PHYSICS, EDUCATION AND TECHNOLOGY

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ABSTRACT

This article stresses upon a relationship between Physics, Education and Technology. It also relates the economic prosperity of a country to science and technology. The emphasis is placed on scientific collaboration among various countries. The authors are motivated by their experience of working with European Organization for Nuclear Research (CERN), which is based in Geneva, Switzerland.

INTRODUCTION

Human beings are the ones with critical conscious in the Universe. The statement is true at least of the present knowledge of the Universe. The human race is capable of controlling nature through the power gained by science. Science is the acquisition of knowledge. Its applications have helped the human race find the cure of number of fatal diseases. It has helped find solutions for good and clean environment. Science is motivated by pure curiosity and the quest of mankind to understand the totality of its existence. Therefore, science is a key element of mankind. On the other hand, physics is the knowledge of matter and its interactions and is a key element of science. By deduction, physics is thus a key element of mankind.

Philosophers of the antique, like Socrates, Plato, Aristotle, and Democritos laid down the foundations of present-day science based on a few axioms and rational deductions. One of the prime examples is Mathematics. The Oriental philosophers and scientists developed Mathematics for its first important practical applications such as: astronomy, geodesy, navigation, etc. Using the strong base, provided by the Oriental scientists, the Western philosophers laid the foundation for Mathematics as a powerful scientific tool. Most notably Kant, Schopenhauer, Descartes and Leibnitz have advanced the above-mentioned idea. Mathematicians like Peano, Gauss, Euler and Neumann developed their science into an indispensable tool for physics.

ROLE OF PHYSICS

Physicists applied and improved Mathematics as a necessary tool to formalize their research, ideas and the philosophical contents of the physics world in order to better understand it. The experimental aspect of physics was developed to verify the theoretical predictions of physicists. The spin-offs from experimental physics were developed for practical applications leading to industrial revolution and our present standard of living. These applications from experimental physics to real life gave birth to technology.

Physics discoveries soon opened more questions than could be answered. Physics and physicists were often in contradiction to the dogmatic contents of spiritual sciences. The earth is not the centre of the Universe, the Universe may have come into existence by the “Big Bang” and it was not created in seven days. In contrast to spiritual sciences, physics must pass the test of reality and should be free from moral or ethical objectives. However, even the most agnostic modern scientist must admit that the beauty and the simplicity of the laws governing the Universe cannot be taken as a mere fact. The beauty of the living creatures cannot be explained by Darwin’s theory only. We must concede that physics does not explain everything. As far as ethical or moral aspects are concerned, there are potential conflicts arising from the applications of physics which must be addressed.

SOCIOLOGICAL CHANGES DUE TO SCIENCE

The problem of science is that it is a product of human mind but excludes inherently the notion of any human feelings. Physics thus cannot be developed without regard to the overall concerns of mankind. The evolution of technologies associated with physics has drastically changed the conditions of life over

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the last 150 years, a very short period in the history of mankind. The sociological changes caused by physics and its direct linkage to technology give rise to the following cycle:

- Development of Technology,
- Industrial Applications,
- Better Economy,
- Increase of Wealth,
- Improvement of Basic Infrastructure,
- Social Stability, Peace and Better Education.

The above cycle has divided our world into the "Industrialized Nations" and the "Countries of the South". The difference of standard of living between the "Industrialized Nations" and the "Countries of the South" will further increase without urgent affirmative action. One can break the vicious cycle by investing heavily in the basic infrastructure of a country, in particular the education and health sector. There are many talented people world-over but without education they will remain talented but uneducated. They will be unfit for science and for the improvement of their country's living standards. Proper basic infrastructure will stop the emigration of competent people and will result in generating expertise. Availability of talented and education people will give rise to more economic possibilities; improve Gross National Product (GNP) and the living standard of the nation.

The industrialized countries spend 2 to 2.5% of their GDP on Research and Development and utilization of Science and Technology. In contrast, the allocation in most of the countries in the South is negligibly small. Today 95% of the new science in the world is created in the countries comprising only 20% of the world's population while the remaining 80% contributes only 5% towards it. This lopsided distribution of scientific activity creates serious problems not only for the scientific community in the countries of the South but also for the development of these nations.

POSSIBLE SOLUTION TO SOCIOLOGICAL PROBLEMS

The South spends out of its scares resources on education but the trend of emigration of trained and educated people is causing most of the investment to go to waste. Governments of the South thus should make a concerted effort to provide opportunities to their scientists to work for their home country. Education is expensive enough for the poor countries of the South and appropriate investments in science and technology infrastructure are often seen as prohibitive on a short time-scale. However, there are many fields where affordable investments are possible, such as data communications, software and database development, engineering, and electronics design.

The real solution to the problem is to create a "political climate of priority" for physics, education and technology. This means investment in education, science and technology. Another important aspect is to invite scientists who have left their home countries. They should be encouraged to contribute towards solving problems confronted by their home countries.

- Sponsorship of fellowships or similar
- Participation to reviews
- Delegation and subcontracting of research work abroad

The government should use the World-Wide-Web to access electronic databases of emigrated scientists from around the world to contract emigrated scientists resident in foreign countries and to make them aware of the problems and task that await them in their home countries. Another possibility is to complement the education of scientists, through participation in international scientific collaboration such as CERN, FNAL, GENOM, provided they find it attractive to return to work in their home country.

ROLE OF CERN

CERN has a tradition to train some 1000-1200 young scientists per year. Typical training period is 1-3 years. The training at CERN provides "hands-on" experience in modern technologies and in an international environment with clear objectives and deliverables. The selection criteria are strict and CERN supports the idea of trainee returning to the institute of origin, thus avoiding brain drain. CERN provides particle beams and laboratory infrastructure to the international Physics-community for high-energy particle Physics research. The CERN does not provide the particle-detectors (experimental devices) which have to be conceived, funded, built and operated by international collaborations, hosted by CERN. These detectors, used with the accelerators at CERN are “super-microscopes” to analyse the constituents of sub-nuclear matter. Their size, complexity and cost imply a truly worldwide international collaboration in which many “Countries of the South” are already participating members.

CERN, as an inter-governmental Physics research institution (not funded to provide industry with new products) has made a number of important technological innovations mainly to cover its own needs or as a by-product of its expertise in the fields of robotics, micro-and macro-mechanics, electronics, medical facilities, super-conductivity, networking and computing (worldwide web), carbon-fibre structures, geodesy, elimination of nuclear waste, ultra-high vacuum, PC boards, ion sources, RF systems, etc..

CONCLUSIONS

Science and technology are undoubtedly the principal agents of progress in the modern world. True economic independence is not possible without a significant degree of autarky in science and technology. Science must become a component of the development of all mankind particularly the less developed ones. The countries of the South must realize that change is a natural phenomenon in human affairs and that development is incompatible with a static and rigid view of the world. The spirit of inquiry to find the facts and rely upon them needs to be encouraged and propagated in the developing countries. As a final note the authors would like to give two quotations of Late Professor Abdus Salam, Nobel Laureate of Physics (1979) and the founder of International Centre for Theoretical Physics:

“…The Third World despite its realization that science and technology are the sustenance, and its major hope for economic betterment, has taken to science as only a marginal activity.”

“…The Third World as a whole is slowly waking up to the realization that – in the last analysis – Science and Technology are what distinguish the South from the North. On Science and Technology depends the standards of living of a nation and its defense standing. The widening gap between nations of the North and the South is basically the “Science Gap”. Now, while the South is making some purposeful efforts to acquire technology, very few of us have yet woken up to the need of acquiring science as well.” “…It is just impossible to talk only of the technology transfer. One should talk of science transfer, first, and technology transfer later. … Unless you are very good at science you will never be good at technology.”

BIBLIOGRAPHY

- An Economic Case for Basic Research, E. Wong, Nature 381, 187, 1996.
- Science Policy and Public Spending, J.A. Kay & C.H. Llewllyin Smity, Fiscal Studies, Vol.6, No.3, p. 14, 1985.
- The Economic Laws of Scientific Research, T. Kealey, Macmillan Pres, London, 1996.
- Why Should Companies - Large or Small - Work with the Universities? J. Baruch, Physics in Business 14, 4, 1997.
- Renaissance of Science in Islamic Countries, eds. H.R. Dalafi and M.H.A. Hassan, World Scientific Publishing (1994).