CHAPTER - III

MILITARY ACTIVITIES IN OUTER SPACE:
PROJECTS, PROGRESS AND PROSPECTS
III.1. Introduction

III.2. The United States Space Weapons Programme
   (1) Kinetic Energy Weapons
   (2) Electromagnetic Railgun
   (3) Laser Weapons
      i. Definition and Meaning.
      ii. Mechanism and Types of Lasers.
      iv. Targets of Laser Weapons.
      v. Advances in Laser Weapon Technology
   (4) Particle Beam Weapons.
   (5) Electromagnetic Pulse Weapon.
   (6) The Layered Ballistic Missile Defence System.

   (1) Types of Space Weapons.
   (2) Killer Satellites.
   (3) Laser Weapons.
   (4) Particle Beam Weapons.
   (5) Kinetic Energy Weapons.
   (6) Radio-frequency Weapons.
   (7) Electromagnetic Pulse Weapon.
   (1) Photographic Reconnaissance.
   (2) Electronic Reconnaissance.
   (3) Early-Warning.
   (4) Ocean Surveillance.
   (5) Communications.
   (6) Navigation.
   (7) Meteorology.
   (8) Geodesy.
   (9) Ballistic Missile Defence Components.

In an exhortative and poignant speech on March 23, 1983 which was televised throughout the U.S., President Reagan announced that he was initiating a major space defence programme. In the early days of Reagan presidency it became quite apparent that space weapons systems research and development are being given meticulous attention and their military potential much valued. But the March 23 speech could be said to be a great leap forward in space weapons research and development. In his speech, President Reagan earnestly implored support to increased military spending. To justify this, he created an awesome and horrific picture of the threat of Soviet nuclear missiles attack. He emphasized the need to develop a defensive system against hostile missiles in the following words:

"What if free people could live secure in the knowledge that their security did not rest upon the threat of instant U.S. retaliation to deter a Soviet attack; that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies?" 2

He further went on to beseech the scientific community -

"... I call upon the scientific community in our country, those who gave us nuclear weapons to turn their great talents now to the cause of mankind and world peace; to give us the means of rendering these nuclear weapons impotent and obsolete." 3

2. Ibid.
3. Ibid.
This initiative of President Reagan was later christened as 'the Strategic Defence Initiative' (SDI) by space scientists and military experts, whereas laymen, and for that matter, journalists labelled it as 'Star Wars' programme. The official U.S. position as regards the scope and modalities of the SDI research was announced within a period of less than one year from the speech.

It is believed that the Soviets are vigorously pursuing space weapons programme as well. This unexpected accentuation of space weapons system in early 1980s and the subsequent developments in this respect have posed a host of legal problems. In the context of the present study, for an appraisal of the issues that have arisen, it is expedient to examine various facets of existing and impending military activities in outer space. The present chapter is devoted to this examination. A reference to technological and technical details is inevitable for several reasons. The lawfulness of weapons or weapons system in most of the cases depends on the damage mechanism, whether it is nuclear or non-nuclear, its mode of operation, its location, location of component parts of the system, etc. Even testing of certain weapons at certain places could be violative of law. Above all, it must

be stressed that for facilitating and developing future legal controls and bans on military activities in outer space, particularly exotic weapons systems, an essential prerequisite is understanding the true nature and basic features of the activity in question and dangers posed by it. This is particularly exigent because utmost care and caution has to be taken while devising legal constraints for regulating a complicated activity to ensure that legal obligations are not obfuscated and circumvented by resorting to technical loopholes. The issue of devising legal controls on military activities in outer space is being considered within and outside the United Nations. In order to ensure that the future legal controls are incontrovertible and infallible, and not susceptible to devious and capricious interpretations, it is imperative that the activity to be regulated is comprehensively studied. It is for these reasons the researcher has dealt with various technological facets, the mode of operation and mechanism of all existing and proposed military activities in outer space in this chapter.

III.2. The United States Space Weapons Programme:

The history of present U.S. initiative in space weapons system can be traced as back as 1957. Over the last more than three decades the emphasis was shifted from one system

to another for several reasons. Until late 1970s the U.S. efforts were more or less furtive, hesitant and haphazard. It is in the 1980s that the space weapons programme was given an irrepresible impetus by the strategic defence initiative. Undoubtedly, the ascensive interest in space weapons system is an obvious consequence of exuberant space activities in general and it incontrovertibly evinces a desire to exploit outer space to attain military supremacy. It will be soon apparent that with ever increasing advancements in military science and technology, attention of military planners was attracted to exotic technologies to serve military ends. The clearest indications of this change are to be found in the developments since early 1980s. It is the purpose of this part to analyse the nature and physical characteristics, examine the destruction mechanism, trace the background and latest technological advancements of various types of space weapons in the United States.

III.2.(1) Kinetic Energy Weapons:

Kinetic energy means the energy created by the motion of a substance, usually a solid substance. The operative mechanism of a kinetic energy weapon is based on causing forceful impact on a target by a solid or explosive substance which is released and directed at the target from a launching device. A project called USAF 7795 was initiated in March
1958, as a part of another project known as project Bold Orion. The primary mission of this project was to test feasibility of an air launched ballistic missile. But in the final stage of demonstration it was tested as an anti-satellite weapon for probable use in future. As a part of project Bold Orion the very first test of a weapon designed to intercept a satellite was successfully conducted on October 13, 1959 by the U.S. Air Force at Eastern Test Range, Cape Canaveral. In December 1961 the U.S. Army gave permission to proceed with Program 505 nicknamed 'Mudflap'. Under this programme several tests were conducted wherein ground launched missiles were fired to intercept objects in the earth orbit. This programme was dropped in 1972 in view of success in another programme, namely, Project 437 THOR. Under this programme fourteen tests were conducted from December 1964 to March 1970 using conventional boosters for antisatellite applications.

During the 1970s the U.S. administration revived its interest in antisatellite weapons by initiating research on

8. Ibid.
10. Ibid., p.118.
12. Ibid.
miniature homing vehicle (MHV) programme. A miniature homing vehicle is a missile like device which is released with great speed and is intended to cause an impact on a satellite and disrupt it. It is an anti-satellite weapon. The programme was being conducted in utmost secrecy until 1975 when a periodical on space technology ferreted out some information regarding the MHV programme. It was reported that the programme was intended to develop a small air or ground launched satellite interceptor that would be directed by a long wave infrared homing or targeting system. Throughout the later half of 1970s the project MHV remained the primary U.S. antisatellite weapon development effort. In the 1980s, despite the significant advances made in directed energy weapons systems, the MHV programme has occupied a conspicuous place on the U.S. military agenda. This conclusion is substantiated by the number of tests conducted and official announcements made by the U.S. administration officials and military scientists. On January 21, 1984 the U.S. Air Force launched an unarmed antisatellite weapon from a F-15 aircraft over the Western Test Range to test the performance of booster and guidance system.

13. Ibid.
15. See generally Aviation Week and Space Technology issues since January 1980.
For ballistic missile defence applications, a small kinetic energy kill vehicle was successfully tested in September 1986. In February 1987 it was announced that the Strategic Defence Initiative Organization was on the verge of producing a cost effective space-based kinetic kill vehicle which would have capability to destroy intercontinental ballistic missiles during their boost phase. In March 1989 it was announced by the SDI organization that it will test numerous kinetic energy weapons for ballistic missile defence applications in coming years.

During recent years, the Americans are giving utmost priority to the Project Brilliant Pebbles which is aimed at developing a device capable of discharging swarms of highly accurate but lightweight interceptors. Significantly, this project has received top level political attention from the Bush administration. The SDI officials have decided to boost funding for this programme.

---

21. Ibid.
From the foregoing, two conclusions emerge. First, the U.S. administration is doubtless determined to develop a kinetic-energy miniature homing vehicle (MHV) for antisatellite applications. Secondly, a kinetic-energy weapon is being developed also for ballistic missile defence applications. The intended targets of the former are hostile satellites in outer space whereas those of the latter are hostile ballistic missiles in their boost phase. It is significant to note that both the weapons appear to be non-nuclear in nature.

III.2.(2). Electromagnetic Railgun

Akin to the kinetic energy weapons described above, is electromagnetic railgun or gun. Such a gun is expected to fire projectiles at velocities in excess 10 kms/second and at ranges over 1000 kms at a firing rate of 60 shots per second. It is to be based on mechanism of mass acceleration and it will operate by accelerating small homing hit-to-kill projectiles with kinetic and non-nuclear impact. Thus, damage and destruction is caused by firing a series of projectiles at an object in succession. It was announced in July 1984 that the U.S. Department of Defence intends to use such a gun against Soviet hunter-killer.
satellites. The most noteworthy feature of the proposed electro-magnetic rail-gun is that it is expected to operate from a space-based platform or from a satellite itself.

This weapon is expected to discharge a dual role, namely, as an antisatellite weapon as well as a ballistic missile defence weapon. In August 1988 the U.S. Air Force acquired three electromagnetic railguns which could attack missiles in mid-course phase by launching small guided projectiles, roughly two kilograms in weight, at a speed of about 2 to 3 kms. per second.

III.2.(3) Laser Weapons :

III.2.(3)(i) Definition and meaning :

The term 'laser' means 'a device, containing a crystal, gas, or other suitable substance, in which atoms, when stimulated by focused light waves, amplify and concentrate these waves, then emit them in a narrow, very intense beam.'

The term 'laser' is an abbreviation of the description of the process applied for its production, namely, 'light amplification by stimulated emission of radiation'.

25. Supra, n.23.


137
III.2.(3)(ii) Mechanism and Types of Lasers

To produce a laser beam various media may be used, such as, solid, liquid, dye, gas, gas-dynamic or chemical. The atoms of any such medium are forced or pumped into an excited energy state. It is the resultant charged beam capable of delivering immense energy at a great distance that has allured military scientists to exploit this phenomenon for probable use as a potential weapon. Otherwise, lasers have many not only innocuous but beneficial applications in such fields as medical sciences, industries, etc.

The lasers that are strategically significant are classified into three types, depending upon the substance used for production, namely,

(a) gaseous,

(b) electronic, and

(c) chemical.

Irrespective of the substance used for production, a strategically significant laser production mechanism has four basic features, namely,

(a) a mechanism is used to generate energy;


29. Ibid.

(b) a mechanism is used to pump the energy thus generated;
(c) When the energy is pumped, a beam of high-energy is emitted; and
(d) this beam of energy possesses high potential for destruction.

The effectiveness of a laser weapons system will depend on both the quantum of energy generated at the source and effective pumping of the energy so as to produce a narrow and intense beam. The process involves transmission of energy from the source to the target via the beam. It is expected that when high energy is delivered at or discharged on the target, it is bound to be damaged, destroyed or exploded.

Two possible damage mechanisms have been suggested. First is 'melt through kill mechanism', in which a target satellite is destroyed by over-heating and literally melting. The second, known as 'impulse loading mechanism' involves production of a shock wave in the target satellite by rupturing its shell. The rupturing is effected by intensely heating the outer layer of the satellite skin whereby surface material is vapourized. The ultimate effect is similar to hitting the satellite with a sledgehammer.

32. Ibid.
33. Ibid., p.104.
Different kinds of lasers are believed to be suitable for different damage mechanisms. Thus, X-ray laser and excimer laser are said to be suitable to deliver a high impulse or shock to a missile to break or blow a hole in it and cause structural collapse of the booster. Whereas a free electron laser, hydrogen fluoride/deuterium fluoride laser with continuous wave mechanism is believed to be suitable to stay on a target until a hole is burned through it and then to switch to another target. It is significant to note that the U.S. is profoundly relying on X-ray lasers since these have been regarded as strategically very efficient and technologically viable. According to the U.S. Department of Defence and congressional officials, the technological breakthrough achieved in high-energy pumped by X-rays from a nuclear detonation has a great potential to negate Soviet nuclear attack on the U.S. targets. It has also been reported that the X-ray laser weapon driven by a nuclear explosion has been playing a key-role in the U.S. strategic defence initiative programme. From a legal


35. Ibid.


stand point it is significant to note that all laser weapons are not nuclear. Only certain types of X-ray lasers could be nuclear in character.

III.2.(3)(iii) Components of a Laser Weapon System:

The essential components of a laser weapon system will necessarily depend upon basing of the system, i.e. whether it is land-based, air-based, space-based or sea-based. In addition to the components required for generation and pumping of the energy, in cases of land and sea based systems, components in outer space may be needed. For instance, space-based mirrors are expected to reflect and direct a laser beam at a target. Indeed, it is believed that rather than generating a laser beam in outer space, it is convenient and preferable to generate it at a ground station and direct it to mirrors orbiting in outer space for relaying and reflecting it to targets. Nevertheless, the U.S. Department of Defence is seriously contemplating setting up of space-based systems of high energy laser battle stations. The impetus for this comes from a finding that space-based laser weapon systems would be ten to twenty times more efficient than those used within the atmosphere and on the surface of the earth. When stationed in outer space,


40. Ibid.
such systems are expected to have ranges of thousands of kilometers.

III.2.(3)(iv) Targets of Laser Weapons:

Laser weapons could be used against following targets.

(a) satellites in outer space,
(b) missiles in outer space,
(c) component parts of weapons systems in outer space,
(d) aircraft in airspace,
(e) ships on the seas,
(f) objects on the surface of the earth, and
(g) objects on celestial bodies.

There is no gainsaying that current research efforts are aimed at developing weapons for use against targets in outer space alone, especially, hostile satellites and missiles. However, this should not demean the annihilating capability of lasers as regards targets on the surface of the earth. The quintessence of the U.S. ideology is overtly reflected in a Department of Defence Official Statement that space based laser weapons could be used, inter alia,

(i) against enemy aircrafts in flight;
(ii) for antiship applications to destroy oil tankers;
(iii) for anti-submarine warfare.

41. Ibid.
42. Ibid.
It is therefore fair to prognosticate that laser weapons, irrespective of their locus, could be used against targets (a) to (g) outlined above.

III.2.(3)(v) Advances in Laser Weapon Technology:

Eugen Sanger, a West German scientist who is regarded as pioneer of space research, indicated in 1958 at great length how pure energy rays can be used to follow and destroy every material body. Within two years from this invention, research was undertaken in the U.S. on space weapon related laser and maser i.e. microwave amplification by stimulated emission of radiation. A part of this research was being conducted as U.S. Air Force Project Blackeye. In 1965 the scope of this research was expanded to include study of particle beam weapons. In the late 1960s, the U.S. Defence Advanced Research Project Agency (DARPA) and the three wings of the U.S. armed forces conjointly commenced studies of lasers and particle beams and their military potential. Although since 1960s the study of beam weapons was on the agenda, significant attention was not given to their military potential until late 1970s. Funding began in the fiscal year 1980 for the development of laser weapons.

43 Benko, et. al., n.11, p.143.
44 Stares, n.6, p.111.
45 Ibid.
46 Ibid., p.213.
47 Ibid.
48 Ibid., p. 215.
Triad - a hybrid of three interrelated projects, namely, Alpha, LODE and Talon Gold - was undertaken. Although at that time it was only at research stage, in anticipation of change in the U.S. presidency, it was left to the incoming administration to determine the future of this project.

After having acknowledged the prodigious potential of laser weapons, the new administration undertook study of the feasibility of a laser battle station in outer space. This idea was overwhelmingly appreciated by the U.S. Department of Defence officials who appeared to be exuberantly enthusiastic that laser battle stations operating in space orbits could blunt a Soviet ballistic missile attack. Thus, by the end of 1980 a strong commitment to laser weapons system was discernable in the U.S. military policy. However, and not unnaturally, the impending change in the U.S. presidency engendered a certain degree of incertitude. As a matter of fact, the doubts were soon dispelled when the new administration under the leadership of President Reagan overwhelmingly encouraged Project Triad. The pertinacious attitude was due largely to the new military doctrine which was blooming under the leadership of President Reagan. It appears that this development presaged the Reagan strategic defence initiative of 1983. Although originally laser weapons

49. Ibid.
50. Ibid.
52. Ibid.
were commensurate with ballistic missile defence, yet the advances made in the technology vindicated that the lasers also possess potential as an antisatellite weapon for use against hostile spacecraft. In March 1983, the U.S. Air Force Space Command emphasised a need of developing a laser antisatellite weapon. On September 6, 1985, the first test of high energy laser against a missile was successfully conducted at High Energy Laser Systems Test Facility, White Sands Missile Range, New Mexico, when a Titan 1 missile casing was destroyed by a high-energy laser from the ground base. By 1986, the U.S. military scientists were banking high hopes on free electron laser to perform a major role in ballistic missile defence system which would be ground based, but coupled with space-based mirror system to point the beam to enemy intercontinental ballistic missiles during their boost phase.

An SDI Organization analysis has revealed in August 1988 that X-ray laser weapons could be developed in relatively very small 'packages' so as to deploy them on mobile ground based launchers, submarines and spacecrafts. The Organization is also reported to have stated that although its research programme is focussed primarily on non-nuclear

technologies in the field of directed energy weapons, yet it is considering nuclear driven directed energy weapons system to determine their feasibility for SDI systems. However, a study conducted by a panel of the American Physical Society in 1987 ironically reveals that the directed energy technology faces many challenges and it requires intensive research for one more decade to overcome the serious obstacles and that a substantial directed energy component as a part of ballistic missile defence system may not be viable and feasible before the year 2000.

Recently, the Strategic Defence Initiative Organization has planned launching of two experimental satellites in the year 1990, which is regarded as most ambitious directed energy weapons related research to date into laser targeting and atmospheric perturbation with application to a future ground based laser weapon. The Low Power Atmospheric Compensation Experiment (LACE) Satellite is expected to stay in orbit for two and a half years, whereas the Relay Mirror Experiment (RME) satellite for six months. The goal is to demonstrate that a space mirror can be used to accurately capture and point a laser beam directed from ground station

60. Ibid.

146
which is expected to further refine the ground based laser  
weapon technology.

III.2.(4) Particle Beam Weapons :

Particle beam weapons in many respects resemble laser 
weapons. For the production of a particle beam, either 
electrically charged or neutral particles are necessary. By 
an electrical mechanism kinetic energy of such particles is 
increased. For this function an electromagnetic device 
which can give 'pushes' to the particles is required. This 
is called an accelerator. In general the entire system 
would need a power supply, an energy storage and staging 
system, sensors to locate and identify targets and also a 
device to aim the beam at the target.

An intense beam of particles could have a potential to 
carry great amount of energy. This can be used for 
destruction. The energy transmitted via a beam could melt a 
hole in a piece of metal or damage, for instance, shielded 
electronic circuits of a satellite. By depositing energy, 
the target is over-heated beyond sustainable limit which 
causes disintegration and destruction. The destruction of 
-----------------------------------------------------------------------------------
61. Ibid.

62. John Parmentola and Kosta Tipsis, ‘Particle Beam 
Weapons’ 240 Scientific American, 1979, p.54.
63. Ibid.
64. Ibid., p.57.
65. Ibid., p.54.
66. Ibid., p.55.
a target using charged particle beam could be achieved through various impact effects such as hole boring leading to rupture due to internal pressure, generation of heat, X-rays and electric currents destroying sensitive electronics, 67 initiation of detonation of high explosives, and the like.

In the U.S., studies on feasibility of using particle beams as weapons were initiated in late 1960s along with laser technology. Indeed, the two systems are often collectively referred as 'directed energy weapons system'. Therefore, most of the observations made in the context of laser weapons hold equally good in relation to particle beam weapons. However, it must be noted that the U.S. is not pursuing particle beam weapons research as vigorously as it is pursuing laser technology studies and antisatellite kinetic energy systems. The projects Chair Heritage and White Horse of the U.S. Navy have been initiated for research into particle beam weapons. In July 1983 it was reported that significant technological advances have been made in particle beam technology so as to foresee a ballistic missile defence system. A difficulty in discerning developments in this technology is that often announcements and comments

67. Din, n.28, p.233.
68. Stares, n.6, p.213.
refer to directed energy research rather than individual references to lasers and particle beams.

III.2.(5) Electromagnetic Pulse Weapon:

A high altitude nuclear explosion is capable of producing gamma rays. These rays travel towards earth's surface and in the transit they meet air molecules in the upper atmosphere. This results into a flash of electrons which are accelerated and deflected by the earth's magnetic field, which generates an electrically charged field over a large area and gives rise electromagnetic pulse which travels towards even larger area of the earth's surface.

An electromagnetic pulse is capable of (a) devastating satellites, (b) disrupting communications, and (c) destroying communication system of a satellite. So far there is no evidence to suggest that the U.S. is seriously contemplating development of electromagnetic pulse weapons. However, the pulse effect has been studied in the U.S. and its possible use as a weapon has been suggested.

70. For instance, see Aviation Week and Space Technology, September 11, 1989, p.35.
72. Ibid.
73. Ibid.
III.2.(6) The Layered Ballistic Missile Defence System:

Rather than relying upon on unitary system of defence against enemy ballistic missiles for 'rendering them impotent', the U.S. military planners have devised a multiple layered system for missile defence which is expected to offer several opportunities to counter ballistic missiles right from their initial stage of launching - the boost phase - upto the final stage - the terminal phase - in which the missiles are expected to home on their intended targets. Intervening in between these two, are two more stages known as post-boost phase and mid-course phase. Various components of such a layered system could be outlined as under:

(a) Sensory system to identify hostile missiles;
(b) Air based, land based and space based weapons - lasers, particle beams, kinetic energy devices; etc.
(c) Component parts of the weapons system such as space based orbiting mirrors; and
(d) Battle management system to manage each phase for battle reliability with components, presumably satellites, in outer space for communication, command and control.

Thus, this system envisages extensive use of outer space for military purposes.
III.3. The U.S.S.R. Space Weapons Programme:

The outstanding obstacle in obtaining reliable and authentic information regarding advances made by the Soviets in space weapons technology is obviously the exquisite secrecy surrounding the Soviet military programmes. Needless to mention, this is the quintessence of the Soviet policy and polity. Source of the meagre details known to the rest of the world lies in furtively and assiduously collected information by the U.S. intelligence agencies. Such information, though its credibility is open to challenge, cannot be outright dismissed as dubitative without due consideration. One is constrained to do so since there appears to be no alternative. The U.S. intelligence has consistently assessed the successes and failures of the Soviet space weapons testing, many of which have been widely published in the Western press. Following is a survey of advances made by the Soviets in various space weapons technologies:

III.3. (1) Types of space weapons:

It is believed that following six types of space weapons are being researched and considered in the Soviet Union.

(a) Killer satellites

(b) Laser Weapons

III.3.(2) Killer satellites:

This is the most vigorously pursued antisatellite weapons programme in the Soviet Union. The so called killer satellites are also designated as 'hunter satellites', 'killer-hunter satellites', 'satellite interceptors', and 'inspector - destroyer satellites'. It has been reported that the programme may have begun in 1963 and that between 1968 and 1982, twenty tests under this programme may have been conducted. The functioning of this system is very simple. A killer satellite approaches the target satellite and explodes in its vicinity, thereby damaging and destroying the target satellite. It is charged with chemical non-nuclear explosives. An explosion in the vicinity of the target satellite is enough to render it useless, homing on is unnecessary. In most tests so far conducted, the killer satellites intercepted the targets at altitudes between some 200 and 2000 kms. It is reported that to increase the


77. Marcia Smith, 'Satellite and Missile ASAT Systems and Potential Verification Problems Associated With the Existing Soviet Systems' in Jasani, ed. n.31, p.84.

operational capability and improve its range, the Soviets are developing a launch vehicle to carry the killer satellites on board. In July 1984 it was reported that the Soviet small winged manned space-plane is in advanced stage of development and that it is likely to serve as a weapons platform that could be used to intercept or attack the U.S. satellites in low earth orbit. One of the earlier reports states that the Soviets are developing a multipurpose reusable spacecraft called 'Kosmolyot' which, once operational, could ferry crews and equipment to and from space stations, launch killer satellites, carry out military reconnaissance and space rescue.

III.3.(8) Laser Weapons:

It has been widely reported in the Western media that the Soviets have been meticulously developing powerful and exquisite laser weapons system. The Americans reckon that the Soviets possess necessary technology to pursue research and development of a laser weapons system. It was reported in June 1980 that the Soviets have been developing very powerful laser weapons since 1978, which will have the capability to damage satellites at altitudes up to 40,000 kms. It is believed in the U.S. military circles that

79. Smith, n.77, p.85.
82. Aviation Week and Space Technology, June 16, 1980, p.60.
Soviets already possess laser weapons capable of destroying the U.S. satellites in low earth orbit. In June 1984 the U.S. Department of Defence officials are reported to have said that the Soviet Union is developing a multi-megawatt carbon-dioxide laser station at Sary Shagan, Kazakhstan. The Americans are apprehensive that the Soviets plan to use laser weapons to 'blind' the U.S. reconnaissance satellites. Accordingly to one U.S. intelligence report, the Soviets have already deployed the first operational ground based laser antisatellite system.

III.3.(4). Particle Beam Weapons:

A panel appointed by the Pentagon concluded in 1979 that the U.S.S.R. is developing charged particle beam weapons on a massive scale. A paper written under the auspices of the U.S. Department of Energy reiterates that the Soviets might have developed a prototype stationary particle beam weapon at the anti-ballistic missile test center at Sary Shagan, Kazakhstan.

83. Ibid.
84. Aviation Week and Space Technology, June 11, 1984, p.16.
85. Ruhle, n.5, p.31.
87. Aviation Week and Space Technology, July 17, 1989, p.27.
III.3.(5) Kinetic Energy Weapons:

The U.S. Defence and State Departments officials said in June 1984 that the U.S.S.R. has designed kinetic energy weapons and is planning to deploy them on spacecrafts. These are believed to be missiles with long wave-length infrared guidance systems. Such missiles will probably resemble the miniature homing vehicle (MHV) being developed in the U.S. with the only notable difference that the U.S. missile is designed for firing from a F-16 bomber aircraft, whereas the Soviet missile is spaceborne.

III.3.(6) Radio-frequency Weapons:

It has been claimed by the U.S. intelligence analysts that the Soviets are developing an exotic space weapon based on radio-frequency technology. It consists of a device which produces strong radio-frequency signals which are capable of interfering with and destroying components of missiles, satellites and re-entry vehicles. The Soviets are expected to test a ground based radio-frequency weapon in 1990s.

90. Supra n.84, p.7.
91. Ibid.
93. Ibid., p.43.
94. Ibid.
III.3.(7) Electromagnetic Pulse Weapon:

It has been reported that the Soviets have conducted nuclear detonations at high altitude above the Sary Shagan radar system presumably to study and examine the effects of electromagnetic nuclear pulse on electronic components. As noted earlier, this weapon is entirely nuclear in character and invariably requires a nuclear explosion in outer space.

III.4. Military Satellites:

Since the early days of space exploration artificial earth satellite technology has immensely attracted the attention of military planners. Unquestionably, this is on account of the unprecedented and unrivalled potential it has to offer to military intelligence gathering and allied military missions. It is clear and undisputed that impetus was given to advances in space sciences and technology to meticulously refine and articulate satellite technology so that it would perpetually subserve military and strategic ends. The insatiable desire to gain more and more information regarding military plans of the adversary motivated both the superpowers to extensively and unabashedly engage in satellite reconnaissance. In course of time, from the technological revelations it became apparent that satellites can be used advantageously for many other significant military purposes. Thus, today satellites are

used for multifarious military missions. These are as under.

(1) Photographic reconnaissance.
(2) Electronic reconnaissance.
(3) Early warning.
(4) Ocean surveillance.
(5) Communication.
(6) Navigation.
(7) Meteorological.
(8) Geodesy.
(9) Ballistic missile defence systems components.

Following is a brief review of the above enumerated military applications of satellites:

III.4.(1) Photographic Reconnaissance:

Satellites equipped with powerful cameras which are capable of taking detailed pictures from outer space have been devised and launched. They detect, locate and identify military targets. These satellites may also be equipped with television cameras, multispectral scanners and microwave radars. Some American and Soviet photo-reconnaissance satellites are capable of distinguishing objects smaller than 30 cms. from an altitude of 185 kms or more. It is

96. Jasani, n.76, p.222.
97. Ibid.
believed that about 40 per cent of military satellites so far launched are photo-reconnaissance satellites.

III.4.(2) Electronic Reconnaissance

With stupendous advances in remote sensing technology electronic equipments capable of 'sensing' data from outer space have been devised. These equipments when carried on board satellites in outer space collect information regarding many kinds of military activities of potential adversaries. Thus information regarding missile testing, radar stations, armament depots, military movements and concentration, atomic explosions, etc. can be collected and relayed to ground stations. Some of these satellites are also capable of intercepting communications of other states by monitoring radio signals.

III.4.(3) Early warning:

Satellites and equipments have been devised and launched into outer space by both the U.S. and the U.S.S.R. to provide early warning of impending ballistic missile attack. It is expected that intercontinental ballistic missiles would require approximately 30 minutes to travel a distance between the U.S. and the U.S.S.R. In case of a launch of such missiles the target nation would become aware of the launch and would take defensive measures.
III.4.(4) Ocean Surveillance:

Ocean surveillance satellites help locate naval ships including submarines. They carry radars which can 'see' through clouds and detect almost every seaborne object - even small pleasure-boats. The oceanographic data so collected is relayed to ground stations and therefrom to submarines which would use it advantageously to launch an attack against hostile submarines in case of an armed conflict. The whole idea is to enhance the efficiency of naval power in maritime warfare. Otherwise also the data relayed by such satellites could be used to trace movement of hostile naval ships and submarines.

III.4.(5) Communications:

Impeccable communication facility is an indispensable pre-requisite of complex and sophisticated military systems. Communications is the heart and soul of modern weapons systems. Satellites play an indispensable and inestimable role in military communications. The distinct advantages of satellite borne military communications system have been outlined as under:

(a) They can provide communications in areas where coverage by terrestrial links is inadequate.

(b) Mobile terminals allow communications to be rapidly established in areas where facilities are absent or destroyed.

(c) They provide a service to mobile ship borne and air borne terminals which is more reliable than high frequency terrestrial communications.

(d) They surpass the conventional systems by simplifying logistics for critical command and control networks serving forces deployed in a combat area.

It has been pointed out that approximately 80 per cent of military communications is carried out using satellites.

III.4.(6) Navigation:

Navigation satellites send coded signals which enable armed forces to plot their own positions with a high degree of accuracy. These satellites are also expected to detect nuclear explosions and to provide data for damage assessment during and after a nuclear attack. Naval surface ships, submarines, aircrafts and missiles determine their positions and velocities using signals emitted by navigation satellites. The U.S. GPS and NAVSTAR systems fall in this category.

103. Ibid.
104. Jasani, n.99, p.3.
III.4.(7) **Meteorology**

A detailed measurement of the properties of the atmosphere is necessary to improve accuracy of missiles. For instance, information regarding water vapour density and wind velocity along a missile's possible route would be essential to enhance accuracy in attack. It has been observed that the advance knowledge of mechanisms of weather and climate formation may enable military planners to manipulate atmosphere for hostile purposes. But it may be recalled that the EMT Convention of 1977 categorically outlaws deliberate modification of the environment for hostile purposes.

III.4.(8) **Geodesy**

Geodesy is an operation which determines the size and shape of the earth, its gravitational field, detailed maps and location on the globe of cities, towns and villages as well as positions of military targets. Geodetic knowledge also improves performance of missiles. Geodetic satellites perform the function of gathering and sending geo-physical data for geodetic analysis.

---

105. Ibid., p.9.
106. Ibid.
107. Ibid.
108. Ibid.
III.4. (9) Ballistic Missile Defence Systems Components:

Satellites of various nature are expected to play a vital role in any kind of ballistic missile defence system. According to the perceived roles of satellites, they could be useful in tracking and identifying warheads, for early warning and in general for battle management. The U.S. Department of Defence is planning a highly sophisticated satellite system to improve early warning and to trigger antimissile weapons. This system, known as the Boost Surveillance Tracking System will consist of satellites which are expected to perform a dual role, namely, that of giving early warning, as well as of activating antimissile weapons. It is reported that the system would be immune from laser, antisatellite and high power microwave attacks and nuclear effects.

III.5. Concluding Observations:

From the foregoing certain issues come to the forefront. It seems apposite to make an inventory of the issues for further examination from legal perspectives. It suffices to enumerate these points to show that the superpowers have

110. Ibid.
111. Ibid.
incontrovertibly commenced the process of outer space militarisation. It appears to be very doubtful whether the process can be reversed or at least halted. It needs little imagination to envisage the basic legal problems arising from these developments. The first and foremost is - whether these activities are in conformity with the obligations of states under international law? And secondly, if not, what additional legal measures and in what form need to be adopted? To answer these and related questions a legal examination of the military activities outlined in this chapter has been attempted in the next chapter.