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*Can be a dialogue between natural sciences and humanities?**

Abstract

The natural sciences, broadly defined as including life sciences (biology, medicine, genetics), earth sciences (geology, meteorology, oceanography, etc.) and physical sciences (physics, chemistry, astronomy) study the nature in all its aspects, whereas the humanities and social sciences (history, philosophy, literature, linguistics, arts; psychology, sociology, etc) study the human condition and social life. Interdisciplinarity, multidisciplinary, crossdisciplinarity and transdisciplinarity can create multiple relationships between the two categories.

In 1959 C. P. Snow suggested that in the modern society there are two cultures, the sciences and humanities, with a gap of communication, mutual incomprehension and sometimes even hostility between them. Later, in 1964, C. P. Snow suggested that a third culture will emerge, closing the communication gap between the literary intellectuals and the scientists. In 1995 J. Brockman introduced the idea that scientists could communicate directly, in an accessible manner, to the public, without the need of middlemen. This is currently illustrated by the presence of scientific topics of broad interest (e. g. biodiversity, climate change, energy resources, genetics, etc) in newspapers and magazines. J. Brockman introduced a third party, the artists, who are active in the dialogue between the two sides. According to J. Potochnik, boundaries between the humanistic culture and science are now blurring.

In a knowledge based society the public understanding is vital for long term support of science, and in turn, the scientists should be accountable to society which provides the resources to support their efforts.

In conclusion, a dialogue between sciences and humanities is necessary as a two way connection between science and society.

* The paper is printed as submitted.

Definitions

Natural science refers to a *naturalistic* approach to the study of the *universe*, which is understood as obeying rules or laws of *natural* origin. The term *natural science* is used to distinguish those fields that use the scientific method to study *nature* from the *social sciences*, which use the scientific method to study human behavior and society; and from the *formal sciences*, such as mathematics and logic, which use a different methodology (definitions according to Wikipedia).

Natural sciences include:

- *physical sciences* (astronomy, physics and chemistry);
- *earth sciences* (or geosciences including geology, geophysics, hydrology, meteorology, physical geography, oceanography, soil science);
- *biology* (botany, zoology, medicine, microbiology, genetics),

There are numerous *cross-discipline fields*: astrophysics, geophysics, physical chemistry, biophysics; biochemistry, geochemistry and astrochemistry; environmental science, oceanography.

The **humanities** are disciplines which study the *human condition*, using analytical, critical, or speculative methods, as distinguished from the mainly empirical approaches of the natural and social sciences.

Examples are: ancient and modern languages, literature, history, philosophy, religion, visual and performing arts (including music).

Social sciences comprise the disciplines concerned with the study of the *social life of human groups and individuals*: anthropology, criminology, economics, geography, history, political science, social studies, psychology, sociology, communication studies.

There are multiple relationships between disciplines leading to notions such as following (as defined by Wikipedia):

- **Interdisciplinarity** – *integration (combination) of multiple disciplines* and professions to create and/or apply new knowledge, in addressing a common challenge

Examples include Environmental science (the study of interactions among physical, chemical, and biological components of the environment), Bioinformatics (the integration of information technology and genomics) and others.

– **Multidisciplinarity** is the act of *joining together two or more disciplines without integration*.

Examples are:

– *Anthropology* which deals with the integration of different aspects of the Social Sciences, Humanities, and Human Biology. It includes Archaeology, Prehistory, Physical or Biological Anthropology, Anthropological Linguistics, Social and Cultural Anthropology, Ethnology and Ethnography.

– *Cognitive science* is the multidisciplinary study of mind and behavior. It draws on multiple empirical disciplines, including psychology, psychiatry, philosophy, neuroscience, linguistics, philosophy, anthropology, computer science, sociology and biology.

– *Nanotechnology* – a field of applied science dealing with the control of matter on an atomic and molecular scale (structures 100 nanometers or smaller).

– **Transdisciplinarity** is the act of taking theories and methods of several disciplines which exist *independently* and applying them to organize and understand different areas or fields. Transdisciplinarity is an integrative form of research and. It comprises a family of methods for relating scientific knowledge and extra-scientific experience and practice in problem-solving.

Example: The study of the relation between science and religion

– **Crossdisciplinarity** – the act of *crossing disciplinary boundaries* to explain one subject in the terms of another, foreign subject or method. Examples: studies of the physics of music or the politics of literature).

The Two Cultures

In 1959 the British scientist and novelist C. P. Snow suggested in a lecture entitled „*The Two Cultures and the Scientific Revolution*”, that there is a break-

down of communication between the „two cultures” of modern society – the sciences and the humanities.

Snow argued that England’s educational elite was split between two distinct groups: the scientists and those in the arts and humanities, and that these groups misunderstood each other to an increasing and disturbing degree.

„Literary intellectuals at one pole – at the other scientists, and as the most representative, the physical scientists. Between the two, a gulf of mutual incomprehension – sometimes (particularly among the young) hostility and dislike, but most of all lack of understanding” (C. P. Snow quotation).

C. P. Snow argues that in their education and training the *scientists* do not learn enough about the humanities, in particular about the moral, political and ideological forces and issues from which their work emerges. The *arts people* know even less about science and technology. Unfortunately, it’s still respectable among educated people to be ignorant of science.

The Third Culture

After the large success of the Snow’s lecture (published in book form), which was much discussed in Europe and America, he wrote in 1964 a follow-up: *„The Two Cultures and a Second Look: An Expanded Version of The Two Cultures and the Scientific Revolution”*. In this book C. P. Snow optimistically suggested that a „*third culture*,” would emerge and close the communications gap between the literary intellectuals and the scientists.

This concept was later picked up in a book *„The Third Culture: Beyond the Scientific Revolution”* by John Brockman (1995). John Brockman negates Snow’s prediction that the literary intellectuals will communicate effectively with scientists. Instead he makes the claim that *the contemporary scientists are the third culture* and there is no need of „middlemen” to establish communication between scientists and society. *Scientists are communicating directly with the general public*. Third culture followers communicate their thoughts to the public and to one another. This is illustrated by several scientific topics receiving prominent attention in the mass media in recent years; these include molecular biology, artificial intelligence, artificial life, climate change, energy resources, biodiversity, nanotechnology, the human genome, etc.

Today, the scientists, as third-culture thinkers, tend to express their knowledge and discoveries in a manner accessible to the intelligent reading public. However, Brockman does point to the continuing gap between the humanities and sciences and clearly shows that the bridge being constructed is still very fragile.

The Importance of Understanding Science

The problem identified by Snow is still valid in our times, but now the costs of ignorance and misunderstanding are higher. If the general public does not understand what scientists do and why it is important – and if scientists are unable to explain their work to nonscientists, in particular to decision makers (politicians) – the society may be reluctant to support basic (curiosity driven) research, and to accept only the target driven or applied research. The mid-term and long-term consequences can be critical (D. Balamuth).

Scientific knowledge is vital to solve the numerous global problems of sustainable development (energy, health, environment, aging of the population, safety, etc.). Therefore, *the society* should support science for its long-term self-interest. On the other hand, *the scientists* must realize that their freedom to pursue research depends of the people who generate the resources to support these efforts. Scientists must be accountable and explain why they pursue the questions they do.

This raises the question: *How scientifically educated need to be the citizens?*

In a democratic society the citizens often should make intelligent decisions about questions which can be answered only with the help of science, such as:

„Should we build nuclear power plants?“

„What should we do about the spread of a disease?“

„What should we do about the privacy of genetic information?“

and many others similar. The conclusion is that the citizens need to understand the basics of modern science in order to take informed decisions on issues of great interest for society.

The Case of the Relation between Science and Arts

A particular, attractive subject to consider is the relation between science and arts. A bridge between science and humanities is made with the work of art-

ists who are using new technologies. Artists are in the middle of the scientific and literary/philosophical communities, and indeed contribute to the creation of a new third culture. By utilising tools familiar to scientists, some artists „are getting closer to an atmosphere of collaboration and mutual respect” (*Victoria Vesna: Art, Science and Technology: Building the Triangular Bridge*).

According to Potočnik (*Creativity and Science in Arts, International Conference: New Paradigms, New Models– Culture in the EU’s External Relations, Ljubljana, 13 May 2008*) the boundaries between *Culture* (and more specifically *Art* and *Science* are now blurring. The evolving relationship between the sciences and arts has always had many facets:

- *Science enables art*: The birth of photography as an art (in the 19th century) and cinema (in the 20th century) were due to the emergence of new technologies. New electronic arts are now being created by the information technologies.
- *Science preserves art*: Modern techniques are safeguarding the world’s cultural heritage.
- *Science brings art to a wide audience*: Information and communications technologies allow the reproduction, distribution and broadcast of the world’s cultural riches to a large segment of humanity.

In its turn:

- *Art helps to bring science to society*: Art can reveal the beauty of nature – as often discovered by science – from the atomic to the cosmic. Scientific ideas and their societal impacts can be translated, popularised and filtered through art. This helps to foster public awareness, interest and understanding.
- *Art decorates the products of science*: Artists and designers soften and humanise the functional and practical inventions of science and engineering.

We can recognize a „creative fusion” between the sciences and arts. The sciences and arts have something in common: they are based on creativity. Both arts and sciences are manifestations of the basic human need to explore, to discover and to create. More and more artists are drawing inspiration from science and use the latest technologies and newest materials in their art. In the meantime, scientists and researchers are developing the artistic elements

of their work and finding ways to use art to communicate. Thus, an exciting new discipline is rising – termed the „third culture”(Potočnik).

In my field, chemistry, this is obvious. A so-called *chemical (or molecular) aesthetics* has emerged in recent years from the recognition of the beauty of some chemical structures. Even in the classical Roumanian literature there are some examples of science as subject in poetry (Roumanian poet Eminescu). Some scientists were also artists, like Ion Barbu – a Roumanian mathematician and poet, and professor Solomon Marcus became famous with his work „*Poetica mathematica*”. These are only beginnings.

