Khan Bahadur Ahsanullah Memorial Lecture

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SECOND LECTURE

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Origin, Structure and Evolution of the Universe and its Long-Term Future

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4. Faculty members, officers, staff of Ahsanullah University of Science and Technology.

Assalamalaikum.

It is indeed a great honour for me to be asked to give the Khan Bahadur Ahsanullah Memorial Lecture. I am pleased, Humbly, to accept the honour.

I will be talking in the general theme of “Origin, structure and long –term Future of the Universe”, but as progress in this or any other scientific field is dependent on science education in Bangladesh and beyond, I will also discuss these matters and the concomitant difficulties and obstacles. Indeed, the far future of the Universe and of mankind also are related to and subject to these considerations.

For these reasons, this lecture will consists of separate parts connected to each other under the general heading.

I will begin with some brief comments on late Khan Bahadur Ahsanullah.

From what I have heard from friends and colleagues and from the above except taken from a report on Ahsanullah University of Science and Technology, it seems to me that it is very befitting and appropriate that the wonderful legacy of service to the community and country left behind by the Late Khan Bahadur Ahsanullah should be continued by his close followers and friends. Every effort ought to be made to carry on and whenever possible, extend the welfare and educational activities that were initiated through the Ahsania Mission. This is all the more necessary in these difficult and uncertain times. In this connection I would like to convey my very best wishes for

a bright and successful future for Ahsanullah University of Science and Technology, in the service of society, the country and the world.

The far future of the Universe

In this part we shall he concerned with the very long-term future of the universe and everything contained in it, on the basis of present knowledge of astronomy and cosmology, in particular the conventional “big-bang” rnodel. As this topic has been dealt with in earlier work by the author [l , 2, 3,4] we shall summarize the earlier work and include some recent developments.

The present structure of the Universe

The basic constituents of the Universe. When considering its large-scale structure, can he taken to be galaxies which are congregations of about 10`` stars bound together by their mutual gravitational attraction. Galaxies occur in groups (called clusters) ranging from a few to a few thousand. lt appears that, on the average, galaxies are spread uniformly throughout the Universe at any given time.

One of the most striking things about the Universe, discovered by E.P. P. Hubble about 1930. is that it is expanding. This means that all galaxies (except possibly those in the same cluster) are receding from each other--the more remote a galaxy. the higher its speed of recession from us. From the rate at which galaxies are moving away from each other, it can he deduced that they must all have been very closely packed about ten to twenty billion years ago. It is generally believe that at that time there was a universal explosion (at every point in the Universe) in which
matter was thrown asunder violently.

Later the matter condensed into clumps. eventually to become the galaxies of the present time. The recession of the galaxies from each other is a continuing consequence of the initial explosion; the so called `big-bang`.

Is the Universe open or closed?

Will the expansion of the Universe continue forever, or will it eventually stop expanding and start to contract'? (The model of the Universe that expands forever is called ‘open’ whereas that which will eventually stop expanding and start to contract is called ‘closed`). This is one of the most crucial unanswered questions of cosmology. The ultimate fate of the Universe and everything in it depends dramatically on the answer to this question. There are several ways, some interconnected, of finding the answer. One is to measure the rate at which the expansion is slowing down. Another is to determine the present average density of the Universe. lf the density is above a certain critical density. the Universe is closed,

whereas if the density is less than the critical it is open.-The critical density itself is determined by the present rate of expansion of the Universe, given by the so called

Hubble constant. Still another way to settle this question is to determine the precise age of the Universe and compare it with the Hubble time; this is given by the reciprocal of the Hubble constant in suitable units, and gives the time elapsed since the ‘big bang` if the rate of expansion had been always equal to the present rate.

There is considerable observational and theoretical uncertainty in these and other methods at present, but indications are that the universe is open.

Death of stars

ln an earlier work [4] we have described in detail how stars die. that is, reach their three final states of white dwarf. neutron star, and black hole. Here we shall briefly describe these three states. The material of white dwarfs consists of nuclei of heavy elements, such as iron, from which electrons have been stripped of and run freely in the star providing a pressure which balances gravity. A white dwarf has a mass about that of the sun but is as big as the Earth. A neutron star consists mainly of neutrons in the form of a giant nucleus. It is about as massive as the Sun but has a radius of some ten kilometers. A black hole is more than a few times the mass of the Sun; in it matter has been crushed to infinite or near infinite density at its centre but neither this centre nor the region near it is observable, because nothing –not even light –can escape from it due to the strong gravity.

Future of an open Universe

Suppose the Universe is open: what will eventually happen to it'? (Consider a galaxy like ours, which is fairly typical . It can he shown that in about in about 10 years, all stars in it will have been "reduced to their final states, so that the whole galaxy will be reduced to a system of black holes, neutron stars, cold white dwarfs, and other smaller forms of cold matter such as planets, asteroids, dust, etc. These will still be bound together in a galaxy, but there will be very little radiation of any kind coming out of it. Galaxies which are not in the same Cluser will continue to recede from each other. The galaxy will then under go a process of dynamical evolution in which most of the stars will be ejected from the galaxy. Those that remain will form a dense central core, eventually forming a single black hole. with a mass about a billion times the mass of the Sun and a size (the region out of which nothing escapes) of about a light day, i.e. the distance light travels in a day. This process will take anything from 10^{18} to 10^{27} years. A cluster of galaxies will collapse into a somewhat bigger black hole. Thus in 10^{27} years or so the Universe will consist of these large galactic black holes with vast empty space in between which will
contain stray neutron stars, cold white dwarfs, and stellar-size black holes wondering singly in the intergalactic space.

Black hole radiation

According to the laws of classical physics. a black hole will last forever. It was shown by S.W. Hawking of Cambridge University [5] that when quantum phenomena are taken into account, a black hole gives off radiation and loses mass eventually to disappear altogether . For stellar size black holes the life –time is about 10^{65} years. Whereas the large galactic black holes will last for about 10^{100} years. Thus after 10^{100} years or so black holes of all sizes will have disappeared and all galaxies as we know them today will have been completely dissolved. The universe will then consists of stray neutron stars, Cold white dwarfs and smaller planets and pieces of matter that were thrown out of galaxies.

Slow and subtle changes:

The slow and subtle changes that will take place in the remaining pieces of matter were pointed out by F.J. Dyson of the Institute for Advanced Study, Princeton [6]. These process occur due to a phenomenon known as quantum tunneling. In this certain barriers known as potential barriers which can not be crossed according to classical physics can nevertheless be crossed according to the laws of quantum mechanics. Because of this phenomenon even the most rigid materials will change their shapes and chemical structure on a time –scale of 10^{65} years or so and behave like a liquid flowing into spherical shape under the influence of gravity. Also because of quantum tunneling any piece of ordinary matter is radio-active. Because it can release energy by nuclear fusion of matter other than neutron stars must ultimately decay to iron which has the most stable nucleus. The life –time for this is about 10^{500} to 10^{1500} years. Suppose we managed to isolate a cube of diamond in space: in 10^{100} years or so it will become a sphere of iron! Also because of quantum tunneling, all cold white dwarfs will collapse and become neutron stars in about 10^{10} years. In a similar period all neutron stars will collapse into black holes and eventually evaporate in accordance with the Hawking process. The other pieces of matter may also decay, but there are some uncertainties in our knowledge of the long-term stability of matter, though Dyson has discussed some possibilities [6l. All these will be affected if the proton is unstable.

Future of life.

lt is almost impossible to predict what forms living organisms will take (assuming they can survive) over such time scales as we have been discussing. However the possibility of survival of life in any form depends on availability of a source of energy, and one can discuss the latter. There will be adequate energy available as long as the Sun lasts, which will be a few billion years. After the demise of the Sun civilization could attempt to move to a different star, while supporting itself by artificial nuclear energy. In 10^{10} years or so all stars will have been extinguished, The remaining civilizations could attempt to extract energy from a' rotating black hole by a process suggested by R. Penrose of Oxford University. ln principle this situation may continue for about $10^{100\ \text{years}}$ as long as galactic black holes last and have rotational energy.

The question whether a civilization can survive indefinitely boils down to the problem of surviving on a fixed finite amount of energy. lt is very difficult to answer this question. but Dyson [6] has put forward interesting suggestions. He thinks it may be possible for a certain, perhaps artificial, form of life to exist indefinitely in an open Universe. However. this assumes that the proton does not decay, or that matter is stable.

Future of a closed Universe

The ultimate fate of the Universe is different if the Universe stops expanding and starts to contract. ln this case there will eventually be a universal collapse of all matter and radiation into a compact space of infinite or near infinite density. The timescale for this depends on the present average density of the Universe. Let us for the sake of argument assume that the present density is twice the critical density. Then the final collapse (the 'big crunch) will be of the order of a hundred billion years from now. There is very little hope of survival for life of any kind of closed universe. The only way in which a recurrence of life can occur is in the : event that the cycle of the 'big bang' and final collapse is repeated, and conditions for the existence of life again develop in some regions. Whenever or not this can happen (assuming that the Universe is closed) is not known. Finally, we will briefly consider two recent developments in particle physics and cosmology which have some bearing on the questions we have been discussing.

Massive neutrinos

According to the standard model. Matter and electromagnetic radiation were in thermal equilibrium in the early stages of the Universe after the 'big bang' They ceased to be in equilibrium when electrons combined with protons to form hydrogen atoms, thereby making the Universe 'transparent The 3^{o} K cosmic background radiation originally discovered by A.A. Penzias and R.W. Wilson is the remnant of the radiation that was in equilibrium with matter.

ln a similar manner. it is believed that in the very early Universe (within a second or so after the 'big bang`) enutrinos (mass less particles which have very weak interaction with matter and spin of half a unit like electrons and protons) ceased to be in equilibrium with matter. Thus there should exist also cosmic background neutrinos and it turns out the temperature should be about 2 ^{o} K. Present technology is not capable of detecting these background neutrinos, if they exist. There have recently been some indications that neutrinos may not be mass less as hitherto supposed, but may have a small mass. lf this is the case, and if background neutrinos exist. the present density of the Universe could be significantly more than has been supposed so far. ln particular, the massive neutrinos could possibly make the density of the Universe exceed the critical density and cause it to be closed. This question is under intense investigation

Proton decay

There are four kinds of force through which elementary particles interact with each other. These are in order of increasing strength --gravitational forces, forces of weak interactions, electromagnetic forces and forces of strong interactions or nuclear forces. It has been a dream of physicists to find a unified description of these forces within one theory. During -1967--68. A .Salam and S. Weinberg, developing earlier work of S. I,. Glashow (see, for example, [9] found a unified theory of weak and electromagnetic interactions. A prediction of this theory was the existence of particles known as $W^{\pm}$ and Z^{O}(the superscripts $\pm$ and ^{0} denote ` respectively the positive, negative, and neutral electric charges of these particles). These particles have recently Been discovered at CERN, with masses as predicted. After the success of the Salam-Weinberg theory there have been attempts to find a theory which unifies three of the strongest forces These theories, which are not definitive yet, are known as grand unified theories of GUTs. One of the predictions of these theories is that the proton, which has hitherto been supposed to last forever should in fact have a lifetime of $10^{31\pm2}$ years. There are important experiments under way in the United States, Europe, and India (the latter being an Indian-.Japanese collaboration) to determine if the proton is in fact unstable. The Indian- Japanese group have reported several candidates and the European one (CERN) have reported one candidate for proton decay [10]. But such a difficult experiment has to be repeated several times by different groups to get final confirmation. A similar experiment at Brookhaven under M. Gold harber has not found any decays and contradicts the Indian results. If the proton is unstable, it will have pro-found consequences for the far future of the Universe. Our cube of diamond will disintegrate into electron and positrons long before it becomes spherical or reduces to iron. The long term- future of life becomes very uncertain, since all matter is made of protons and neutrons (the latter would also decay). In Hawking's opinion ,even if GUTs are wrong and the proton is stable against the kind of decay predicted by them according to the quantum theory of gravitations should decay in any case, with a life time about 10^{45} to 10^{50} years. Thus if the proton is unstable for any reason the picture presented above will have to be suitably in modified.

Science Technology and Development in Bangladesh

I have been involved in research and teaching, in mathematical and theoretical physics, for almost four decades, and lived abroad for many years, over twenty years in the UK and about five years in the US. I returned to Bangladesh permanently in 1984. Apart from purely scientific matters, I have some interest in social problems, national, regional and global, and over the years I have developed a certain point of view and I would like to share some thoughts, for what they are worth, with listeners and readers about some of these matters.

Let me give a brief summery. I will discuss the relevance of science and technology for development and issues such as basic versus applied science and some other aspects of education. I will talk about negative effects of science and suggestions fore dealing with these. I will mention certain social problems, such as the gap between the rich and the poor, injustice in the society and human conflict. An important part of this presentation will consist of extracts from writings of distinguished scientists and other prominent men, which express in various ways their views of nature and the world and such matters that are worth pondering over. Some of these excerpts, but not all, I have mentioned in my earlier writings, from which I will take the liberty of drawing other material. One of the basic themes running through the discussion will be how to promote development and enhance harmony in society to ensure a better future for all. I have no definitive solutions, but only humble suggestions.

It is truism to say that the application of science and technology can help the developing countries to eradicate poverty, hunger and disease and raise the standard of living of the people. Thus it is well-known that modern agricultural methods can improve the yields of crops, modern medicine can check the prevalence of disease, and advanced communication networks can help improve the infrastructure that is needed in administrating these developments, and so on. In principles all these are possible, but in practice, many difficulties arise. Lacks of education, apathy, inefficiency, etc are well-known obstacles to progress in any field.

In any enterprise such as the application of science and technology for development, one needs the collective and strong will of the nation, with a nucleus of highly motivated and capable individuals who are supported fully by the society, government and the nation.

Partly for these difficulties, scientific and technological development cannot be seen in isolation, but must be seen as a part of economic, political, cultural, moral and intellectual development, which are all dependent on each other.

After this brief excursion into generalities, I want to consider some more specific points, such as the question of basic or fundamental as opposed to applied science, and would like to emphasize the need to promote basic science in the Third World, as well as applied science.

This point has been made in the past by Prof. Abdus Salam, among others. In this connection I would like to quote the following portion from the Draft National Science and Technology Policy of Bangladesh published by the Science and Technology Division of the Government of Bangladesh in 1985. I believe this is still relevant today:

> " While in a shattered economy like ours goal-oriented research will continue to be emphasized, a certain proportion of basic research must also be carried out in the Universities, Research and Development Organizations and other enterprises because it provides solid foundation to applied research and development. This type of research will be carried out by those with originality and innovativeness of a high order. Successful accomplishment of basic research .....results in the creation of manpower imbued with great intellectual quality, self-confidence and the ability to find new and innovative solutions to problems."

Basic and applied science complement each other. It is sometimes said that today's basic science is tomorrow's applied science. Let me give a couple of examples of the connection of basic with applied science. We use various forms of energy in our daily life, such as electricity in households. This is usually produced by some fuel, which produces energy through chemical reactions (such as burning) in which the outer electrons of atoms take part. An atom consists of a nucleus made of neutrons and protons, around which the electrons revolve. The nucleus is small and tightly bound, the electrons move in large and loosely bound orbits. The mass of the atom resides essentially in the nucleus, but the diameter of the atom is about a hundred thousand times larger than that of the nucleus. In one centimeter one can place about a hundred million atoms next to each other. Now it takes about a million times more energy to detach a neutron or a proton from the nucleus than it does to detach an electron from the atom. From this basic scientific fact we can surmise that from the same amount of suitable material one can get about a million times more nuclear energy than fuel energy. Of course production of nuclear energy must be made cheap and completely safe, problems which have been partially solved and are being considered both by theoretical and experimental physicists.

In Bangladesh, because of various problems that have been arisen in state educational system, private universities and colleges have a role to play in education. However, I believe the bulk of mainstream education, at all levels, must be provided by the state. The following excerpt from Adam Smith may be relevant (quoted by Amartya Sen in his Development as Freedom) in which he expresses "his frustration at the parsimony of public expenditure in the field of education":

> "For a very small expense the public can facilitate, can encourage, and can even impose upon almost the whole body of the people, the necessity of acquiring those most essential parts of education."

Private colleges and universities can play an important role supporting role to state situations. Both state and private academic institutions should be under the

“umbrella” of some central authority such as the Ministry of Education and the University Grants Commission, and there could be regular meetings and discussions to create and maintain an appropriate balance. An important aspects is that private academic institutions should be conscious that they exists not just for an affluent section of society, but they should make every attempt to be of genuine service to the whole academic community and society by providing scholarships to indigent students, library facilities to all the students and interested public, holdings regular seminars on matters of general interest etc. there are, of course, financial constraints and some of these activities may be taking place already, but these considerations may be kept in mind. I am sure efforts are being made in this direction, but further steps could be taken to make the cooperation between state and private education sectors more effective and meaningful.

The second example is so called superconductivity. It has been known for many decades that if the temperature of some metals is lowered below a certain point, the electric resistance disappears almost completely, which is then called a state of superconductivity. Until 1986 the temperature of the superconductors was fairly low and not so useful practically. In the last decade new superconductors have been found with high room temperature. If this trend continues and if superconductivity can be created at ordinary room temperature. this will have enormous significance for the energy industry, because one will be able to send electricity over vast distances at much reduced cost. The theoretical explanation of high temperature superconductivity is a difficult problem; the person who finds the answer will be fortunate. The scientists who found the phenomenon experimentally (Profs. G. Bednorz and K. A. Muller) were awarded the Nobel Prize.

Basic science is used increasingly in modern engineering. In many engineering projects the leaders have to know not only some basic science, but also economics and some social science. A writer makes the following comment about modern engineering:

> ***"The need for men who can view engineering, wide and complex as it is, as a single field of operation with relatively few basic laws and methods is increasingly recognized. Such men can work well with people from other disciplines and, when they gain sufficient experience and judgment, can successfully plan and direct vast enterprises."***

The importance of basic theoretical understanding in practical applications emerges also in the work of John Maynard Keynes, one of the leading economists of the century. In the preface of his famous book, The General Theory of Employment, Interest and Money, he says:

> ***"This book is chiefly addressed to my fellow economists. I hope that it will be intelligible to others. But its main purpose is to deal with difficult***

questions of theory, and only in the second place with the applications of this theory to practice.".

Notwithstanding the emphasis on theory, or perhaps because of it, the book has had an enormous influence.

One of the obstacles to good scientific research in Bangladesh as in many Third World countries is the poor quality of science education in schools and. colleges. There is little effort to impart to the students a true understanding of basic scientific principles. The students are not encouraged to find out and work out things by themselves - they usually get the material by heart and reproduce it in the examination. This reflects the poor quality of the teachers themselves. I believe if the teachers are exposed to a modicum of basic scientific research, this will improve the quality of their teaching, thereby contributing to good science education in schools and colleges.

At the Second General Conference of the Third World Academy of Sciences held in Beijing China in 1987, the late Prof. Abdus Salam made the following remarks:[3]

"I had the privilege of meeting Chairman Deng last year, when I came to China for preparations of this meeting. I was deeply impressed by his insistence on science transfer in addition to technology transfer. He remarked that the science of today is the technology of tomorrow, and that China and Third World must build tomorrow's Science for tomorrow's technology. In this respect, we of the Third World Academy of Sciences follow Chairman Deng's lead in humble way."

Prof. Salam went on to explain the main purpose of the meeting:

"… to honour the recent prestigious recent achievements of scientists of the south, by making prestigious awards in the basic sciences of Physics, Chemistry, Biology and Mathematics; to listen to them…"

" … to reflect on the growing gap in sciences between the South and North which, in our view, is the real reason behind the disparity in economic well-being and influence."

" It is a sad fact that the South , while it spends similar proportions of its GNP on defence, education and health as the North, does not spend more than on twelfth of the proportionate amount on science and technology. To highlight this, let us remember that if, like the North, the South was spend 4% of its educational budget on

basic sciences, this would amount to 3.5 billion dollars to be used for building up self-reliant basic sciences in the South. We shall be pleading for the allocation of 4% of the educational budget for basic sciences from the leadership of the South."

"… (A) most important reason for our being here in this beautiful city of Beijing is to study Chinese science in depth. As we all know, China was the world leader on creative technology until about 1600. Since 1949, it has had a state policy of enhancing science which has enabled China to increase its researchers' population from 500 in 1949 to 300000 in 1985 an incredible growth factor of 1: 600 in 36 rears with a high impact on China's development!"

The enormous 'growth factor', because of China's size and situation, is, of course, unrealistic for Bangladesh, but the emphasis on science is important. I remember th Chairman of the Local Organizing Committee , Prof. Lu Jiaxi, gave the following reasons for China's success in science: " Self-reliance and collective spirit". This could well be emulated in Bangladesh. [4]

It is well-known that there are some negative aspects of science and technology, which arise from their misuse. I wrote some years ago:[5]

" It is clear even to the causal observer that a certain aspect of science has been highly successful. We have television, jet airliners, space travel, and the many advances in medicine. The list is endless and well- known. As is also well-known, science and technology have brought in their wake weapons of destruction on an unprecedented scale which have raised acute political, social and moral problems as well as purely scientific ones. The tackling of those problems presumably require considerations other than purely scientific ones; in other words, the advance of science and technology has given rise to problems which cannot be solved by scientists alone. Even in the putative beneficial aspects of sciences there are problems. Technical developments have caused a proliferation of consumer and luxury items far beyond the needs of society, with consequent depletion of the source and valuable resources of the planet and concomitant danger to the environment, not to mention the dehumanizing effect of the ethos of the consumer society.

One of the things I want to stress is that we must get away from the idea of catching up with the First or the Second World. There are many aspects of the advanced world, which are direct results of technological innovations, which I believe are or would be undesirable for many societies of the Third World I do not simply mean thing like nuclear weapons, which are obviously a threat to the whole of mankind, nut more mundane things, such as the proliferation of automobiles in the advanced countries, with the concomitant pollution and nervous strain and road deaths. Another example

is the unprecedented increase in mindless television and video programmes, which is a direct result of technical advance. There are many such examples of so-called scientific development which would be, and in some cases already are, harmful for our societies." Let me now add a few somewhat pessimistic remarks, first by late Nobel Laureate radio astronomer Sir Martin Ryle: [6]" Our world is one-eyed evolution has now reached the stage where as a species we may soon die… we, as scientists should be able to see this more clearly than most and must use our influence to change the too limited aspirations governments."

The following is a quote from Bertrand Russell:[7]

" So long as national states exist and fight each other, only inefficiently can preserve the human race. To improve the fighting quality of separate states without having any means of preventing war is the road to universal destruction."

One of the starkest examples of what Russell had in mind is, presumably, the existence of nuclear weapons, which can destroy humanity many times over. Although scientists are not, in main, responsible for this state of affairs, I believe, as Ryle implies, they cannot be

absolved completely from their responsibility in this matter. Ryle's remark reminds us of the two world wars in which, at every stage, the governments involved thought they were following the right steps, leading eventually, to what sociologists would call 'unintended consequences of purposive action'. Over fifty million innocent people around the world lost their lives! I believe this could happen again, in regions including the

Indian subcontinent. Ryle's message seems to be that we must not allow this to happen again. There appears to be a Frankenstein in human beings, which surfaces now and then, which we must learn to recognize and control. It is almost as if we are pawns at the hands of some malevolent deity. playing out a sort of Hessian **" glass and game**" turned sinister!

Environment

I want to mention something about the environment, which has been much discussed in recent years. The problem of the green house effect and the ozone layer are well-known, in which much more work is needed which may take years if not decades. It is well said that we should regard the environment as not something that we have inherited from our forefathers, but as something we have borrowed from future generations; we must ensure that we leave it in at least as good a condition as we found it.

It is also clear that to solve the enormous problems of the environment, to devise means of having sustainable development into the indefinite future, it is not enough to do more research and work harder, but it is also a question of inculcating an appropriate ethos and developing a culture and civilization in the true sense, where the primary attitude of mind is that of mutual respect, care for the environment and concern for the well-being of all living creatures, instead of ,as at present, the acquisition of wealth and power through science and other means, and the use of these to dominate over other people and nations.

In each generation thinking and concerned citizens of the world must strive to create and maintain the new ethos. Each generation has to struggle to preserve, sustain and cherish life in this beautiful planet Earth –our home in the universe.

Further about science, technology, education and development

I would like to discuss some further points that relate to science, technology, education and development in a wide sense. As we know, purely scientific questions and problems can be extremely complicated and deep; it is natural that many meetings, conference and workshops are devoted entirely to such questions and problems. However, as indicated by the above remarks, the importance and technology for other fields of knowledge, for various human activities and for society in general is undeniable. We have a series of conferences at the Research Centre in Chittagong on the foundation and philosophy of mathematical and physical sciences, which are meant, in a small measure, and in our humble capacity to provide a forum in which wider questions relating to science can be discussed, primarily towards philosophy, passively leading to wider issues. Hya Prigogine, who was awarded the Nobel Prize for Chemistry in 1977.

says:

"The role of philosophy in motivating new avenues of research in science cannot be undermined. Philosophy's objective is to analyse the methods of science to axiomatize and to clarify the concepts used."

One is, for example, reminded of the circumstance that Einstein (1879-1955) was influenced in his General Theory of Relativity by the ideas of the philosopher Ernst Mach (1838-1916).

The year 1996 gave us the opportunity, in the third conference of the series just mentioned to commemorate two important events in the history of ideas, namely the four hundredth birth anniversary of Rene Descartes (1596-1650) and three hundred and fifty years of the birth of Gottfried Wilhelm Leibniz (1646-1716). They are

probably the only examples of a person who is a front-rank philosopher as well as mathematician.

Descartes was the greatest of French philosopher, whose astonishing analytical genius was displayed in the invention of coordinate geometry and in his contributions to theoretical physics, to methodology and to meta physics.

Russell says that Descartes

"is usually considered the founder of modern philosophy, and I think, rightly. He is the first man of high philosophic capacity whose outlook is profoundly affected by the new physics and astronomy."

He further says

" Descartes was a philosopher, a mathematician, and a man of science. In philosophy and mathematics his work was of supreme importance; in science,, though creditable, it was not so good as that of some of his contemporaries"

Leibniz was a ***"German philosopher, mathematician and man of affairs, one of the major systemic thinkers of modern times, important both as a metaphysicians and as logician and distinguished also for his independent invention of the differential and integral calculus."*** **Russell says Leibiz**, "was one of the supreme intellects of all time."

In the preface of his book History of Western Philosophy, Russell says, ***"With the possible exception of Leibniz, every philosopher of whom I treat is better known to some others than to me."*** Russell made a special study of Leibniz, so his views about the latter are important.

Leibniz invented calculus independent of Newton. All through his service he continued his intellectual pursuits, in Mathematics, science, technology, philosophy, theology, law; politics and history. The works that he left behind continue to be of great interest until the present time.

Betrand Russel himself was one of the great mathematicians in 20^{th} century. Not only that he was one of the great philosopher of the century. But he worked continuously more against war, for peace and humanity.

Those who think that scientists live in ivory towers, will be surprised to read the following excerpt from Roger Penrose's book ` Shadows of the Mind'. I am quoting at

some length because I consider this excerpt to be very relevant to the matters we are discussing.

Can robots save this troubled world?

“As we open our newspapers or watch our television screens. We seem to be continually assaulted by the fruits of Mankind’s stupidity. Countries, or parts of countries, are set against one another in confrontations that may, from time to time, flare into hideous warfare. Excessive religious fervour, or nationalism, or separate ethnic interests of particular demagogues, may result in continuing unrest and violence, sometimes boiling over to outbursts of unspeakable atrocity. Oppressively authoritarian regimes still subjugate their peoples, keeping them in check by the use of death squads and torture. Yet, those who are oppressed, and who might seem to have a common purpose are often locked in conflict with one another, and when given a freedom that they may have been long denied, may seem to choose to use that freedom in horribly self-destructive ways. Even in those fortunate countries where there is prosperity, peace, and democratic freedom, resources and manpower are squandered in apparently senseless ways, Is this not a clear indication of the general stupidity of Man” Though we believe ourselves to represent the pinnacle of intelligence in the animal kingdom, this intelligence seems sadly inadequate to handle many of the problems that our own society continues to confront us with.

Yet, the positive achievements of our intelligence cannot be denied. Among these achievements are our impressive science and technology. Indeed, whilst it must be admitted that some of the fruits of this technology are of distinctly questionable long-term (or short-term) value, as is borne witness by numerous environmental problems and a genuine fear of a technology-induced global catastrophe, it is this same technology that has given us our modern society, with its comforts, its considerable freedoms from fear, disease, and need, and with its vast opportunities for intellectual and aesthetic expansion, and for mind-broadening global communication. If this technology has opened up so many potentialities and, in a sense, increased the scope and the power of our individual physical selves, can we not expect much more in the future?

There is little doubt in my own mind that there is indeed, implicit in our (frequently computer-driven) technological society, at least one direction with an enormous potential for enhancing intelligence. I refer, here, to the educational possibilities of our society, which could gain great benefit from different aspects of technology-but only if it is used with sensitivity and understanding. Technology provides the potential, by use of well-produced books, film, television, and interactive computer-controlled

systems of various kinds. These, and other developments, provide many opportunities for expanding our mind or else for deadening them. The human mind is capable of vastly more than it is often given the chance to achieve. Sadly, these opportunities are all too frequently squandered, and the mind of neither young nor old are provided the openings that they undoubtedly deserve."

Incidentally Prof. Penrose lectured at the first Chittagong Conferences on Mathematical Physics in January 1986. The late Prof. Abdus Salam, who inaugurated the conferences, after his usual recitation from the Holy Qur'an, said: "I am happy to see Roger Penrose, one of the world's greatest mathematicians". Last year I was invited by Penrose to give a talk at Oxford. As usual, I used chalk and blackboard, and remarked that I have never seen Roger use anything but chalk and blackboard, or notes (except on one occasion when he used a hand-written transparency). Prof. Penrose has retired from the Rouse Ball chair of mathematics at Oxford; he was awarded the Order of Merit, Britain's highest civil award. He is making strenuous efforts to understand 'the mind'!

We continued with this 'collage', of seemingly disparate items which, nevertheless, hopefully, will form a harmonious and integrated whole.

Penrose has displayed considerable insight into the contemporary scene. I am sure he is aware of the unscrupulousness, or worse, of established institutions. The 'unspeakable atrocity ' of Hiroshima and Nagasaki were not Perpetrated by the likes of the Hutu and the Tutsi!

Kofi Annan, the UN Secretary –General, made the following statement at the general assembly in 1998:

"The member in which technical assistant is provided….. needs to be critically re-examined. Technical assistance as it was originally conceived was designed to close the technical capacity gap between industrial and developing countries by accelerating the transfer of knowledge, skills and expertise, thereby building national capacity. In some cases this has been done but, in many others, technical assistance has had precisely the opposite effect, reining in rather than unleashing national capacity. It has been observed that today, after more than 40 years of technical assistance programmes [in Africa],90 per cent of the $12 billion a year spent on technical assistance is still spent on foreign expertise-despite the fact that national experts are now available in many fields."

Self-reliance, or lack of it ,is I believe a major problem in Bangladesh. I have written and spoken about it several times in the past few years. Although some relatively minor benefits do accrue, foreign aid is not only unnecessary, in the long run it is damaging, and may eventually be devastating. The late Rajib Gandhi is reported to

have said in the Indian parliament that in the foreign aided projects, only 15% of the total amount allotted is spent on the actual purpose for which it is meant. Some years ago Dr. D.P. Pattanaik, a linguistics experts from India, visited the University of Chittagong. Dr. Pattanaik had received the “Padma Shree” from the Indian government and had been involved for some years in development work. He mentioned 5% instead of Mr. Gandhi’s 15% . Whether the actual figure is 5%,15% or 20%, it is clear from these remarks that a significant portion of the foreign aid funds to India used to go astray. This situation is consistent with the above statement by the UN Secretary –General. It appears that foreign aid to India has diminished considerably in recent years. It will be generally agreed that the physical and administrative infrastructure in

Bangladesh is weaker than in India. The percentage of foreign aid that is utilized is likely to be less than the figure mentioned. The last paragraph of the first essay in my Bengali book Shilpo Shahitto O Shamaj. ('Art, Literature and Society') published by Rahat-Siraj Publications in Chittagong in March 1998, reads. in translation, as follows the chapter is entitled Bangladesh Unnoyon ('Development of Bangladesh')]: ·

. "Let_us not impose on the tribal people the enormous imbalance that foreign aid has created in our country. We are more or less tolerating this condition (how much longer?'); they will not be able to tolerate it. At the same time. we must resist the negative effects created by foreign aid in our country. In reality, this is also one of the main reasons of the competition, sometimes leading to violence in the elections. Any government can bring under its control an enormous amount of money without sufficient accountability. Even though many in the government have good will, we are not sufficiently aware. Although there is some improvement. this helps to create that "secret jealousy". which eventually adds fuell to violence. I have said before, that I am for not taking a single penny of foreign aid. After my return to this country-twelve years ago, this conviction and opinion has grown stronger and stronger. " i _'

I returned permanently to this country in 1984. Although the book from which this extract is taken was published in 1998, clearly the piece was written around 1996. I I might add, in the year 2002, that after more than seventeen years of return to this country, this conviction is even stronger;

Writing about "***experiments in economic development in the modern era",***

Noam Chomsky. in his book 'Profit over People published in l999, makes the following remarks

’….the designers tend to do quite well. though the subjects of the t

experiment often take a beating."

The first major experiment was carried out two hundred years ago, when the British rulers in India instituted the **Permanent Settlement",** which was going to do wondrous things. The results were reviewed by an official commission forty years later, which concluded that **"the settlement fashioned with great care and deliberation has unfortunately subjected the, lower classes to most grievous oppression",** leaving misery that **"hardly finds a parallel in the history of commerce"**, as **"the bones of the cotton weavers are bleaching the plains of India."**

The remarks following the above excerpt from Chomsky's book are very significant.

"But the experiment can hardly be written off as a failure. The British governor general observed that "the*Permanent Settlement', though a failure - in many other respects and in most important essentials, has this great advantage, at least, of having created a vast body of rich land proprietors deeply interested in the continuance of the British Dominion and having complete command over the mass of the people."

The situation depicted in the last excerpt. I believe, has continued to the present times, in one or another. In view of what I have said earlier about foreign aid, one could make a parody of the above remarks, as follows:

"Foreign aid, though a failure in many other respects and in most important essentials, has this great advantage, at least, of having created a consideration body of rich professionals, administrations and politicians, deeply interested in the continuance of Western (and Eastern!) influence, domination and markets, and having a significant power over the mass of the people"

Thank you all for patient hearing.