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THE ROLE OF SCIENCE AND TECHNOLOGY IN THE CONTEXT OF INTERNATIONAL SECURITY, DISARMAMENT AND OTHER RELATED FIELDS

Letter dated 24 April 1991 from the Permanent Mission of India to the United Nations addressed to the Secretary of the Disarmament Commission

I have the honour, on behalf of the Indian delegation, to submit a paper entitled "The role of science and technology in the context of international security, disarmament and other related fields", an item under consideration in Working Group IV at the current session of the Disarmament Commission.

I request that you have this paper circulated as a document of the Disarmament Commission.

(*Signed*) I. S. CHADHA
Ambassador

Annex

THE ROLE OF SCIENCE AND TECHNOLOGY IN THE CONTEXT OF INTERNATIONAL SECURITY, DISARMAMENT AND OTHER RELATED FIELDS

Scientific and technological developments and their impact on international security

Working paper submitted by India

1. Ours is the age of the advanced scientific-technological revolution. Science and technology has brought profound changes in the economic, social and cultural life of society and has fundamentally transformed international relations. However, science and technology possesses a double-edged nature and can be made to work for good or for evil. On the one hand, as a highly creative force, science and technology has become a cardinal variable for human development, well-being and progress. On the other hand, we are increasingly experiencing the negative side effects of this revolution. These range from the threat to human life by the ever-growing lethality of modern weapons, especially doomsday nuclear arms, to the pollution of air and water and environmental degradation. The use of science and technology for military purposes and the accumulation of weapons of mass destruction amount to the perversion of science. Such use contradicts the basic aim of science and technology: the betterment of the human condition.

2. The central factor differentiating the current age from the one we are entering in the twenty-first century is, and will increasingly become, the determining role that science and technology plays in all aspects of our lives. The new globalism imposed by the pressure of technology matches, of course, the globalization of problems which are susceptible to solution only through collective, global endeavour. Technology is the motivating power of the modern age and in the matter of security areas, it is the key determinant. It is clear that the suspicion and hostile motivation generated by a fragmented world order that has fuelled the arms race and created adversarial stances and military doctrines, can finally be laid to rest in a peaceful and non-violent world order that destroys once and for all the seeds of conflicts. The confrontation can be resolved by returning to the inspiration which has formed the basic principle of the Charter of the United Nations. The programme of action for a global dialogue proposed by India at the third special session of the General Assembly devoted to disarmament with a view to ushering in a nuclear-weapon-free and non-violent world order and unwinding of the various manifestations of the arms race was an attempt in this direction. It takes into account the security concerns of all States. At one level we need to build confidence and trust; and at another to develop new institutional mechanisms to cater to the imperatives of the technological age. The idea of a multilateral verification body under the guidance of the United Nations has to be seen in this context as a support to efforts to take scientific and technological developments from under the shroud of military

secrecy. There is thus a need to sensitize all decision makers to the contradiction inherent in the logic of collective security in the emerging world, which demands the removal of unpleasant technological surprises and the containment of its negative potential on the one hand, and the ethos of military secrecy that currently perpetuates polarization and insecurity rather than generating collective purpose, on the other. The choice is clear. Humanity can either master its destiny through strengthening the collective approach or undermine its future through division. Technology can serve either end. The development in relations between major post-war adversaries are in the direction of halting and overcoming rifts that have plagued us in the past. This favourable political evolution has to be accompanied by positive efforts to harness, to the benefit of all, science and technology, the single most important propellent in the times before us. The process of moving from actual and potential destabilizing fragmentation to an integrative globalization with an enlightened notion of collective security requires conscientious debate and management.

3. The starkest reflection of the dichotomy between the emerging logic of globalism and that of a fragmented world is the phenomenon of the arms race. The arms race has been the antithesis of the search for collective security; and science and technology - which should have provided the means for overcoming poverty and disease and which can be a creative unifying force - has increasingly been devoted to military purposes. The fact that a large proportion of resources, both material and human, are spent on military research and development requires no repetition. Equally harmful to the security environment has been the relationship between security doctrines and the development of new weaponry propelled by technological advance. Allied with this is the vast reach of the scientific-bureaucratic-military industrial complex with its dependence on the arms race. These are formidable forces that proponents of the new vision have to contend with; and in accelerating this outcome, the re-evaluation of the role played by science and technology in the security environment of the future and in developing enlightened security doctrines would be a central factor.

4. Paragraph 39 of the Final Document of the Tenth Special Session of the General Assembly, the first special session devoted to disarmament (General Assembly resolution S-10/2), contains the following provision:

> "Qualitative and quantitative disarmament measures are both important for halting the arms race. Efforts to that end must include negotiations on the limitation and cessation of the qualitative improvement of armaments, especially weapons of mass destruction and the development of new means of warfare so that ultimately scientific and technological achievements can be used solely for peaceful purposes."

5. More than 12 years after the adoption of the Final Document, efforts for "arms control" in both bilateral and multilateral forums have focused primarily on the quantitative expansion of arsenals. At no stage have the qualitative aspects of the arms race been addressed, even though it has been known for some time now that a very large part of the huge sums currently

spent on armament by the major Powers is devoted to making qualitative improvements in the existing weapon systems and in developing new systems. As a matter of fact, most of the nuclear "arms control" agreements provide for the upgrading of the existing weapon systems and specify "permitted" areas for further improvement of weapons. Even the INF Treaty has left the loophole permitting the military use of the fissionable material which will be made available as a consequence of the destruction of the delivery vehicles. Non-ballistic cruise missiles of the same range as those being destroyed under the INF Treaty are now being deployed from sea-based platforms. The scale of expenditure on military research and development and the pace of technical change in the military sector are unprecedented historically. This is the result of the emergence in the post-Second World War period of a large number of industrial and research establishments devoted exclusively to the design, production and refinement of new weapon systems. Such systems are often developed without reference to the political climate or even the prevailing security doctrines. Quite often, this takes place without reference even to the actual weapons developed by the adversary. The history of weapons development in the post-Second World War period is replete with examples of such a self-propelled momentum overtaking whatever meagre results "arms control" measures may have achieved.

Components of the qualitative arms race

6. Today, the world stands on the threshold of a new arms race. A number of technologies that have the potential to transform completely the methods of war-fighting and the nature of warfare are in advanced stages of development. The maturity and application of these technologies would have far-reaching implications for international security and would be a major set-back to efforts for disarmament. The following are some of the areas in which new and emerging technologies with far-reaching military applications are taking shape:

(a) Nuclear weapons: The first-generation nuclear weapons are based on fission, the second generation on fusion. The second-generation weapons designs have increased the sophistication and improved the yield-to-weight ratio of nuclear warheads. The central feature of the third-generation nuclear weapons is the ability to pick and choose specific effects of nuclear weapons and enhance them, while suppressing the unwanted ones. The neutron bomb, or the enhanced radiation weapon, is the precursor of third-generation nuclear weapons. A number of designs of such weapons are being actively explored. These include X-ray laser, in which the energy of the nuclear explosion is channelled into focused beams of intense X-ray radiation. The gamma ray laser, microwave weapons and nuclear devices that can generate powerful electromagnetic pulses are other third-generation concepts that are being explored. Concurrently, more accurate and precise modes of delivery of nuclear warheads are being developed to avoid the large collateral damage, inevitable in less accurate delivery. The manoeuvrable re-entry vehicle (MARV) and the Earth/ice penetrators are technologies that are likely to increase dramatically the ability to deliver nuclear weapons with pinpoint accuracy. New directions in the use of nuclear energy for military purposes are also evident. Plans to deploy compact and powerful nuclear reactors in space are in advanced stages of development. The new military space missions for reactors include the powering of beam weapons, battle stations and supporting satellites. In the field of ballistic missile defence, the specific weapons being developed include the Directed Energy Weapons (DEWs), in which the destructive energy itself is directed against the target at the speed of light (consisting either of laser or of particle beams) and the kinetic energy weapons (KEWs), which derive their destructive energy from the momentum of propelled objects (this includes electromagnetic rail guns, which can propel objects to very high speeds). The first generation DEWs are already being tested as counter-sensor weapons against precision-guided munitions (PGM) systems, combat-vehicle sensors and reconnaissance, surveillance and target acquisition (RSTA) systems. Successful development and deployment of DEWs may help to preserve the combat efficiency of large combat vehicles such as surface warships and heavy armour in the face of the rapidly growing threat from guided weapons. The kinetic energy weapons under development are planned to be both space-based and ground-launched and could be employed as nuclear and non-nuclear interceptors designed to destroy enemy missiles and nuclear warheads. Preliminary tests have already been carried out and it is expected that these technologies could mature in the next decade. The Inertial Confinement Fusion Technology (ICFT), a technology intensively studied since the 1970s, would confine micro-explosions (miniaturized hydrogen bombs) of up to 300 kilograms. TNT equivalent in above-ground reactor vessels. The micro-explosions may eventually be helpful for studying exotic weapon phenomena. The design for a "high energy density facility" (HEDF) which would be able to contain explosions of up to 300 tonnes (0.3 kiloton) in a seismologically "quiet" vessel is also being studied.

(b) Electronics, computers and artificial intelligence: The ongoing revolution in electronics and computers is further transforming the nature of warfare. Weapon systems are moving from the "smart" to the "intelligence" phase. Unprecedented capabilities for command, control and intelligence (C^3I) systems required for enhanced war-fighting capabilities are under development. A whole range of surveillance sensors and high-speed automated data-handling systems are being built. Of particular importance is the development of fifth-generation computers and artificial intelligence. Artificial intelligence techniques are likely to be used initially in aiding soldiers in handling enormous amounts of information in a very short time in a complicated environment. Artificial intelligence techniques are also being considered for the development of autonomous vehicles and automated battle management systems. The impact of the new developments in computer hardware and software extend to nuclear war-fighting and strategic defence to conventional warfare.

(c) Superconductivity: Superconductivity is a phenomenon in which materials lose their electrical resistance, resulting in virtually no loss of energy when electricity is transmitted. Large supercomputers would overcome problems of overheating and play an important role in future command, control and communication systems. New materials have opened up possibilities for high temperature superconductivity that will maintain growth rates of computer capability well into the next century. This would lead to improvements in computer and satellites and would allow greater information collection and storage, which will aid battle management considerably.

(d) Information system: A sizeable part of the spiralling cost of weaponry and counter-weapons is known to be due to the information systems. Complex innovations in communication sensor decoy systems have become increasingly integrated with more select presentation of information using advanced graphics. Information technology continues to play a vital role in the modernization of a new generation of weapons.

(e) Conventional weapons: The advances in weapon technology have already led to the conceptualization of strategic warfare without nuclear weapons. The use of ICBMs is being contemplated with conventional weapons. New types of delivery systems, such as transatmospheric vehicles and space planes capable of speeds ranging from 5 to 30 times the speed of sound and large payload capabilities are being developed. These vehicles can operate in the atmosphere and space and can negotiate intercontinental distances in 10 to 15 minutes. The space planes capable of horizontal take off from and landing at normal airfields, lend themselves to greater flexibility in utilizing near-Earth space for military purposes and in carrying out a variety of offensive missions in a short span of time. Reconnaissance, surveillance and target acquisition (RSTA) has become important in devising ways to attack armoured concentrations, warships and aircraft with great efficiency. In theory precision guided munitions (PGMs) could destroy the full range of ground, air and sea-based targets. The economic costs of PGM/RSTA systems are extremely heavy.

(f) Materials technology: Materials technology is a crucial area in the military applications of new technologies. In the construction of weapons, new materials will allow aircrafts to fly faster, ships to stay longer at sea and submarines to range further. Reduced size for performance will reduce the detectability. Jet engines that can operate at higher temperatures will introduce greater efficiency and thrust. New combat power will become available for weapon-guided control and processing. New sensors will make possible the detection of enemy by day and night. In space, the new materials will use yet greater improvement. Indeed it has been the need to develop materials to cope with the heat on re-entry into the Earth's atmosphere that has prompted much of the research. The reduction of weight, increase of strength and increase in engine performance might eventally blur the distinction between air and space. It would help in the construction of "low observables" or "stealth" aircraft for surveillance and attack purposes. These systems once again are likely to be extremely expensive.

(g) Space technology: Space will occupy a greater role in future military operations. Space-based platforms will provide important support to RSTA, navigation and communications. By the turn of the century, sensor technology may have matured enough to provide coverage of mobile, air, ground and sea movements which would be of invaluable help in targeting long-range missile systems. Satellite navigation may also make long-range PGMs affordable by reducing the cost of their guidance systems. Because of this development, the importance of mobile or hidden targets, or what are designed as strategically relocatable targets (SRTs), will increase. Space to Earth weapons could include beam weapons, orbiting nuclear and conventional armed re-entry vehicles (RVs) and electromagnetic pulse (EMP) generators.

(h) Chemical and biological weapons: The past few years have seen an enormous explosion in mankind's knowledge of the molecular and cellular processes of life. There is also the emerging ability to manipulate these processes through genetic engineering and biotechnology. If these abilities are tapped for military purposes, there could be a new race to develop weapons for chemical and biological warfare. Binary chemical weapons have also been developed wherein two chemicals are converted into super-toxic nerve gases, once the projectile is fired. This technological innovation has removed barriers such as difficulty in storage and transportation which had worked against the production and deployment of new technology chemical weapons. Ecological hazards caused by the release of genetically engineered organisms into the environment, genetic manipulation and human cloning and further development of biological and toxin warfare agents are among some of the persistent concerns associated with biotechnology. The use of accumulated knowledge of biotechnology for deadly purposes affecting humans, animals and crops would be an ultimate disaster.

7. The developments described above have far-reaching implications for the defence strategy of various countries. While qualitative improvement in the military fighting equipment has steadily taken place, there is reason to believe that in view of rapid advances in technology, particularly in informatics and communication technology, we may witness a revolution in warefare driven by modern technology. If allowed to proceed unchecked, these advances would bring about radical changes in the means of war fighting and in security doctrines. The systematic deployment of new categories of high technology weapons may create an entirely new military operational environment that could seriously undermine the security of those nations which are not equipped with advanced weapons.

Implications of the new arms race

8. The qualitative arms race and the development of the new weapon systems have important implications. These include the following:

(a) They carry a much greater risk in case of outbreak of war, particularly nuclear war. Many weapons already operate in a semi-automated or fully automated mode. Automation of entire weapon systems, however, would result in a quantum leap in the dangers. The risk of war as a result of an accident or misjudgment would be much greater.

(b) Furthermore, most of the new weapons systems are offence-dominated. Even the defensive ones have the effect of making offensive strikes possible with greater impunity. Together with the immensely increased accuracy and lethality of these weapons, this is likely to increase the incentive of pre-emptive strikes. This could lead to a renewed arms race in both offensive

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arms and in building defences and could introduce these weapons into outer space, which has so far remained free from them.

(c) Moreover, a reasonably accurate assessment of the capabilities of new weapon systems, force levels, force targets and force postures and deployment is going to be extremely difficult in a period of rapid technological change. There would, therefore, be a tendency to proceed on the basis of "worst-case" scenarios, which would result in an increase in the instability of the security environment.

(d) Discrete and selective deployment of tailored nuclear weapons with little collateral effect may tend to increase their perceived utility and hence, their usability. The non-nuclear nature of the powerful new weaponry may tend to make it more acceptable morally and politically.

(e) The distinctions between tactical and strategic weapons and conventional and non-conventional weapons would become blurred, leading to the erosion of thresholds. These new trends have complicated the problem of monitoring and verification of emerging weapon systems. Many of these systems will be smaller in size, more mobile and flexible. In fact, we may have already come to the point of no return in this regard.

(f) New weapon capabilities are likely to be available only to a few States and their allies, providing them with hegemonistic capabilities and increasing their predisposition to engage in coercive diplomacy.

(g) The new technologies pose a serious threat to the existing arms control and disarmament agreements by offering technological and strategic incentives to nations for breaking out of the current restrictions. They would also introduce new complexities which may make further agreements difficult.

(h) Security cannot be viewed purely in military terms. Military spending reduces productivity in two ways - first through misallocation of resources; and secondly, by denying the civilian sector resources for long-term investment on which productivity critically depends. The effect of huge military spending in the militarily significant States largely determines the health of the global economy and frequently sends down convulsions in the third world. The developing countries are doubly affected - first through the direct adverse effect of the military expenditure that they themselves incur to keep pace with technological developments in the military field for their own security; and secondly, through the adverse effect on the global economy of the military expenditures of the high military spenders.

<u>Suggestions for action</u>

9. The real challenge in the field of disarmament is to devise arrangements for controlling the new arms race. To distinguish technology as constructive or destructive is a complex task. Nor is it easy to make a sharp distinction between research and development or testing for development. In the context

of a comprehensive disarmament programme, seeking to eliminate weapons of mass destruction and reducing conventional armaments to the minimum needed for defence, the efforts to control the qualitative arms race would be of great significance and indeed necessary. It may be worthwhile to recall that as far back as 1962, successive United States and Soviet draft proposals on a treaty on general and complete disarmament provided for control on the conversion of military research and development for peaceful civilian purposes. These proposals provided for the establishment of an International Disarmament Organization (IDO) within the framework of the United Nations which would (a) collect reports from the parties to the treaty on any basic scientific discovery and any technological invention having potential military significance, and (b) work out on the recommendation of the expert study groups, concrete arrangements for verification by the IDO that such discoveries and inventions were not utilized for military purposes. It is the right of the public to have access to information at the global level on issues of life and death. While increased public awareness will put a measure of restraint on these developments, it is also the duty of the world scientific community to be alert in this regard to anticipate developments and to make the world aware of their implications. The following suggestions are, therefore, put forward for achieving greater transparency and understanding in this critical and sensitive area:

(a) Technology assessment and forecasting panel: The Secretary-General should have at his disposal a technology assessment and forecasting panel consisting of a small group of eminent scientists and strategists. The task of the panel would be to identify and monitor those developments in the field of new and emerging technologies which have military applications, assess their likely impact on international security and make projections based on such monitoring and assessment. The Secretary-General should consult this group from time to time. On the basis of such consultations and periodic reports to be submitted by the group, the Secretary-General should disseminate their assessment and forecasting on a wider basis, through various means including reports to the General Assembly, the Security Council and the Conference on Disarmament.

(b) National panels of experts: Member Governments should make more or less similar arrangements at the national level. They should constitute panels of scientists which should report periodically to the Government and should be available for consultations from time to time. They should widely disseminate the information and assessment provided by the panel. The Governments, in turn, should submit an annual report to the Secretary-General. The Conference on Disarmament should also impress upon all member Governments that whenever an emerging technology appears to have the potentiality of leading to the development of new weapons and new means of waging war, the details of such technologies should be given wide publicity.

(c) Unit in the Department for Disarmament Affairs: A unit should be established in the Department for Disarmament Affairs to monitor and study the implications of new technologies with potential military applications. The Secretary-General's panel should be able to draw upon the information and study compiled by the unit.

(d) New technology projects and technology missions: There should be greater international cooperation in the field of research in new and emerging technologies with a view to developing them for peaceful purposes. To this end, new technology projects and new technological missions should be undertaken under the aegis of the United Nations. This will result in avoiding duplication of efforts in this high-cost area, fostering trust and promoting global progress and stability.

(e) Banning of technological missions clearly designed for developing new weapons: Negotiations should also start to ban those technological missions which are clearly designed for the development of new weapons and means of warfare.

(f) Guidelines in respect of new technologies with potential military applications: Guidelines should be drawn up under the aegis of the United Nations in respect of new technologies with potential military applications. To begin with, the guidelines could be voluntary in nature. They should be observed by Governments directly responsible for carrying out military research and development and also be recommended for observance by private laboratories and research institutions. Emphasis in the guidelines should be on the transparency, the widest possible dissemination of information nationally and internationally, consultations with and reports to national authorities and the United Nations. They should also include such regulatory measures as may be found feasible. The Secretary-General should set up a group of experts for evolving such a set of guidelines.

Technology transfer and development

10. Technology has a universal character and is a key factor for the progress of mankind. All countries have the right to benefit from advances in science and technology which is the common heritage of mankind. Owing to a variety of reasons so far, the distribution pattern of technology has been unfavourable to developing countries. During the 1980s while the developed countries spent between 2 and 2.5 per cent of their GNP on research and development, the developing countries were able to spend less than 0.2 per cent of their GNP for the same purpose. The development of new and ongoing technologies requires fairly large financial resources, and developing countries may be left out from promising areas such as modern biotechnology, materials technology and micro-electronics. It would be necessary for all developing countries to have better access to these technologies and their transfer should take place under favourable terms and conditions. Since the beginning of the 1980s, the slow-down of technology flows to the developing countries, compounded by the new challenges brought about by technological change, is a matter of great concern. The domination of commercial transactions in the transfer process and reverse transfer of technology (brain drain) has cancelled out the advantages enjoyed by traditional production in developing countries. Apart from limiting technological diffusion or upgrading, there has been a tendency to obstruct developing countries' access to state-of-the-art technology, especially in those areas considered crucial by developing countries for trade and development and in relation to high technology and new and emerging technologies.

11. The establishment of uniform and higher standards of intellectual property rights protection and enforcement, restriction of performance requirements on foreign investment and opening up of developing countries' services sectors before they are on a competitive level would have negative implications for the transfer to and development of technology in these countries. The situation is further exacerbated by the impasse reached in the completion of other international instruments, such as the international code of conduct on the transfer of technology and the Revisions of the Paris Convention for the Protection of Industrial Property, aimed at encouraging the flow of technology to developing countries and at enabling them to reduce the technological gap.

12. The trade and technology policies followed by developed countries should assure unhindered access of developing countries to critical, high, new and emerging and state-of-the-art technology. It would be desirable that cooperation arrangements on joint research and development on these technologies be established, encouraged and enhanced, in agreed areas, between developing and developed countries, as well as among developing countries.
