Science, Technology and Peace on Earth

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I. Changing World and Causes of Conflict

During the long history of the development of mankind, the planet of earth seemed to be an infinitely large place where one could never reach its end. The earth was so immense, with limited population, that the impact of human activities to the biosphere seemed quite negligible. But after the industrial revolution and especially in the twentieth century things have changed dramatically. World population increased from in this century 1.5 billion to 6 billion and with the advancement of communication technologies and transportation equipment, the earth has shrunk in relative terms. This sudden transition from “unlimited space” to “limited space” has extremely significant consequences, yet the development of human society, moving along the track of infinity for a long time, has not seemed to be able to adapt to the new reality that the earth is “limited.”

On the “limited earth,” with so many people pursuing unlimited material comforts, perhaps the most important challenges for scientists are problems related to the use of energy and the impact on our living environment. It was not until thirty years ago, that the dual effects of technological change and population growth on the biosphere attracted some serious concern. The 1972 UN Conference on the Human Environment was such an example. As the world is becoming smaller and smaller, challenges for each country to combat against a deteriorating living environment have become global problems and must be seen as challenges for all humankind as well. Ozone Holes, the global warming trend and the reduction of sunshine by 15% in Southeast Asia during the last several decades due to particulate matters produced by combustion of low grade fuels are such examples. If we examine the world in its entirety, we find that it is in fact in many ways overdeveloped, especially in terms of the excessive consumption of natural resources and the damage done to our living environment. From the point of view the generation of CO_2 by human activities and the consequent worsening of global warming trend, the common practice of categorizing countries as “developed,” “developing,” and “underdeveloped” has become increasingly unrealistic, and even the so called “developed” and “developing” countries are often not sustainable and they should all be categorized as “overdeveloped.” Unfortunately, every developing country has been attempting to follow closely in the footsteps of the so-called “developed” countries, obsessed with improving their material comforts, especially in terms of increasing per capita income. When I arrived at Berkeley, California, as a graduate student in 1962, Taiwan was extremely poor. The first day in campus I was shocked to see people, after washing their hands in the restroom,

using paper towels to dry their hands then throwing the towels away. But at the present time, the so called “civilized” part of Southeast Asia seems to have all caught up with this kind of wasteful process.

The “developed” countries’ patterns of growth, which require excessive or often wasteful consumption of natural resources, obviously are not the ideal models for “not yet overdeveloped” countries to emulate. We need to find a new, sustainable way of development for human society, paying special attention to harmonizing the relationship between humankind and nature. It is interesting to note that when India became independent, in response to the question of how the people in that country could catch up with the living standard of the people in Britain, Gandhi rightfully recognized and said: “To achieve this standard of living for its population England had to colonize the entire earth. If India wants to achieve the same standard for its vast population one has to imagine how many earth it would require to colonize.”

It is in a sense very ironic that the global warming trend, a problem which could become so serious that it may eventually lead to the termination of the humanity from the surface of the earth, will completely disappear when fossil fuels, which took millions of years to accumulate, are depleted. However, the likely onset of the energy crisis due to the gap between supply and demand of petroleum will undoubtedly present a formidable challenge for humankind. We should also recognize the fact that modern civilization, especially as associated with the prosperity and conveniences achieved in the twentieth century, depends mostly on the energy provided by the combustion of petroleum and other fossil fuels.

Global reserves of various types of fossil energy, unfortunately, remain limited. It is estimated that the time to depletion is 40 to 60 years for crude oil, and 80 to 100 years for natural gas. Natural gas could last a lot longer if we learn to exploit the abundant methane clathrate deep in the ocean. However, production will probably peak much earlier, perhaps within the next twenty to forty years for crude oil and natural gas. This means that before we are halfway through this century, it is very likely that the gap between energy demand and supply will have greatly widened, and the energy crisis will be here to stay.

In fact, the arrival of the energy crisis will also signal the arrival of a food shortage, as modern agriculture depends greatly on chemical fertilizers, which require a fair amount of energy to synthesize. 30% of food could be in fact attributed to petroleum. Without abundant and inexpensive energy, we will not have enough fertilizer to maintain such high efficiency in food production. 60% of fibers also came from petroleum at present. Energy crisis and shortage of foods are most likely to become major causes of conflict in the globalized world in foreseeable future.

Certainly we cannot go on as we have been doing. Things have to change – and we are the ones who must make it happen. We have to face the problems resulting from energy usage and

the closely related impacts on our environment. If we are to achieve sustainable development for the entire world, we must all increase energy efficiency, reduce dependence on fossil fuels, develop renewable energies, maintain biodiversity, make a more careful examination of population policies, and reduce the consequences of all human activities on our living environment and ecosystems. But, perhaps most important of all, it is time for those who live in developed countries and consume excessive amounts of natural resources to ask themselves the question “If everyone on earth were to live like us, could the earth carry the burden?”

The other cause of conflict that we need to pay attention to is the fact that although globalization of the world economy is driving us toward a borderless society, it will not reduce the differences among peoples in various regions overnight. Establishment of a new, common global culture, together with more effective ways of communicating among all the peoples, will certainly take time. The differences among cultural heritages, languages, and religions that make this world so rich and colorful will not, and should not, be made to disappear. As the world shrinks in relative terms, and contact between peoples becomes more frequent, whether or not difference in civilization are likely to cause an inevitable crash (as suggested by the well-known scholar Huntington), would seem to be entirely dependent on how well peoples around the world learn to communicate and to understand, appreciate, and respect different cultural heritage. To become good citizens of the global village, we need to learn quickly and also to teach our young people to take a global view and to respect, appreciate, and understand the different cultures of different peoples.

II. Responsibility of Scientists

Now let us move our attention to the subject of science and society. As a scientist, I often ask myself if the advancement of science has really brought substantial benefit to mankind. Some might argue that the advancement of science and technology might have brought benefit to only about one third of the people on earth. Developed countries seem to have fared better than others. For example, when we glorify the tremendous impact of the industrial revolution which started more than two hundred years ago, we must not forget that those countries that failed to catch the wave became colonies of Western powers and suffered immensely as a result. In a sense, the recent history of mankind has been marked by strong competition among nations.

Although substantial progress has been made in recent years in international collaboration, the high-tech-based economic competition among nations based on information technology, biotech and nano science is still playing the tune to which the entire world marches. It goes without saying that in this competition there will be both winners and losers. Countries that lag behind in this round of competition will again be trapped in poverty and misery.

We should all recognize the fact that the increasingly interconnected world cannot be a safe

place if a large portion of its population still suffers from poverty, disease, illiteracy, unemployment, and other barriers to survival. Scientists can play key roles in finding the solutions to these problems. That might be the part of reason why we are gathering here today. First of all, scientists should work together to make sure that science shall not be used by some to dominate others, and to cause damage to our living environment. In 1995, Sir Joseph Rotblat, a Nobel Laureate, urged in his acceptance speech that 'the time has come to formulate guidelines for the ethical conduct of scientists, perhaps in the form of a voluntary Hippocratic Oath.' He argues that scientists should not pursue scientific truth simply for truth's sake without considering the ethical implications of their research. He emphasizes the social responsibility of scientists and believes that holding an "amoral" attitude towards science is actually "immoral," as personal responsibility is tied to the likely consequences of one's action. Although the idea of an ethic for science can be traced all way back to Francis Bacon in the seventeenth century, pledges founded on the values and responsibilities shared among scientists and engineers have become quite common in recent years. For example, the Peace Pledge Movement for scientists, launched in Japan in 1999, is committed to the Peace Pledge which reads: 'I, undersigned below, pledge with honor and dignity: To the best of my knowledge, I will not participate in research, development, manufacture, acquisition and utilization of nuclear weapons as well as other weapons of mass destruction.' This year, Dr. Daniel Tsai and Dr. D. S. Chen both associated with National Taiwan University gave a proposal for young bioscientists admitted to their College of Medicine, to declare: 'At the moment of my becoming a member of the bioscience community, I do solemnly declare that I will respect the value and dignity of life and conduct myself to honor this profession. I acknowledge that I have a special responsibility for promoting the welfare of humankind, and will so behave as to pursue and exercise my bioscience knowledge in an ethical and socially responsible way. Never will I use my training to do harm to others or the environment, neither will I do anything to diminish social justice. Whatever action I take and career I choose, I will consider their moral implications. Since I realize that only ethically responsible bioscientists can hope to contribute to peace and security, and thus promote genuine human flourishing. I make this declaration wholeheartedly and upon my honor.'

It is certainly very important for the individual scientist to see to it that science brings benefits to mankind, but it should not to be used for evil purposes or to cause unexpected negative consequences. However, if we continue to engage in the fierce high-tech-based economic competition among nations, it might not be enough for the individual scientist not to participate in the research, development, manufacture, acquisition and utilization of nuclear, biological and chemical weapons or their means of delivery. At the current stage of human development on Earth, there is a difference between the responsibility of the individual scientist and of scientists as a whole. If we do not fully appreciate and understand the rules of the game and consequences of competitions in a globalized market driven economies, and other social differences, practicing so called "good sciences" for good purpose can still produce miserable losers among us when they are used as a means of economic competitions. Just like the

industrial revolution in the past, new global competitions based on information science and biotechnology are sure to produce losers, and again these nations will remain poor and miserable. We need to realize that a nation can sustain its prosperity only when they are also surrounded by prosperous neighboring nations. Commitment to help making our neighbors prosperous seems to be one of the best tactics in the globalized world.

III. Sharing of Scientific Knowledge and Technologies in a Globalized World

For centuries, the scientific knowledge accumulated by mankind has been shared quite freely among scientists. Scientists generally still believe firmly that the knowledge accumulated through their efforts should be shared by all – as advocated by Francis Bacon long time ago. Early last century, when Madame Curie was asked why she didn't apply for patents on her discoveries (after all, if she had done so, she would have been as wealthy as Thomas Edison at that time). Her reply was quite simple. She did not want to take that advantage because she believed that scientific knowledge should belong to all mankind. In fact, it was her idealistic way of life which attracted me so much that I decided to become a scientist when I was young. In a modern society, however, when scientific knowledge is further developed, transformed into technology and put to use in society, it becomes the basis for economic competition. Protection of patents and intellectual property rights has become a very important issue, and the sharing of knowledge now stops at basic scientific knowledge and so called "pre-competitive" technology. Competitive technology is not freely shared. However, the gap, or time lag between scientific discovery and technology in the marketplace has become shorter and shorter. The lag was 100 years for automobiles, five years for computers, and only 18 months for microprocessors. Now, in certain areas of scientific investigation, it is no longer possible to distinguish between basic research and associated competitive technology.

As the relationship between science and technology has become closer, the dilemma of "to share or not to share" has become an important issue – not only for application of technologies, but also for the basic scientific discoveries themselves. It certainly does not seem fair if some countries produce most of the public scientific knowledge, while others mainly dedicate themselves to protected, mission-oriented technological development to gain economic competitiveness. Certainly, in a market-driven economy, free and open economic competition and adequate protection of intellectual property rights are necessary for development. Yet, we must ask seriously whether, in a highly globalized world, we can find a new and better way to allow both creation and sharing of knowledge as well as technology to be carried out in a more orderly fashion to promote sustainable development for the entire world. Strong global public support for the advancement of science and for the development of technology, and shortening the patent protection period, might move along in that direction. In recent years, in the field of high energy physics and astronomy, scientists share their knowledge quite freely and have been more willing to help each other across national boundaries. On the other hand, in the field of biology, scientists tend to protect their intellectual property rights more tightly. In an

international meeting of biological sciences, it is often seen that scientists try to learn as much as possible and reveal as little as they can on critical issues. Whether this is due to the fact that high energy physics and astronomy are supported by public funds while the profit-making pharmaceutical industries dominate certain areas of biological research is worth studying in detail.

Many of the problems we face today are problems that cannot be solved with current scientific knowledge and technologies – they await the accumulation of new knowledge and the development of new technologies. That is why it is so important to continue our efforts for the advancement of science and technology, and for the education of a new generation of creative scientists.

III. Concluding Remarks

The 21st century will be the critical turning point for mankind. I am quite certain that the globalization of the world economy will ultimately reduce the risk of military confrontations being used to settle international disputes. If what replaces military confrontation, however, is simply high-tech-based economic competition, then the tensions between advancement of science and sharing of technology, between economic rationality and the political passions of nation states, will not be resolved, and the advancement of science and technology will continue to be used as a tool of domination by some, rather than liberation for all. If, however, we learn to solve problems together, learn to share knowledge, new technological options and the limited resources available, learn to respect and understand different cultural heritages, then it will be possible to realize the establishment of a genuine global village that enables sustainable development for all.

This is the first time in human history that all human beings on earth have been faced with learning to work together and live together as one family in a global village – the time for finally realizing that the planet Earth on which we live is only finite in space, capacity and natural resources. This is a necessary awakening – vital for the survival and sustainable development of mankind. I believe that if we make the correct choice at this crossroads, then the 21st century is likely to be marked as the great turning point, or great transition – the beginning of a new era in the history of mankind.