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negotiation. In recent decades, environmentalists and New Age spiritualists have been on steep learning curves in relation to totemic sensibilities in indigenous communities; but, equally, indigenous peoples have been keen to discover what the West's disenchanting have to offer in their struggle against neo-colonial domination.

When Lévi-Strauss penned *Le Totémisme Aujourd'hui* his intention was to dissolve the phenomenon into something different and far broader. While his intention has been supported by examination of the fuller content of totemic systems, the core problematic relationships between "nature" and "culture" (animality and humanity, "primitive thought" and "modern thought") have remained ideologically to the fore. Indeed, the British anthropologist Roy Willis recently observed that, thanks to the ongoing twinning of primitivism and ecological concern, the period after *Le Totémisme Aujourd'hui* has been marked by a kind of "totemic revival" (1990: 5). The Chippewa situation described above can be taken as symptomatic of this neo-totemic environment in which the contrast between indigenous and non-indigenous peoples has become synonymous with the opposition between human nature ("the soul") and its corruption by technocratic rationality. But Lévi-Strauss's words still strike a note of caution; totemic emblems have never been restricted to natural species, any more than they have been exclusively religious in the conventional sense. We live in a world dense with personal and corporate emblems, only some of which resonate with the juxtaposition of religion and nature.

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- See also: Anthropology as a Source of Nature Religion; Ecology and Religion; Estés, Clarissa Pinkola; Indigenous Religions and Cultural Borrowing; Religious Environmentalist Paradigm; Totemic Practices in Borgu (West Africa).

Traditional Ecological Knowledge

The theme of traditional ecological knowledge is important for the consideration of a broad range of questions related to nature–human relations. Different groups of people in various parts of the world perceive and interact with nature differently, and have different traditions of environmental knowledge. Their perceptions and knowledge are in part shaped by their values, worldviews, and environmental ethics – religion in the broader sense. In the exploration of environmental ethics and religion toward an ecologically sustainable society, indigenous peoples and traditional ecological knowledge have attracted considerable attention from both scholars and popular movements. Traditional ecological knowledge may be defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment." As a knowledge–practice–belief complex, traditional ecological knowledge includes the worldview or religious traditions of a society. It is both cumulative and dynamic, building on experience and adapting to change, as societies constantly redefine what is considered "traditional." It is an attribute of societies with historical continuity in making a living in a particular place.

Many discussions of traditional ecological knowledge and indigenous knowledge focus on North American Indian peoples. However, there are traditions of ecological knowledge in various indigenous societies in South America, Australia, and parts of Africa and Asia. Culturally transmitted, cumulative, multigenerational knowledge is held also by some groups that have European backgrounds, such as Newfoundland fishers and Swiss Alpine people.

TEK in Our Common Future

Tribal and indigenous peoples' . . . lifestyles can offer modern societies many lessons in the management of resources in complex forest, mountain and dryland ecosystems . . . These communities are the repositories of vast accumulations of traditional knowledge and experience that link humanity with its ancient origins. Their disappearance is a loss for the larger society, which could learn a great deal from their traditional skills in sustainably managing very complex ecological systems (*Our Common Future* 1987: 12, 114–15).

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Traditional ecological knowledge may be considered as a sub-set of indigenous knowledge, defined as local knowledge held by indigenous peoples or local knowledge unique to a given culture or society. There is controversy over the term, traditional. Some scholars consider that the term implies backwardness, and instead favor "indigenous" or "local." Others point out that many indigenous peoples themselves see "tradition" in a positive light. They do not take it to mean inflexible adherence to the past but rather to mean time-tested and wise.

These considerations make it difficult to generalize about traditional ecological knowledge. But in any case, one cannot generalize about "the Amerindian (or African) view of nature." Every cultural group has within it a range of environmental values and ethics, and a range of practices. Environmental relations of a group are not uniform; they are shaped by the day-to-day contingencies, as well as their worldview and ethics. Environmental ethics do not describe how people actually behave, but indicate how they *ought to* behave. Human-nature relations tend to be ambivalent; there often is a discrepancy between belief and practice.

Origins of Traditional Ecological Knowledge and its Development as a Field

The intellectual roots of traditional ecological knowledge are in ethnoscience (mainly ethnobotany) and human ecology. The field started with the documentation of lists of species used by different indigenous groups, and elaborated a science of folk taxonomies of plants and animals, and later, of other environmental features such as soils. Early ethnobotany goes back at least to Barrows' 1900 work on Coahuila Indians of southern California who made a living in a seemingly barren desert environment by harvesting no less than 60 kinds of edible plants and 28 kinds of medicinal plants. The science of folk taxonomies is often associated with the name of Harold Conklin who documented in the 1950s the extensive plant knowledge and classification systems of traditional groups such as the Hanunoo of the Philippines.

There is a technical literature on various kinds of indigenous environmental knowledge. For example, traditional agricultural practice is a major field of indigenous knowledge; others include traditional medicine and architecture. Much of the indigenous knowledge literature is not about ecological relationships but about other kinds of ethnoscience, including agriculture, ethnobiology, ethnopharmacology, ethnoveterinary medicine, and ethnopedology (soils). Some of these areas, for example, traditional practices of water conservation and erosion control, are directly related to ecological knowledge, but others (e.g., ethnoastronomy) are less so.

The shift of emphasis from the documentation of species used by indigenous groups and their taxonomy, to a consideration of functional relationships and mechan-

isms, gave rise to the field of traditional ecological knowledge. The field borrows from the cultural ecology tradition of the anthropologist Julian Steward who emphasized the study of *adaptive processes*, and argued that social organization itself may be considered an ecological adaptation of a group to its local environment. This emphasis on adaptive processes in human-nature relations may be seen in some of the key volumes on traditional ecological knowledge. As defined in this literature, traditional ecological literature overlaps with cultural ecology, ecological anthropology or anthropological ecology but is not a sub-set of these fields because it often goes beyond the discipline of anthropology.

The rapid development of traditional ecological knowledge as a field in its own right started with the documentation of a tremendously rich body of environmental knowledge, not just of species but also their ecological relations, among a diversity of groups outside the mainstream Western world. These included studies of shifting cultivation and biodiversity conservation in tropical ecosystems, and traditional knowledge and management systems in coastal fisheries and lagoons, semi-arid areas, and the Arctic. These studies showed that a variety of traditional peoples, in diverse geographical areas from the Arctic to the Amazon, had their own understandings of ecological relationships and distinct traditions of resource management.

By the mid-1980s, the rapidly growing literature on traditional ecological knowledge led to a recognition in the international arena of its potential applications to contemporary resource and environmental problems. This recognition is reflected in *Our Common Future*, the 1987 report of the World Commission on Environment and Development. The report pointed out that indigenous peoples hold a wealth of knowledge based on thousands of years of experience, and that their practices can offer modern societies lessons in the management of resources in complex forest, mountain and arid land ecosystems.

Traditional Ecological Knowledge and Science

Even though the importance of traditional ecological knowledge is recognized in the international arena and the number of publications has grown rapidly since the 1980s, the relationship between Western science and traditional knowledge has remained controversial. There are both similarities and differences between traditional science and Western science. Both kinds of knowledge are ultimately based on observations of the environment, and both result from the same intellectual process of creating order out of disorder. But they are different in a number of substantive ways. Traditional ecological knowledge is often an integral part of a culture, and tends to have a large social context. Different kinds of traditional knowledge have their own rules, but they are different from science regarding rules of evidence and repeatability.

Some of the conflict between science and traditional knowledge is related to claims of authority over knowledge. In the modernist tradition, Western science is seen as having a monopoly on truth. Hence, knowledge and insights that originate outside institutionalized Western science are not easily accepted. Scientists tend to dismiss understandings that do not fit their own (and this often includes understandings of *other* scientists using different paradigms). Scientists tend to be skeptical, demanding evidence when confronted with traditional knowledge that may not easily lend itself to scientific verification.

Some traditional knowledge may include elements, such as the religious dimensions of the environment, which do not make sense to science. For example, many of the Dene (Athapascan) peoples of the North American subarctic consider that some non-living parts of the environment (including rivers and mountains), as well as all living beings, have spirit. Science has no tools for the study of the spiritual dimensions of the environment, but nevertheless such beliefs are important for understanding Dene traditional ecological knowledge.

For their own part, traditional knowledge holders are skeptical of book learning, and tend to dismiss scientists who do not have extensive first-hand knowledge of a specific land area. As well, they are often baffled by the preoccupation of scientists to measure and quantify everything. Power relations become an issue when Western experts and Aboriginal experts have different political agendas. Traditional ecological knowledge has frequently been used to assert indigenous land and resource rights and to fight government-imposed development projects on native land. In turn, science may be used to justify the very same projects.

Hence the issue is complex, even if one agrees with postmodern philosophers of science that Western scientific methodology is merely one way, and not the only way, to acquire knowledge. However, it is the one that happens to be the dominant knowledge system by far, and the one used as the basis of environmental decision-making by centralized bureaucracies throughout the world.

Significance of Traditional Ecological Knowledge

Traditional knowledge and Western science need not be thought of as opposites. Rather, it may be useful to emphasize the potential complementarities of the two, and to look for points of agreement rather than disagreement. The use of traditional knowledge contributes to conceptual pluralism, and expands the range of approaches and information needed to solve environmental problems.

The explosion of interest in traditional ecological knowledge since the 1980s is in part related to its practical significance. However, the interests of different parties are quite different. For many indigenous groups, the broader social and cultural aspects of traditional knowledge are very significant, and this is one of the reasons why dealing

with traditional ecological knowledge has become politically volatile. In many indigenous areas, researchers no longer have a free hand to conduct their work independently from the people themselves.

Politically organized groups of indigenous peoples are beginning to assert control over their knowledge systems for at least two reasons. First, some indigenous groups have seen their knowledge and biological resources (for example, medicinal plants) turned by others into profit-making commodities. Thus, they have started to ask the question of who benefits from the recording of their knowledge, and to investigate how they themselves can control their knowledge and products.

Second, indigenous knowledge has become a symbol for many groups to regain control over their cultural information. Reclaiming their indigenous knowledge has become a major strategy in many parts of the world for movements of cultural revitalization. For example, many of the Aboriginal groups in Alaska and Northern Canada have been carrying out their own traditional knowledge studies as part of an effort to strengthen their culture, educate their young people, prepare land and resource claims, and assert their rights. Such revitalization is not merely a cultural exercise; it is about empowerment and political control.

The need for indigenous groups to control their knowledge has to be balanced against the importance of traditional ecological knowledge as the common heritage of humankind. There are tangible and practical reasons why traditional ecological knowledge is important for the rest of the world's people. I have identified seven areas in which traditional ecological knowledge is significant. First, it is a source of biological knowledge and ecological insights. Second, indigenous knowledge is important for the sustainability of difficult-to-manage ecosystems such as tropical forests. Third, it is important for community-based conservation by connecting human values with conservation values. Fourth, some traditional systems are of special interest for biodiversity conservation because they are based on multiple-use principles that distribute resource-use pressures in space and time. Fifth, in-depth local environmental knowledge and trends over time for a given site are important for environmental assessment. Sixth, traditional knowledge is essential for development, especially for "bottom-up" (as opposed to top-down) development planning with people.

Finally, traditional ecological wisdom is a source of inspiration for environmental ethics. Belief systems of many indigenous groups incorporate the idea that humans are part of the natural environment, and their relationship with nature may be characterized as peaceful co-existence. Callicott points out that some traditional ecology sees humans and nature in a symbiotic relationship, with mutual obligations leading to "respect," a central idea in the relations of many Amerindian groups with nature.

These observations are significant. The explosion of interest in traditional ecological knowledge in recent years reflects in part the need to derive ecological insights from indigenous practice, and the need to develop a new ecological ethic based in part on indigenous wisdom.

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- See also: American Indians as "First Ecologists"; Domestication; Ecological Anthropology; Ecology and Religion; Environmental Ethics; Ethnobotany; Ethnoecology; Evolutionary Biology, Religion, and Stewardship; Harris, Marvin; Indigenous Environmental Network; Native American Languages (North America); Rappaport, Roy A. ("Skip"); Religious Environmentalist Paradigm; A Religio-Ecological Perspective on Religion and Nature; Traditional Ecological Knowledge among Aboriginal Peoples in Canada; Water Spirits and Indigenous Ecological Management (South Africa); Yunnan Region (Southwest China and Montane Mainland Southeast Asia).

Traditional Ecological Knowledge among Aboriginal Peoples in Canada

Each contracting Party shall, as far as possible and as appropriate: Subject to national legislation, respect, preserve and maintain knowledge, innov-

ations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices (from www.biodiv.org – the Convention on Biological Diversity's website).

For generations, indigenous peoples in what is now known as Canada have been using their own knowledge systems to live sustainably with the land. Indigenous knowledge systems are unique systems of generating, storing and transmitting knowledge completely separate and independent from Western science and Western epistemologies. Rooted in relations with the spirit-world, indigenous knowledge continues to provide Aboriginal peoples with unique worldviews, languages that are constructed to reflect those worldviews, systems of governance, values, and processes and ways of knowing and interacting with the land. Aboriginal philosophies and values reflect worldviews that are based on interrelationships and interdependency with the natural world and all other elements of the cosmos. Traditional teachings, stories, songs, dances and ceremonies reinforce the importance of relationships and process in the lives of individuals, communities and nations. Indigenous knowledge is dynamic and creative and, although it varies from nation to nation, has certain common elements and themes. Indigenous knowledge is at once ancient and contemporary knowledge, recording through the oral tradition the collective knowledge of a people in addition to documenting the impacts of colonization, colonialism and environmental destruction. Experts in indigenous knowledge are not academics or researchers who study TEK, but they are the Elders and knowledge-holders who not only hold the knowledge, but who have lived the knowledge and the teachings over the course of their lives. It is these experts who are best equipped to provide leadership around this topic, and it is these experts that need to be included in an effective way in discussions regarding the many potential applications of Traditional Ecological Knowledge (TEK).

During the initial stages of colonization, Europeans were dependent upon indigenous peoples and their knowledge for their survival. The colonizers relied upon technology in the areas of transportation, hunting, fishing, food gathering, nutrition, healthcare and navigation. They relied upon Aboriginal peoples for their most basic needs and in turn had great respect for indigenous knowledge. However, as the settler economy developed and the infrastructure needed to support the colonizers way of life was realized, they no longer relied on Aboriginal peoples and