Future Trends in the Exploration, Use and Mis-Use of Outer Space

by

Prof. U. R. Rao
Member, Space Commission/Dr. Vikram Sarabhai Distinguished Professor
Department of Space, Bangalore, India

1. Introduction

Prof. Kusru, His Excellency, the Ambassador of Germany, Dr. Stephan Von Welck and Distinguished members of the audience.

I am indeed very grateful for the opportunity to speak on "Future Trends in the Exploration, Use and Misuse of Outer Space", a subject which is as vast as space itself and which, more than any other discipline, will dictate the course of human history in the next millennium. My own connection with Germany goes a long way back. I knew Dr. Von Braun very well and in fact we were Co-Chairmen of an important Space Conference in Texas in the 1980s. Even prior to that, during my tenure as a Post Doctoral Fellow at MIT in the late sixties, I was a colleague of Dr. Reimar Lust of Germany who was the past President of the European Space Agency and now is the Chairman of the Humboldt Foundation. We had two other illustrious colleagues working with us at the same time, Dr. Minoru Oda of Japan and Dr. Ken McCracken from Australia, both of whom played a stellar role in the development of space activities in their own countries.

The cooperation of ISRO with the Space Agency of Germany DLR has been outstanding over the years. What started as a one way street for the training of young ISRO scientists in German Space Establishments has now grown to become a two-way street involving, as the Ambassador stated, launching of the German remote sensing pay-load on our satellites. This is to be followed by the launching of the German built satellite on our PSLV in the next few months. The data from our remote sensing satellites IRS-1C and IRS-1D, which are undoubtedly the best remote sensing satellites in the contemporary civilian world today, are now regularly being received in Germany, through a cooperative arrangement. This is the second such ground station to be established in a foreign country, after the EOSAT station in Norman, Oklahoma in USA.

2. Developments in Space

As we enter the third millennium, we may look back at the amazing discoveries and developments, in the field of space science and technology during the last four decades, since the birth of the space age initiated by the launch of the Russian Sputnik in 1957. My friend Prof. Kusru referred to our planet earth as a global village, because as we view the earth from the vastness of space, it is truly a small village. While space has no doubt established human connectivity across the entire planet extending even to the remotest corners of the world, the real question is what is the nature of this global village ? I will come back to this question a little later.

The rapid developments in space technology spurred initially by the severe competition between the two super powers provided a great impetus to space science resulting in spectacular discoveries. Space technology opened up the entire window of the electromagnetic spectrum to the scientists who were till then essentially viewing the Cosmos through the intervening atmosphere primarily in the narrow optical window. This enabled space scientists to discover entirely new celestial objects in the sky which were predominantly emitting radiation in the ultra violet, infrared, X-rays and Gamma Rays. Exotic celestial objects like Pulsars, Neutron Stars, Quasars and even Black holes, which were not even dreamt off, were discovered in quick succession taking advantage of the availability of space platforms. Scientists could trace back the history of the universe all the way to the so called Big Bang beginning though the faint microwave remnant from the birth of the universe and extend their vision to the end of the universe. Today we are excited about the possibility of life on Mars. A few planetary systems, other than our own, have been discovered adding to the speculation on the existence of intelligent life elsewhere in the universe. Planets and Planetary atmospheres, compact objects and galaxies, stars as they are born and those which are exploding have all now become accessible to us. While we did not even know that Earth had a magnetosphere, now we are able to look at magnetospheres of solar system planets, and distant stars.

It was Prof. Ludwig Bierman of Germany who originally hypothesized the existence of continuously blowing supersonic plasma stream, later named as solar wind by Dr. E. Parker, by examining the dynamics of comet tails. The successful discovery of the continuously blowing solar wind oozing out of the sun at a tremendous velocity of 300 to 1000 kms per second by Mariner-II in 1966, with which I was also associated, provided the first clear proof of its existence. Very soon it was clear that this tenuous plasma stream is what provides the energetics for many of the spectacular phenomena happening on the Earth, such as the magnificent aurora, magnetic storms, electrical break downs, etc. We now know that Venus is so hot, that even lead can melt. Even more, with the sulfuric acid raining all the time, it is such a hell that I do not think, anybody would like to go there. We have been able to virtually stare at Comet Haley from the Giotto spacecraft and look at its physical and chemical composition. We have already begun discussion on Kuiper Express which will take a close look at the asteroid belt. No doubt, in not distant future, we will be able to realise the dream of Tsilkovasky, who prophesized that "One day we shall be able to ride on the asteroids". Space technology has opened up the entire universe providing us, for the first time, a proper perspective of the significance of human beings on this planet. Hopefully, we will not only discover life but even intelligence elsewhere in the universe in the coming decades.

Even more important is the ability of space platforms to take a synoptic look at vast areas on the earth which has enabled us to utilise space technology capabilities for communication, navigation, education, meteorological forecasting, disaster management, management of natural resources and environmental monitoring. Successful application of space remote sensing for looking at land use, agricultural monitoring, ocean dynamics, mineral prospecting, urbanisation and environmental degradation have enabled space scientists to initiate sustainable integrated development at micro level. Continuous monitoring of increase in green house gases, ozone depletion, global warming scenario, coastal area degradation and deforestation have provided the quantitative estimate of the alarming manipulation of our environment by anthropogenic activities. The global conference on environment held in 1992 at Rio was primarily to focus on the environmental aspects of anthropogenic activities, which, if left unchecked, could result in the destabilisation of the green house equilibrium with catastrophic consequences to the humanity as a whole.

Remote sensing and meteorological satellites have become invaluable for providing timely information on natural disasters to enable us to take appropriate steps in terms of disaster management and also evolving strategies, involving structural changes, for long term mitigation of such disasters. Spectacular progress has been achieved in remote sensing technology which is already providing repetitive imageries at 5 meter resolution and is expected to provide 1 meter resolution imageries in the next couple of years. Ocean monitoring satellites are providing information on the dynamics, temperature distribution, surface winds, moisture content and phyto-plankton density across the oceans. These inputs derived using optical as well as active microwave remote sensing techniques are not only providing vital inputs for meteorological forecast but also in identifying areas of fish rich shoals to maximise fish catch. Rapid developments in silicon technology, computers, power sources and inertial systems have resulted in substantially reducing the weight of the satellites. 500 kg. class of mini-satellites, 100 kg. class of micro-satellites and even 10 kg. nano satellites have already become operational to carry out limited application missions in a cost effective way. Space scientists now talk of femto satellites of a few grams to micro grams which could be launched in tens of thousands, as a swarm of mosquitoes, the output from which could be combined using well known aperture synthesis techniques, thus adding to the romance of space exploration.

Space technology has virtually revolutionised global communication by initiating the so called third wave information revolution. Information revolution in turn has been responsible for the emergence of a demassified society which is primarily based on specialised production centers, segmented nich markets and customised services as against mass production, mass manufacture, mass distribution, mass entertainment, and mass education, characteristic of the second wave industrial revolution. With information being generated at the rate of 20 trillion bits a day, we necessarily need information on information or so called secondary information. Information and databases have become our modern encyclopedia. Development of powerful global as well as national information infrastructures, which can be quickly accessed at will anywhere on land, air or sea has become imperative for all nations and industrial enterprises wishing to successfully compete in the knowledge based global market place.

Satellite communication era began in 1965 with the launching of the Early Bird, the first communication satellite which had just about 240 voice channels. Spectacular developments in digital compression techniques and satellite technology have made it possible to provide satellites with a capacity of 20,000 voice channels in addition to the TV channels. Thanks to digital compression techniques, it is now possible to transmit video at 4 mega bits/second and CD quality audio at 32 kilo bits per second. Developments in terrestrial communication systems have resulted in local area networking which combined with satellite communication has become the backbone of multi-media services across wide area and metropolitan area networking systems, with satellite based VSATs providing the connectivity. While Internet communication provides the link to the outside world, Intranet and Extranet systems have paved the way for virtual private networking. Global mobile personal communication systems with low earth, intermediate and even geostationary satellites are being introduced. The distinction between audio, video, data and message has completely vanished due to the confluence of powerful computers and communication technology. Video on demand, DTH, bandwidth on demand have become the buzz words of modern communication society.

Satellite communication market is predicted to grow from the present base of $80 billion a year to over $300 billion a year by 2010. The greatest expansion has to be necessarily in the developing countries because of their poor infrastructure. In India alone, the number of telephones, for example, that will be added in the next 10 years to increase the telephone density from the present 1.4 per 100 to say 8 or 10 per 100, will be more than the number of telephones that will be added in all the developed countries put together. The growth rate of VSAT networking, which has been doubling every year, is a clear example of the expansion which is likely to happen in developing countries. No wonder the global market is focusing its market expansion particularly in India and China, the two large developing countries which are poised on the threshold of communication explosion.

The over crowding of the geostationary arc at 36000 km. above the equator where all geostationary communication satellites are located was considered to be a limiting factor for a long time. Technology solutions such as frequency reuse, use of multiple polarisations, collocation of satellites, shift to higher frequencies etc., have greatly eased the problem. Use of digital compression techniques have made it possible to use one transponder for broadcast services where ten were needed earlier thus considerably lessening the demand as well as cost of the space segment. Global and regional personal mobile communication Systems, in combination with cellular systems, have made the dream of providing human connectivity anywhere across the world on land, air or sea into a reality. Digital audio broadcasting has already become operational over Africa with the operationalisation of AfriStar and within the next year is expected to become available over the Asian and American continents.

With the GPS based navigation systems steadily gaining in importance over the last two decades, the concept of free flight which has been the goal of every aeronautical engineer, is poised to take off. Free flight concept is based on the use of GPS system for navigation, along with collision avoidance technology and geographical information system which allows the flight commander to choose his own flight path without requiring ATC control. With the avoidance of human intervention which is prone to error and the pilot's ability to choose optimal path, free flight could not only be expected to be safer but also result in at least 25% saving in aviation fuel.

3. State of the Global Village

It is now widely recognised that the second wave industrial revolution was essentially based on maximising the output without caring for the conservation of natural resources and hence was basically unsustainable. If only we had carefully computed the economic benefits taking into account the externalisation factors, we would have recognised that historically humankind has traded its collective human labour against much larger entitlement of commodity bundles, the negative balance being accounted against over-exploitation of natural resources. The green revolution has no doubt helped in increasing the global food grain output from about 600 million tons in 1950 to almost 2,000 million tons in 1995. Only one third of this increase is due to increase in the area of cultivation, the rest being attributable to increased irrigation, use of hybrid cultivars and application of chemical fertilizers and pesticides. However, the negative repercussions of the very green revolution due to extensive water logging, inadequate drainage and indiscriminate use chemicals and fertilisers have resulted in the serious degradation of over 1200 million ha. of land globally. Widespread deforestation to the tune of almost 17 million ha. per year has caused severe soil erosion, resulting in increased run-off of rain precipitation, land degradation and lack of adequate water recharging all over the world.

Over 100 million ha. of prime agricultural land in India today is degraded. The once fertile belt of agricultural area in the Indo-Gangetic plain has become highly saline. As a result 60% of sugarcane growing area in UP and Bihar, produces only 30 tons/ha., just one third of that produced in Karnataka, Maharashtra and Andhra Pradesh, which yield on an average 90 tons/ha. Water management particularly in the developing countries is so bad that nearly 25% of the people do not have access to clean drinking water. Every day 25,000 people die due to water borne diseases and almost one-fourth of the global population have become susceptible to malarial infection. Increased soil erosion from one ton per hectare to almost 10 tons per hectare due to severe deforestation has made Brahmaputra, the largest sediment carrying river in the world.

While the availability of additional land for agriculture has dwindled to less than 0.2% per year, the potential for increased irrigation is limited, the population in the developing countries continues to grow exponentially. Even the most optimistic estimates indicate that the global population by 2050 is likely to reach 11 billion of which over 9.5 billion will be residing in the developing countries. The explosive growth in population is primarily confined to the developing nations which are already suffering from large scale illiteracy, poor agricultural productivity, industrial backwardness and poor quality of life. The population in India is expected to cross 1.6 billion by the middle of next century. Even at the present level of per capita food intake of just 2400 calories per day, which is much less than that recommended by FAO, the developing countries are forced to import over 120 million tons of food grains. Even assuming the growth in food grain production continues at 2% per year, which is a very optimistic assumption, the developing countries would need to import over 400 million tons of food grains by 2050. India will have to import 30-50 million tons of food grains per year by 2020, even assuming the growth of food production to continue at 2.7% per year.

While space has shrunk time and distance transforming our planet into a global village, the question we have to ask is what is the real nature of this global village. It is certainly not a homogenous happy village, where everybody on the planet is assured of a minimal decent quality of life. 80% of the global population residing in the developing countries, contribute to less than 15% of the global GDP with just 20% of the people in the industrialised world accounting for over 85% of the global GDP. Typical is the case of India which while having 16% of the global population possesses only 2% of the area, accounts for less than 3% of the global energy production and contributes just to 1.2% of the global GDP. The annual per capita income in India which is around 400 dollars is less than a fortieth of that in US. The amount of per capita arable land available in India is just around 0.15 hectare. as against over one hectare in developed countries. 45% of the Indian population continue to be illiterate and 25% do not even have access to clean drinking water. The agricultural productivity in the developing nations varies between 0.5 tons to 2.5 tons per hectare, as against 4.5 tons per hectare in industrialised nations. Considering the explosive growth of population in the developing nations, the greatest challenge in the coming decades is going to be to provide adequate food, health, economic and environmental security to all the people in the world. The question is can space technology provide solutions to evolve a truly equitable global village.

4. Space for Sustainable Development

In the modern era where science and technology has become the most powerful currency of power and ability to instantaneously access the vast information and databases has become vital for competing in the globalised market place, it is only the optimal use of the developments in space communication that can provide the comparative advantage to a nation in achieving economic security. With the phenomenal developments in the growth of satellite communication, India today has the necessary infrastructure to establish the required human connectivity across the entire nation. The poor export market of just around 40 billion dollars a year and the low productivity and efficiency of our industrial infrastructure, rated a low 39 among 80 industrial nations, is partly due to the earlier emphasis on inward booking import substitution policies but largely due to the prevalent large scale illiteracy. The liberalisation policy adopted in 1991, if sincerely followed, will help us in global competition and will also release a large part of the public funds for tackling societal problems such as education, sanitation, environment, and health care through privatisation of transport, communication and energy infrastructure, on which so far almost 50% of plan outlay has been expended.

Eradication of large scale illiteracy and in particular female illiteracy is now universally recognised as the key to development. Accumulated evidence clearly indicates that family planning can only be successful by improving female literacy. Starting with SITE programme in 1975 India has made considerable progress in the use of satellite technology for providing distance based developmental education to remote areas. Recent experiments conducted on a small scale have established the feasibility of one way video and two way audio distance education centeres for providing locale and culture specific conventional, continuing, as well as special education even to remote area population. A fairly large scale experiment to disseminate a wide variety of educational programmes on health, hygiene, family planning, environment and better agricultural practices to the predominantly tribal population in Jhabua District of Madhya Pradesh is now being successfully carried out. The answer to the massive problem of eradication of illiteracy truly lies in the large scale implementation of distance education using dedicated satellites.

The only way to ensure food security to the people is by substantially increasing the productivity, on a sustainable basis. The food grain productivity, on an average, in India and in most of the developing countries is around 1.6 to 1.8 tons per hectare, much less than that realised in industrialised countries which have achieved a figure of over 4.5 tons/hectare. Calculations indicate that the productivity figure in India and other developing countries has to reach a minimum of 4.5 tons per hectare by 2050, if large scale starvation is to be avoided. Such a development has to be completely sustainable which means it must be accompanied by adequate measures for conservation of soil, conservation of water and respect for environmental integrity. Initiation of sustainable integrated development requires the combined use of biotechnological and space inputs. Vital information provided by space remote sensing on soil moisture, soil type, landuse practices, agriculture, vegetation, command area irrigation, waste land configuration, flood and drought disasters need to be carefully analysed for each watershed to evolve strategies for conservation of soil and water. Combining space inputs with biotechnological inputs involving dwarf variety of hybrid cultivars, genetic seeds, integrated pest and fertilizer management strategies and appropriate fertigation practices it is possible to achieve enhanced productivity of food grains. Continuous monitoring from space will provide advance information on the onset of any degradation enabling us to take appropriate mid-course correction, thus ensuring the long term sustainability of agricultural practices. Actual field experience gained from the initiation of sustainable integrated development strategy over a number of watersheds in India has clearly demonstrated that it is indeed possible to double food grain production over the next 20 years, by combining bio-technological inputs with space remote sensing derived information.

5. Misuse of Space - International Mechanisms for Preventing Misuse

Phenomenal developments in space technology have fully established their capability to improve the quality of life of people by providing the most effective means for communication, broadcasting, navigation, eradication of illiteracy, improved weather prediction, disaster monitoring, management of natural resources and initiation of sustainable integrated development. However, like any other sophisticated technology, space technology is also prone to massive misuse. The establishment of the UN Committee on Peaceful Uses of Outer Space (UN-COPUOS) in 1958, which has 61 Member States, was essentially to regulate the use of space for peaceful purposes and ensure that all nations benefit from the use of this technology. UN-COPUOS took the first significant step in the development of Space Law in 1963, with the adoption of "Declaration of Legal Principles Governing the activities of states in the exploration and use of outer space" which is often referred to as the Magna-Carta of Space. Since then, UN-COPUOS assisted by its two sub committees, the scientific and the legal subcommittees, has adopted five multilateral treaties which include agreements on the rescue of Astronauts, international liability for damage caused by space objects, registration of objects launched into outer space and the agreement governing activities of states on the Moon and Celestial bodies. In addition to the five treaties, four sets of legal principles governing the activities of state in the exploration and use of outer space, use of artificial satellites for international direct television broadcasting, the principles relating to remote sensing of earth from space and the use of Nuclear Power source in outer space, have also been agreed upon. Responding to the needs of the countries and realities of the day, UN-COPUOS was successfully democratised two years ago, with chairmanship of UN-COPUOS going to a developing country for the first time in its history. As you are all aware, I was unanimously elected as the Chairman of UN-COPUOS in 1997.

Even though the memberships of UN-COPUOS is as of now limited to 61 countries, under its overall direction two UNISPACE Conferences involving all Member States of the world, the first in 1968 with Dr. Vikram Sarabhai as the Scientific Chairman of UNISPACE-I and the second in 1982 with Prof. Yash Pal as the General Secretary. These two Conferences were instrumental in bringing awareness of the potential of space technology applications to the entire world and actively promoting international cooperation to enable the vast benefits of space technology applications reach all countries, developing countries in particular. The fall of the Berlin Wall, the end of the cold war and increasing commercialisation of space technology including the launch scenario have opened up new opportunities for all countries to benefit from space. In the meanwhile the number of countries utilising space technology has also increased substantially, even though the degree of utilisation and capability differs widely from country to country. Notwithstanding under the changed international order, UN-COPUOS strongly felt the need to organise a third UNISPACE Conference open to the participation of all the Member States of the world in July 1999, under my Chairmanship.

The outer space treaty defines a launching state as the state providing for the launch vehicle, the state whose spacecraft is launched or the state from whose territory the launching takes place. With commercial entities taking over the fabrication of spacecrafts and launching them and the scene of launching shifting to platforms on the open seas, need has arisen to redefine the outer space treaty. While the Space Charter states that space shall be used for peaceful purposes and for the benefit of all nations, the definition of peaceful purposes continues to be a matter of interpretation. Fortunately the charter forbids the placing of nuclear weapons and weapons of mass destruction in space. Unlike the Moon and the celestial bodies which have been reserved by common consent for 'exclusively' peaceful purposes, the word ' exclusively' is deleted as far as the Earth's orbit is concerned. This has automatically legitimized spying as a necessary means for keeping watch on non-peaceful activities. Rapid developments in technology now allows one to virtually look at somebody else's backyard, through electronic, optical, micro wave and infra red eyes. Use of knowledge derived from remotely sensed information on mineral wealth, agricultural production, economic activities over other countries for private profit or exploitation has made a number of developing countries, which do not possess adequate expertise, very vulnerable. The misuse of direct broadcasting from space for cultural invasion of traditional societies is no more a fiction.

Appropriation of the geostationary arc at 36,000 km above the equator, from where all geostationary communication satellites operate, has been and continues to be based on 'first come, first served' principle. The developing countries who were late in taking advantage of the benefits of space technology today find themselves in a precarious position, unable to get a slot allotted for operating their own satellites. A number of equatorial countries, on the other hand have put in a territorial claim for the geostationary arc above their country based on arguments of sovereignty. The demarcation between air space or delimitation of space still remains an open question. In the meanwhile, a few nations have either already obtained or filed for a number of slots in the geoatationary arc which they may not be able to use. Notable example is Tonga which has filed for 27 slots. Unethical, real estate selling of geostationary slots have already begun. I am afraid many of these issues will continue to be debated in the years to come and some more new issues will be added to the list. The brighter side of the picture is that we have a mechanism where all multilateral issues can be debated and a reasonable solution could be hopefully found to ensure peaceful development of space activities.

Whereas the space liability treaty is reasonably clear regarding the liability for damage to property and people on the earth, the liability for damage to space objects, which has now become a distinct possibility with the numerous objects flying in space, is at best nebulous. The space debris problem has indeed become a serious hazard with an estimated millions of debris dispersed in space of which more than 40,000 objects, larger than 10 cm, have actually been tracked. Any collision of these objects moving with a velocity of something like 8 kms per second with an active space satellite, can be truly catastrophic. UN-COPUOS has finally started discussion on space debris and it is hoped that a satisfactory solution will be found to minimise the debris hazard atleast in the future.

The treaty on the moon and celestial bodies specifically states that these celestial bodies, which form the common heritage of humankind, can only be used for exclusively peaceful purposes and for the benefit of entire human kind. When this treaty was adopted, commercial exploitation of moon and celestial bodies was not considered a practical feasibility. The picture has significantly changed with the development of technology and it is indeed within the realm of reality to think of commercial exploitation of these celestial bodies in the years to come. While the cost of launching into the geostationary orbit is about 30,000 US Dollars per kilogram with present day rocket technology, newer technologies being developed are aimed at reducing this cost by an order of magnitude to about 3,000 dollars or less per kg. Already a number of travel agencies are busy in selling intercontinental travel ticket for 10,000 dollars. Reduction of launch cost is the key factor which will facilitate commercial exploitation of moon and celestial bodies or even establishment of space habitats, and large space manufacturing facilities. The question is when commercial exploitation of Moon becomes a reality, how do we ensure that the benefits from such commercialisation will reach the entire human kind. The question of intellectual property rights, applicable law on the moon, maintenance of law and order and a host of other issues are yet to be agreed upon. Process of law making which has generally been a post-facto reaction response needs to become proactive, anticipating the developments which are within the realm of technological reality.

The principles relating to remote sensing of the earth from space, while allowing unrestricted remote sensing, demands that the sensed state must have the priority for obtaining the data over its territory. There is, however, no mechanism to ensure this because under the pretext of cloud cover or some other technical reason the sensing state can deny the imagery. Since remote sensing has essentially been used for meeting societal requirements, it has not yet become fully commercial. Remote sensing activities, so far have been subsidized by the States which have operated such satellites. The scenario, however, is fast changing, with the entry of a number of commercial operators building satellites which can image at 1 meter resolution. The commercial operators expect to reap substantial gains by selling value added services in addition to imageries to a vast customer base which is likely to include insurance companies, real estate developers, planners, disaster management outfits etc. Todate over 800 reconnaissance satellites have been launched primarily by USA and USSR. With the improved capability, the dividing line between the traditional spy satellites and the civilian satellites has significantly narrowed down to such an extent that serious doubts have been expressed regarding the need to build and operate expensive spy satellites. Commercialisation of high resolution imaging, which will make them readily available to anybody who is willing to pay the price, is bound to create new security concern across the world.

The first treaty, which deals with the principles on the exploration and use of outer space for peaceful purposes, does not explicitly prohibit non-peaceful activities. Interpretation of this treaty by Super powers does not prohibit military activities, as far as they do not constitute an aggressive posture. With a pile up of over 20,000 nuclear war heads by USA and Russia and lesser number by UK, France and China and the advances made in ballistic missile technology, space has indeed become a major area of threat to peace in the world. Even though the end of cold war and SALT treaties have tried to lessen the threat, and the star war scenario has receded, attempts are again being made to renew the star war race. The principle of no first use of nuclear armament has not been accepted by all the nuclear powers. The list of nuclear powers is growing with Israel, India, Pakistan and other countries ready to join the club. The committee on Disarmament with 61 Member States, which was specifically created in 1979 with the mandate to deal with nuclear threat, ban on production of fissile material, nuclear disarmament, environmental modification, production and stock piling of chemical weapons and prevention of arms race in space has failed to make any headway, except in the case of chemical weapons. Anti-ballistic missiles are being stock piled by missile powers. The committee on disarmament continues its endless debate on these issues, forming committees and then sub committees in a typical bureaucratic fashion, without being able to halt the arms race in space. Even in the case of the chemical weapons treaty, which has been signed by 160 countries, only 47 have ratified it so far. The tragedy is that the US and Russia which have the largest stockpiles, are yet to ratify the chemical weapons treaty. While the romance of the space age has been truly exciting, the misuse of space for destructive purposes threatens the very existence of human kind on this planet. Continuous vigil is required to ensure that the vast potential of space is used only for achieving sustainable growth and providing food, health, economic and environmental security to all people and not misused for destructive purposes.

I hope UNISPACE-III will deal with these issues and also provide the necessary impetus to enable all countries, developing countries in particular, to maximally benefit from the use of space technology. As India has consistently argued over the last three decades, the benefit from the use of such high technology can truly accrue to any nation, only when its indigeneous capability is established and a degree of self-reliance is built. It is extremely important to channalise international cooperation to promote the application of high technology towards national development on a self-reliant basis. Our best hope lies in making UNISPACE-III, in which all

Member Nations of the world will participate, succeed in realising its stated objectives for achieving a better and safer future.

May I thank you, Mr. Chairman, once again, for the opportunity given me to talk on space developments to this august audience.