this gets confused and cannot play the piece at all any more.[18]

[18] In this paragraph I have, in the light of the topic of this paper, interpreted Polanyi's ideas in my own way and by doing so not done too much violence too them, I hope. To compare consider Polanyi's own words: "I regard knowing as an active comprehension of the things known, an action that requires skill. Skillful knowing and doing is performed by subordinating a set of particulars, as clues or tools, to the shaping of a skillful achievement, whether practical or theoretical. We may then be said to become 'subsidiarily aware' of these particulars within our 'focal awareness' of the coherent entity that we achieve. Clues and tools are things used as such and not observed in themselves. They are made to function as extensions of our bodily equipment and this involves a certain change of our own being" (Polanyi 1962, p.vii). This quotation shows that Polanyi talks about human knowing in a state of either practical or discursive consciousness (how the unconscious might come in is less clear). He shows the general structure that applies to any kind of human knowledge: It relies **explicitly** on a set of parts, but only by shifting the awareness away from them can one **implicitly** obtain a comprehension of the whole. The success of practical knowledge depends entirely on a successful activation of the implicit component. Or could we ride a bicycle simply and only on the grounds of the following instructions: to keep our balance we have to take "to heart that in order to compensate for a

Support for Polanyi's notion of a structural parallel between reality and human consciousness comes from the holographic hypotheses about the organization of the universe by Bohm (1980) and the neural processes leading to human cognition by Pribram (1971). They also connect to the postulated relationship between the implicit and the explicit. In optical holography a hologram recorded for a scene with separate objects has the property that each part contains information on the whole. What we normally perceive as the world can be likened to a reconstruction of the objects from the hologram, i. e. we get the impression that the world consists of distinguishable objects.[19] This raises an interesting question: as we are made of the same stuff the world is made from, could the parallel also mean that we have knowledge about the world within us? Berman (1981) seems to think so when he says that we spend a large part of our conscious lives looking busily for something that, on the unconscious level, we know all along. Perhaps one can interpret a mystical experience as a more or less successful instance of access to such knowledge. Should this be true then perhaps the surprising parallels between scientific insights in modern physics and eastern mysticism as described by Capra (1983) are not really surprising.[20]

Some biologists and philosophers, among them Riedl (1981) and Vollmer (1983), have developed what is known as evolutionary epistemology[21]. They put the old question, which has been worrying philosophers throughout the centuries, namely how human beings get to know things about the world they live in, on a biological foundation. According to them organisms learn during biological evolution in that experiences made about aspects of the environment are somehow stored and applied to dealings with the environment in the form of expectations, which then are confirmed or not confirmed. This can be understood as a circular, or because there is a linear component of progress involved, rather a spiral-like process which starts with the acquisition of knowledge in genetic apparatusses and ends with learning processes of neural systems and brains. The notion is clearly one of the transfer of information or of a mapping from environment to organisms. Maturana and Varela (1985) are definitely opposed to this idea. They stress the autonomy of organisms which they see as

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given angle of imbalance a, we must take a curve on the side of the imbalance, of which the radius (r) should be proportionate to the square of the velocity (v) over the imbalance: r v^2 / a" (Polanyi 1974, p.144)? Explicit knowledge of this kind is ineffectual. Conversely, theoretical knowledge discursively formulated may be instrumental, but possibly dangerously incomplete.

19 A hologram is a photographic recording of the inferential pattern produced by two coherent beams of light, one being reflected from a scene of interest, the other being an undisturbed reference beam. The scene can be reconstructed from any part of the hologram. As we will discuss below, we may be able to take the notion of implicateness or implicity as a more general metaphor applying to other realms of reality as well.

20 There are still other findings which point to the possibility of a mathematical paradigm common to both the genetic code and the Chinese I Ching system of prophesy (Katya Walter in a Workshop on "One World of Matter and Mind" held in the Cortona-Week 1989, an alternative meeting of students, faculty and non-academic people organized by Pier-Luigi Luisi from the ETH Zurich).

21 In German: *Evolutionäre Erkenntnistheorie.*

organizationally closed (autopoietic) systems.[22] Influences of the environment on living systems do not contribute to their organization, they rather take the form of 'perturbations' to which organisms will answer with some degree of structural adaptation with the goal of maintaining their organization. Biological evolution in this view is not so much a result of the 'extraction of lawfulness from nature' by organisms, as Lorenz (1973) puts it, but a consequence of some innate drive for creative change and development in living beings. An optimum fit to the environment is not a prerequisite for survival. All that is required is a degree of fit sufficient to allow the organism's organizational continuity. This may be a rather extreme position at the other end of the spectrum, but it lets us continue the speculation about the existence of knowledge within us which we began with Polanyi's notion about structural similarities between human knowledge and the world at large. Perhaps Kant's a priori categories of cognition, such as space and time, are indeed present from the beginning, and not acquired in the course of the biological evolution, as the representatives of the evolutionary theory of cognition would have it.

5 Knowledge and human ecology

What does this all mean in the context of human ecology? If we wish to understand it as an endeavour with the aim to contribute to the solution of the human-environment problem we must be interested in the role that **all** different kinds of knowledge can possibly play in influencing the relationship between humans and the environment. The present problem in our society and culture seems to be that we do not put them to the right use, nor are we able to find what an appropriate integration of them might be. Clearly knowledge derived from discursive consciousness, particularly in the form of expert knowledge, is overvalued, while implicit forms of knowledge are underestimated in their importance, disregarded or perhaps found to be a nuisance. In the following I shall therefore point to some shortcomings and problems associated with the former and refer to some of the 'wisdom' contained in the latter. The paper will then end with some hints regarding the question of integration.

Since the time of Francis Bacon science has been understood as an undertaking which is supposed to provide us with knowledge about nature sufficient to control it and thereby free humankind from a status of dependence. Because of this there is an eminently technological aspect to our modern civilization from the start. In many in-

[22] Maturana and Varela are known for their theory of autopoiesis, a system theory of living beings. The term 'autopoiesis' derives from the Greek and literally means 'self-production': An organism is a system consisting of components that entertain processes which in turn produce the components. Hence the system is totally circular or organizationally closed and autonomous. The notion of autonomy and organizational closure (not necessarily of autopoiesis in the strict sense) also applies to neural systems, such that an organism creates its own world. For a fuller account of the theory of autopoiesis see Steiner (1989).

stances the thinking in terms of control has not been restricted to the environment, but also has been concerned with human societies, hence expressions such as 'social technology' or 'social engineering'. More recently, however, a feeling of loss of control or of being unable to achieve control has become more and more widespread. The occurrence of the ecological crisis clearly is one factor at the roots of this development, but internal developments in science have played a part as well here. The most recent such development is the emergence of various forms of non-linear system theory[23] which, because of the existence of bifurcations and random fluctuations which decide upon the path a system may take at those bifurcations, points to the impossibility of forecasting the development of systems of this kind. Also the empirical evidence is accumulating concerning human projects that have failed or led to disastrous unintended consequences. As examples consider the 'great planning disasters' described by Hall (1980), the 'erroneous ways in development aid' documented by Hagen (1988) and the 'normal accidents' associated with large-scale technology discussed by Perrow (1987). And Dörner (1989) provides us with a psychological (though technocratically oriented) analysis of the 'logic of failure'.

These and other experiences make us wonder what role expert knowledge in the form of scientifically formulated statements and ensuing technical implementations can play at all in the solution of our present-day problems. Doubtlessly there are quite a number of issues involved here. I shall restrict the discussion to the following two critical aspects: a) the complexity of the problems, and b) the time factor. Let us begin with the issue of complexity which so often serves as a kind of 'excuse' if we realize our incapability to deal with environmental problems adequately. Vollmer (1983), one of the proponents of the evolutionary theory of cognition, sees the problem in the following way: phylogenetically the working of our mind is adapted to the relatively simple mesoscale world of ordinary phenomena that are accessible to our bodily senses. Within a very short time in evolutionary terms humans have managed to develop a science that has pushed forward into the previous unknown of the macroscale (up to the cosmos at large) and the microscale world (down to the subatomic particles). Technology which could be developed as a consequence may have a spatial and temporal reach of influence such that it is beyond the comprehension of our mind. For those who think we have this problem because our knowledge is not good enough yet, there are logically two possible solutions. Either we have to accumulate more scientific knowledge and manage it by means of expert systems or we have to correct our own human shortcoming and train ourselves in such a way that our thinking gets away from the usual linear format and approaches a lateral, network or holistic mode (Vester 1984, Ulrich and Probst 1988, Dörner 1989). Presumably we should do both, ideally.

The problem of complexity would have less severe consequences if we were to allow ourselves the necessary time to proceed with anything new very cautiously in the form of a step-wise trial and error scheme. This is, of course, exactly what we are **not** doing. On the contrary, we live in a time of an unprecedented, staggering development of science and technology with constant acceleration. In a traditional setting

[23] For a critical account of system theory, linear and non-linear, see Steiner, Furger and Jaeger (1991).

instrumental knowledge is developed gradually by being passed on from generation to generation and being tested over and over again within generations during the lifetimes of individuals, as will be illustrated by the examples given below. By pointing this out we clearly do not want to advocate an abandonment of science. It can, of course, lead to new insights. The real problem, however, is that under present circumstances there is no time available for technical measures derived from such insights to be gradually modified and developed into an ecologically sustainable new tradition. Unintended consequences of human actions are the rule rather than the exception. And science cannot really help here as it is not in a position to make reliable forecasts. The way we go about the problem then today is that, once we have recognized that certain human activities have resulted in undesirable consequences, we try to take corrective steps and by so doing immediately produce new unintended consequences.[24] We end up in a continuous cycle of correcting the corrections, without allowing ourselves the time for corrective feedback processes to take hold and lead to a new stability. The bigger a technical scheme the greater the chances that it may lead to unforeseen devastating effects. It is for this reason that Kirsch (1989) thinks that preventive environmental policy, which presently is being advocated strongly, is impossible in principle. And the debate between him and Weichhart (1989), who, by citing examples of preindustrial societies that were fairly stable in environmental terms, maintains that this is possible, simply reflects a conflict in thinking between a person who sees the present society as one without a tradition (with respect to the problem at hand, at least) and one whose arguments refer to societies with traditions.

My contention is that the 'more-of-the-same' philosophy of the technocrats will lead to more of the same, namely more disasters, more failures, and more catastrophes. To change our path we have to start to acknowledge the importance of implicit forms of knowledge. With respect to tacit knowledge applied in states of practical consciousness I shall present to the reader three examples in the following. The first one is reported by Josefson (1988) from the domain of health care, but we should have no problem to translate it into environmental situations. Josefson is alarmed about the present trend in many countries to educate hospital nurses for their job with a university program (which fosters theoretical, propositonal knowledge) rather than with a traditional apprentice-type practical training on the job under the supervision of older experienced nurses (which is geared to the development of tacit knowledge). To document her misgivings she conducted interviews with nurses. In one of them the following incident is reported: "A nurse of around 50 describes her work in a post-operational ward where she has had 30 years' experience. One day a patient was admitted to her ward: he was a middle-aged man who had just undergone surgery. After a short conversation with him the nurse quickly realized that his condition was not normal, although the man said he felt surprisingly well. She called out the physician on duty, a young doctor with little experience who, seeing that the patient's vital signs were

[24] This statement refers to cases where, in fact, something is done. We are all also, of course, familiar with situations where nothing is done (yet) as science is incapable of proving related cause-effect relationships convincingly and, consequently, the 'culprits' are given the benefit of the doubt.

normal, reproached the nurse for calling him out unnecessarily. Later in the day, the patient died, and the post mortem uncovered a complication that could not have been diagnosed by an examination of his vital signs. The nurse's comment was that she noticed that something was out of the ordinary, but could not explain how she had arrived at this conclusion. Previous experience, of course, she pointed out, was a decisive factor" (Josefson 1988, p. 26-27).

There are many instances of human-environment issues which parallel the implicit versus explicit knowledge problem or, expressed in a different way, the conflict between 'people's science' and expert science. We will give two examples here. The first refers to a case which is typical for technical aid programs in the Third World; it is reported by Richards (1986) and it concerns rice cultivation in Sierra Leone. Traditional agriculture relies on a mix of three types of rice: a) Quick-maturing rice planted on low-lying land with moisture-retentive soils; b) Medium duration rice alternating with a variety of intercrops on rain-fed upland farms; c) Long duration 'floating' rice planted in water courses. Even during colonial pre-war times this technology was regarded as being backward by the authorities. Consequently, they started a drive to introduce South India style large-scale water-controlled swamp cultivation deemed more advanced. However, up to the present time, farmers have proven fairly resistent to this idea. They have their reason: the traditional mix provides for ecological and economic risk minimization and stability. It is, in the view of the farmers, "a better, safer, more productive 'package' than anything on offer from development agencies" (Richards 1986, p. 191). Conversely, extended irrigation methods tend to be an all-or-nothing commitment especially because they are labour-intensive. They do not leave room for simultaneous upland farming which for the indigenous farmers constitutes a very important supplement. A technology transfer approach such as this one, which is blind to the real needs of the local people, is only possible because of the "isolation - social, mental and residential - of development experts and scientists from the day-to-day realities of village life." Richards 1986, p. 185). An alternative approach is "based on the notion of mobilizing Africa's most under-utilized resource - the ecological knowledge, skill and inventiveness of the mass of ordinary farmers" (Richards 1986, p. 184), which means that researchers and planners should go out into the field and 'educate' themselves through a process of participatory observation.[25]

Still, this type of problem is not exclusive to Third World countries. Similar issues concerning the contrast between traditional agricultural methods and modern technology are of importance in industrialized Western countries. The difference probably is that in developing countries this contrast manifests itself mainly as an active attempt of development experts at substituting indigenous by presumably more advanced tech-

[25] Raffestin and Lawrence (1990) describe the problem in this way: "The interrelations between the various consequences of human products and processes ... are frequently overlooked by contemporary politicians and planners ... From this perspective, it is necessary to distinguish between the tacit know-how (in which theory and practice are interrelated) used by populations in so-called 'undeveloped countries' to regulate human activities, and the explicit know-how (in which theory and practice are also interrelated, yet clearly distinguishable) applied by decision-makers in so-called 'developed countries'" (p. 105).

nology, while in Western countries farmers tend to adopt industrialized methods of agriculture by themselves simply for reasons of economic pressure. Take the example of the ecologically particularly sensitive mountain areas of Switzerland as described by Messerli (1989) in his overview of the results and insights of the Swiss Man-and-Biosphere (MAB) research program run between 1978 and 1985. These mountain regions, settled since the Middle Ages, have seen some periods of ecological crisis before, but by and large farmers have been able to develop a sustainable system of utilization which has led to a condition of ecological stability. As described by Bätzing (1988) in more detail this system is based on a formula which equates production with (environmental) reproduction. It means that unavoidable damages done to the environment in the course of agricultural production are being compensated by the necessary amount of regenerative work. For example, agricultural soil having been washed down is collected downslope and carried and distributed again upslope. Also, of course, preventive measures are taken to begin with, such as when slopes are terraced to avoid soil erosion as much as possible in the first place. The beauty of the mountain landscapes is, apart from the scenery provided by nature itself, largely the result of these farming practices. It is what makes them so attractive for tourists. However, now the enormous tourist boom that has developed since World War II has started to threaten its own basis, not only because of the direct effects in terms of large-scale consumption of space by buildings, roads, parking lots, ski lifts and runs, but also because of indirect effects on agriculture. The latter, to be able to survive economically, retreats from peripheral areas, which are left to themselves, and concentrates on the more suitable and accessible areas with a program of intensification and mechanization. As a result, the balance between production and reproduction is lost. This is why Messerli calls for a backward orientation in the sense that the traditional cultural mountain landscape should be taken as a reference value to which agricultural practices should be geared. The related knowledge, however, is largely implicit and 'stored' in those members of the local farming population who have grown up at a time traditional methods were still practiced. It is lost for good once there is no longer any transmission from one generation to the next anymore. As Messerli says, "it is ... unimaginable that science can ever replace the local knowledge and experience which generations of mountain farmers have accumulated over many centuries of concrete work on nature" (p. 12).

If Polanyi is right, all knowledge that can be formulated explicitly is incomplete with respect to the reality of the world. This is particularly so with regard to expert or scientific knowledge (and within this category especially to knowledge expressed in some kind of formal language) as it tries to focus on some parts and the relations between them very sharply. Naveh and Lieberman (1984) in their treatise on landscape ecology realize this when they say that it does not suffice to describe an ecosystem in purely formal terms. Such a description must be complemented by statements in natural language. And, of course, in the light of the foregoing one might claim that even the use of natural language is not sufficient, but that on top of it we should also rely on non-verbal information such as, for example, those provided by pictures, sounds and smells. We remember Polanyi's notion that only by defocussing from the parts can we hopefully grasp the meaning of the larger whole. This gives rise to the following speculative question: is there any reason to believe that in the natural world things have some kind of meaning separate from socially created meanings within a

certain culture? If they have could it mean that maybe there is indeed some connection between facts and (intrinsic) values, a relation that our modern western mind has declared very vigorously to be impossible? Is perhaps the notion of a 'naturalistic fallacy' itself fallacious?

Obviously there are religious undertones to such a question. And, as Pratt (1990) says, "religion, archteypes, and works of art are important ways in which we are 'in the world'" (p. 4). It leads us to ask how far feelings can be a factor in cognition or, in other words, how we can get access to the unconscious in a perhaps less haphazard way than provided by dreams.[26] There is, of course, a method which has been practiced within the context of eastern religions for centuries, namely various forms of meditation as a kind of concentration on oneself with a submersion into deeper structures of one's psyche. According to eastern religious theory, it is the way to ultimate enlightenment. It has been disdovered in the western world as a means for personal psychotherapy which can be practiced alone or, better, in groups (see, for example, Schwäbisch and Siems 1981). There are probably different explanations possible of what is actually happening in meditation. At a measurable physiological level it has been found that during meditation brain currents take on a pattern which is identical with the one observed in the so-called REM-phase of sleep[27]. The interpretation then is that meditation provides a possibility of accessing the unconscious in a state of wakefulness. It is recommended as a technique to alleviate stress and to get rid of 'garbage' that has accumulated in the unconscious. Seen in a more positive way meditation is supposed to release inherent psychological resources existing at a deeper level of an individual's consciousness. Gustavsson (1990), who investigated the effects of meditation practice on management teams, found that the persons concerned became able to express more subtle levels of their personalities such as emotions and intuition and to integrate them into decision-making. There can be hardly any doubt that such effects should make a difference for the quality of social relations as well as of relations to the environment.

To reiterate: the argumentation in this paper does not aim to suggest that science should be abandoned. Clearly it can provide us with *some* answers relevant to coping with the environmental crisis. For example, it can help to define limiting values of physical quantities of pollutants allowed to escape into the environment. However, instead of the usual sectorial application there should be a balanced, interdisciplinary use of expert knowledge. And, more important even, it should be embedded in and combined with other types of knowledge. The good that human reasoning can do is that it can break with bad traditions[28] and help to establish new ones. Here science is

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[26] Note, however, that there are dream specialists who believe that you can address questions to the unconscious which then are answered in dream form.

[27] REM stands for 'rapid eye movement'. It refers to a shallow phase of sleep with dreams which occurs before waking up.

[28] Previously, in talking about traditions, we have simply referred to the fact that societies can create their own worlds. This leaves the question open whether such worlds are good or bad. Obviously they can be one or the other, and they can be it with respect to social or environmental issues, or both.

in a paradoxical situation: in the course of enlightenment its development has helped to get rid of erroneous dogmas and suppressive social structures. By doing this, however, it has created a new tradition itself: the belief that science has all the answers and that all problems can be solved by scientific means. This again is a bad tradition which must be abandoned. To this end science must examine itself critically in a self-reflective process, and society at large must reformulate the role it wants to assign to science within itself. By doing this it will find that is has to revise its socio-cultural structures in general. Milbrath (1989) describes this process as follows: "We must learn how to become conscious of our ways of knowing. ... As we do so, we will come to recognize the key role that society plays in knowledge development, in development of beliefs about how the world works, and in value clarification (or obfuscation). Recognizing that our beliefs and values are culturally derived frees us to reexamine them to see if they can be revised to serve us better" (p. 85). We can now see that the environmental crisis is really a socio-cultural crisis of humanity. As Evers and Nowotny (1987) point out, expert knowledge is particularly in high demand at times of crisis. The problem is that crisis invariably means uncertainty. Hence there is no single expert opinion, but two or more conflicting ones. To overcome the conflicts society must enter into a discourse which must be based on more resources than just scientific knowledge. It needs a process of regeneration which Milbrath (1989) calls 'social learning'. The important recognition is that such processes can, in fact, shape a society and hopefully establish a new tradition, one that leaves enough room for free, pluralistic thinking on the one hand and helps to reestablish connections to our biological past with its manifestations in the unconscious on the other.[29] Only with a suitable combination of implicit and explicit types of knowledge can we hope to acquire something like an ecological intelligence, sapience or wisdom.

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[29] When I talk about 'society' here I use the term in a metaphorical way, meaning a growing number of individuals who will take part in such a process. Experience shows that it usually starts with alternative groupings of some kind, such as green parties in the political scene at present. It is important to note that the 'shaping' of society then comes from below and works its way upwards, in contrast to the notion that a society can be planned from above.

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