March 2002

SCIENCE AND TRADITIONAL KNOWLEDGE

Report from the ICSU Study Group on Science and Traditional Knowledge

Explanatory note

The recommendations in this report are those of the authors and have not yet been ratified by the ICSU Executive Board and General Assembly. In setting out these recommendations for future ICSU activities, the authors have defined a number of possible actions and are fully aware that they may not all be implemented and, indeed, that alternative actions might eventually be considered more appropriate. The ICSU General Assembly will formally consider the report and its recommendations at its meeting in September 2002.

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INTERNATIONAL COUNCIL FOR SCIENCE

CONSEIL INTERNATIONAL POUR LA SCIENCE

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SECTION 1: BACKGROUND

The World Conference on Science (WCS) was organized by UNESCO in cooperation with ICSU and took place in Budapest, Hungary, from 26 June to 1 July 1999. The objectives of the Conference were to help strengthen the commitment of ICSU and UNESCO's Member States and other major stakeholders to science education, research and development, and to define a strategy that would ensure that science responds better to society's needs and aspirations in the twenty-first century.

The results of the Conference are embodied in two principal documents: (i) *Declaration on Science and the Use of Scientific knowledge* and (ii) *Science Agenda - Framework for Action*.

The *Declaration* affirms that scientific knowledge has led to remarkable innovations that have been of great benefit to humankind. But it also notes at the same time the challenge to use this knowledge in a responsible manner to address human needs and aspirations. This is a task that needs many partners, and both the *Declaration* and the *Framework for Action* call for a broad collaboration between science and society in meeting the challenges of the future.

A proper interaction between science and local cultures is crucial to achieve this task. In this connection paragraph 26 of the *Declaration* observes:

> "that traditional and local knowledge systems as dynamic expressions of perceiving and understanding the world, can make and historically have made, a valuable contribution to science and technology, and that there is a need to preserve, protect, research and promote this cultural heritage and empirical knowledge."

This principle is expanded in the *Framework for Action,* see section 3.4, *Modern science and other systems of knowledge.* Of particular relevance for ICSU is paragraph 87 of section 3.4:

> "Governments should support cooperation between holders of traditional knowledge and scientists to explore the relationships between different knowledge systems and to foster interlinkages of mutual benefit."

The *Declaration* and the *Framework for Action* were unanimously adopted by the 26th General Assembly of ICSU, which was held in Cairo from 27 to 30 September 1999. The GA did, however, express some concerns with part of the WCS documents, notably paragraph 26 of the *Declaration* and section 3.4 of the *Framework*, and, in particular, with the phrase "traditional and local knowledge systems". The GA acknowledged "the importance of empirical knowledge built up over generations and grounded in practical evidence but emphasized at the same time that such knowledge must be distinguished from approaches that seek to promote anti-science and pseudo-science."

The GA recognized that the relation between traditional knowledge and modern science is both important and highly complex, and that it is an issue that cannot adequately be dealt with in a few lines in a general resolution. The GA, therefore, requested of the Executive Board of ICSU to set up a critical study of this issue; see Resolution 1 of the 26th General Assembly of ICSU (Annex I).

The Executive Board of ICSU subsequently discussed the matter at several meetings. In the report from the EB meeting on 18-19 February 2000 it was noted that

> "the ICSU study should be limited to a review of the WCS texts specifically dealing with traditional knowledge (*i.e.* paragraph 26 of the Declaration on Science and Section 3.4 of the Framework for Action) and not examine the wide range of traditional knowledge systems themselves. The concern expressed in the ICSU GA Resolution was directed to the relationship between traditional knowledge and modern science and the need to avoid any misuse of these texts to support pseudo-science or anti-science activities. Therefore, the ICSU study might focus its attention on how those texts should be interpreted by the ICSU family so as to enable the "empirical knowledge built up over generations and grounded in practical evidence" to be best interpreted and integrated within modern sciences. [...] The group would also be asked to provide recommendations on what action ICSU and others might take in this area to follow up the WCS."

At its meeting on 19 September 2000, the EB of ICSU decided to set up a small Study Group to prepare a report on this issue for the next session of the General Assembly in Rio de Janeiro in September 2002. The mandate specifically asks the Study Group:

> (i) to carry out the required analysis of the relationship between traditional knowledge systems and modern science; and
>
> (ii) to give advice to ICSU on further action (see, in particular, paragraph 87 of the WCS *Framework for Action*).

The EB of ICSU appointed the following members and observers of the Study Group (see Annex II):

Members:
- Jens Erik Fenstad, Norway, Chair,
- Paul Hoyningen-Huene, Germany,
- Qiheng Hu, China,
- John Kokwaro, Kenya,
- Jan Salick, USA,
- Wesley Shrum, USA,
- B. V. Subbarayappa, India,

Observer:
- Douglas Nakashima, UNESCO, Paris.

The Study Group was established in mid 2001 and was asked to prepare a Report for the next GA of ICSU in 2002. This meant that the Study Group had to submit its Report to the EB of ICSU by the end of January 2002. The Study Group has had an opportunity to meet three times: a first organizational meeting on 2-3 October, 2001; a working session on 10-11 December, 2001; and a final session on 28-29 January, 2002. All meetings have taken place in Paris.

The Study Group has carefully discussed its mandate and has tried in the very limited time at disposal to produce a report which can serve as a "working document" for ICSU in the necessary follow-up actions. The Group started by observing that terms such as "traditional knowledge", "local knowledge" and "indigenous knowledge" are difficult to pin down in precise definitions. We have therefore in section 2 tried to give in general terms a characterization of these words to guide further discussion. In section 3 we have reviewed and given examples of cooperation/interaction between science and traditional knowledge. We observe that this interaction has been both fruitful and extensive up to this time and we emphasize that this is an interaction which must be kept distinct from issues of pseudo- and anti-science. In section 4 we analyze further the relationship between science, pseudo-science and traditional knowledge. In sum sections 2 to 4 address the concerns expressed in part (i) of the mandate. The analysis is necessarily brief, but we hope that it can serve as a starting point for future cooperation between modern science and traditional knowledge systems. In section 5 we deal with part (ii) of the mandate and give some advice on further action.

SECTION 2: ON THE NATURE OF TRADITIONAL KNOWLEDGE

In this paper, we will use the term “Traditional Knowledge” in the following sense, which is in accordance with common usage of the term in the literature. Traditional knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview (see, *e.g*., contributions by B. and E.A. Berlin, M. Langton, R. Mathew, K. Ruddle, L. Séhuéto and commentary by D. Nakashima, Session on “Science and other systems of knowledge”, in *World Conference on Science. Science for the Twenty-First Century: A New Commitment,* A.M. Cetto, ed. Paris: UNESCO, 2000, pp. 432-44). Traditional knowledge provides the basis for local-level decision-making about many fundamental aspects of day-to-day life: hunting, fishing, gathering, agriculture and husbandry; preparation, conservation and distribution of food; location, collection and storage of water; struggles against disease and injury; interpretation of meteorological and climatic phenomena; confection of clothing and tools; construction and maintenance of shelter; orientation and navigation on land and sea; management of ecological relations of society and nature; adaptation to environmental/social change; and so on and so forth.

While the present document focuses upon the term ‘traditional knowledge’, it is important to realize that this designation is only one of several currently employed by practitioners in the field. A variety of scientific, social and political considerations make it all but impossible for a single term to suit all settings – each one has its shortcomings (see D. Nakashima and M. Roué, 2002: Indigenous Knowledge, Peoples and Sustainable Practice, in *Encyclopedia of Global Environmental Change*, P. Timmerman ed. Chichester: John Wiley & Sons). The term ‘traditional knowledge’ or ‘traditional ecological knowledge’ (TEK), for example, may be misleading as it underscores knowledge accumulation and transmission through past generations, but obscures their dynamism and capacity to adapt and change. Another widely used term, ‘indigenous knowledge’ (IK), emphasizes attachment to place and establishes a link with indigenous peoples. For some, however, this connection narrows the term’s application and excludes certain populations who are not officially recognized as ‘indigenous peoples’, but nevertheless possess sophisticated sets of knowledge about their natural environments. In contrast, terms such as ‘local knowledge’ are easily applied to a variety of contexts, but suffer somewhat from their lack of specificity. Yet other terms that are encountered are ‘indigenous science’, ‘farmers’ knowledge’, ‘fishers’ knowledge’ and ‘folk knowledge’.

It is obvious that TK, like any other form of knowledge has been developed within specific cultural groups over a specific period of time and within specific environmental and social settings. At the same time, history has demonstrated how knowledge has been actively shared and exchanged among societies, and in this matter, holders of traditional knowledge do not differ. They acknowledge, accept and adopt elements from other knowledge systems, just as other societies adopt elements of traditional knowledge.

As any other system of knowledge, TK is embedded within specific worldviews. In this respect modern science is not different, it is also anchored in a specific worldview and, more to the point, a specific view about man’s relation to nature that is strongly instrumental (see , *e.g.,* Keith Thomas, 1983: *Man and the Natural World*. Oxford UP). In contrast, the worldview embraced by TK holders typically emphasizes the symbiotic nature of the relationship between humans and the natural world. Rather than opposing man and nature as in Occidental thought, traditional knowledge holders tend to view people, animals, plants and other elements of the universe as interconnected by a network of social relations and obligations (see, *e.g*., Ann Fienup-Riordan, 1990: Original Ecologists? The Relationship between Yup’ik Eskimos and Animals, in *Eskimo Essays*, A. Fienup-Riordan, ed. London: Rutgers UP).

Holistic cosmologies that intertwine elements that are ecological and social, as well as empirical and spiritual, have confounded scientists who may seek to separate ‘fact’ from ‘superstition’. Such a dualistic approach, however, contains certain dangers. Practices that appear in the first instance as superstitious to the outside observer may, once additional knowledge about the environment and culture is acquired, prove to be appropriate and empirically sound ways of coping with environmental problems. Furthermore, practices may have latent meanings that may only be revealed through a fuller understanding of the culture as a whole. In general, by isolating elements from a worldview that interweaves empirical, spiritual, social and other components, as TK does, one tends to misrepresent both the elements and the whole.

SECTION 3A: INTERACTIONS OF SCIENCE AND TRADITIONAL KNOWLEDGE

While it is possible to indicate, as we have done in general terms, a loose set of properties that are appropriately ascribed to traditional knowledge, such characteristics must be viewed as provisional and sensitizing rather than definitive and mutually exclusive. Traditional knowledge is a broad umbrella, encompassing configurations as diverse as decision-making strategies among shepherds (Agrawal 1993), multiple tree cropping systems of small-holders (Thrupp 1989), techniques for domestication of crops (Reed 1977; Rhoades 1989), and plant classification systems (Brush 1980).

What bears emphasis is that traditional knowledge has often played a role in the development of modern science and will continue to do so in the future. This can be seen in the development of hypotheses, research designs, methods, and interpretations employed by scientists, as shown by contemporary historians of science. It is evident in Linneaus' use of folk taxonomies in his development of biological classification systems, and the physics of Galileo, who used knowledge of ballistics developed by craftsmen at the arsenal in Venice.

Examination of these cases aids in understanding the historical relationships between knowledge embedded in a traditional context and the development of modern science. The experience of the past half century reveals a variety of relationships between science and traditional knowledge, in which the general trend has been from mutual disapproval towards mutual appreciation.

"Ethnoscience" is a scientific approach to traditional knowledge, based on the work of Harold Conklin among the Hanunoo of the Philippines in the 1950's. Through elicitation of responses to both natural objects such as plants, diseases, soils, and animals, and human activities such as agriculture, scientists developed an appreciation of the coherence of indigenous knowledge systems, their empirical precision, and their attunement to local environmental contexts. Ethnobotanists discovered cases in which the number of plant species recognized by local communities was greater than the number of scientific species recognized in an area. The general realization was that traditional peoples were a potential source of knowledge for science in areas such as biodiversity (Zent 2000). Such realization has not been limited to academic scientists, but extended to pharmaceutical and agricultural companies in the 1980s and 1990s and led to concerns about bioprospecting and indigenous property rights.

As ethnobotany grew during the 1970s and 1980s, scientific interest increased as well, with contributions not only from anthropology but also from biological systematics, structural linguistics, cognitive psychology, and logic. It should be noted that the debates continue on the extent of universality of classification systems (Berlin 1992, Ellen 1998, Atran 1991).

While most of this work has been academic in nature, examining traditional knowledge for its own sake, utilizing it for enhanced scientific understanding, and analyzing the relationship between knowledge systems, another approach to local knowledge originated with scientists in nonacademic contexts. During the 1980s, researchers in multilateral and bilateral development agencies began to recognize the significance of indigenous knowledge for sustainable development, both for environmental conservation and technologies for agricultural productivity. For example, scientists in the international CGIAR (Consultative Group on International Agricultural Research) system began to value participatory technology development, using the traditional practices and indigenous knowledge of local populations as a starting point. As ecological concerns gained currency in the late 1980s, these approaches were extended to the management of natural resources, utilizing participatory rural appraisals, conservation strategies, and interdisciplinary collaborations that relied heavily on local knowledge. In practical terms, scientists began to work closely with indigenous communities to promote their mutual interest in sustainable agriculture and ecological practice. Such work is likely to increase in importance during this century, both because of the recognition that many environmental problems are local in nature and the need for the cooperation of traditional peoples in addressing global issues.

These relationships between scientists and indigenous communities have been criticized by some advocates of postmodern perspectives that emphasize hegemonic power relationships embedded in certain forms of knowledge. Western science, insofar as it embodies cultural constructions that disenfranchise and subordinate traditional populations, tribal groups, and women, is viewed as an enemy of the indigenous knowledges that are inherently consistent with the political aims of empowerment and land rights for these groups. Although this approach seems to value indigenous knowledge for its own sake, the notion of compatibility between the land rights of local communities and environmental conservation has come into question, based more on the stereotype of an "ecologically noble savage" than consistent findings on the relationship between the use of indigenous knowledge and ecological well-being (Zent 2000).

Recently, traditional knowledge (TK), through modern ethnobotanical research, is informing science in many areas of natural resource management. TK helps scientists understand management of biodiversity; TK informs science about natural forest management; TK is providing scientific insight into crop domestication, breeding, and management; TK gives scientists new appreciation of the principles and practices of swidden agriculture, agroecology, agroforestry, crop rotations, pest and soil management, and other areas of agricultural science. We discuss this in more details below.

SECTION 3B: TRADITIONAL KNOWLEDGE AND ETHNOSCIENCE

The relationship between traditional knowledge and science has always been very close in ethnobiology and in the broader field of ethnoscience. Ethnobiology is the study of the reciprocal interactions between people and biological organism and of traditional knowledge about these interactions; while ethnoscience is the study of interactions and of traditional knowledge of the physical and biological world (Martin 2001). Traditional knowledge informs and profoundly influences ethnobiology and ethnoscience. Traditional knowledge is often adapted by science and re-applied in contemporary contexts and through contemporary management (Cunningham 2001). Thus, traditional knowledge is useful to science and to contemporary society.

Historically, the scientific study of traditional knowledge has a long history in the Western tradition, built on Greek, Roman, and Islamic foundations. The development of traditional knowledge in botany progressed with the establishment of botanical gardens and the publication of herbals and botanical treatises in Renaissance Europe beginning in in the sixteenth century and spreading rapidly (Ambrosoli 1997). Linnaeus' codified use of Latin binomials for plant and animal nomenclature was founded on his studies of traditional Lap knowledge and naming (Balick and Cox 1997). Systematic study of traditional knowledge has no less history or impact in other parts of the world (Minnis 2000) such as the Egyptian, Chinese, South –Asian, and the Incan empires. Modern ethnobiology dates to the late 19th century (reviewed in Cotton 1996) and flourishes today as one of the most popular biological and anthropological subdisciplines at many universities. Dedicated scientific societies and journals on ethnoscience proliferate including the International Society of Ethnobiology (ISE), the Society of Economic Botany, the Society of Ethnobiology, as well as many regional societies.

Traditional knowledge has informed modern science in many areas, most notably in taxonomy, medicine, agriculture, natural resource management, and conservation. Here, the impact of traditional knowledge on these sciences is detailed to recognize the positive influence and to argue for the recognition of traditional knowledge by ICSU. For example, in taxonomy many species new to science have been pointed out by traditional peoples knowledgeable in the flora and fauna of their environment (*e.g*., new species of primates were recently discovered in Central and South America, new ungulates in Southeast Asia, and new plant species throughout the tropics under the guidance of traditional people and their knowledge).

Medicine is influenced by traditional knowledge in many ways. Western medicine is founded on Greek traditions, and in other parts of the world such as China (Lin 2001) and India (Mishra 2002) traditional medicine is actively supported and researched. As many as 80% of the world's people depend on traditional medicine for their primary health care needs (WHO *et al.* 1993). The combination of traditional and scientific knowledge is evidenced *e.g*., in the USA where 25% of all prescriptions contain plant materials (Farnsworth and Soejarto 1985). The use of traditional knowledge in bioprospecting for new pharmaceuticals is an active scientific pursuit (Chadwick and Marsh 1994). Disowning the role of traditional knowledge in medicine would disenfranchise 80% of the world's population, ignore much of modern medicine, and curtail discovery of new drugs and treatments of diseases for which we still have no satisfactory cures.

Agricultural sciences and natural resource management are being influenced by traditional knowledge, through modern ethnoscience research. Traditional knowledge is providing scientific insight into crop domestication, breeding, and management (Conklin 1957, Boster 1984, Nabhan 1985, Brush 2000, Johns and Keen 1986, Salick, Cellinese, and Knapp 1997). Principles and practices of swidden agriculture, agroecology, agroforestry, crop rotations, pest and soil management, and other areas of agricultural science are documented by ethnoscientists (Conklin 1957, Bunch 1982, Hecht and Posey 1989, Smole 1989, Salick 1989). Traditional knowledge informs science about natural forest management (Posey 1985, Peters 1990, Pinard 1993, Pinedo-Vasquez *et al.* 2001, Salick 1992). Scientists are beginning to understand management of biodiversity through ethnoscience studies (Nabhan 2000, Salick *et al.* 1999, Irvine 1989, Johnson 1989). Our appreciation of the subtle and often unarticulated indigenous strategies in natural resource management has been fostered through ethnobotanical studies of indigenous knowledge. This has inestimably promoted scientific advancement in natural resource management.

Conservation strategies can be based on traditional knowledge and resource use (Redford and Padoch 1992, Redford and Mansour 1996). Application of the ethnosciences to conservation (Cunningham 2001) enables effective management and partnerships without which conservation is doomed. From the harvesting of individual plant or animal resources to the management of entire landscapes and ecosystems, learning from local people allows conservationists to integrate their programs with real human needs and practices.

Conservation by exclusion and isolation will not be sustained in the face of growing poverty and hunger. Applying ethnosciences and traditional knowledge to sustainable development is a further step with great potential (Bennett 1992) but also fraught with problems including land tenure, genetic resource ownership, intellectual property rights and benefit sharing (ten Kate and Laird 1999). Recognizing the worth and value of traditional knowledge to science is only a first step, thereafter involving scientists in issues of professional ethics (Cunningham 1996).

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SECTION 4: ON THE RELATIONSHIP AMONG SCIENCE, PSEUDO-SCIENCE AND TRADITIONAL KNOWLEDGE

In this section, we will discuss the relationship among science, pseudo-science and traditional knowledge. First, we have to treat the notoriously difficult problem of the demarcation between science and pseudo-science. With an understanding of the characteristics of pseudo-science at hand, we will then proceed to characterize the contrast between pseudo-science and traditional knowledge.

a) On the demarcation of pseudo-science from science

Philosophers of science have discussed the demarcation of pseudo-science from science for many decades. Unfortunately, early hopes of finding a sharp criterion that would unambiguously and in full generality demarcate pseudo-science from science have not been fulfilled, and are not entertained any longer (see, *e.g*., the contributions by Imre Lakatos, Paul Thagard, Michael Ruse, Larry Laudan, and the commentary by the editors in *Philosophy of Science: The Central Issues* (Martin Curd and J.A. Cover, eds.) New York: Norton, 1998). The main reason is a growing awareness of the extreme inner diversity of science. Different sciences are much more dissimilar to each other than previously thought, and there is little hope to expose the unity of science by an appeal to a unique scientific method or any other means (see, *e.g*., Feyerabend, Paul K., 1993: *Against Method*. 3rd ed., London: Verso; *The Disunity of Science: Boundaries, Contexts, and Power*, ed. by P. Galison and D.J. Stump, Stanford UP, 1996). Consequently, the demarcation of science from pseudo-science can certainly not be achieved by a single universal criterion. What counts as good scientific practice in one scientific field may be outdated or even inappropriate in another scientific field. At best, we may expect that there are different criteria whose validity depends on the respective scientific context and, furthermore, on time, which is very unsatisfactory. In addition, many practices, ideas, concepts, models, hypotheses and even speculations in a lively field of science are of a heuristic character without being explicitly marked as such on every instance of their occurrence. Even the degree to which some element of science is accepted as a heuristic device or as a more or less solid result may vary from one scientist to the other. These factors make the contrast between science and pseudo-science appear somewhat blurred.

However, the case to demarcate pseudo-science from science is not so hopeless even if we take the inner diversity and the heuristic elements of science into account. Two main approaches present themselves. The first one is broadly sociological, concentrating on social aspects of a pseudo-science, and the second one is epistemological. To start with the sociological approach, we may note that a pseudo-scientific field is always in more or less explicit competition with a corresponding science from its very birth, and it is typically not propounded by people with an education in the scientific field it is competing with. For example, there is a movement against relativity theory that defends ideas about time and space that are more in agreement with common sense than relativity theory. The competition with science is evident, and proponents of the movement are typically not physicists but people from other professions, including some proportion of electrical engineers. A better known movement is creation science, which competes strongly with evolutionary theory. Again, many if not most proponents of creation science are not professional biologists, and the extra-scientific, *i.e.* religious origin of the movement is obvious. However, this approach results only in a necessary but not in a sufficient condition for a demarcation of pseudo-science from science. Pseudo-science does stand in competition with some established scientific tradition, but so sometimes do minority views within science, fighting a prevalent tradition, without becoming unscientific. Thus, we need additional evidence in order to characterize some field as pseudo-scientific which should concern its cognitive content.

The second approach to demarcate pseudo-science from science is thus epistemological. It is based on a somewhat more advanced form of a characterization of science given at the World Science Conference in Budapest in 1999 (see Paul Hoyningen-Huene: "The Nature of Science", in *World Conference on Science. Science for the Twenty-First Century: A New Commitment*, E.M. Cetto, ed. Paris: UNESCO, 2000, pp. 52-56). According to this account, science is characterized as having a higher degree of systematicity than comparable pieces of everyday knowledge. This higher degree of systematicity concerns six aspects of science: how science describes, how science explains, how science establishes knowledge claims, that science has an ideal of completeness, how science expands knowledge and how science represents knowledge. Due to its ideal of completeness, science has an inbuilt dynamics towards the improvement of knowledge. This dynamics can abstractly be described as the tendency to constantly increase the systematicity of knowledge and thereby to make progress. Descriptions become more systematic by higher degrees of accuracy of observation, explanations become more systematic by theories that are more and more comprehensive, new and more accurately repeated experiments increase the degree of systematic testing and thereby the efficiency of detecting mistakes, repeated surveys of the field increase the awareness of knowledge gaps, and so on. In any area of science, the tendency to increase the systematicity of knowledge in all practically possible directions can be observed. In contrast, many of the pseudo-scientific fields are comparatively static. It is extremely rare that such fields attempt a systematic assessment of their cognitive claims. In particular, where claims are of an essentially probabilistic nature, like in all talk about tendencies or (not exactly specified) influences, systematic statistical testing procedures are called for. But very rarely do pseudo-scientific movement get involved in any sort of statistical testing procedures; anecdotic evidence prevails. If cognitive claims of pseudo-scientific movements are systematically evaluated at all, this is usually not done by the movement itself in a self-critical way, but by science. Furthermore, in pseudo-scientific fields usually no attempt is made at a systematic expansion of cognitive claims into new areas; typically, with respect to scope, pseudo-scientific movements are extremely conservative. Mostly, the dynamics to be observed in pseudo-scientific fields (if any) is defensive: it consists at most of attempts to oppose the counter-attacks of the respective scientific tradition.

To sum up: Pseudo-science is an enterprise that is always in competition with science; it poses as science by mimicking it. But a closer look reveals that pseudo-science displays a developmental pattern that is very different from the developmental pattern of science proper. Whereas science tries to increase its systematicity with respect to all those aspects of systematicity where it is feasible, pseudo-science is mostly static and if moving forward at all, it is only enhancing its protective belt against criticism from the scientific tradition it tries to displace.

b) On the demarcation of pseudo-science from traditional knowledge

Now, the demarcation of pseudo-science from traditional knowledge is fairly straight-forward. As we have said earlier, traditional knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. It has thus typically originated quite independently of science in a particular cultural setting, mostly also quite independently of Western culture. Traditional knowledge is therefore neither intended to be in competition with science, nor is such a competition the necessary result of their interaction. On the contrary, as we have seen earlier, traditional knowledge has informed science from its very beginnings and it continues to do so until today. If a competition between science and traditional knowledge arises at all, then the initiative typically comes from people who want science to replace these other forms of knowledge. Pseudo-science, on the other hand, tries at least partly to delegitimize existing bodies of scientific knowledge by gaining equal epistemological status. The existence of pseudo-science as an enterprise fighting science is thus invariably bound to the existence of science whereas traditional knowledge stands on its own feet.

SECTION 5: ADVICE TO ICSU ON FURTHER ACTION

The 26th General Assembly of ICSU unanimously endorsed the two principal documents of the WCS, the *Declaration* and the *Framework*, and called upon all members of ICSU to

> "distribute and make both documents and this resolution widely known among members of the scientific community, promote the principles set out in the *Declaration*, and take the appropriate steps to translate into concrete action the *Science Agenda - Framework for Action* by implementing the recommendations set out within it, forging new partnerships to do so".

This recommendation specifically includes section 3.4 of the *Framework*, and the Study Group was asked to give advice to ICSU on further action, with special reference to paragraph 87 on "how to support cooperation between holders of traditional knowledge and scientists to explore the relationships between different knowledge systems and to foster interlinkages of mutual benefit".

The *World Conference on Science* recorded the remarkable progress of science and technology , but pointed at the same time to the challenges ahead to use this knowledge in a responsible manner to address human needs and aspirations. To meet this challenge scientists need to be aware of the cultural setting of their trade. To translate scientific and technological knowledge into meaningful actions requires knowledge and awareness - both of the local arena of action and of the general assumptions and value issues implied in science and technology.

Science and technology have traditionally been called upon to strengthen industrial and economic development, both in the industrial and the developing worlds. Today there is an increased emphasis on issues of health and sustainable environment; see the AAAS Address by J.Lubchenco on *Entering the Century of the Environment: A New Social Contract for Science* (Science, vol 279, 3 January 1998). We have seen a change from a focus on the introduction of new and advanced technologies to a concern for and a need of an evaluation of social and environmental impact.

In the specific context of the Study Group this adds up to an increased importance of strengthening the interaction between holders of traditional knowledge and scientists. One first principle to stress is that *the cooperation must be a meeting of equal partners and that there must in all interactions be a just reward or return to all involved*. On the specific issue of intellectual property rights we **recommend** that ICSU participates in the work of the World Intellectual Property Organization (WIPO), specifically in the *Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore.*

Education and capacity building have long been a major concern for ICSU and its Member Organizations; see in particular the activities of CCBS (the Committee on Capacity Building in Science) and COSTED/IBN (the Committee on Science and Technology in Developing Countries—Incorporating Biosciences and Other Scientific Networks). There is also a substantial educational activity in many of the scientific unions. A major goal of ICSU has been to strengthen science education and the understanding of science in the developing countries. The Study Group is not suggesting any major changes to these activities. As affirmed by the WCS, strengthening modern science education is a major goal for developing countries. We would, however, in this connection like to emphasize that a science curriculum must properly interact with local experiences and systems of traditional knowledge to be fully effective. This is particularly important in the biological and environmental sciences. Awareness of this fact is important in ICSU's activities in education and capacity building. **Further action** on this issue is a challenge particularly addressed to CCBS and COSTED/IBN and the member unions.

A major ICSU activity is the promotion of joint research projects across the sciences. It has always been a goal for ICSU to involve partners from developing countries in such activities. It follows from our general discussion that holders of traditional knowledge as well as local scientists are potential partners in such research projects. This is particularly important when the theme of the project is health or sustainable development. The Study Group **recommends** that ICSU and its Member Organizations take active step to promote, when appropriate, such joint partnerships in research projects. We will in particular mention the International Geosphere-Biosphere Programme (IGBP), the International Human Dimension Programme on Global Environmental Change (IHDP), and DIVERSITAS: An Integrated Programme of Biodiversity Science. To draw on international expertise of TK the Study Group **recommends** that the International Society of Ethnobiology becomes an International Scientific Associate of ICSU.

The Study Group has been particularly concerned with the gradual weakening and disappearance of traditional knowledge. This is a trend that must be reversed and the Study Group **recommends** that ICSU and Member Organizations take steps

- to sustain traditional knowledge systems through active support to the societies that are keepers and developers of this knowledge,
- to promote training to better equip young scientists and indigenous people to carry out research on traditional knowledge,
- to promote and develop research to better appreciate traditional knowledge,
- to organize an international symposium on science and traditional knowledge.

A proper understanding of the relationship between science, traditional knowledge and pseudo-science is important for the further development of both science and traditional knowledge. Given the current impact of pseudo-science, it is important to better understand this phenomenon in order to enhance awareness among decision-makers and the public at large. The Study Group therefore **recommends** that ICSU and its Member Organizations support further critical studies on pseudo-science in its social context, especially on its functioning and its motivation.

The Study Group has had a limited time available for its work, and its recommendations can only be seen as the first steps in a long process. To carry the work forward within the ICSU structure the Study Group **recommends** that ICSU form an "ad hoc working group" on science and traditional knowledge.

As a first step the Study Group **recommends** that ICSU actively promotes the cooperation between traditional knowledge and science at the UN *World Summit for Sustainable Development* in Johannesburg in 2002.

TEXTS FROM THE UNESCO-ICSU WORLD CONFERENCE ON SCIENCE RELATED TO TRADITIONAL KNOWLEDGE

WCS- DECLARATION ON SCIENCE:

26. that traditional and local knowledge systems, as dynamic expressions of perceiving and understanding the world, can make, and historically have made, a valuable contribution to science and technology, and that there is a need to preserve, protect, research and promote this cultural heritage and empirical knowledge.

WCS-SCIENCE AGENDA:

3.4 Modern science and other systems of knowledge

83. Governments are called upon to formulate national policies that allow a wider use of the applications of traditional forms of learning and knowledge, while at the same time ensuring that its commercialization is properly rewarded.

84. Enhanced support for activities at the national and international levels on traditional and local knowledge systems should be considered.

85. Countries should promote better understanding and use of traditional knowledge systems, instead of focusing only on extracting elements for their perceived utility to the S&T system. Knowledge should flow simultaneously to and from rural communities.

86. Governmental and non-governmental organizations should sustain traditional knowledge systems through active support to the societies that are keepers and developers of this knowledge, their ways of life, their languages, their social organization and the environments in which they live, and fully recognize the contribution of women as repositories of a large part of traditional knowledge.

87. Governments should support cooperation between holders of traditional knowledge and scientists to explore the relationships between different knowledge systems and to foster interlinkages of mutual benefit.

RESOLUTIONS OF THE 26TH GENERAL ASSEMBLY OF ICSU

1. World Conference on Science.

The 26th General Assembly of ICSU

Noting the successful holding of the World Conference on Science in Budapest from 26 June to 1 July 1999;

Recognizes and appreciates the partnership with UNESCO in the organization and staging of the Conference;

Records its grateful appreciation to the Hungarian Government and the Hungarian Academy of Sciences for their generosity and cooperation in hosting the Conference;

Expresses concern about parts of the documents adopted by the Conference, notably paragraph 26 of the *Declaration on Science* and section 3.*4 Modern science and other systems of knowledge* of the *Framework for Action*; of particular concern is the phrase "traditional and local knowledge systems". The importance of empirical knowledge built up over generations and grounded in practical evidence is acknowledged but such knowledge must be distinguished from approaches that seek to promote anti-science and pseudo-science, and which degrade the values of science as understood by the ICSU community. ICSU reaffirms its support for the values and methods of verifiable science;

Recognizing that the relation between traditional knowledge and modern science is both important and a highly complex political and sociological question and one that cannot be addressed in a few lines of a wide-ranging document;

Requests the Executive Board of ICSU to set up a critical study of this issue.

With the above **reservations**, the 26th General Assembly of ICSU

Decides to endorse the two principal documents of the Conference: the *Declaration on Science and the Use of Scientific Knowledge* and the *Science Agenda - Framework for Action,* taking into account the concerns expressed; and

Urges all ICSU Members to:

- distribute and make both documents and this resolution widely known among members of the scientific community, promote the principles set out in the *Declaration*, and take the appropriate steps to translate into concrete action the *Science Agenda - Framework for Action* by implementing the recommendations set out within it, forging new partnerships to do so;

- keep the ICSU Secretariat regularly informed of all measures they have taken to implement the *Science Agenda - Framework for Action.*

Annex II

Members of the *Ad hoc* ICSU Study Group on Science and Traditional Knowledge

Jens Erik Fenstad is a Professor of Mathematics at the University of Oslo, Norway. He was Vice-Rector of the University and a former President of the International Union of History and Philosophy of Science (Division of Logic, Methodology and Philosophy of Science). He was a member of the Executive Board of ICSU and is now the Chair of the UNESCO World Commission on the Ethics of Scientific Knowledge and Technology.

Paul Hoyningen-Huene is the Director of the Center for Philosophy and Ethics of Science at the University of Hannover, Germany. He gave the plenary lecture on "The Nature of Science" at the World Conference on Science (WCS) in Budapest, 1999.

HU Qiheng is a Research Professor on Automatic Control of Chinese Academy of Sciences. She is the past Vice-President of CAS and Vice-President of China Association for Science and Technology (CAST). She is a member of the ICSU SCRES (Standing Committee on Responsibility and Ethics in Science) and heads the Internet Society of China.

John Kokwaro is a Professor of Botany at the University of Nairobi, Kenya. He is a specialist in systematics and ethnobotany. He is a Fellow of the Linnean Society, London, and was the first Executive Director of the African Academy of Sciences.

Douglas Nakashima is a Programme Specialist in the UNESCO's Science Sector, Paris, France. He heads the UNESCO project on "Local and Indigenous Knowledge Systems in a Global Society (LINKS)". He was a co-organizer of the WCS Session on "Science and Other Systems of Knowledge".

Jan Salick is the Curator of Ethnobotany at the Missouri Botanical Garden, USA. She is a Past-President of the Society of Economic Botany, a member of the US National Committee of the International Union of Biological Sciences, and a Fellow of both the American Association for the Advancement of Science and of the Linnean Society .

Wesley Shrum is a Professor of Sociology at Louisiana State University, USA. He is Chair of the US National Committee of the International Union of History and Philosophy of Science and Secretary of the Society for Social Studies of Science.

B. V. Subbarayappa is a Professor at the National Institute of Advanced Studies in Bangalore, India. He was the Executive Secretary of the Indian National Science Academy and a former President of the International Union of History and Philosophy of Science (Division of History of Science). He chaired the WCS Session on "Science and Other Systems of Knowledge".