

Western science and traditional knowledge

Despite their variations, different forms of knowledge can learn from each other

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Cultures from all over the world have developed different views of nature throughout human history. Many of them are rooted in traditional systems of beliefs, which indigenous people use to understand and interpret their biophysical environment (Iaccarino, 2003). These systems of managing the environment constitute an integral part of the cultural identity and social integrity of many indigenous populations. At the same time, their knowledge embodies a wealth of wisdom and experience of nature gained over millennia from direct observations, and transmitted—most often orally—over generations.

The importance of this traditional knowledge for the protection of biodiversity and the achievement of sustainable development is slowly being recognized internationally (Gadgil *et al.*, 1993). For example, Article 8 of the Convention on Biological Diversity urges us to "...respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity...." (United Nations, 1992). In addition, traditional or indigenous knowledge has been rediscovered as a model for a healthy interaction with, and use of, the environment, and as a rich source to be tapped into in order to gain new perspectives about the relationship between humans and nature.

However, our difficulty in approaching the knowledge from indigenous cultures is already reflected in the way in which we describe and name it. No universal definition is available, and many terms

are used to establish what indigenous people know (Berkes, 1993), including traditional knowledge or traditional ecological knowledge, local knowledge, indigenous knowledge or science, folk knowledge, farmers' knowledge, fishers' knowledge and tacit knowledge. Each of these terms carries different implications, and there is an ensuing discussion about which one is the most appropriate. The word 'traditional', for example, places the emphasis on the transmission of knowledge along a cultural continuity, but might ignore the ability of traditional societies to adapt to changing circumstances. Another widely used word, 'indigenous', is meant to highlight the autochthonous nature of this knowledge, but it might overlook knowledge from populations who are not officially recognized as indigenous. The word 'local' can be applied to different geographic contexts, but it lacks specificity. At present, traditional ecological knowledge is interpreted as a cumulative body of knowledge, practices and representations that describes the relationships of living beings with one another and with their physical environment, which evolved by adaptive processes and has been handed down through generations by cultural transmission (Berkes *et al.*, 2000).

Many indigenous populations have relied for centuries or even millennia on their direct environment for subsistence and autonomy. Over time, they have developed a way in which to manage and use their resources that

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ensures their conservation into the future. Such traditional societies are interested more in preserving their own social, cultural and environmental stability and integrity than in maximizing production. Consequently, there is no 'exploitation' of nature—which they do not consider as a collection of commodities—in the interaction between humans and natural milieu. On the contrary, their way of life is based on a strong sense of interconnection and interdependence. This also applies to their social life. Ethics is explicitly part of the traditional approach. Relationships are based on reciprocity and obligations towards community members. Natural resource management is based on shared meanings and knowledge (Berkes, 1993). Activities in traditional societies often include a strong symbolic dimension in which every action is highly ritualized, and allow humans to participate in the preservation of the natural order. Of course, these rituals differ between cultures, as each society has its own belief systems, which determine its cultural identity and type of technology.

Traditional knowledge has developed a concept of the environment that emphasizes the symbiotic character of humans and nature. It offers an approach to local development that is based on co-evolution

with the environment, and on respecting the carrying capacity of ecosystems. This knowledge—based on long-term empirical observations adapted to local conditions—ensures a sound use and control of the environment, and enables indigenous people to adapt to environmental changes. Moreover, it supplies much of the world's population with the principal means to fulfil their basic needs, and forms the basis for decisions and strategies in many practical aspects, including interpretation of meteorological phenomena, medical treatment, water management, production of clothing, navigation, agriculture and husbandry, hunting and fishing, and biological classification systems (Nakashima & Roué, 2002). Beyond its obvious benefit for the people who rely on this knowledge, it might provide humanity as a whole with new biological and ecological insights; it has potential value for the management of natural resources, and might be useful in conservation education as well as in development planning and environmental assessment (The World Conservation Union, 1986).

Of course, I am not trying to assert the ideal of the 'noble savage'. Not all indigenous people have lived or are living in peace and harmony with nature; history has seen many cultures disappear after they had exhausted the environment's ability to sustain their population, such as the Maya or the Anasazi in the Americas. However, many existing traditional practices are ecologically healthy, and we cannot simply dismiss them as primitive and unscientific belief systems.

In all cultures, humans have gained knowledge by conceptualizing empirical observations to better understand nature, and thus interpret and predict it (Iaccarino, 2003). The problem is how to study and analyse indigenous knowledge and belief systems. Of course, we cannot depend only on their empirical aspects, but must embrace their specific worldviews. It is not possible to simply reduce them to practical knowledge that is exclusively based on experience as opposed to theoretical knowledge, which is developed through deductive or inductive reasoning. In any case, discovering the fundamental principles of dealing with nature in many far-off cultures is not an easy task. Western science—which is deeply rooted both in the philosophy of Ancient Greece and the

Renaissance—and traditional knowledge systems have developed radically different strategies to create and transmit knowledge, and it is exceedingly difficult to analyse one form of knowledge using the criteria of another tradition.

Still, there is a vast body of literature on such comparisons between Western science and traditional knowledge systems, which has identified various characteristics and opposing views. Western science favours analytical and reductionist methods as opposed to the more intuitive and holistic view often found in traditional knowledge. Western science is positivist and materialist in contrast to traditional knowledge, which is spiritual and does not make distinctions between empirical and sacred (Nakashima & Roué, 2002). Western science is objective and quantitative as opposed to traditional knowledge, which is mainly subjective and qualitative. Western science is based on an academic and literate transmission, while traditional knowledge is often passed on orally from one generation to the next by the elders. Western science isolates its objects of study from their vital context by putting them in simplified and controllable experimental environments—which also means that scientists separate themselves from nature, the object of their studies; by contrast, traditional knowledge always depends on its context and particular local conditions (Nakashima & Roué, 2002).

In general, traditional knowledge systems adopt a more holistic approach, and do not separate observations into different disciplines as does Western science (Iaccarino, 2003). Moreover, traditional knowledge systems do not interpret reality on the basis of a linear conception of cause and effect, but rather as a world made up of constantly forming multidimensional cycles in which all elements are part of an entangled and complex web of interactions (Freeman, 1992). Of course, there is always the risk of oversimplifying by reducing the things of interest to essentials and/or dichotomies. However, from this brief overview of the dissimilarities, we can gain an understanding of how hard it is

to compare two systems of knowledge that are so profoundly different. Trying to analyse and validate traditional knowledge systems by using external (scientific) criteria carries the risk of distorting such systems in the process. At the same time, we cannot extract just those parts of traditional knowledge that seem to measure up to scientific criteria and ignore the rest. This process of cognitive mining would atomize the overall system and threaten traditional knowledge with dispossession (Nakashima & Roué, 2002).

However, Western contemporary culture and philosophy does offer some interesting ideas as to how to deal with these problems. The Austrian-born philosopher Paul Feyerabend, for example, questioned the widespread assumption that only Western science holds the criteria to determine the truth. As Feyerabend pointed out, any form of knowledge makes sense only within its own cultural context (Feyerabend, 1987). Similarly, the British anthropologist Gregory Bateson has compared knowledge about the material world to a map and the terrain it describes: the map itself is not the terrain, but only one representation of it (Bateson, 1979). Just as different maps can give accounts of the same territory, so too can different forms of knowledge about the material world. Its actual representation ultimately depends on the observer's view.

Contemporary hermeneutics—a branch of philosophy concerned with the theory of existential understanding and interpretation of texts—and, to a certain extent, complex thinking can offer useful approaches to compare different forms of knowledge and rationality. Complex thinking has provided new insights, and has contributed to a renewed interpretation of the concept of nature, and a new paradigm of science and epistemology. This new approach has brought a greater awareness of the shortcomings of simple explanations in comprehending reality. It aims to overcome the limits of both reductionism and holism by integrating them into a wider perspective, which investigates the complex structure of interconnections and retroactive relationships in the real world.

According to the classic epistemological approach, the creation of knowledge is a process of qualitative refinement and quantitative accumulation. Its goal is to

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disclose the ultimate foundation—the ‘meta’ point of view from where we can see the ontological order and the objective truth—and to provide a neutral and universal language to explain natural phenomena (Ceruti, 1986).

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Complex thinking has strongly questioned this notion of a meta point of view along with its heuristic value as a principle for the creation of knowledge. Instead, it seeks and analyses the web of relationships among different perspectives. This is continually redefined in a dynamic process involving multiple points of observation and explanation. These places are fundamentally incommensurable, yet they can complement each other and be part of a constructive network. What matters, in fact, is the possibility of including multiple viewpoints that are vicarious in building a cognitive universe and can disclose a more complete picture of reality.

In this context, the hermeneutical notion of a ‘horizon’ as expressed by the German philosopher Hans-Georg Gadamer seems to be highly relevant: “Horizon is the range of vision that includes everything that can be seen from a particular vantage point” (Gadamer, 1960). Rationality intrinsically works from this point, which starts the process of comprehension through which we can interact with other and different horizons, and ultimately expand our own knowledge horizon.

The encounter between different cultures and knowledge systems can then be regarded as an encounter between different macrohorizons; such systems come from different traditions, and each has its own way of understanding phenomena and its own ‘logic’ that allows the observed phenomena to be placed within an overall vision. Nevertheless, all representations of reality are expressions of the same cognitive features that are inherent in human nature.

Traditional environmental knowledge is an important part of humankind’s cultural heritage—the result of countless civilizations and traditions that have emerged over human history. This cultural diversity is as important for our future as is biodiversity. It is a potential

source of creativity and enrichment embodied in several social and cultural identities, each of which expresses its uniqueness (United Nations Educational, Scientific and Cultural Organization, 2002). However, European colonization has eroded and destroyed much of this traditional knowledge by replacing it with Western educational and cultural systems. The trend towards a global culture might even worsen this situation and enhance a process of cultural homogenization.

Scientific knowledge has long held a central role and attained a dominant position in our developed societies, but we cannot ignore the fact that other valid knowledge systems exist. The imposition of Western scientific ideas and methods not only causes disruption to existing social and economic relationships, but also might spoil the local knowledge. Allowing science to be the final arbiter of the validity of knowledge, and to establish the threshold beyond which knowledge is not worthy of its name, would create the conditions whereby an astonishing cultural heritage is transformed into a monolithic structure. Instead, we would be better advised to recognize the value of this heritage, and to devise strategies for its preservation for the benefit of present and future generations.

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First, a renewed approach to dialogue among cultures is required. Such a dialogue can only take place if there is a common principle shared by all participants. All humans from all cultural backgrounds have the same biological nature. At the same time, however, a dialogue is only possible because there is diversity at various levels. Eliminating these differences or staying in rigid isolation eliminates the conditions needed for a potentially mutually beneficial converse.

By acknowledging the uniqueness of each knowledge system, we can go well beyond a mere pluralist approach to knowledge. Dialogue can become a tool for social cohabitation, as well as for discovering and enhancing knowledge. It should be based on a sense of profound hospitality because it arises from different

identities and traditions, which are interested in exchanging their perspectives and experiences. This should not be anathema to Western science—in fact, it is through dialogue that new insights have emerged from the ancient Greek academies to today’s laboratory meetings and scientific conferences. In this sense, a dialogue can catalyse the development of shared meanings, which are key factors in binding people and societies together as vehicles of social cohabitation (Bohm, 1996).

The real world is too complex to be compressed into static conceptualizations. Dealing with this complexity requires approaches and strategies that maintain a continuous openness and willingness to discover and learn (Morin, 1990). This dialogue should take place with the unknown and the otherness. By shifting our perspective, and looking at other paths to knowledge that humans have developed and lived, we might create the necessary conditions for hitherto unknown knowledge to be revealed. All of these perspectives describe the human experience of reality. We need to open ourselves to participating in the experience of others, and yet we should also be aware that this opening can only start from where we already are—from our point of view or the tradition to which we belong. Our historical and culturally embedded perspective has been described by Gadamer as the “initial directedness of our whole ability to experience” (Gadamer, 1967). Nevertheless, from our delimited horizon we can still accept the invitation of other paths to knowledge and might well learn from them.

For example, some authors (Freeman, 1992; Iaccarino, 2003) have suggested that traditional knowledge systems can be helpful in dealing with complex systems: “The understanding of complex systems remains a major challenge for the future, and no scientist today can claim that we have at hand the appropriate methods with which to achieve this. Thus, we cannot discuss the future of science without taking into account the philosophical problems generated by the study of complexity. Modern, or Western, science may not be best suited to fulfil this task, as its view of the world is too constrained by its characteristic empirical and analytical approach that, in the past, made it so successful. We should therefore remember

the contributions of other civilizations to the understanding of nature. [...] Such traditional or indigenous knowledge is now increasingly being used not only with the aim of finding new drugs, but also to derive new concepts that may help us to reconcile empiricism and science" (Iaccarino, 2003).

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There is little doubt that modern science can gain a lot from such a dialogue. It has been extremely efficient in studying specific aspects of the natural world—those that are achievable through observation and experimentation—but operates in an environment that is either strictly controlled, such as a laboratory, or highly simplified. This approach is crucial in order to make generalized claims about the validity of scientific propositions, because it allows hypotheses under the same or highly controlled conditions to be tested and verified. However, an increasing number of critical voices argue that an approach based on reductionism—as helpful as it has been in the past—might no longer be sufficient to analyse and understand higher levels of complexity (Kellenberger, 2004; van Regenmortel, 2004). Moreover, scientists work only at specific levels of analysis. The theories formulated at each level are based on key observations, and, therefore, can explain only a specific set of facts (Iaccarino, 2003). Hence, the integration of methods and results from different approaches and levels of analysis can become essential.

These considerations seem to be particularly relevant for studying biological, ecological and social phenomena that include different levels of complexity. As already mentioned, the Western tradition of thinking is developing a different approach to gaining knowledge from complex systems, but it would be equally useful to learn how traditional approaches explain such complexity. Not only are they more holistic, but also they seem to be better suited to coping with the uncertainty and unpredictability that are viewed as intrinsic characteristics of natural systems. Western science and traditional knowledge constitute different paths to knowledge, but they are rooted in the same reality. We can only gain from paying attention to our cultural history and richness.

REFERENCES

- Bateson G (1979) *Mind and Nature: A Necessary Unity*. New York, NY, USA: Dutton
- Berkes F (1993) Traditional ecological knowledge in perspective. In Inglis JT (ed) *Traditional Ecological Knowledge: Concept and Cases*, pp 1–9. Ottawa, Canada: International Program on Traditional Ecological Knowledge and International Development Research Centre
- Berkes F, Colding J, Folke C (2000) Rediscovery of traditional ecological knowledge as adaptive management. *Ecol Appl* **10**: 1251–1262
- Bohm D (1996) *On Dialogue*. London, UK: Routledge
- Ceruti M (1986) *Il Vincolo e la Possibilità*. Milan, Italy: Feltrinelli
- Feyerabend P (1987) *Farewell to Reason*. London, UK: Verso
- Freeman MMR (1992) The nature and utility of traditional ecological knowledge. *Northern Perspect* **20**: 7–12.
www.carc.org/northern_perspectives.php
- Gadamer HG (1960) *Wahrheit und Methode*. Tübingen, Germany: Mohr
- Gadamer HG (1967) *Kleine Schriften I (Philosophie, Hermeneutik)*. Tübingen, Germany: Mohr
- Gadgil M, Berkes F, Folke C (1993) Indigenous knowledge for biodiversity conservation. *Ambio* **22**: 151–156
- Iaccarino M (2003) Science and culture. *EMBO Rep* **4**: 220–223
- Kellenberger E (2004) The evolution of molecular biology. *EMBO Rep* **5**: 546–549
- Morin E (1990) *Introduction à la Pensée Complexe*. Paris, France: Editions Sociales Françaises
- Nakashima DJ, Roué M (2002) Indigenous knowledge, peoples and sustainable practice. In Timmerman P (ed) *Encyclopedia of Global Environmental Change. 5: Social and Economic Dimensions of Global Environmental Change*, pp 314–324. Chichester, UK: Wiley
- The World Conservation Union (1986) *Tradition, Conservation and Development*. Occasional Newsletter of the Commission on Ecology's Working Group on Traditional Ecological Knowledge No. 4. Gland, Switzerland: The World Conservation Union
- United Nations (1992) *Convention on Biological Diversity (with Annexes)*. No 30619. Rio de Janeiro, Brazil: United Nations
- United Nations Educational, Scientific and Cultural Organization (2002) *Universal Declaration on Cultural Diversity*. Paris, France: UNESCO
- van Regenmortel MH (2004) Reductionism and complexity in molecular biology. *EMBO Rep* **5**: 1016–1020



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