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CONTEXT, ESSENTIAL CONTENTS OF, AND FOLLOW-UP TO, THE WORLD CONFERENCE ON SCIENCE HELD IN BUDAPEST IN JUNE 1999

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The World Conference on Science (WCS) was jointly organized by UNESCO and ICSU and it was held in Budapest from June 26 to July 1, 1999. Let me recall that ICSU stands for 'The International Council for Science'. On the one hand, it is a world-wide, non-governmental organization grouping, with 25 international scientific unions representing all the different disciplines of the natural sciences and mathematics. On the other, it has nearly 100 national or regional members, mostly Academies of Science with a largely interdisciplinary composition. The Pontifical Academy of Sciences belongs to this latter category of ICSU membership.

While the international scientific unions promote science at the level of specific disciplines, ICSU does so at the level of interdisciplinarity. Together with various partner organizations such as UNESCO, ICSU promotes world-wide co-operation in scientific investigations on issues of common interest by initiating and supporting special programmes. A good example is the World Climate Research Programme (WCRP). Through its multitude of co-ordinating activities, ICSU reaches a large number of scientists throughout the world. It was thus an ideal partner for UNESCO in the planning and holding of the WCS.

The aim of the World Conference on Science was to reflect on the conduct of science, its methods, its applications, and its various interfaces with human society. Therefore the WCS differed very much from normal scientific congresses with their practice of presenting recent results and discussing new ideas.

The WCS was structured into three subsequent forums. One full day was devoted to Forum I in which science and its methods were defined and

the importance of international co-operation and scientific education was emphasized. This gave rise to the presentation of examples of recent advances in scientific knowledge and to an evaluation of the value of such knowledge for humanity.

Another day was devoted to Forum II in which various aspects of the interface of science with society were illuminated, such as the public perception of science, the impact of science on development, on the economy, on future generations, and on sustainability.

The WCS was attended by a total of about 2000 delegates, political leaders, scientists, and representatives of many other groups of society. Parts of the sessions were plenaries, others were split into parallel thematic meetings in which suitable time was reserved for discussions.

The three last days were made over to Forum III in which national and other delegations were allotted time to present their views on the relevance of science and its application for human society and more specifically for those nations which were represented. Although some critical voices were raised in this session with regard to some of the impacts of science, a large majority of votes were clearly in favour of a firm commitment to science and its value for the development of human society.

The generally frank and open-minded atmosphere encountered throughout the WCS might have something to do with the propensity of scientists to inter-communicate. Let me explain what I mean. Most objects of study in the natural sciences are of a global nature. Physical and chemical properties of matter are of the same nature everywhere on the planet and possibly in the universe. Similarly, major characteristics of life are shared by all organisms on all continents and in the oceans. For this reason, scientists have the habit of discussing the results of their research with each other world-wide, independently of their place of work. This communication facilitates the progress of scientific knowledge and it has the side effect of strengthening mutual trust and establishing links of personal friendship between the discussion partners. It is well known that in the practice of science, differences in opinion are not solved by fights, but by experiments and data collection, which can reveal the scientific truth. Therefore, world-wide scientific intercommunication and co-operation can have lasting effects on the establishment and stabilisation of peace, and this on a global scale.

Another interesting aspect of the conduct of science was discussed at the WCS – that of the social contract which exists between the world of science and society. Few people may be aware of this, but this social contract results

from the fact that the bulk of acquired scientific knowledge serves society through helping the practical and philosophical application of available knowledge. At the WCS this long-term contract was frequently addressed, and one thus spoke of a renewal of this social contract. It is based both on mutual trust and on expectation. Society expects scientific knowledge to find applications which work to the general benefit of society, throughout the world, and scientists expect a general recognition of the cultural relevance of their work and they thus also expect the required support.

It is in this context that during a plenary session of the last day the WCS accepted by consensus two well prepared texts, one entitled 'declaration on science and the use of scientific knowledge' and the other 'science agenda – framework for action'. It is difficult to summarize these already condensed documents which deserve to be carefully read in extenso.[1] Besides explaining what science is and what its cultural contributions are, the documents represent a kind of list of rights and duties of the world of science, as well as of society in relation to science. The 'framework for action' bases its recommendations on the 'declaration' and it challenges all the partners to become seriously engaged in follow-up activities. This, of course, also concerns the Pontifical Academy of Sciences.

In the meantime both the 'declaration' and the 'framework for action' have been presented to, and adopted by, the general assembly of ICSU. More recently they have also been adopted by the general assembly of UNESCO. They have thus become binding documents. Such established engagements between society and the scientific community did not exist before the WCS.

I may mention that at the general assembly of ICSU in Cairo this fall the statements on traditional knowledge in the WCS documents were criticised, and the scientists were invited to reflect on the correct interpretation of these statements. In contrast, the major parts of the contents of the adopted documents are straightforward and free of ambiguity.

Many of the follow-up activities to be given to the WCS will concern the practical application of acquired knowledge. This may often lead to new or newly-adapted technologies in support of human welfare and commodities. Other applications may, instead, help to improve the sustainability of the environment and a more responsible use of available resources.

To finish, let me reflect on the already mentioned philosophical or

[1] Science International, Special Issue on the World Conference on Science, September 1999, ICSU Secretariat, Paris.

world-view dimensions of acquired scientific knowledge. I will do this on the basis of an example chosen from my personal field of research in microbial genetics. According to the Darwinian theory of evolution, biological evolution depends on genetic variations, on natural selection exerted on populations of variants, and on geographical and reproductive isolation. In most textbooks on evolution, genetic variants are said to result from accidents and errors. However, a critical reflection on available data on the molecular mechanisms of the spontaneous formation of genetic variants in bacteria indicates that this is only a minor part of the truth. Many genetic variants are, instead, brought about by the action of specific bacterial enzymes, the products of genes located in the genomes of the micro-organisms. These genes are called evolution genes as I outlined in more detail at the Plenary Session of the Pontifical Academy of Sciences of 1996.[2] The gene products referred to here are actually variation generators and they work both inefficiently and non-reproducibly. A well studied example is the transposition of mobile genetic elements which – under the influence of an enzyme called transposase – can undergo a translocation with the DNA molecules of the genome.

Another class of evolution genes controls the frequency of genetic variations by keeping this frequency low and at a tolerable level which can ensure a certain degree of genetic stability of a species. An example of this kind of gene action is found with the systems of repair of genetic alterations on DNA which may indeed be brought about by damage caused by a mutagen or also by the properties of the limited molecular stability of nucleotides.

This novel notion of the existence of specific genes serving primarily biological evolution would deserve deeper philosophical reflection. Let me just make a few relevant remarks. First, the coexistence in the same genome of genes for products responding to the needs of biological evolution and of more classical genes responding to the needs of each individual life merits particular attention. Second, the occurrence of genetic variation generators working both inefficiently and non-reproducibly may call for a reflection on the definition of genetic determination. This may also be relevant for genes other than generators of variations in the nucleotide sequences of genomes. A more realistic definition of genetic determination may have a

[2] W. Arber: “The Influence of Genetic and Environmental Factors on Biological Evolution”, in Plenary Session, The Pontifical Academy of Sciences, on “The Origin and Early Evolution of Life” (Part I), *Commentarii*, 4, N. 3 (Vatican City, 1997), pp. 81-100.

deep impact on the public perception of the feasibility and impact of genetic manipulations. Third, while nature itself takes care of the steady evolution of life and has developed specific genes for this purpose, biological evolution is not strictly directed towards a specific goal. Rather, the direction which evolution takes depends on the life conditions encountered by the populations of organisms and on the occurrence of more or less randomly produced genetic variants in these populations. The underlying process of a steady dialogue between living beings and their environment is as a matter of fact natural selection.

It is my hope and conviction that the progress of scientific knowledge will continue to provide to all human beings on this planet both the technological and the material help to satisfy the daily needs for a life in welfare as well as a deeper understanding of the basic rules and laws of nature including its evolution. Such insights may help us in our cultural evolution to safeguard biodiversity and to ensure the sustainability of the foundations of life. These are the general goals of the social contract which was renewed between the scientific community and society at the World Conference of Science.