Check against delivery

Science and Security

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Professor P. Balaram, Director IISc,
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Distinguished guests,
Ladies and Gentlemen.

Thank you for asking me to deliver an Indian Institute of Science Golden Jubilee Lecture. It is an honour, a privilege, and rather humbling to speak at an institution that has been an intellectual home to so many great Indian scientists, an institution that has done so much for science in India, an institution whose reputation for excellence is global.

I thought that I would speak on Science and Security, on how science has changed our security, and how science has made it possible for us to be more secure even while it has changed the very meaning of security. I will not presume to tell an audience such as this about the science behind these changes. You know it so much better than me. What I would like to speak about is how science has changed our security calculus: how science has changed our definitions and uses of power; how science has changed the distribution of power within societies and in the world; and, the opportunities and challenges that this throws up for us in India.

The definitions and uses of power

There is no question that science is one of the major shapers of our world. In the last sixty-five years it has changed the currency of power, adding nuclear

weapons, WMD, and their delivery systems to arsenals. Technological change has also opened new domains for contention – cyber and outer space – and rewritten the rules in older domains such as maritime security. Lastly, information and communication technology (or ICT) has now brought unprecedented power into the hands of individuals and small groups, state and non-state actors, terrorists and others. If you add to this mix the rise of multiple powers, you have a recipe for a high degree of uncertainty and instability in the international system.

We live in a time when science has clearly accelerated the pace of change. In my lifetime alone we have already seen two revolutions in military affairs, both a direct result of the application of science to war. Each changed our definition of power, and our understanding of the uses of power.

The Nuclear Revolution

The first revolution in military affairs was the result of the creation of nuclear weapons seventy years ago. This was not just another weapon, more powerful than any that man had known before. This was such awesome power that it generated a whole new doctrine for its use, the doctrine of deterrence. For the first time it was fear of the weapon and not its actual use in destroying the enemy that was soon realised to be its function. And this doctrine led logically to a situation where both sides sought “Mutual Assured Destruction”, or MAD. (Just pause for a minute and think of that phrase, of what it means, and of the change in thinking that it represented.) The next logical step from “Mutual Assured Destruction” was to outlaw defences against the delivery of these weapons, so that each side could assure the destruction of the other. This was done in a 1972 treaty between the superpowers banning anti-ballistic missile defences. Nuclear weapons were thus the world’s first political weapon. They were not war-fighting weapons, but the currency of power.

In the forties and fifties some optimists amongst us thought that the destructive power of nuclear weapons was so great that they would actually

make war unthinkable. These optimists were, sadly, proven wrong by human ingenuity. Other forms of war-fighting were not abolished as a result of fear of nuclear escalation, though direct conflict between nuclear weapon states has been limited and has only occurred in the form of border skirmishes, (Chengpao Island and Kargil).

There was another aspect of the nuclear weapons revolution that we sometimes ignore. Making nuclear weapons was big and complicated science, bigger and more complicated than anything known before. Making this weapon required the richest and most powerful state in the world to devote unheard of resources and talent to its making. (Urban legend has it that at one point of time the Manhattan Project took almost one-fourth of US electricity production to enrich Uranium to the required levels.) Because of the effort required, in effect nuclear weapons empowered those few rich and powerful states that had the wherewithal to make these weapons. They effectively entrenched existing power differentials in the international system for more than fifty years. And this was sought to be buttressed legally by drafting a Non-Proliferation Treaty which declared it illegal for any state which had not developed nuclear weapons before 1968 to do so. Interestingly, as knowledge of the technology spreads and its costs decline, we see the NPT monopoly beginning to fray around the edges.

Today we face the consequences of nuclear deterrence – nuclear proliferation and the threat of nuclear terrorism -- around us, in a far more uncertain context than before. The global response to nuclear proliferation in our neighbourhood, and to the prospect of nuclear weapons in the hands of terrorists, has been slow and hesitant, because these issues are seen within a shifting political balance and are subject to a calculus of immediate political expediency by the major powers. Unfortunately, limited war under nuclear conditions remains possible, and adversaries need to be deterred.

India, therefore, had no choice but to develop and deploy nuclear weapons of her own, as a means to deter nuclear threats and coercion. The Indian nuclear doctrine is unique among the nuclear weapon states, with its emphasis on

minimal deterrence, no first use and assured retaliation, and its direct linkage to nuclear disarmament. We have made it clear that while we need nuclear weapons for our own security, it is our goal to work for a world free of nuclear weapons, and that we are ready to undertake the necessary obligations to achieve that goal in a time-bound programme agreed to and implemented by all nuclear weapon possessors and other states.

The ICT revolution

The second and more recent revolution in military affairs has been the application of information and communications technology to war and, indeed, to every aspect of our lives.

Compared to the nuclear revolution the ICT revolution has had four contrasting effects.

- It has brought power to non-state actors and individuals, to small groups such as terrorists. It has given small groups and individuals the means to threaten and act against much larger, more complex and powerful groups. Since the technology is now available or accessible widely, and is mostly held in private hands, (unlike nuclear technology), ICT has redistributed power within states.
- It has created a whole new domain of contention which did not exist until recently, cyber-space. And here we have to unlearn some of the lessons we have just learnt from the nuclear revolution. Traditional deterrence hardly works in a battle-space like the cyber world when the speed of operations and attack is almost that of light. In fact, you can argue that at these speeds there is a premium on attacking first.
- In existing or conventional domains like maritime security and outer space ICT has changed the nature of contention. For instance ICTs are used in traditional domains like the sea by modern day pirates to change the balance in their favour. The use of GPS navigation, communication interception technology and the lethality of modern

firepower have helped the resurgence of this old menace off the Horn of Africa.

- If nuclear weapons hardened and entrenched the balance of power between states, ICT changed the national security power calculus between states. After several centuries, once again the state is not the sole or always the predominant factor in the international system. In some cases, it is businesses and individuals who now determine our technological future and it is these units that a successful policy must now increasingly deal with.

We see the practical effects of these changes all around us.

We have seen technology place increasingly lethal power in the hands of non-state actors. This can range from the benign to the dangerous as the technology itself is value neutral. In West Asia today we see its use by popular movements to mobilise people and influence opinion against regimes across the Arab world. Regimes across the world now take the power of ICT very seriously.

Equally, terrorism is technologically enabled and knows no boundaries today, even drawing on support from within state systems. Within states, the lethality of terrorism and insurgencies, and the strength, reach and lethality of groups like Al Qaeda and LeT are directly linked to their empowerment by these technologies. We felt the effects directly in Mumbai when the terrorists used VOIP communications with their handlers. These technologies have eliminated the State's monopoly of violence. Today the internet provides jehadi and other terrorists, separatists and LWE with an effective means of recruitment, propaganda and communication. There is a risk that we are ceding this space to our enemies, and as a consequence, may also be losing the battle for the minds of the young who depend increasingly on the internet for their information and opinions.

The same technologies also empower the state in terms of its capacity for internal surveillance, interception and so on. But their power and reach raise fundamental issues about the lines that a democratic society must draw between

the collective right to security and the individual's right to privacy. What makes it more complicated is the fact that these technologies are not just available to the state, where laws and policies can control and limit their use. They are widely available in the public domain, where commercial and individual motives can easily lead to misuse that is not so easily regulated unless we rethink and update our legal and other approaches.

Between states, technology has expanded the spectrum, the line between conventional and non-conventional warfare has blurred. The definition of force, the classic marker of power, has now expanded, thus changing the utility of force as traditionally configured.

Information technologies and their effects have made asymmetric strategies much more effective and attractive. In situations of conventional imbalance between states, (like China and the USA), we see that asymmetric strategies are increasingly common. For instance, developing a ballistic anti-ship cruise missile against carrier fleets, building a very large missile force and a fleet of SSBNs and SSNs, and developing and displaying cyber war and anti-satellite capabilities, use technology for a weaker state to neutralise or raise the cost and deter the use of military strengths of stronger countries.

All the major powers are developing offensive cyber capabilities as well as using cyber espionage. So are smaller powers. One estimate speaks of about 120 countries developing the capacity for cyber warfare. But by its nature, as Wikileaks showed, the threats in this domain are not just from states. These technologies have also enable individuals and small groups to use cyber space for their own ends. We are subject to unwelcome attention from many of them.

We are in the process of putting in place the capabilities and the systems in India that will enable us to deal with this anarchic new world of constant and undeclared cyber threat, attack, counter-attack and defence. We need to prepare to deal with both risks to cyber space and risks arising through cyber space. While NTRO is tasked to deal with the protection of our critical infrastructure, institutions like CERT-IN have proved their worth during events like the Commonwealth Games in defending our open systems. We have made a

beginning in putting in place a system of certification and responsibility for telecommunication equipment and are working on procedures and protocols which will rationalise communication interception and monitoring. We need also to create a climate and environment within which security is built into our cyber and communications working methods.

While these are practical responses to immediate phenomena, it is in science that we should seek long-term and lasting answers to these security issues and to the forms that they may take in the future. For India to pursue access to and mastery of the science behind these technologies therefore becomes crucial to our future and to our ability to provide the security that India's continued growth requires.

Ironically, while the new ICT technology has led to a diffusion of political and military power, technology itself is increasingly generated, produced, and owned by an ever smaller number of countries and corporations, even while its products are manufactured in more and more locations around the world. The balance between defence and civilian technology has also shifted. In the past, most technological innovation (like radar and the internet) originated in the defence sector. Today communications and other technologies that are changing military affairs are largely products of the civilian sector.

Technology Security

There is a great deal for us in India to do as a result of these changes.

There is the immediate task of harnessing the fruits of science to the nation's security. By this I do not only mean building the nuclear weapons and other products of science that we possess and need for our security.

It also means setting up structures and institutions which enable us to use the new technologies and to answer the new threats they pose. The same ICT that empowers small groups is also available to and should be used by the state for

intelligence, surveillance and counter-terrorism. It is for the state to show the same quickness in learning that its enemies have shown in the recent past.

We must also start to think of technology security as a national goal. I do not mean by this that we must aim for autonomy or complete indigenisation of every technology that could affect our future. But we must be able to guarantee and secure our own critical systems, and to generate enough of our own technology to do so. And we must do so seamlessly between civil and defence technologies, bridging this divide which has become so entrenched in the last fifty years.

We must do this work ourselves for the simple reason that access to high technology is controlled and limited by the holders under several intellectual property and technology denial and control regimes. Our experience of resuming civil nuclear cooperation with the rest of the world in 2005-8 shows that it is when you have shown the ability and will to go it alone and master technologies yourself that the world is ready to work with you.

Which technologies should we be concentrating on for the future? While certain strategically significant sectors pick themselves, betting on individual technologies is a gamble that is probably best left to scientists and individual entrepreneurs not the state. But it is essential in a technologically driven world that India makes the transition from being purely a consumer of others' technological products to becoming a producer and generator of technological innovation in critical areas. This requires the state to provide the necessary environment and incentives, tying defence acquisitions and R&D to that in the civilian sector. Today we are not even a manufacturer in several critical technological sectors. A few emerging economies have started making that transition, namely Brazil and China.

Our space and nuclear programmes prove that we have the capability to absorb and to develop our own technologies when government is supportive. But we are yet to show the same capacity or policy will in telecommunications, civil aviation and aerospace and other technologies of the future. In telecom, we are actually further behind today in terms of generating or owning our own

technology than we were twenty years ago. Where we have made progress, in biotechnology and chip design, for instance, it has been thanks to some of our scientists, technologists and entrepreneurs.

India has two great advantages and an international moment that make it possible to aim at a much higher level of technology security. As our recent experience of the telecom sector shows, when we leverage access to our large domestic market, we can set rules and conditions that enable India to develop the required expertise and capabilities. Secondly, we do have people who are qualified to build our capacity, both in India and in our diaspora abroad. And in a situation where defence is increasingly dependent on the civilian sector to generate innovation, and export control regimes in major technology powers are being adjusted in our favour, we have a favourable concatenation of circumstances that we should be able to use to build the technological capacities that we need.

I would also regard the emergence of new domains of contention, cyberspace, outer space and the awareness of the global commons, as an opportunity for a country like India to leapfrog stages and to prepare for the future rather than the past. But that is another fifty minute lecture by itself.

National security in its broadest definition is and will be determined by our scientific prowess. By this I mean questions of energy security, food security, and access to critical raw materials, strategic materials and technologies, all of which would affect our quest to transform and develop India. Unfortunately we are not a natural resource rich country. In our quest to ensure the factors necessary for our own growth we therefore have no choice but to seek answers in our own science and technology if we are not to be totally dependent upon external solutions to several constraints on our development.

Unfortunately, the daily rush of business means that these issues do not always receive the sort of attention in our strategic calculus that their impact on India's medium and longer term future merits. We tend to leave these issues to the cognoscenti and the specialist. Yet the answers to many of these problems can only be found in science. This is true of water scarcity in a planet where 80%

of the surface consists of water and where it is the energy cost and technology of desalination that are the constraint. It is true of food security where Malthusian predictions have so far been averted by scientific discoveries. It is also true of energy security where India is best placed and most in need of finding competitive and practical ways of using nuclear, solar and other renewable energy sources. These are all questions of India's future survival and security. Here again we must look to science and its practical applications in India for the answers.

Conclusion

I suppose that all that I have said might be summed up by saying that in security, as in other fields of human endeavour, knowledge is power, and today knowledge is science. I have tried to describe some of the recent effects of science on our security. No one can predict the course of science in the years to come, or its future effects on our security. But what is certain is that your success in this institution, and in other basic science institutions like yours around India, will be crucial to our attempt to build a safe, secure and prosperous India.