Memorial Lectures

The Annual Rajiv Gandhi Science and Technology Lecture was delivered by Prof. Lord Martin Rees, Master of Trinity College, Cambridge and President of Royal Society. This annual event was held in Bangalore on 12 January 2007 in partnership with the Jawaharlal Nehru Centre for Advanced Scientific Research and the Indian Institute of Science. It attracted a large and distinguished audience from Bangalore's scientific community.

The theme of Prof. Rees's lecture was '21st Century Science: Cosmic Perspectives & Terrestrial Challenges'. Some excerpts are reproduced here. The full lecture is available from the Foundation.

We were also privileged to welcome Prof. Wangari Muta Maathai, the 2004 Nobel Laureate for Peace, to deliver the Eighth Rajiv Gandhi Memorial Lecture in New Delhi. She spoke with passion and eloquence and touched many hearts. An abridged version of her lecture is reproduced here. The full lecture is available from the Foundation.

Excerpts from The Twelfth Rajiv Gandhi Science and Technology Lecture by **Prof. Lord Martin Rees**, President, The Royal Society, London

"21st Century Science: Cosmic Perspectives & Terrestrial Challenges"

The Three Frontiers of Science

General relativity and quantum theory are the twin pillars of 20th century physics. But at the deepest level they contradict each other – they haven't yet been meshed together into a single unified theory. In most contexts, this does not impede us because their domains of relevance do not overlap. Astronomers can ignore quantum fuzziness when calculating the orbits of planets (and in all larger systems). Conversely, chemists can safely ignore gravitational forces between individual atoms within a molecule because they are nearly 40 powers of ten feebler than electrical forces. But at the very beginning of the cosmic expansion, when everything was squeezed smaller than a single atom, quantum fluctuations could shake the entire universe. To confront the overwhelming mystery of what banged and why it banged we need a unified theory of cosmos and microworld. Einstein famously spent the last half of his life searching in vain for such a theory. In retrospect, his efforts were doomed, because little was then known about the forces that hold atomic nuclei together, and because he was famously dissatisfied with quantum mechanics.

Prof. Lord Martin Rees

But there is now intense effort on these theories. Just as all material has an atomic structure, theorists believe that space and time are themselves structured on some tiny scale – a trillion trillion times smaller than atoms. According to superstring theory, what we think of as a point in our ordinary space may actually be a complex origami in six further dimensions, so tightly wrapped that it is very hard to detect it.

The elaborate geometry of ten dimensions may lead to the unified theory that Einstein vainly sought – a theory which might (incidentally) yield a deeper understanding of 'lambda'. The quest is no longer premature. I say 'may lead', because there's no guarantee that even a 'new Einstein' would succeed. Indeed, this opens issues of the limits of science, and the genuine issue of whether human brains are matched to these subjects? It is remarkable that our brains, which evolved to cope with the everyday world encountered by our remote ancestors on African savannahs – should have been able to achieve an understanding of the cosmos and the microworld. But perhaps we will hit a limit: even if there is a unified theory, it could be beyond our mental powers to grasp it – just as quantum mechanics is beyond the mental powers of a dog.

A unified theory would be the culmination of an intellectual quest that started with Faraday and Maxwell's unification of electric and magnetic forces and continued through Einstein and others. It would exemplify what Eugene Wigner called "the unreasonable effectiveness of mathematics in the physical sciences".

But I hope it is not curmudge only to point out that a 'final theory' would offer absolutely zero help to 99 per cent of scientists. Calling it a "theory of everything", as some popular books do, is hubristic and misleading.

It would indeed unify two great scientific frontiers, the very big and the very small. But there is a third frontier: the very complex. The most complicated entities we know of – we ourselves – are midway between atoms and stars. It would take about as many human bodies to make up a star as there are atoms in each of us.

Indeed, our everyday world presents intellectual challenges just as daunting as those of the cosmos and the quantum. The weather is harder to predict than celestial orbits are. Insects are harder to understand than stars – their structure is far more intricate. Dietetics and child care – two subjects we all care about – are notorious for their lack of consensual progress.

Complexity has a comparable intellectual icon, of course – Charles Darwin. Like Einstein, his legacy is a great unifying idea– though he was a thinker of utterly different style – a 'synthesiser' where Einstein was a system-builder. He showed how, in the famous concluding words of the *Origin of Species*: "whilst this planet has been cycling on according to the fixed law of gravity, from so simple a beginning... forms most wonderful have been and are being evolved".

Cosmologists aim to trace things back before Darwin's "simple beginning" – to set our Earth in a broader cosmic context, and to understand the origins of planets, stars, and the atoms they're made of. The sciences are sometimes likened to different levels of a tall building – particle physics on the ground floor, then the rest of physics, then chemistry, and so forth: all the way up to psychology – and the economists in the penthouse. There is a corresponding hierarchy of complexity – atoms, molecules, cells, organisms, and so forth.

But the analogy with a building is poor. The 'higher level' sciences dealing with complex systems have their own autonomous concepts, and aren't imperilled by an insecure base, as a building is. To understand why flows go turbulent or chaotic, or why waves break, we treat the fluid as a continuum – its subatomic details are irrelevant. An albatross returns predictably to its nest after wandering ten thousand miles in the southern oceans. But this is not the same kind of prediction as astronomers make of celestial orbits and eclipses.

Twenty-first century technology offers huge opportunities; but it will present new threats, and new ethical dilemmas more diverse and more intractable than nuclear weapons did. It will, for the first time, change human beings themselves – through mind-enhancing drugs, genetic modification, and 'cyberg' techniques.

Problems in biology, and in environmental and human sciences, remain unsolved because scientists have yet to elucidate the patterns, structures, and interconnections – not because we don't understand subatomic physics well enough.

Life In Space

We've recently learnt something that has made the night sky far more interesting. Stars aren't mere twinkling 'points of light'. They are orbited by retinues of planets, just like the Sun is. So far, such planets have been detected only indirectly – and the techniques are only able to detect planets resembling Jupiter and Saturn, the giants of our Solar System, rather than objects the size of the Earth. However, we may not have to wait more than a decade or two before this becomes possible.

Is there life on these worlds? We know too little to assess whether this is likely or unlikely. I'm hopeful that in the coming decades we'll understand how life began here on Earth and know whether simple life is widespread. Even if primitive life proves to be common, the emergence of 'advanced' life may not be.

What about human life spreading beyond the Earth? Later this century, it's likely that robots and fabricators will pervade the solar system. But will people have followed them?

In the 1960s manned spaceflight went from cornflakes packet to reality. But since then its glamour has faded. It is 34 years since the last lunar landing. The Apollo programme is a remote historical episode: children know the Americans landed men on the Moon, just as they know the Egyptians built the pyramids; but the motivations seem almost as bizarre in the one case as in the other.

When I am asked about the case for sending people into space, my answer is that as a scientist or practical man I'm against it, but as a human being I'm in favour. Practical activities in space – for communications, science, weather forecasting and navigation) – are better (and far more cheaply) carried out by computers and robots. The practical case for manned spaceflight gets ever-weaker with each advance in robotics and miniaturisation.

The international space station is a huge turkey in the sky – neither practical nor inspiring. I am nonetheless an enthusiast for space exploration as a long-range adventure for (at least a few) humans.

I hope humans will sometime venture to the Moon and beyond – and indeed that some people now living may walk on Mars.

The first travellers to Mars, or the first long-term denizens of a lunar base, would confront hostile environments: nowhere in our Solar system offers an environment even as clement as the Antarctic or the top of Everest.

Space doesn't offer a solution to Earth's problems. Indeed we could be threatened by space technology were it used to develop weaponry – that is just one example of the misdirection of technology. I shall refer later to others.

Einstein's Broader Influence

Back, now, to Einstein. His 'archetype' status has a downside: it unduly exalts "armchair theory". Pure thought by itself would not have got us far – we are no wiser than Aristotle was. The cumulative advance of science requires new technology and new instruments – in symbiosis, of course, with theory and insight. The cosmic discoveries I mentioned earlier depended on space technology, sensors for faint radiation, powerful computers, and so forth: instruments like the great particle accelerator at CERN in Geneva; the world's largest optical facility, the VLT in Chile; and the GMRT, the giant radio telescope here in India.

Why has Einstein's fame so disproportionately eclipsed other 20th century scientists – Planck and Bohr, Dirac, and Schrodinger? Partly, perhaps, because he engaged more overtly with themes that fascinate so many people – time, space, origins and the cosmos. It was fortunate for science that its pre-eminent practitioner purveyed such an engaging and idealistic image, and was always ready with a cogent aphorism.

Einstein's fame extends far wider than science. He is as much

an icon of creative genius as Beethoven. His impact on culture has been pervasive, but ambivalent. It seems a pity, in retrospect, that he called his theory 'relativity'. Its essence is that the local laws are just the same in all inertial frames. 'Theory of Invariance' might have been an apter choice, and would have staunched the misleading analogies with relativism in other contexts.

But in its humanistic 'spin-off' relativity has fared no worse than other pivotal scientific concepts. Heisenberg's uncertainty principle – a mathematically precise concept – has been hijacked by devotees of mysticism. And Darwin has likewise suffered tendentious distortions, especially in applications to human psychology.

But in one important respect, Einstein had an exceedingly positive global influence, which still resonates – and this leads in to the second theme of my lecture. When the nuclear threat first loomed over us, he was an inspiration and moral compass to other scientists. Back in 1955, just a week before he died, he co-signed, with Bertrand Russell, a manifesto that launched the Pugwash Conferences, an international forum for scientific discussions on disarmament and world affairs.

It was Joseph Rotblat who organised the Einstein/Russell manifesto, and became the driving force behind Pugwash. He died in 2005, aged 96, but until his very last year he campaigned and travelled untiringly in the cause of nuclear arms control.

Rotblat was among those who worked at Los Alamos on the Manhattan project that led to the atomic bomb. The great Hans Bethe was another. These people belonged to the 'golden generation' of physicists who established our modern view of atoms and nuclei. After World War II they did not say that they were 'just scientists' doing their job. They deemed it their duty to alert the public to the implications of their work, and to campaign for arms control.

These men set an admirable precedent for researchers in any branch of science that has grave societal impact.

21st Century Hazards

The nuclear threat will always be with us. But it is based on basic science that dates from the 1930s. What are the potential impacts of 21st century science?

A few years ago I wrote a short book. I entitled it 'Our Final Century?' My UK publishers deleted the question mark. The American publishers wanted a scarier title – 'Our Final Hour'. In the US, people want instant (dis)gratification. My theme was actually a serious one – that the Promethean power of science and technology will offer myriad opportunities, but will also confront us with ever more threats and ethical conundrums than nuclear weapons did. We are entering an era when – for the first time – our species can threaten the Earth's future. Over most of history, the threats have come from nature – disease, earthquakes, floods, and so forth. But now they come from us: we have entered what some call the anthropocene era.

I guessed that, taking all risks into account, there was only a 50 per cent chance that we would get through to 2100 without a disastrous setback. This seemed a depressing conclusion. However, I was surprised by how many of my colleagues thought a catastrophe was even more likely than I did, and so considered me an optimist.

There are indeed powerful grounds for being a techno-optimist.

But we can plausibly predict some disquieting trends. Technology offers greater opportunities then ever before, but poses graver risks too. These may not, like nuclear war, threaten a sudden world-wide catastrophe – but they are, in aggregate, as worrying and challenging.

Human actions are transforming, even ravaging, the entire biosphere – perhaps irreversibly – through global warming and loss of biodiversity. In our ever more interconnected world – where more people, worldwide, live in megacities – there is greater vulnerability to infectious diseases. And we're causing a sixth wave of extinctions. The depletion of fish stocks, for instance, is causing concern. Overall, the loss of species may equal that in the five great extinctions in the geological record– we are destroying the book of life before we have read it. We've entered the new geological era, the anthropocene. We don't fully understand the consequences of our many-faceted assault on the interwoven fabric of atmosphere, water, land and life.

These environmentally-driven threats – 'threats without enemies' – need international priority. They should loom as large in the political perspective as did the East/West political divide during the Cold War era. Unless they rise higher on international agendas, remedial action may come too late to prevent 'runaway' climatic or environmental devastation.

Highest on today's agenda seem to be the linked issues of energy and climate. Owing to the burning of fossil fuels, CO_2 levels are higher than at any time in the last half million years. The International Energy Agency (IEA) has forecast that, on current projections, coal, oil and gas will supply most of the world's ever-growing energy needs for decades to come. Because of growth in the developing world, by 2030, energy consumption will then be 50 per cent higher than today. If that trend continues, CO_2 will rise to 550 parts per million – twice the pre-industrial level – by 2050, and three times that level later in the century.

The higher CO_2 rises, the greater will be the chance of something grave and irreversible: the melting of the Greenland icecap and so forth. The environmental cost curve is convex – twice as much temperature rise is more than twice as bad.

Some adverse effects of warming can be offset by adaptation, but the most vulnerable people are in Africa, Bangladesh and similar regions – and they are the least able to adapt. The cost of coping with increased heat and drought and reduced biodiversity would negate the benefits of aid.

Climate change is a global threat and needs global remedies – remedies that combine adaptation and mitigation, with the economic burdens equitably shared. It's now a political and economic problem – even more challenging than the science.

The challenge of global warming should stimulate R and D into a whole raft of manifestly benign innovations – for

conserving and storing energy, for sequestration of carbon from fossil-fuel-burning power stations, and for power generation by novel 'clean' means (biofuels, innovative renewables and nuclear fusion). The expertise in this country can be crucial here – and there must surely be a hope that India can achieve Western-level prosperity via the 'cleaner' and more efficient generation of energy.

The stakes are high – the world spends three trillion dollars per year on energy. The proportion of that which is now spent on R and D is miniscule.

These are long term issues. But all of us are surely mindful of our heritage, and the debt we owe to centuries past. History will judge us harshly if we discount too heavily what might happen in 50 or 100 years. Humans are collectively endangering our planet, but there are novel and growing vulnerabilities from individuals too.

...environmentally-driven threats – 'threats without enemies' – need international priority.... Unless they rise higher on international agendas, remedial action may come too late to prevent 'runaway' climatic or environmental devastation.

Technical change is so fast that we cannot confidently conceive what people's lifestyles, attitudes, travel patterns and energy needs will be beyond 2050. The world's geopolitical and economic pattern could be hugely changed from today's. Twenty first century technology offers huge opportunities; but it will present new threats, and new ethical dilemmas more diverse and more intractable than nuclear weapons did. It will, for the first time, change human beings themselves – through mind-enhancing drugs, genetic modification, and 'cyberg' techniques. Even a single technically-capable person will soon have the capability to cause massive disruption through error or terror. The relevant techniques and expertise will be accessible to millions – they do not require large special purpose facilities, as nuclear weapons do.

Opinion polls show that people are positive about science– indeed they trust scientists (especially those in academia) more than they trust most other trades and professions. But they worry that science's applications could be running out of control. There will be more and more 'doors that we could open but which are best left closed' – for ethical or prudential reasons.

Scientists surely have a special responsibility. The atomic scientists inspired by Einstein set a fine example. They didn't say that they were 'just scientists' and that the use made of their work was up to politicians. They took the line that scientists should not be indifferent to the fruits of their ideas – their intellectual creations.

Scientists should try to foster benign spin-offs of their research, but constrain, so far as they can, the threatening 'dark side'.

Cosmic Perspective

Ever since Darwin, we've been familiar with the stupendous timespans of the evolutionary past. But most people aren't yet mindful that the vistas stretching ahead are even longer – they could be infinite. Our sun is less than half way through its life. Six billion more years will elapse before it flares up, engulfing the inner planets. There is enough time for further evolution as dramatic as what's led from the very first life to humans. It will not be humans who witness the Sun's demise: it will be entities as different from us as we are from bacteria.

Suppose some aliens had been watching our planet for its entire history, what would they have seen? Over nearly all that immense time, 4.5 billion years, Earth's appearance would have altered very gradually. The continents drifted; the ice cover waxed and waned; in accord with Darwin's concepts, successive species emerged, evolved and became extinct.

But in just a tiny sliver of the Earth's history – the last one millionth part, a few thousand years – the patterns of vegetation altered much faster than before. This signalled the start of agriculture. The pace of change accelerated as human populations rose. But then there were other changes, even more abrupt. Within fifty years – little more than one hundredth of a millionth of the Earth's age – the carbon dioxide in the atmosphere began to rise anomalously fast. The planet became an intense emitter of radio waves (the total output from all TV, cellphone, and radar transmissions.)

And something else unprecedented happened: small projectiles lifted from the planet's surface and escaped the biosphere completely. Some were propelled into orbits around the Earth; some journeyed to the Moon and planets.

If they understood astrophysics, the aliens could confidently predict that the biosphere would face doom in a few billion years when the Sun flares up and dies. But could they have predicted this unprecedented spike less than half way through the Earth's life – these human-induced alterations occupying, overall, less than a millionth of the elapsed lifetime and seemingly occurring with runaway speed?

If they continued to keep watch, what might these hypothetical aliens witness in the next hundred years? Will a final spasm be followed by silence? Or will the planet itself stabilise? And will some of the projectiles launched from the Earth spawn new oases of life elsewhere?

The fate of this 'pale blue dot' in the cosmos will depend on how we choose to apply our expanding scientific knowledge. Choices made in this crucial century will resonate into the more distant future, perhaps even far beyond the Earth.

The young Einstein's science will plainly endure. But a sure future for our fragile planet requires also the vision of the old Einstein – global, humanistic and far-seeing. Wise choices will require idealistic and effective campaigners – not just physicists, but biologists and environmentalists as well. They must be inspired – as were Jawaharlal Nehru and Rajiv Gandhi – by the belief that science offers bright prospects for India and for the world, provided that it is channelled with wisdom and vision.

Excerpts from the Eighth Rajiv Gandhi Memorial Lecture by **Prof. Wangari Muta Maathai**, Nobel Laureate

"Environment, Democracy and Peace: A Critical Link"

In 1972 the world met in Stockhom, Sweden and discussed the Human Environment for the first time under the auspices of the United Nations. At that conference it was Indira Gandhi who drew attention to the world that poverty was one of the great pollutants.

Since then, the world may not have done much to reduce poverty and economic injustices everywhere, but it has understood that poor people tend to overuse their environment and subsequently, a degraded environment is unable to support livelihood. Indeed it pushes people into even greater poverty. Understanding that linkage between poverty and the environment is crucial to sustainable development and we owe that insight to Indira Gandhi.

Prof. Wangari Muta Maathai

It took the next three decades before the Norwegian Nobel Committee would draw the world's attention to the fact that there is a strong linkage between the environment, governance and peace. The Committee called upon the world to expand the definition of peace and security and to include in that definition, responsible and accountable management of the limited resources on the planet. It also called upon the world to look at the more equitable distribution of those resources.

In order for humankind to manage and share resources in a just and equitable way, there is need for a governance system that is more responsive and inclusive; one in which most people feel that they belong, and one in which the voice of the minority is listened to even if the majority will have their way; one that respects human rights, the rule of law and deliberately and consciously promotes equity. Indeed, many of the conflicts and wars in the world are over access, control and distribution of resources like water, food resources, grazing ground, minerals and land.

Conflicts and wars are born out of a feeling of injustice, exclusion and oppression. When people feel that they are not receiving justice and equity, that they are marginalized or discriminated against, they seek justice and equity, using whichever means are available to them, sometimes violence and sometimes non-violence.

By managing resources better, by recognizing the link between sustainable management of limited resources and conflicts, mankind is more likely to pre-empt the root causes of many conflicts and wars and create a more peaceful and secure world. That is the link between environment and peace. You will remember that when the environment was recognised in the year 2004 by the Nobel Peace Prize Committee, many people had doubts on the connection between peace and trees. Well, that is the connection. By managing resources better and recognising this linkage we can decide to get to the root causes of the conflicts.

An appreciation that a degraded environment leads to conflicts as communities scramble for the available limited resources is what partly inspired the establishment of the Green Belt Movement, some thirty years ago in Kenya. Initially the activity was devoted to planting trees and protecting forests, to meet the felt needs of communities. But in the course of time, the need for good governance, respect for human rights and promotion of equity became evident because without these it was impossible to live in peace in long term. Therefore, the Green Belt Movement embraced a pro-democracy campaign for better governance even while working for the protection of the environment.

During that period an approach for environmental primary care was developed that was intended to empower citizens to take action to improve especially their immediate environment, understand how good governance is necessary for responsible and accountable management of resources and embrace the challenge of being part of the solution rather than complaining about it.

The Green Belt Movement has shared this approach with many other countries especially in Africa where the continent is threatened especially by desertification processes, where the majority of people still practice subsistence agriculture and depend on fuel energy. The Green Belt Movement shares information and opportunities to have experiential learning by working directly with rural communities.

The involvement of citizens is extremely important because citizens must recognize the resources and the process of protecting them. Therefore, informing, practicing, getting rid of inertia and moving to take action is very important in this campaign.

Much of the funds raised both at home and abroad go into planting of trees, for educating people on civic and environmental education, advocacy and networking.

The largest numbers of participants in the Green Belt Movement are women and they have made tree planting an income generating activity, because for every tree that is planted and survives women are paid about ten US cents and this money is used to meet the felt needs of families like food, clothing, school fees and domestic utensils and even for shelter. And there is nothing more satisfying than to have a family tell you that they have beautified their homes with the trees they themselves planted.

The Green Belt Movement was initiated in 1977 at the occasion of World Environment Day and seven trees were planted. Today, we are counting forty million trees and are still counting. And so we feel extremely encouraged from seven trees to forty million trees. The reason we share this number is not to impress, because there is nothing to impress about, because there is still a lot of work to be done, but especially to be able to empower ourselves and to appreciate that no matter how much the problem is, we must never give up. And that we start small and work and work towards our destiny. It is reason for ordinary citizens to empower themselves and to take action rather than complain, and also to encourage each other to take action.

Individually and collectively we can all make a difference.

It is also for that reason that recently, with UNEP, the United Nations Environment Programme, the Green Belt Movement and ICRAF launched a campaign to plant a billion trees worldwide. And if that word has not reached India I hope it will reach today. We are in need of planting a billion trees worldwide and I know Indians can do that on their own if every Indian planted a tree.

In doing the work of the Green Belt Movement, we have been faced with many challenges some of which I would like to share. First of all, we find that everybody wants to delay decisions on actions which would benefit the environment. The responsibility to inform and encourage people to take action becomes a very heavy burden because as soon as you have spoken people seem to forget what you have just said.

As for the poor in the world, they are often caught in a vicious cycle of living in a degrading environment and therefore, remaining poor or getting poorer because their environment continues to degrade. Sometimes a degraded environment is all that is available to them. They are often trapped in a cycle of poverty, powerlessness and degraded land and settlements. The challenge for them to break that cycle through training and empowerment initiatives takes resources, time, patience and commitment. Many people want results yesterday and so it is very, very difficult sometimes to convince them, especially the development agencies, that these issues take time, that we need to be patient.

It is the future generations that will confront the consequences of today's destructive activities of the current generation. Sometimes it is people far away from where the destructive activities are that pay the price.

As we all know, the environment degrades slowly and may not be noticed by the some people even if it happens right there before their very eyes. If they are poor, selfish, greedy or corrupt they would be more concerned about satisfying their immediate needs and wishes than worrying about the consequences of their actions especially in the long term.

Unfortunately, the generation that destroys the environment may not be the one that pays the price. When forests are cut, for example, leaves dry up slowly and so it is lost a little at a time. It is the future generations that will confront the consequences of today's destructive activities of the current generation. Sometimes it is people far away from where the destructive activities are that pay the price. For those causing the trouble, it is more convenient to postpone concern for environmental problems to a later date when there will be no elections and when survival is not a priority. One of the issues that even the future generations will have to deal with is climate change, which the Kyoto Protocol was endeavouring to assist.

The responsibility to address the problems in good time for the common good of all calls for visionary political leadership. It also calls for will on the part of governments and corporate social responsibility on the part of the corporations and business partners. Individuals too have choices to make. Recently, I learnt that we each one of us need at least ten trees to take care of the carbon dioxide we individually exhale. So there you are! Where are your ten trees? If any one of you has not planted his or her ten trees you are using somebody else's trees. I have also been advised that I shall probably have to plant eight trees upon my arrival in Kenya to deal with the greenhouse gases that will be emitted as a result of my coming here to India. So it means every time I travel I have to plant some ten trees. More and more we should become conscious of the impact of our individual actions. This is what I am trying to draw your attention to so that we can see what we ourselves do, what kind of footprints we leave behind.

While it is important to plant trees it is also very, very important to protect the trees that are standing. National forests are especially important now that scientists have expressed their concern regarding climate change and its consequences. At least now we cannot say 'may be', 'perhaps'. Forests are major

carbon sinks and sites of immense biodiversity, much of which is still to be discovered.

Many countries in the world that have their own land covered with forests are involved in the logging of forests very far away from home. This disconnect needs to be addressed because the world is one and we need to protect not only the local environment but the environment far away. The services that the Amazon basin is providing to us all on the planet is not far even though the forest itself, may seem to be very far from us. This is because while some resources like the huge forests ecosystems within the tropics may be very far, their services impact on us at distant places.

But there is constant pressure to sacrifice forests for human settlements, agriculture and industry. We need the forests, but forests do not need human settlements. Whatever options we must make, it is always better to be guided by the common good, not only of the present generation, but also of generations to come. Politically, it is more expedient to sacrifice the long term common good and the intergenerational responsibility for the convenience and opportunities of today. But morally, we are required to make the better options for the common good of all. We have a responsibility to protect the rights of generations which cannot speak for themselves today.

Perhaps another way of putting it is to say that humankind needs a clean and healthy environment to sustain life, but the environment does not need humankind. This is as true today as it will be true many generations down the road of time.

Governments and corporations can do a lot to assist societies adapt and adopt lifestyles that are less dependent on fossil fuels and resources that are limited. Some of the doable initiatives to deal with climate change include consuming less energy and other limited resources, planting trees, protecting those that are standing, investing in research and development of other sources of energy like wind, solar and hydropower. Nuclear power has enough controversies especially with respect to the issue of security and safety and that debate will continue.

At an individual level we can do a lot to conserve the resources we use. For example we can learn to conserve water. In the morning we wash and when you live in a country where there is a lot of water it is very easy for you to open the tap and let it run because you are not concerned. But sometimes, even if you don't need to conserve, you train yourself to conserve in order to draw attention to yourself that you are dealing with a resource that is extremely scarce and in many parts of the world people do not have access to clean drinking water. And if what is happening to the world continues, water is indeed going to be one of the resources that we are going to wage war over. I wish to emphasise the fact that protecting the environment and promoting cultures of peace takes patience, it takes commitment, it takes persistence. Too often we want things to happen yesterday. We have to be patient, we have to be committed and we have to stay on course. It has to become a conscious and a deliberate struggle to change our mindset to include the environment into our equation of peace and security. We need to bring into our discussions and into our mindset the issue of equity. It is not possible to live in peace if we do not have equity. It is not justice to have a large number of people living in utter poverty while others are living in utter affluence. Somehow, sooner or later, we must change our mindset so that we can look for a balance.

Perhaps another way of putting it is to say that humankind needs a clean and healthy environment to sustain life, but the environment does not need humankind. This is as true today as it will be true many generations down the road of time.

In conclusion, let me share with you a short story that reminds me about that need to take action, the need for patience, the need to be committed and the need to be persistent. It is a story of a hummingbird. I actually heard this story in Japan

Well, there was this huge forest that caught fire and all the animals in the forest decided to leave the forest and save themselves. They came to the edge of the forest and watched the fire from a distance: overwhelmed and disempowered by the raging fire.

Except this hummingbird, which said, 'I am going to do something about the fire!"

And so it flew to the nearest stream and brought a drop of water in its beak and put it on the raging fire! It flew fast back and forth, every time bringing a drop of water in its beak and putting it on the fire.

In the meantime the other animals were watching in dismay as the fire raged. "What can you do?" the other animals wondered aloud. "You are too small, you cannot put off such a fire!! Come and join us and watch the fire!!"

Unmoved, the hummingbird kept its focus, maintained its commitment, remained focused and responded without losing patience or speed.

"I am doing the best I can!" And that is what we are all called to do. No matter who we are, no matter where we are, no matter how overwhelmed we may be, we must always do the best we can.

And that is what we are called to do: the best we can!