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# VARIATION AND UNIFORMITY IN THE CONSTRUCTION OF BIOLOGICAL KNOWLEDGE ACROSS CULTURES

This chapter examines the extent to which knowledge of biological entities and processes varies according to different human life experiences and cultural traditions.[1] It attempts to relate this to global, transmodern, scientific biology, with its origins in Western cultural history. What connects the first with the second is the increasingly well-documented recognition that all peoples share a basic way of apprehending the natural world, grounded in a common evolutionary history, even though this cognitive underpinning is everywhere filtered through the local particularities of environmental and cultural experience. Such a shared infrastructure of perception and cognition has been termed "natural history intelligence" and is linked to modular theories of the mind. What this means usually includes (1) a shared concept of basic natural kind (a species-like concept) reflecting a view of the biological world as a series of discontinuous entities; (2) an ability to recognise and respond to things as living matter, and more specifically an "algorithm for animacy" (Bulmer, 1970; Reed, 1988; Atran, 1998; Ellen, 1996; Boster, 1996); (3) a capacity to intuit certain kinds of behaviour based on expectations derived in part from common experiences linked to phylogenetic similarities or observations of human behaviour, and (4) strategies for classifying biological diversity (Atran, 1990; Boster, 1996; Keil, 1994; Mithen, 1996: 52–54). Because none of this is accessible other than through its local cultural versions, distinguishing what are shared human universals from what are simply culturally widespread is problematic. This has given rise to some lively debates.

## DIFFERENT WAYS IN WHICH KNOWLEDGE IS CULTURALLY EMBEDDED

Although underlying cognitive strategies influence how people construct what they know about the biological world, most knowledge is culturally transmitted and shaped by environmental and social forces which vary from place to place. In part, what people know is constrained by local ecology, although what is uniquely human is the capacity for acquired biological knowledge to diffuse independently of what can be experienced in local habitats. Thus, people may



*H. Selin (ed.), Nature Across Cultures: Views of Nature and the Environment in Non-Western Cultures*, 47–74.

have concepts for snakes, even if they have never seen one. Scientific biology is, in one sense, an extreme development of such an intuitive biology, augmented by the possibilities offered by effective cultural transmission, since the capacity to generalise and hypothesise is grounded in the way science aggregates knowledge of species and ecologies beyond what a scientist might have local first-hand experience of as a non-scientist.

Before going further it is useful to reflect on the relationship of culture to knowledge, knowledge to intelligence and on different kinds of knowledge. This has become necessary because of recent developments in anthropology and cognitive science. The default understanding of knowledge, at least in anthropology, is usually of what we might call "conscious", "cognised" or "reflective" knowledge: something we are aware of acquiring and using, and often do so purposefully in order to solve various technical and social problems. However, people also acquire knowledge unobtrusively and unreflectively as part of the process of socialisation and growing up. This is no less knowledge than that which we consciously articulate or recognise. One example of this kind of knowledge is "bodily knowledge" – knowledge acquired and stored as part of doing and recognising in particular practical contexts. An example is learning how to harvest rice with a Javanese finger knife, which requires sensory and motor skills which are often readily transmitted across generations but which are not explicitly formulated into a set of rules. Such techniques are, rather, acquired through mimicry, experience and informal apprenticeship. Much knowledge of the first (cognitive) kind is clearly encoded in language; in other words it is "lexical knowledge" (such as in plant and animal nomenclatures), and where this yields regularities in how people relate different living kinds, it translates into "classificatory knowledge". However, much knowledge, particularly of natural processes, is only partially lexically expressed. Where classificatory knowledge generates categories with no lexical markers, these are termed "covert categories" (Taylor, 1990: 42–51), but where knowledge is manifestly evident although not necessarily systematically expressed in language, we might speak of "substantive knowledge" (Ellen, 1999). Most knowledge of the biological world is substantive in this sense and classifications can be understood as codes to access and manipulate it.

There is another way of looking at the knowledge people have of objects and processes in their environment: not in terms of how they engage with nature, or the degree to which that engagement is encoded in cultural representations, but in terms of its division into empirically organised areas of substantive knowledge (the so-called "ethnosciences": ethnobotanical (plant) knowledge, ethnozoological (animal) knowledge, ethnoanatomical knowledge, ethnoveterinary knowledge and so on). Although people themselves may seem to divide their knowledge of the natural world in this way, this approach – displaying the bias of encyclopaedic, literary-based theoretical knowledge – is best reflected in the conventional partitioning of Western science, which in turn has influenced the development of ethnobiology. One of the great problems in researching how other people understand their biological worlds is ensuring that these conventional etic[2] divisions are not imposed on the subjects of our research. It is true that this framework for looking at pragmatic knowledges of biological form and process is helpful when seeking to make inventories of what people know about individual species or varieties. However, from the point of view of comparative study it is probably more useful to distinguish several kinds of knowledge organisation, irrespective of the type of organism or uses involved. Such an approach distinguishes (a) classificatory knowledge from (b) knowledge of anatomy, autoecology and processes with respect to individual organisms, or groups of organisms; from (c) knowledge of ecological systems (synecology: plant interaction, dynamics of various kinds of landscape, seasonality, food chains, pest ecology); and from (d) knowledge of the general principles of plant and animal biology. In the past research on local "folk" knowledge tended to emphasise the first of these (predominantly, the classification of macro-organism diversity), although increasingly it has become apparent that the application of insights from the second three may more than compensate for detailed knowledge of the first. However, how all this ethnoecological knowledge connects up into some larger whole presents considerable analytical difficulties, since it is less easy to disaggregate in local emic terms, partly because it is characteristically intermeshed with symbolic and aesthetic representations.

Another problem in studying biological knowledge cross-culturally is knowing to what extent we can generalise about the knowledge of particular populations, or indeed of societies or cultures. Knowledge is distributed geographically between populations, and it is also important to distinguish levels within the same population. Not all persons are equally expert, and important knowledge is always disseminated through social networks. For example, there are now some excellent demonstrations of the mechanisms which transmit genetic variability in *Manihot esculenta* (manioc, cassava, tapioca) amongst Aguaruna (Boster, 1986) and Guyanase Makushi women (Elias, Rival and McKey, 2000). Commonly applied knowledge, shared by all the members of the community, needs to be distinguished from more specialised knowledge shared by only one category of users. An example of one extremity of such a distribution is that of individual healers, where knowledge is hidden, secret, and transmitted to very few people. Important practical questions arise as to which of these – the individualised or the shared – are the most significant, or indeed what we mean by "significance", since this can be measured along a number of different (indeed, contrasting) axes (say, ecological versus social) and especially when it is evident that knowledge is dynamic and changing. Many descriptions of ethnobiological knowledge tend to aggregate knowledge obtained from different individuals in an unweighted fashion, or present the knowledge of a few individuals as if it were that of the entire population. When this methodological relationship between aggregated data and inference is transparent and its limitations understood, it can be described as the "omniscient speaker-hearer convention", but when the relationship is obviously misunderstood and abused through the drawing of false inferences, then we might speak of the "omniscient speaker-hearer fallacy" (Berlin, Breedlove and Raven, 1974: 58–59; Gardner, 1976).

But however we divide up different kinds of knowledge, they must always be understood in a broader context, both in terms of other kinds of knowledge and in terms of the context of social relations. Local knowledge of environmental resources is socially embedded, and only under very special conditions can it become modular, free-floating and transferable. It has become conventional to distinguish symbolic from technical (mundane) knowledge, following Durkheim and Mauss (1901). This distinction overlaps, although is not entirely equivalent to, the distinction between knowledge (as an abstract body of principles) and know-how (applied practice), or Geertz's (1966) "models of" and "models for". This convergence of cognitive and symbolic anthropology (Colby, Fernandez and Kronenfeld, 1980; Ohnuki-Tierney, 1981) is easy to understand when one realises that all human populations apprehend the social in terms of the natural world and the natural in terms of metaphors drawn from the social world. The two are intrinsically complementary, although in certain neurological pathologies they may conflate in unusual ways (as in varieties of autism); other kinds of confusion between the two may be perceived as culturally deviant. The classificatory language we use for plants and animals is derived from the way we talk about genealogical relations, and we understand the functional dynamics of both organisms and ecological systems in terms of our experience of participating in social systems, where technology provides numerous productive analogies: say, the heart as a pump, the blood vascular system as a thermostat or the brain as a computer. More generally people attribute meaning to parts of the natural world around them by investing them with human and spiritually anthropic qualities (animism). Increasingly, historical and cultural studies of scientific practices and thought are revealing this tendency.

Anthropologists, however, have had much more to say of the natural world as a source of symbols (Bulmer, 1979; Fox, 1971; Rosaldo, 1972; Rosaldo and Atkinson, 1975; Rival, 1998). For example, they have discussed how natural species are used to signify group difference (totemism), or why certain species should be used as symbolic reflections of fixed moral orders, while others should be prohibited (Douglas, 1966). They ask why certain species should be selected as symbols because they have properties which make them "good to think" with rather than necessarily being "good to eat" (Bulmer, 1967; Leach, 1964; Tambiah, 1969). On the whole, animals provide more, and more salient, primary symbols than plants, perhaps for anthropomorphic reasons. In all human populations some species or group of species predominate as symbols. This can be because they are not only economically important, such as zebu cattle (*Bos indicus*) amongst the pastoralist Bodi of southern Ethiopia (Fukui, 1996) or the palm *Borassus flabellifer* amongst the Rotinese of eastern Indonesia (Fox, 1977), but also often because of the visual characteristics and metaphoric possibilities particular species present. Examples are bowerbirds or birds of paradise in the highlands of Papua New Guinea (Healey, 1993; Hirsch, 1987), the powerful social and sexual imagery of the mudyi tree (*Diplorrhyncus condylocarpon*) amongst the Ndembu of Zambia (Turner, 1967), or the contrasting imagery of grains versus roots or trees versus lianas. Occasionally, symbolically salient organisms are those which have medicinal, including psychoactive, properties, such as the betel palm, *Areca catechu*, in the case of the Nuaulu of Seram in the Moluccan islands (Ellen, 1991), or ayahuasca (*Banisteriopsis caapi*) amongst the Jívaro cluster of the Amazonian foothills of Ecuador and northern Peru (Metzner, 1999).

## CLASSIFICATORY KNOWLEDGE

The study of ethnobiological classification, or folk classifications of plants and animals, has tended to dominate anthropological approaches to the understanding of biological knowledge across cultures. This is partly historical, but it is also because understanding local classifications provides an essential framework for talking about other kinds of knowledge. Understanding folk classification is important for numerous reasons: (1) fieldwork necessitates learning the terms and concepts through which local people deal with the biological world, (2) direct translation into scientific nomenclature is not always possible, (3) scientific and vernacular categories do not always match, (4) names and categories provide important ethnobiological information, and (5) local processes of decision-making and environmental management can only make sense with respect to the categories employed by decision-makers. Additionally, irrespective of the practical role of classificatory approaches, they provide important data for cognitive and linguistic studies. But knowledge of folk classification is of limited value without scientific determinations, which permit proper cross-cultural comparison, generalisation and identification, including the degree to which folk categories deviate from scientific taxa and from each other. Phylogenetic classification therefore serves as a baseline and framework for analysis. For example, Nuaulu attach the label **sinsinte** to all kinds of *Codiaeum variegatum* (croton), a polychromatic waxy-leaved shrub with important symbolic qualities. However, they distinguish several sub-types: **sinsin totu onate**, **sinsin totu nawe**, **sinsin amasen**, **sinsin totu pukune**, **sinsin msinae**, and **sinsin matapai**. Since these are represented as species-like groupings, we can say that they "over-differentiate" the category. By contrast, earthworms, which they label **tumanai**, regardless of family or genus, are by the standards of Linnean classification, seriously "under-differentiated".

### *Basic organisation of classifying behaviour: words and categories*

Most studies of ethnobiological classification approach the subject linguistically, because most data acquired in fieldwork settings are generated through interviews and by hearing people talk about wildlife, because this is how most people themselves share classificatory knowledge, and because many classificatory strategies are revealed through language. However, it has long been recognised that words are not always a good guide to the existence of categories: there may be several words which label the same category (synonyms), and the same word can be used for quite different organisms. Moreover, some categories may exist without being labelled.

The nomenclature for labelling categories tells us something both about classificatory knowledge and also about the attributes which people find important in distinguishing different plants and animals. Most languages label plants and animals below the "basic level" with some variant of the binomial system: that is two terms, the first indicating a more inclusive category and the second a less inclusive category, the two being linked by a "kind of" relationship. Thus, for Nuaulu **sinsin msinae**, "red **sinsinte**", is a binomial. In this case the more inclusive category is identified not only by its priority, but because it has been lexically reduced: thus **sinsinte** becomes **sinsin**. Local linguistic conventions have to be carefully observed, and it is important to note, for example, that **tobako sinsinte** and **kasipi sinsinte** are not kinds of **sinsinte**, but are, respectively, kinds of tobacco, *Nicotiana tabacum*, and manioc, *Manihot esculenta*. In this linguistic context **sinsinte** becomes, instead, an adjectival qualifier. The kinds of adjectival qualifiers used vary, from descriptions of diagnostic visual attributes, uses and smells to sounds. Birds and frogs, for example, are disproportionately distinguished using onomatopoeic references to their call (Berlin, 1992: 232–259). There have been several attempts to develop a typology of lexemes to allow accurate description of ethnobiological nomenclatures (Conklin, 1962; Berlin, Breedlove and Raven, 1973).

### *The structure of categories*

Early attempts to understand how ethnobiological categories are established and used employed a distinctive feature model, in which category A was thought to be distinguished from category B in terms of a number of key distinctive features. For example, birds have wings, feathers, beaks and fly, in contrast to fish, which swim and have fins. This model was largely drawn from lexicography and logic (Conklin, 1962). However, it was noted that the condition of contrast required for this model to work was not always evident. Thus, category A might be linked to category B by one common attribute, and category B linked to category C through a different common attribute, thus linking categories A and C even though they had nothing in common: this is known as "polythetic classification" (Ellen, 1979: 11–12). As work on ethnobiological classification expanded it became obvious that the digital distinctive feature model was inadequate, and that a better way of modelling the cognition of basic and more inclusive categories might be in analog terms, as cognitive prototypes. In this model the brain has an image of, say, "birdness" or "treeness" to which incoming perceptual images are matched; the presence or absence of particular features is not an overriding consideration, only closeness of match (Rosch, 1977). In this core-periphery model an image could be a close match or a marginal match. Thus, in British English classification of birds, a robin would match closely the core prototype, but an ostrich would be marginal. Of course, in practice, both the notion of contrasting features and cognitive prototypes are necessary to understand how classifications work.

### *The relations between categories*

It has become conventional, following the analytical procedures of cognitive anthropology, to begin any analysis of classificatory knowledge of natural entities by establishing a cognitive or semantic domain or field (Frake, 1969). The domain in question can be established at varying degrees of classificatory inclusiveness: thus it might de determined as "all living things", "plants", "trees" or "rice", depending on the focus of the analysis. Although the domain may be isolated for analytical reasons, and is to this extent arbitrary, its boundaries are generally understood to reflect distinctions which are empirically important for the population who share them. Thus, if a population has no concept of "tree", then such a category cannot be established as a cognitive domain. On the other hand, as we have noted, categories do not need to be labelled in order to exist, even at the level of domain. Where a cognitive domain has been established, it is usually understood that most categories which sub-divide it will be labelled, and a domain or field identified in terms of its labels is usually known as a "lexical field". Of course, the lexical field for plants may not correspond to the cognitive domain, because of the existence of covert categories at various levels of inclusiveness.

The earliest work on cognitive domains modelled the internal sub-divisions of a domain largely in terms of the taxonomic model: that is, in terms of a hierarchical model of contrast and class inclusion. This is partly because this form of classifying is so dominant in the literary and scientific tradition of the West and particularly because of the precedent of Linnean taxonomy. The work of Brent Berlin (1972, 1992; and Berlin with Breedlove and Raven, 1973 and 1974) developed the taxonomic idea further, putting forward a strong claim for it to be considered the general way in which ethnobiological classification works cross-culturally, hypothesising that a series of taxonomic ranks could be established, broadly reflected in the main ranks of the Linnean scheme: unique beginners, life forms, intermediates, generics, specifics and varietals (Figure 1). These terms have been widely adopted and are a useful way of structuring a discussion of variation in classificatory knowledge of the natural world. Other writers have preferred different terms (in part to avoid confusion with Linnean nomenclature) and these are also indicated in the figure.

"Unique beginners" define a cognitive domain. Thus concepts such as plant and animal are such, even where no labels exist. Many languages have no word for either of these, even though there is linguistic and non-linguistic evidence to confirm that people have the category. "Life forms" are the second rank, usually few in number and including almost all other categories in the domain. Thus, bird, tree and fish are obvious life forms, and their cognates exist in most languages. However, a problem arises because in some languages many life forms can be identified, in the sense that they themselves are not members of any other more inclusive group which might be called a life form, and which are seen directly as sub-categories of a particular unique beginner. Thus, frogs, bats, and bamboo, in some folk classifications, may contrast with other more salient life forms. This is a difficulty for the Berlin scheme, and to ensure that the life forms remain "few in number" they are reassigned to the category "unaffiliated generic". Most categories in a folk classification system are either generics or specifics, to use Berlin's terms, and these terms suggest strong correspondence with the Linnean ranks of genus and species. The lowest rank

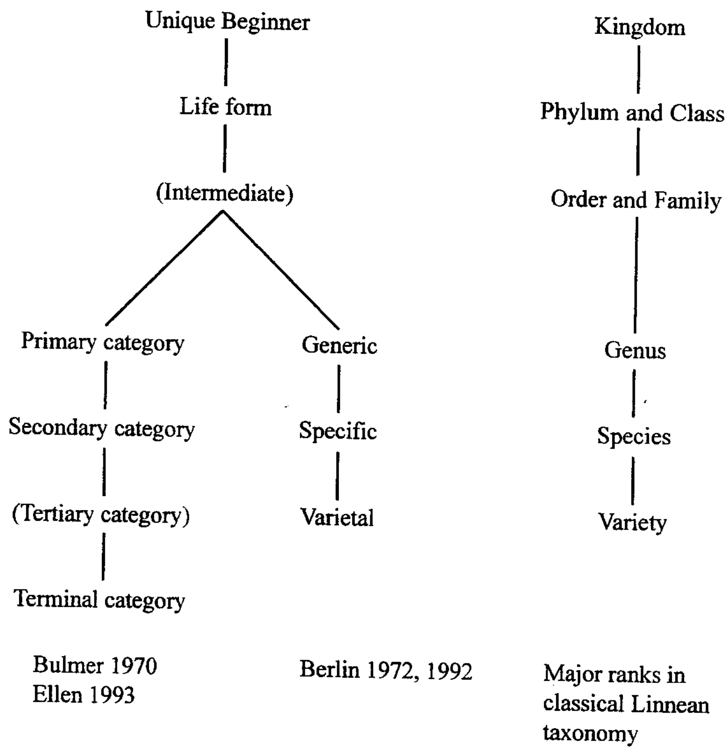


**Figure 1** Some commonly used terms for classificatory ranks found in ethnobiological studies.

in the Berlin scheme is "varietal", which is mainly of significance when dealing with domesticates, and we shall return to it in that context. Finally, Berlin uses the term "intermediate" to refer to a rank between life form and generic. In the empirical examples with which he deals, this rank is weakly developed, although it is approximately equivalent to family in the Linnean scheme, where it is much more significant: e.g. rose-family versus ginger-family, felids versus canids, and so on. This may be because groups of this kind are not best perceived locally where biodiversity is limited but become apparent when many natural kinds are grouped together at a regional or global level.

There are difficulties with Berlin's universalist-evolutionist model: it assumes too rigid a notion of contrast in delineating categories, the levels are difficult to sustain given the way we know individuals use classificatory information, there is less hierarchical depth in practice than anthropological representations of aggregate folk knowledge imply, and although the mind appears to generate readily the notion of "basic category" (natural kind), its identification with the generic level is not always easy. Also problematic is the centrality given to general-purpose schemes and their purported cognitive independence of the specific functions to which classifications are put, as well as the underplaying of the role of variation, not only between people but between different occasions. These two latter issues will be returned to later. In response to these problems,



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critics have emphasised classificatory alternatives to taxonomy (e.g., paradigms, keys, fuzzy logics), and have distinguished between ways of representing the relations between organisms and storing knowledge (Ellen, 1993: 215–234; Hunn and French, 1984; Randall, 1976).

## HOW ETHNOBIOLOGICAL CATEGORIES AND KNOWLEDGE VARY, CHANGE AND EVOLVE

Many early studies of ethnobiological classification paid relatively little attention to variation within a single population, sometimes providing a misleadingly uniform picture. Work over the last 30 years has identified the different ways in which knowledge varies within a population (as between, say, consistency, flexibility and sharing), how it is socially distributed according to age, gender, locality and division of labour and how it may be presented differently according to mundane versus symbolic schemes, or general-purpose versus special purpose schemes.

Berlin (Berlin, Breedlove and Raven, 1966) institutionalised the distinction between what we call "general-purpose" and "special-purpose" classificatory schemes. By the former Berlin indicated classifications based mainly on visual morphological and behavioural features, which he hypothesised were likely to have a high degree of constancy across cultures. By special-purpose functional classifications he indicated classifications which were related to the various uses to which fauna and flora might be put. Thus, classifications of animals as meat, or plants as medicinals, were special-purpose in this sense. The distinction is of major theoretical significance, because if it can be shown empirically to hold true then it provides the main grounds for supporting certain universalist and evolutionary characteristics of human cognition of the natural world (see above). Beyond this, however, the distinction enables us to examine how knowledge of the biological world is embedded in cultural knowledge, is stored and retrieved. Thus, even if it can be shown that there is an underlying universal general-purpose classificatory tendency, there can be little doubt that general-purpose schema are inadequate to understand all people know about individual species, much being embedded in particular special-purpose domains or discourses, such as medical knowledge.

Some progress has also been made in understanding how ethnobiological classification varies between different kinds of human population. It is now accepted, for example, that how much people know (especially as this is reflected in the names they supply for kinds of organisms) is strongly correlated to biodiversity. It has also been suggested that hunter-gatherers generally have less extensive nomenclatures for plants and animals, are less likely to use binomials and adopt more flexible classifications. Agricultural populations tend to encode classificatory information more systematically and lexically, perhaps because of larger group sizes and because of greater social sharing of knowledge in the course of production (Morris, 1976; Ellen, 1999). Where domesticates are clearly established and important it is usual to find extensive and complex varietal level classifications reflecting genetic diversity (e.g. Brush, 1992; Iskandar and Ellen, 1999). Farmers may possess a more extensive formal knowledge of forest products than foragers, which enables them to cope with the greater subsistence risks associated with agriculture.

Variation in people's classificatory knowledge is often the first stage of a process of change (Barrau, 1979; Nabhan and Rea, 1987). Short-term change and flexibility often arise through the semantic extension of categories to include new natural kinds and the assigning of low profile entities to residual categories. Where new categories are recognised these are indicated in language by marking. Thus, the introduction of *Lycopersicum esculentum* (tomato) into France in the seventeenth century was accompanied by the formation of the marked term **pomme d'amour** (love apple), contrasting it with the unmarked **pomme** (apple). Similarly, British English oak was qualified as **turkey oak**, to describe *Quercus cerris*, a non-native naturalised species from southern Europe and Asia Minor. In turn, the native *Quercus robur* was optionally then renamed the "common" **oak**, to effect the adjectival contrast. Sometimes a name moves with a plant. Thus, the Nuaulu for tomato is **tamati**, probably from the Dutch **tomaat**. Other new names are based on assumed place of origin, as in Ambonese Malay for *Manihot esculenta*: **ubi kastella** (Castilian/Spanish tuber/yam).

Work on long-term evolutionary changes in folk-biological classification has demonstrated how basic categories aggregate and segregate into folk biological ranks, the order in which they do so and, in particular, on how life forms evolve (Berlin, 1972). Brown (1984) has suggested that there is a regular sequence in which life form terms are added to language. This in part reflects basic shifts in subsistence behaviour and social organization, such as from gathering and hunting to agriculture, from minimal to elaborate divisions of labour, from non-centralised societies to states, from preindustrial to industrial economies, and from oral to literate traditions. What is contested is the extent to which there is a unilinear progression in life form encoding rather than a widespread evolutionary convergence in the way uses for plants and animals reflect this (Randall and Hunn, 1984). As has been noted, the numbers of plants named in agricultural societies is, for example, systematically larger than in non-agricultural societies, while more all-encompassing labels (life forms, intermediates, and so on) become more important, while basic level names become relatively less important in post-agricultural societies. The twin processes of domestication and cultivation give rise to observable differences between populations in their classificatory knowledge. Differences between wild and domesticated forms of the same natural kind are often lexically expressed (Nabhan and Rea, 1987), sometimes marking genetic differences, but sometimes simply location – e.g., that plants are grown in fields rather than in the forest. Indeed, in many societies the boundary between wild and domesticated, cultivated and non-cultivated is very fuzzy, especially in swiddening and agroforestry systems, where it seems more accurate to speak of degrees of management (the balance between simple extraction and purposeful or inadvertent regulation). This fuzziness is deliberately used in some indigenous management systems, which actively foster and exploit the interbreeding of wild and cultivated stock, both plant cultivars and animals. Recent exemplary discussions of the former include studies of *Manihot esculenta* amongst the Makushi in Guyana (Elias,

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## KNOWLEDGE OF INDIVIDUAL ORGANISMS AND GROUPS OF ORGANISMS

There are now numerous studies of the substantive ethnoecological knowledge of different populations, and it would be impossible in this chapter to summarise them adequately. Any summary is likely to grossly underestimate what local people know. Here I refer to a few illustrative studies, but there are other useful collections (Johannes, 1989; Inglis, 1993; Nazarea, 1999; Williams and Baines, 1993) and monographical studies of the knowledge of particular peoples (e.g. Felgar and Moser, 1985; Friedberg, 1990; Heinz and Maguire, 1974; Hunn, 1990; Kocher-Schmid, 1991; Revel, 1990).

The classificatory knowledge employed to aggregate and segregate categories of different natural kinds is synthetic, meaning that the logic involved is inductive, moving outwards from the basic categories established for groups of discrete living creatures. This is in contrast to the analytic logic involved in understanding the relationship of different parts of organisms, where the subject starts with a single physical specimen and deductively classifies its parts. "Organism partonymy"[3] is at the basis of human understanding of how individual kinds of organisms appear, grow and reproduce. How much people know about the anatomy of a particular organism is closely related to how much people need to know to take advantage of its usefulness, although even the management of honey-producing bees and wasps amongst the Brazilian Kayapó hardly seems sufficient to explain the detail of their systematic nomenclature of parts of the head exoskeleton (Posey and Camargo, 1985). In some cases the use of particular partonyms (say words used for infloresence [flowering parts]) may provide clues as to how local people recognise different groups of organisms.

The densest knowledge of individual natural kinds is that which people have of domesticates and organisms which they husband: Peruvian Quechua potato knowledge, knowledge of rice amongst the Baduy in upland West Java, or Etoro knowledge of pigs in the New Guinea highland fringes (Kelly, 1988). This knowledge is often best reflected in local recognition of sub-specific genetic diversity, such as for the major starch staples (Boster, 1986; Brush, 1992; Iskandar and Ellen, 1999), in cultivation and management strategies, in folk genetics (Fukui, 1996), and what people know about feeding, growth, reproduction and behaviour, such as Baka perceptions of the growth cycles of Dioscorid yams (Dounias, 1993: 625). Similarly, Kayapó (Posey and Camargo, 1985) have an intimate knowledge of arthropod ontogenetic stages, the entrance tubes to Meloponinae (stingless bee) nests (Figure 2a), the internal structure of the nests (Figure 2b), and the relationship between nest structure and habitat niche. Such understandings of reproductive biology often feed into traditional strategies for conservation, as demonstrated by Johannes (1978) for marine resources in the Pacific, while detailed and perceptive knowledge of behaviour of large mammals is linked to the needs of human predation, such as amongst the !Kung of the Botswanan Kalahari (Blurton-Jones and Konner, 1976).

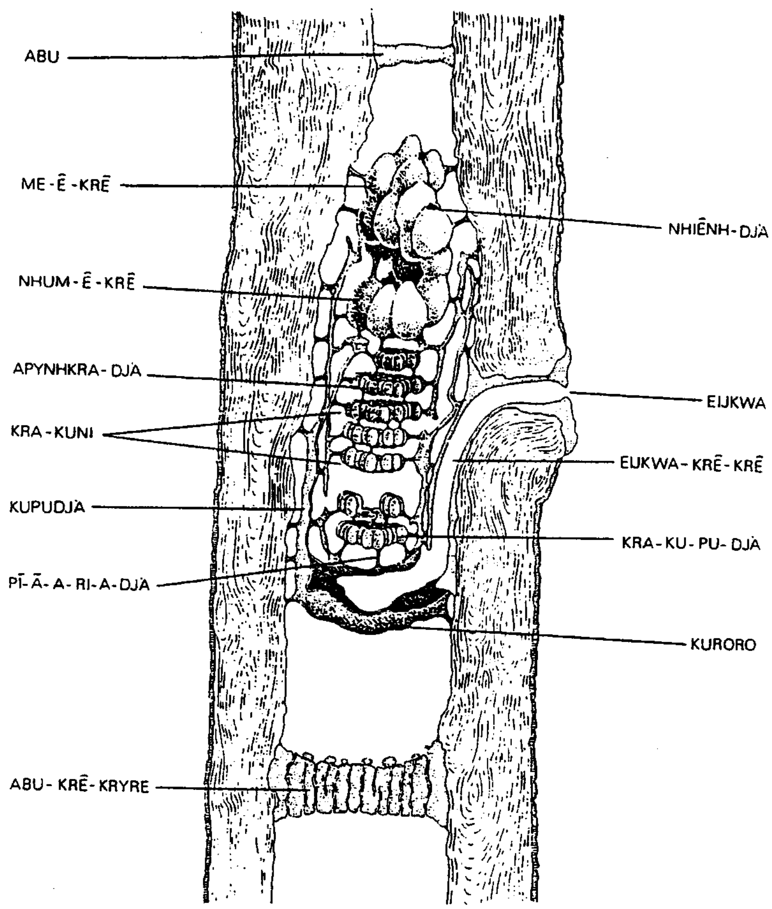


**Figure 2a** Schematic structures of Melipona nests with Kayapó nomenclature: *abu* (batumen), *me-ê-krê* (honey pot), *nhum-ê-krê* (pollen pot), *apynh kra-djà* (brood cell), *kra kuni* (brood comb), *kupu-djà* (involucrum), *pi-ã-ari-a-djà* (pillar), *abu-krê-kryre* (lower batumen with drainage channels), *nhiênh-djà* (pot opening), *eijkwa* (entrance structure), *eijkwa-krê-krê* (entrance gallery), *kra-ku-pu-djà* (cocoon), *kuroro* (shell of nest). From Posey and Camargo, 1985: 253.

Indeed, it is now well known that traditional peoples have many mechanisms for the protection, regulation and sustainable production of natural resources. Often these are reinforced by, or are part of, general ritual prohibitions. Some environmentalist literature has made improbable and untested claims for this knowledge, linking it to over-romanticised notions of traditional wisdom and edenic ecological harmony. While unsupported claims should be treated with caution, many practices do serve as effective and useful regulators, depending on knowledge of reproductive cycles or animal population dynamics of individual species in order to best determine closed seasons for harvesting or prohibitions on particular areas, populations, or species (Zerner, 1994).

Ethnobiological knowledge shows just how difficult it is to separate knowl-



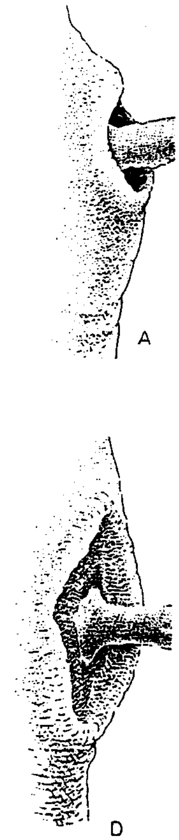


**Figure 2b** Types of Meli
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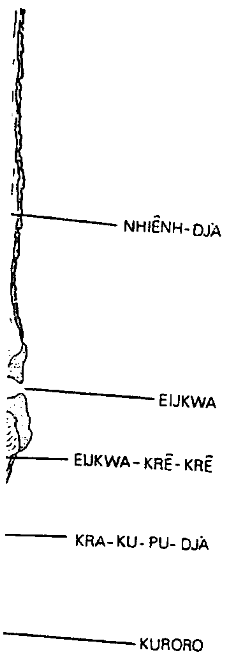


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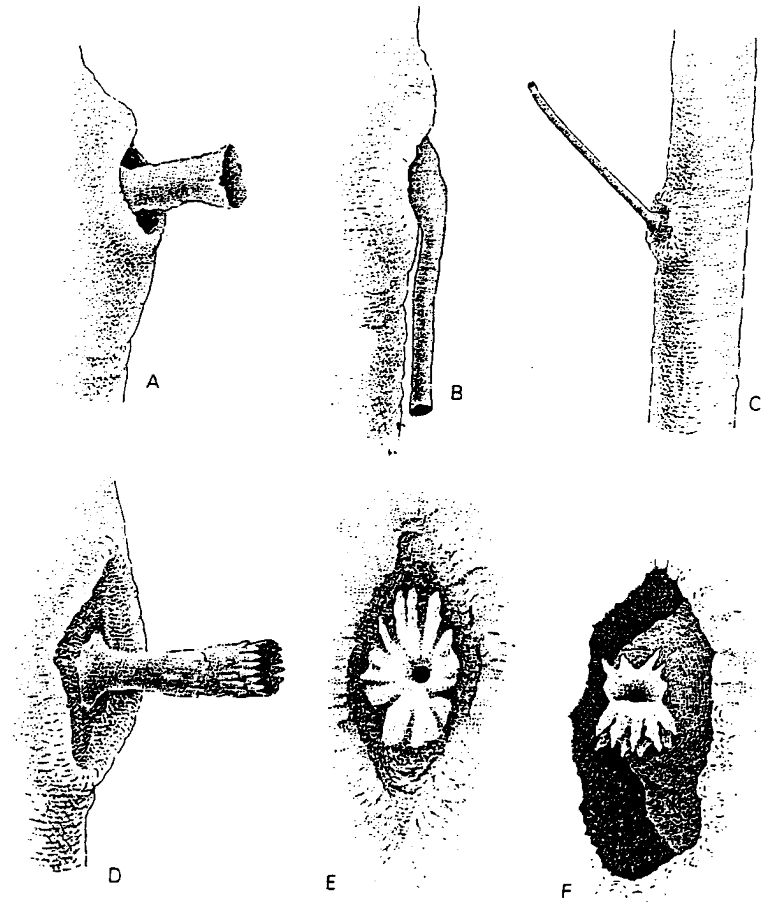


**Figure 2b** Types of Meliponinae entrance tubes recognized by the Kayapó with their respective "focal species": (A) *imrê-ñy-kamrek (Scaptotrigona nigrohirta)*, (B) *imrê-ti (S. polystica)*, (C) *õ-i (Tetragona truncata)*, (D) *udjy (Melipona seminigra pernigra)*, (E) *menhire-udjà (M. melanoventer)*, (F) *ngài-kumrenx (M. rufiventris flavolineata)*. From Posey and Camargo, 1985: 254.

edge of one species from that of another, especially where relations of parasitism, symbiosis and mutualism are involved. Crop diseases are a case in point. Thus, in a classic study, Page and Richards (1977) have shown that in seeking solutions to *Zonocerus variagatus* infestation of manioc, Nigerian farmers accumulated a detailed knowledge of the life cycle of this pest. Similarly, using knowledge of the role of ants in the biology of semi-domesticated yams acquired by Baka Pygmies in southern Cameroon, McKey, *et al.* (1998) have discovered that several wild yam species of the forest understorey have complex biotic defences involving the production of nectar rich in amino-acids and sugar during its growth phase, which is highly attractive to ants. However, the presence of the ants also protects the apex of the new growing stem from attacks by herbivorous insects. These observations of mutualistic interrelationships between yams and ants open up a new perspective on our understanding of vine growth and the role of starch-rich reserves stored underground by tuber plants, with concrete applications for pest control. Thus, to understand disease and to diagnose it competently is to a large extent to understand the life cycle, ecology and manifestations of pathogenic organisms (Whiteford, 1997), while to understand the effects of medicinal plants involves understanding their physiology, ecology and anatomy, where the best opportunities are usually afforded by agricultural settings (Logan and Dixon, 1994).

## KNOWLEDGE OF ECOLOGICAL SYSTEMS

A common feature of ethnobiological knowledge is the way in which knowledge is structured in terms of networks of understanding, linking individual species together in living contexts and entire landscapes, in contrast to formal science in the West which historically reified the species and species-centred approach to understanding early. This body of knowledge is sometimes called "ethnoecology", and may be systematically reflected in local classifications of vegetation types and understandings of ecological relationships, knowledge of soil, topographies, environments which are often knowingly or inadvertently created and maintained by humans, through the management of long fallows, and soil restoration through use of additives and irrigation (Ellen, 1982: 211–226; Johnson, 1974; Sillitoe, 1996; Lansing, 1991). More disconcerting is the way in which these systemic understandings are closely interwoven with symbolic constructions of the world (Hughes, 1983; Nelson, 1983), which has occasionally led to their scientific credentials' being questioned (Diamond, 1987) by some and elevated (Johannes, 1987) by others.

In the same way as knowledge of individual organisms is closely linked to experience through domestication and husbandry, so knowledge of ecological systems arises through the requirement to manage resources. Increasingly, all major environments which people inhabit are being reinterpreted as having co-evolved with people and been managed consciously or inadvertently. Kayapó (Posey, 1988: 89–90), for example, maintain buffer zones between gardens and forests which contain plants with nectar-producing glands on their foliage which inhibit aggressive ants and parasitic wasps from crops. They also modify savannas by fire and by creating forest islands with concentrations of useful plants. Indigenous forest-fallow cultivation and arboricultural practices throughout the tropics have repeatedly been shown to maintain forest rather than destroy it (Conklin, 1954; Balée, 1989; Dove, 1983; Fairhead and Leach, 1996), amplifying its diversity through the transmission of germplasm from elsewhere, as well as the density of useful plants and animals. Stéphanie Carrière (1999) has shown how Ntumu in southern Cameroun preferentially spare useful trees and those which are characteristic of old secondary forests. Such practices increase the number of these species over time and enhance the value of the forest. Associations between trees and crops – now sometimes called "agroforestry systems" – have been shown to reduce the risks of declining soil fertility in the face of increasing population pressure and to contribute to the regeneration

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of fallow and mature forest. Carrière also shows that Ntumu understand the ecological principles upon which these strategies are based. Similarly, Laden (1993) and Ichikawa (1999) have illustrated how the density of species supplying non-timber forest products is higher along Congolese Mbuti trails in the Ituri than in unvisited forest. Local peoples have often had a long-term impact in creating distinctive patterns of biotopes.

This kind of systemic knowledge differs from biological science in emphasising long-term processes, including cyclical environmental change. In a few cases knowledge of irregular reproductive patterns has been exploited as a useful strategy in times of hardship. Dove and Kammen (1997) show how forest-dwelling peoples of Borneo understand the dynamics of mast fruiting of dipterocarps [a family of trees used for timber], triggered by slight climate fluctuation, in places attributable to the El Niño Southern Oscillation. These events are irregular and local, but result in the mass flowering and then fruiting of different dipterocarp species, which provides a windfall source of food for humans through direct consumption, the marketing of edible nuts, and indirectly through the additional food released for game animals upon which humans are dependent. [Editor's note: see the article, Central Andean Views of Nature and the Environment, by David Browman in this volume.] In the language of sustainability, the value of such long-term though irregular sources of food, which supplement normal subsistence practices, are greater than short-term timber extraction which destroys the possibility of the mast altogether. Comparing the extent to which knowledge is actually used may provide one measure of the danger of extinction of local knowledge. However, much (perhaps most) ethnoecological knowledge has only occasional and long-term adaptive advantages. Consequently, if knowledge and actual resources are allowed to erode because of perceptions of their short-term unimportance, this may be damaging for the long-term survival of populations (Dounias, 1996).

Ethnoecological knowledge systems also foster diversity (Nazarea, 1998), and for good reason. We now find that enclaves which have maintained a range of diverse traditional crop landraces have often been better at buffering instability. Much of the breadth of traditional knowledge of environmental resources, and the extent to which this knowledge is transferred between populations, arguably insures against long-term ecological oscillation, even if much of it seems irrelevant to survival at any one time. Diversification of crops in general and varied patterns of management tend to keep pest populations relatively low, even under conditions of intensive cultivation. Moreover, there is a strong correlation between biodiversity and cultural diversity, and where there has been cultural (including linguistic) erosion so local biological knowledge and associated management techniques have been depleted or replaced (Maffi, 2001), instituting a kind of poverty (of knowledge), diminishing control over local livelihoods and diminishing the options available for flexible response.

Just as knowledge of individual organisms is embedded in ecological knowledge of the relations between them, and the relationship of assemblages of living things is understood in wider landscape and functional contexts, so there is a link between all culturally varied biological knowledges and local constructions of that aspect of the world we call "nature". We know enough now of cross-cultural conceptions of nature to predict that it is everywhere defined in relation to local social convention; its construction is everywhere diagnostic of how people understand the world and their place within it. Nowhere is it completely without ambiguity – sometimes positive, sometimes negative, sometimes reified and named, sometimes covert and implicit, by turns male and female. It is influenced by the extent to which people consciously manipulate and transform their surrounding environment (e.g. Reichel-Dolmatoff, 1976; MacCormack and Strathern, 1980; Ellen, 1996). But at the same time, most conceptions of nature are underpinned by conceptual universals. One is the notion of what is "natural" (primordial, essence), second is the tendency to contrast ourselves as humans and individuals with those biological others that lie outside of and around us, and third is a compulsion to recognise and classify natural kinds as things in ways which suggest that we are evolutionarily adapted to cognise the natural world in broadly the same way. Thus, human biological knowledge, in whatever cultural tradition it has developed, always and simultaneously informs and reflects adaptive behaviour through flexible cultural learning constrained by a common human cognitive framework and is at the same time embedded in particular social worlds.

## KNOWLEDGE OF THE GENERAL PRINCIPLES OF PLANT AND ANIMAL BIOLOGY

In terms of understanding human cultural adaptation to different environments, knowledge of general principles of biology may be more important than breadth of formal knowledge or depth of substantive knowledge of individual organisms. What is central here is the ability to transfer general lessons learned with respect to one organism to another. To some extent this may relate back to a general module for natural history intelligence which predisposes us to recognise common aspects in the functioning of living things. But much substantive knowledge of individual types of animals derives from analogical reasoning with respect to human bodily functioning. Thus, knowledge of human anatomy mutually reinforces knowledge of animal anatomy. Every time a Nuaulu hunter dismembers a deer and removes its internal organs for food and augury, the activity is serving as a proxy for human dissection. Knowledge of the human body is, therefore, partly based on knowledge of animal bodies acquired in hunting, food preparation and livestock keeping, while understanding of animal physiology, pathology – and even psychology – derives from modified human experience. However, it is necessary to distinguish the productive explanatory use of analogy across species from the use of human anatomical nomenclature to describe the parts of other organisms, as when, for example, Baka (Dounias, 1993: 624) describe yams in terms of human body parts.

Recent work has also demonstrated the capacity for culturally unrelated people to innovate essentially similar understandings of ecological process. The repeated discovery of the properties of nitrogen-fixing plants is one well-reported example (e.g. Iskandar and Ellen, 2000). Sinclair and his associates (in press; also Walker *et al.*, 1999) have shown resemblances in conceptualising the interaction between trees, agricultural crops and soils, in the contrasting agroecological and cultural conditions in Nepal, Sri Lanka and Thailand. They document similar understandings of how large water droplets falling from certain leaves cause splash erosion in both Nepal and Latin America. More generally, widely distributed "hot-cold" frameworks encode locally specific interactions amongst plants. For example, in central Sri Lanka, "cold" species such as banana (*Musa acuminata*) are said to have a positive effect on other species because the surrounding soil is moist, thereby providing a favourable microclimate for other plants. By contrast, "hot" species such as clove (*Myristica fragrans*) were perceived to have a negative effect on neighbouring plants, and the soil under clove trees was considered unsuitable for cultivation. Other patterns of convergence in general perception of biological properties are observable in relation to medicinal plants. The co-evolution of such plants and cultural systems must have been taking place for in excess of 10,000 years, and their pharmaco-logic is a fundamental species characteristic of humans. Regularities in the selection of taxonomically unrelated plants on the basis of chemical similarities, biases towards certain plant families displaying useful patterns of bioactivity, and a clear understanding that the properties of plants which make them toxic are the same as those which make them desirably bioactive, all provide evidence of this (Johns, 1990; Moerman, Pemberton, Keifer and Berlin, 1999).

The stereotyping of traditional biological knowledge as static is palpably false. What people know about plants and animals is constantly being tested and revised locally, and diffuses between populations. Some institutions of knowledge exchange connecting very different kinds of cultural groups have ancient roots, for example those between pygmy and Bantu in central Africa (Bahuchet, 1993). Plants whose bioactivity was discovered in other parts of the world have, since the sixteenth century and earlier, augmented European pharmacopoeias. For example, *Cinchona officinalis* (quinine) bark was introduced into Spain from the Andes in 1639. These are all examples of knowledge hybridisation, syncretisation or integration. When terms like this are used they often imply contact between science and folk science. Thus, the Baduy of upland west Java (Iskandar and Ellen, 2000) have introduced a previously tabooed leguminous tree, *Paraserianthes (Albizia) falcataria*. By alternating this commercially valuable perennial with rice, soil fertility is maintained, the socio-economic position of the Baduy improved, and swidden farming continues in a very nearly sustainable way. The mechanism for its successful introduction was its perceived similarity to existing nitrogen-fixing cultigens.

At a local level, much general biological knowledge is linked to the way organisms are grouped according to their usefulness. In all societies biological knowledge is innovated and embedded in applied contexts, and therefore all knowledge people have of organisms is, ultimately, because it is useful. But measurements of utility are tricky, and what is useful may include organisms which interact with those which are directly consumed or used in another way, or which are useful only because they are salient. Thus, when Nuaulu are hunting cassowaries (*Casuarius casuarius*) it is as important to have knowledge of plants on which cassowaries browse as much as of cassowaries themselves. Similarly, plants may be understood in terms of the technological uses to which they are put, emphasising qualities such as hardness in wood, the ductile strength of lianas, the engineering properties of bamboo internodes, or chemical properties in relation to dyeing and poisoning. Knowledge organised through functional modules may reveal intricate understandings of, say, the different chemical properties of the roots, stems and leaves of the same species, how bioactivity can only be achieved by combining different species or preparing the same organic ingredients in different ways. Knowledge of biological products used medicinally is evident from modes of preparation and treatment; for example, where detoxification processes are involved (Johns, 1990) or in the decisions to apply medicaments simply or as compounds (Berlin and Berlin, 1996). In the latter case, there may be knowledge of bioactivity which arises from the chemical changes which arise, although mixtures may also simply affect palatability or symbolic significance.

A very specific context of use is Western biological science, and it is to this that we must now turn.

## CHARACTERISING BIOLOGICAL SCIENCE, FOLK KNOWLEDGE, AND SCHOLARLY KNOWLEDGE

Where the dividing line lies between scientific biology and other kinds of biological knowledge is by no means obvious. Simple, formal, definitions of what science is are always problematic because they end up excluding practices and kinds of knowledge which are, in common-sense terms, integral to how science works. Science is, sadly, not consistently "rational, objective and produced according to the canons of scientific method", but is rather "messy, contingent, unplanned and arational", a polythetic practice largely concerned with "trying to get the world to fit a particular kind of solution" (Turnbull, 2000: 6, 14). In the general sense of systematic knowledge, it was never uniquely Western, being dependent on the cross-fertilisation of different knowledge traditions (Turnbull, 2000: 227–228). In comparison with the kinds of knowledge systems which we have so far considered, science is undoubtedly in continuous rapid flux and in search of universal rather than local understandings (Hunn, 1993: 13–15), while, socially, "real" science is generated in laboratories, research stations and universities (Chambers and Richards, 1995: xiii). Of course, polythetic or essentialist, this is a model which scientists, decision-makers and administrators have now internalised throughout the world, and which often comes with a built-in assumption that other kinds of knowledge are less prestigious.

What is left, once we have defined "biological science", is ethnobiological knowledge, or "indigenous biological knowledge". But what this means is by no means clear, as terminologies, definitions and cognate concepts vary throughout their geographical, local-global and various historic and disciplinary refractions. There are many indigenous biological knowledges, each accessing the real world to various degrees of imperfection and subjectivity. These biological kinds of knowledge, which for well over 10,000 years have constituted the main body of our adaptive knowledge, are diverse, but in contrast to that scholarly and scientific knowledge self-consciously embodied in textual traditions, they have a number of broad common characteristics (Ellen and Harris, 2000: 4–5). They are rooted in particular places and sets of experiences, are generated by people living in those places, are mostly orally-transmitted or transmitted through imitation and demonstration, are a consequence of practical engagement in everyday life constantly reinforced by experience and error, are the product of generations of intelligent reasoning, and are often a good measure of Darwinian fitness. They are empirical rather than theoretical in character, orality to some extent constraining the kind of organisation necessary for the development of true theoretical knowledge. The redundancy which they embody aids retention and reinforces ideas; they are fluid and the outcome of continuous negotiation, constantly changing, being produced as well as reproduced, discovered as well as lost, although often represented as static. They are characteristically shared to a much greater degree than global biological science but are still socially clustered within a population, by gender and age, for example, and preserved through distribution in the memories of different individuals. Specialists may exist not only by virtue of experience but also by virtue of ritual or political authority. Although knowledge may focus on particular individuals and may achieve a degree of coherence in rituals and other symbolic constructs, it does not exist in its totality in any one place or individual, devolved not in individuals at all, but in the practices and interactions in which people themselves engage. As we have seen earlier, where local biological knowledge is at its densest, organisation is essentially functional. It is characteristically situated within broader cultural traditions, so that separating the technical from the non-technical, the rational from the non-rational, is problematic.

By comparison, the great scholarly ways of knowing come midway between these essentially local knowledges and biological science. They combine knowledge dependent on an agreed shared authority with that of the personal authority of a practitioner. They are often grounded in written texts and resemble the European scholarly traditions. Galenic, Chinese and Ayurvedic traditions of medicine differ from each other, but each have a notion of scholarship in common (Bates, 1995; Zimmerman, 1989). Where the scholarly and local folk traditions merge is unclear, and as in the European case there is historical evidence to suggest, for example, that the great Asian herbalist systems have been systematically absorbing and then replacing local folk knowledge. We see here something very reminiscent of the codifying and simplifying processes which accompanied the incorporation of European folk knowledge into the early modern scholarly traditions.

In Europe and the Mediterranean, codified pharmacopoeias such as the *De Materia Medica* of Dioscorides widely displaced local knowledge and oral tradition, but uncodified knowledge persisted and gradually filtered into organised texts as the number of modern remedies of European folk origin manifestly attest to. Western folk knowledge is just as important as it ever has been; it is just different, informed by science where appropriate and located in different contexts. We might contrast French rustic truffle collecting (Pujol, 1975) with high-tech Icelandic fishermen (Durrenburger and Palsson, 1986). These folk traditions have themselves become highly codified. During mediaeval and early modern Europe, proto-scientific knowledge of plants and animals superseded folk-knowledge by classification, analysis, comparison, dissemination (usually through books and formal learning) and thus generalisation. The process was not sudden; for a long time common experience, oral tradition, personal experience and learned authority contributed to the received wisdom upon which organised specialist knowledge, particularly medical knowledge, depended (Wear, 1995: 158–159). Delineating the boundaries between uncodified folk knowledge, professionally restricted organised knowledge, and proper scientific knowledge is not always easy. Neither are the ethnographic origins of incorporated elements of knowledge always straightforwardly evident. Sometimes ideas are of European folk origin (such as use of the foxglove, *Digitalis purpurea*, as a treatment for oedema [swelling]), but from the sixteenth century onwards European medicine increasingly incorporated herbal remedies of Asian and American origin. By the later middle ages and the beginnings of modern European global expansion, there emerged a self-consciousness about the desirability of obtaining new knowledge. The *Coloquias* of Garcia da Orta and the *Hortus* of Hendrik van Rheede tended to privilege strongly local medical and biological knowledge and to lead to effective discrimination against older Arabic, Brahmanical and European classical texts and systems of cognition in natural history (Grove, 1996). We can see a similar – although in terms of the epidemiology of ideas, less complex – process in the work and influence of George Rumphius. This resulted in the publication of scientific accounts of new species and revisions of taxonomies which, ironically, depended upon a set of diagnostic and classificatory practices which, although represented as "Western science", had been derived from earlier codifications of indigenous knowledge (Ellen and Harris, 2000: 8–10).

During the nineteenth and twentieth centuries local knowledge was increasingly tapped and codified, at home and abroad. Charles Darwin, for example, utilised the accumulated experience of pigeon fanciers in working out the details of natural selection, while colonial science systematically assimilated local knowledge of plants (e.g. Burkill, 1935). Such practices became so routinised that, once absorbed into scientific solutions, local biological knowledge disappeared from view, insufficiently real to merit any certain legal status or protection in the same ways which gave value and ownership to western scholarly knowledge and expertise. Even when the knowledge was clearly being utilised it was often redescribed in ways which eliminated any credit to those who had brought it to the attention of science in the first place. Thus, the boundaries between science, scholarly knowledge and folk knowledge, as these terms apply to biological phenomena, are constantly shifting, and the distinctions themselves are not always helpful. All knowledges are anchored in their own particular socioeconomic milieu; all are indigenous to a particular context,

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Indeed, more generally we can see that modern natural history arose through a combination of such indigenous scholarship and field studies (Zimmermann, 1995: 312), field studies themselves drawing on the knowledge of local experts. Some have argued that the phylogenetic taxonomies of contemporary post-Linnean biology are based on a European folk template (Ellen, 1979; Atran, 1990) and, arguing a rather different tack, others have gone further by claiming that the European folk scheme and that of modern biology are no more than variants on a single cognitive arrangement to which all humans are predisposed through natural selection (Atran, 1998; Boster, 1996).

## THE REDISCOVERY OF ETHNOBIOLOGY AND THE INVENTION OF "INDIGENOUS KNOWLEDGE"

From about the mid-1960s the tendency to marginalise local biological knowledges had begun to be put into reverse, prompted by a combination of romantic idealism and pragmatism (Conklin and Graham, 1995). This infectious combination has sometimes merged scholarly and local oral traditions, confusing ideal symbolic representations with hard-headed empirical practice, inevitably leading to a particular version of the "science wars" in which the contestants (put crudely) are those who see ethnobiology as a kind of science and biology as a kind of ethnobiology, against those for whom science represents a unique methodology for discovering the truth (see e.g. Diamond, 1987 versus Johannes, 1987; Anderson, 2000). Despite this, the demand for local biological knowledge from developers and industry at the present time shows no signs of ceasing (Sillitoe, 1998).

One of the main problems, though, with the development industry's appropriation of ethnobiology has been its transformation into a kind of context-independent knowledge mirroring the structure of Western science, parts of which can be conveniently modularised and transferred. Fairhead and Leach (1994: 75) argue that this risks overlooking broadly held understandings of agroecological knowledge and social relations. So, for example, research and extension agents examining tree management practices used by Kuranko farmers in the Republic of Guinea fail to take into account farmers' tree-related knowledge which involves a much broader range of knowledge: of crops, water, vegetation succession and the socioeconomic and ecological conditions which influence them. More radically, Richards (1993: 62) proposes that the range of skills and strategies employed by farmers often extends beyond simple applied knowledge into a fluid body of improvisations relevant to immediate needs, rather than the outcome of a prior stock of knowledge about inter-species ecological complementarity. By presenting agroecological knowledge as a decontextualised inventory of practices, all agency and creativity is drained, reducing it to a packageable commodity, secured and easily transferable from one place to another. Furthermore, as local knowledge is analysed and documented for use, it undergoes changes which necessarily result from the specific orientations, strategies and agendas of those using it, as well as from the transformations which inevitably occur through translation. Hobart (1993: 14) underlines some of the potential problems that can occur when knowledge is collected and codified into bite-sized chunks. And, as we have already seen, once ethnobiology is drawn within the boundaries of science it is difficult to know where to place the boundaries between the two. Indeed, changing the boundaries is often sufficient to redefine something as science, as what defines it is to a considerable extent determined by who practices it and in what institutional context the practices take place. The danger of turning local knowledge into global knowledge is that at the empirical level all local knowledge is precisely that, local, relative and parochial, no two societies perceiving or acting upon the environment in the same way; which is, of course, its applied strength. The corollary is that writing it down makes it more portable and permanent, but also changes some of its fundamental properties, all of which reinforce dislocation. Knowledge – as anthropologists repeatedly tell us, and as was demonstrated in the second section of this chapter – is grounded in multiple domains, logics and epistemologies.

Finally, there are important connections between local biological knowledge, identity and conceptions of property. Nowadays, many savvy local peoples see their knowledge as part of their patrimony. The disappearance of species, names for species and knowledge of their use and significance is increasingly a concern for local peoples themselves. This is not only a pragmatic matter but connects with people's sense of their own culture more generally. States and NGOs, as well as native people, have sought to protect rights to such knowledge, especially where there are threats of biopiracy; there are concerns about the expropriation of knowledge and intellectual property by pharmaceutical and other companies and agencies. This has given rise to a whole set of new issues, merging the philosophies, legal traditions and discourses of the West and of the rest. In some cases, cross-fertilisation of different local traditions and the reification of folk knowledge have occurred. Third World politicians, scientists and others have had to work out for themselves how indigenous or traditional knowledge is to be defined and whether its existence is altogether to be welcomed. When it becomes a means by which to flag problematic local minorities who seek to make political and cultural claims against a government, it is clearly threatening; if it can be defined in a more inclusive way and commoditised, it is a resource to be exploited. However it is constructed and represented, ethnobiological knowledge is self-evidently valuable, and understanding its range and intellectual foundations is no less important today than it ever has been, and in the context of the loss of so much biological and cultural diversity, much more so.

## NOTES

[1] The contemporary ethnobiological literature is huge, and I have here provided only selected bibliographical references, in some cases to flag historical benchmark studies, in others to illustrate some of the more interesting, accessible and influential work. For a general recent collection on ethnobiology, see Medin and Atran (1999). A useful bibliography covering the older literature,



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particularly on folk classification, is Conklin (1971). On research methods in ethnobotany see Martin (1995), and in ethnozoology see Bulmer and Healey (1993).

2 *Emic* is a perspective in ethnography that uses the concepts and categories that are relevant and meaningful to the culture under analysis, that is, a view from the inside. *Etic* is a perspective that uses the concepts and categories of the anthropologist's culture to describe another culture, that is, a view from the outside.

3 A word or lexical item indicating that it is 'part-of' some whole. Thus, "leg" is a body partonym, and "root" a plant partonym. Thus, partonymy refers to the phenomenon of referring to parts of a whole through specialised terms. By extension, partonymy refers to the classification which underlies such lexical sets.

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