CHEMICAL WEAPONS AND ARMS CONTROL

Dissertation submitted to the Jawaharlal Nehru University
in partial fulfilment of the requirements
for the award of the Degree of
MASTER OF PHILOSOPHY

RAJIV NAYAN

CENTRE FOR INTERNATIONAL POLITICS,
ORGANIZATION AND DISARMAMENT
SCHOOL OF INTERNATIONAL STUDIES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI-110067, INDIA

1991

Dedicated to

those who

sacrificed their lives

for noble causes

जवाहरलाल नेहरु विश्वविद्यालय
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI - 110067

C E R T I F I C A T E

This is to certify that the dissertation entitled "Chemical Weapons and Arms Control" submitted by Rajiv Nayan is an original work and has not been previously submitted in part or full for any other degree or diploma in this or any other University.

Prof. (Mrs) Sumitra Chisti
(Chairperson)

Prof. M. Zuberi
(Supervisor)

CENTRE FOR INTERNATIONAL POLITICS,
ORGANIZATIONS AND DISARMAMENT.
SCHOOL OF INTERNATIONAL STUDIES.

JULY 1991.

GRAM : JAYENU TEL. : 667676, 667557 TELEX : 031-73167 JNU IN

CONTENTS

ACKNOWLEDGEMENT

As last letter of my dessertation is over I wish thanking those persons who have helped me since the inception of this work. First of all, I would like to give my sincere thanks to my supervisor, Mr. M.Zuberi who regularly advised me how to procure materials and even helped me with relevant materials. He constantly corrected, encouraged and advised me for proper academic devlopment with an unthinkable degree of affection. I think my dessertation would have remained incomplete if he had not showered his generous qualities on me.

A special thank is also deserved by Suresh Bhaiya who gave me what I needed during this period.

I am, really, thankful to my parents, sisters and friends who continuously gave me moral support.

Also, I must acknowledge help given by staff of the Jawahar Lal Nehru University Library, the Library of Indian Council of World Affairs, the Library of Institute for Defense and strategic Analysis, Nehru Memorial Museum and Library, U.N.O. Information Centre and its Library and American Center Library.

NEW DELHI

DATE : 17.07.91

Rajiv Nayan

RAJIV NAYAN

PREFACE

Inspite of emergence of the nuclear weapons, belief in the general war deterring propensity of chemical weapons still survives. It is mainly from deterrence theory that broad rationales for possessing chemical weapons have long been derived. Governments are prevented from displaying in public any other rationales, for the 1925 Geneva Protocol requires that resort to the weapons be Contemplated only for reprisals or in-retaliation. Many non-nuclear weapon states might see chemical weapons as accessible alternatives to nuclear weapons the poor man's deterrent. And for the nuclear weapon states, the deterrence of aggression must be rooted in the maintenance of a range of retaliatory and other military options, this is, patently capable of countering attack at whatever level it is delivered. Any gap in that range might, because of mutual deterrence existing at higher escalatory levels, constitute a 'window of opportunity' for an aggressor. Thus, the process vitiates the entire deterrent posture. It is this notion of an imbalance in the chemical armament of opposing forces amounting to a gap having what would in effect be strategic significance that provides the most influential rationale today for maintaining chemical weapons capabilities. The 'window of opportunity' concept imputes to chemical weapons an ability to function as an intra-war deterrent. One way of analysing its plausibility is to identify the prerequisites which the

conception must satisfy if the intra-war deterrence is to operate.

The US Defense Department is on public record as believing that its forces in Europe are now well enough protected to be capable of surviving any surprise chemical weapons attack that Soviet forces might deliver. Soviet forces in Europe are believed by an authoritative British analyst to be less capable of surviving surprise chemical weapons attack but more capable of withstanding anticipated or repeated ones. If that is indeed so, it would seem that chemical forces have values to North Atlantic Treaty Organisation (NATO] against Soviet forces, not as an intra-war chemical weapons deterrent, but as first-use weapon. And they would have value to The Soviet Union against United States forces, not as a first use weapon, but as a chemical weapon deterrent.

But the very notion of deterrence and accumulation of chemical weapons has been subject to numerous objections. The moral discomfort stems in part from propaganda generated during the First World War, wherein the Germans were cast as the personification of evil. Use of gas was held up as the ultimate evidence of their degeneracy Victor Lefebure, who wrote the first critical appraisal of the chemical warfare problem at the conclusion of World War I, credits the situation to the

circumstances surrounding the first German gas attack which, "arriving at the peak of allied indignation against a series of German abuses, in particular with regard to the treatment of prisoners left the world aghast at the new atrocity".[1] The true underpinnings may go deeper to classical aspects of chivalry and an aversion to weapons not readily associated with "fang and claw".[2]

In the category of chemical weapons are 'all weapons, which include toxic chemicals intended for purposes not prohibited under the convention, as long as the types and quantities involved are consistent with such purposes, munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals, which would be released as a result of the employment of such munitions and devices; and any equipment specifically designed for use directly in connection with the employment of such munitions or devices".[3], Chemical Weapons along with Biological Weapons and Atomic Weapons are considered weapons of mass destruction.

---

1. Victor Lefebure, The riddle of the Rhine, (New York, E.P. Dutton, 1923) p.23.

2. Ann Van W. Thomas and A.J. Thomas, Jr., Legal Limits on the use of Chemical and Biological weapons,(Dallas,197Ø) p.36.

3. United Nations General Assembly, Report of the Secretary-General on Chemical and Bacteriological [Biological] Weapons and the Effects of Their Possible Use, (New York], 1 July 1965, p. 4.

But these chemical weapons are highly diversified. Some are designed for the mass destruction of life over wide areas, others are only for localized effects. Some are intended to kill, others to disable temporarily. Some can be used by the individual, while others require the concerted action of aircraft or missile crews. There are a member of ways in which toxic material may be introduced into an organism. The agent may enter the organism through the natural intake of air, water, or food. Plants may be damaged after absorbing a chemical agent from contaminated soil. People or animals may be poisoned or infected after consuming contaminated water or food. For the latter purposes, the chemical weapons may consist of no more than a small phial or highly potent agent that can be emptied into food-processing or water-treatment equipment by a saboteur. Of much wider utility in the chemical warfare are weapons that disseminate the agent in a form suited for inhalation or for contact with the surfaces of the organisms under attack. Bulk dissemination depends greatly on weather and other local conditions for maximum effectiveness.

Further, there are certain similarities between chemical weapons and other categories of weapons of mass destruction-biological and chemical weapons have been dealt with together in a number of international agreements and documents.

Furthermore, all biological processes depend upon chemical or physio-chemical reaction, and what may be regarded

today as a biological agent could, tomorrow, as knowledge advances, be treated as chemical. A combination of biological and chemical weapons can be used with a view to obtaining greater effectiveness or to making their detection more difficult. The means of delivery of chemical and biological agents are similar and in the armed forces of many countries the same services deal with chemical weapons as means of warfare and protection. Chemical and biological weapons do have one more central common property. They are uniquely anti-life; they destroy or impair life without at the some time destroying things. Also, both are capable of being dispersed in the air and they travel with the wind in a similar manner. They may contaminate terrain, clothing, food, water, and equipment, and unlike projectiles they can penetrate any area where the air can circulate. They are also primarily effective against living organism, whether men, animals or plants, but their effects-against man at least-can be offset to some degree by protective masks, protective clothing and collective protection devices.

While chemical weapons may be either anti-life or anti-plant or anti-soil, atomic weapons in every case do comprehensive damage. ~~atomic~~ They are not able to discriminate among animal life, plant life and so on. Chemical weapons are of both varieties, discriminatory and non-discriminatory.

However, there are differences between chemical weapons and the two other categories of weapons of mass destruction. In

comparison to biological weapons, chemical weapons are much quicker to produce their injurious effects because biological agents require an incubation period which may be a matter of weeks, and depend on conditions favourable to contagion. Chemical agents, once they are delivered, may produce an instantaneous effect. They are, moreover, much more controllable than biological weapons, in the sense that the nature and extent of the damage they cause is much more predictable. Biological agents, however, are much more potent on a weight-for-weight basis than chemical warfare agents since, under favourable environmental conditions, they can multiply after dispersion, and so smaller and less costly amounts can inflict casualities over a much more extensive area. On the other hand, biological agents are more susceptible than chemical agents to sunlight temperature and other environmental factors. Once disseminated a biological agent can retain its viability, that is, ability to live and multiply while losing its virulence, that is, ability to produce disease and injury.[4]

Although chemical weapons can cause damage over an extensive area, with long term residual consequences, especially if herbicides or persistent agents are employed repeatedly, the effects of biological weapons can be even more extensive if less predictable. As they infect living organisms they can produce

---

4 ibid., p.8.

disease, and sometimes epidemics, by man-to-man transmission. They may even be carried by travellers or migratory birds and animals to distant localities. Since, they are intrinsically unpredictable, the effects of biological warfare agents can even spread back over the forces discharging them or over their own civilian populations.

In contrast to nuclear weapons, chemical weapons are impossible to aim. Effects of chemical weapons are also less predictable, while the use of these weapons is difficult to detect. Unlike nuclear explosions, there is no visible evidence, especially if chemical weapons are mixed with conventional explosives. Troops in the target zone have little or no warning and some casualities are certain to result from a chemical attack. Chemical agents kill or incapacitate faster than nuclear radiation that can take hours or days fully to disable soldiers outside the immediate blast and firestorm zones of nuclear detonations.

As there is continuous sophistication of chemical weapons so is the determined attempt made by leader of states from time to time to dismantle and prohibit the development and use of chemical weapons. The efforts have been to mitigate the evils of war by agreeing to codes or rules regulating its conduct. International documents were adopted prohibiting the use of certain types of weapons such as some explosives and incendiaries, as well as poison and gases.

There are innumberable occasions when talks, dialogues and negotiations have failed to yield any worthwhile result but there has been an event like the signing of the Geneva Protocol of 1925 which banned the use of chemical weapon in wars. In the case of chemical weapons, the concepts of disarmament as well as arms control are in operation.

The concept of disarmament conveys the total elimination of weapons from the stockpiles while arms control visualises the limiting and regulating of arms. The concept of arms control had gained much currency in the writings of western strategic thinkers in the 196Øs. This concept, although developed in the context of nuclear weapons has been applied to other weapons also.

Brennan maintains that arms control includes the possibility of disarmament, "either in limited or extensive ways", or the possibility of "arms limitation", which may or may not constitute a reduction of forces.[5] Thus, the concept of arms control, however, connotes an approach to armament policy which encompasses quantitative amounts and qualitative kinds of weapons in being, as well as development, deployment and utilization of such forces. While Schelling and Halperin have defined arms control as all the forms of military cooperation between

---

5. D.G. Brennan, Arms control and Disarmament : American view and Studies, (London, 1961], p.7

potential enemies in the interests of reducing the likelihood of war, its scope and violence if it occurs and the political and economic costs of being prepard for it.[6] Hedly Bull outlines concisely the five objectives which he believed to have been the essence of the new approach to arms control. Arms control is not an end in itself but a means to an end; it rests on there being some perceived area of common interest between antagonistic powers; arms control and defence strategy are not mutually contradictory by nature and must be developed in harmony with overall security; it imbraces a wider area of military policy than simply that which is covered by formal argeements.[7] The most important immediate goal of arms control is to stabilise the relationship of mutual deterrence between the superpowers.

---

6 Thomas C. Schelling and Morton H. Halperin, Strategy and arms Control, (Washington, 1985), p. 2.

7. Hedley Bull, "The Classical Approach to Arms control Twenty years After", in Robert O' Neil and David N. Schwartz, ed., Hedley Bull on Arms Control, (Essex, 1987), pp. 119-2Ø.

Chapter - I

CHEMICAL WEAPONS

Chemical weapons consist of three components, namely, chemical warfare agents or chemical agents; their precursors and chemical munitions.

chemical Warfare Agents:

Chemical warfare agents have been defined in a report authorized by the UN General Assembly as' chemical substances, whether gaseous, liquid, or solid, which might be employed because of their direct toxic effects on men; animals and plants.[1] Initially chlorine and phosgene, both lung irritants, were the principal agents employed to inflict casualties. Now, there are several thousand highly toxic substance known today. But of these only about seventy have been employed or stored as chemical warfare agents.[2] Again, every year invention of new deadlier chemical combinations come into existence inflating the qualitative quantity of chemical agents. These chemical agents have been divided into some major categories.[3]

---

1. United Nations General Assembly, Report of the Secretary General on Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, 1969, p.6.

2. The National Defense Institute of Sweden, Chemical Warfare Agents, (Stockholm, 1983), p.13.

3. John Cookson and Judith Nottingham, A Survey of Chemical and Biological Warfare, (London and Sydney, 1969), p. 181.

Riot control or Harassing Agents :

The harassing agents are also known as irritating agents and vomiting or tear gas sensury irritants. The harassing agents, lachrymators, sternutators, vomiting agents and orticants have a history dating back from World War I, including the use of tear gas by police forces. In some cases, these agents have been described as non lethal. This is patently untrue. None of these agents is non-lethal. All these gases are characterized to a greater or lesser degree by a large difference between the concentration needed to incapacitate and needed to kill. Agents like the lachrymators provoke a temporary flow of tears, the strenutators induce sneezing and coughing while the orticants irritate the skin to cause severe itching or stinging sensations. Some of these can produce casualties in riot control operations. The principal requirements of these agents for field use are a lack of persistence and an effect which does not last much longer than the period of exposure. Under these circumstances smoke generating grenades are preferred because smoke is very quickly dispersed. Some of these agents can also be spread as crystals which generate gas when disturbed. Further, the main agents of the 'lachrymatories' are Brombenzylcyanide, Chloracetophenone, ortho chlorbenzalmalononitrile. Brombenzylcyanide has the same properties as the other lachrymatories, but produces more serious effects. It is a potent irritant and is lethal to animals when the concentration is high or the exposure is long. At room

temperature chloracetophenone takes the form of white crystals. To be used effectively it must be vaporized or made into a very fine powder.

While the effects of brombenzylcyanide are intermediate and their duration is usually five to ten minutes more than the time of exposure. It causes an extreme burning sensation of the eyes with copious tears, difficulty in breathing and tightness of chest, involuntary closing of the eyes, sinus and nassal drip, nausea and vomiting. The vomiting agents consist of diphenylaminochlorarsine, diphenylchlorarsine, etc.[4] It may be used in military or para-military operations, counter insurgency operations or in limited or general war where control of target personnel by the incapacitating effects is desired and where possible deaths are acceptable. The effects of this gas resemble those of the lachrymatories but are more severe. The pain, headache and tightness of the chest are worse than for the lachrymatorics. Now there is a number of newly developed compounds for this purpose-chloropicrin, trichlorethylchloro-formate, Phosgene and chlorine were the main lethal agents of world War I.

Blood Gasses:

The first one of these to be developed for use in war was prussic acid. The effects of prussic acid are due to its

---

4. ibid, p.19Ø.

affecting oxidation processes, especially the absorption of oxygen by haemoglobin. In high concentrations such as might occur in confined spaces, it could be considered a fulminant poison, that is, a poison with an extremely rapid action. In low concentrations it may be detoxicated as swiftly as it is absorbed. Liquid prussic acid attacks through the skin and the eyes and may be effective in causing death in this fashion. In future applications the gas would probably be used as a spray. The munitions included balloons, and it was recognized that its function would be mainly in tunnels and similar confined spaces.

The second blood gas considered is cyanogen chloride, which may be evolved when decontaminating solutions are used cyanogen chloride is probably one of the war gases least readily absorbed by gas masks and thus protection is difficult.

Nettle Gases:

These are mainly skin irritants. These are a step up from the orticants. Exporure to them has been likened to being thrown naked into a bed of stinging nettles, hence the name. These were sometimes referred to as 'Red Cross' agents. A typical gas of this category is dichloroformoxine. It is difficult to see any particular use for these gases tactically at present against trained and protected troops. The ideal lethal agent would be imperceptible and therefore non-irritating. Riot control agents must be non-lethal. The nettle gases could have

possible application against ill protected guerrillas or in counter-insurgency operations.

The Choking Agents :

Of these gases, Phosgene is the most important. This gas and the related di-phosgene were both used in World War I. Phosgene was used in some late gas cloud attacks and in shells. It was so dangerous that it even survived as a weapon in World War II, when it was one of the four main gases stockpiled. It was partially replaced for some purposes by hydrogen cyanide. The earlier Chemical Warfare agents mainly had their effect by contact irritation of the respiratory tract or by effects on the skin and eyes. Phosgene has a systematic action. Phosgene and chlorine, another member of this group, have their main action on the lungs or the respiratory passages. They cause pulmonary oedema. In the case of phosgene, these effects may be considerably delayed. With chlorine, however, immediate irritation occurs. The action of Phosgene on the respiratory tract is typical of this type of agent.[5] Phosgene is not persistent at normal temperatures and its effect is therefore very dependent on meteorological conditions. The United State department of State has allged that phosgene oxime or a similar substance may have been used in the Soviet operation against the

---

5. J. Perry Robinson, "Chemical Weapons", in S. Rose, ed., Chemical and Biological Warfare, (London, 1968), p.12Ø.

Mujahidins in Afghanistan.[6]

Vesicants:

In the history of chemical warfare these agents were among the first used in World War I by the Germans. The multiple effects of the vesicants, and their significance, were not realised at the time of their first use. Between the wars, however, mustard gas was considered to be the most serious threat in the event of a further conflict. The first use of mustard gas was in shells, not in the gas cloud method. Four types of vesicant have been prominent for chemical warfare. These are mustard gas, the nitrogen mustards, lewisite or dew of death and Ethyl dichlorarsine.[7]

Among mustard gases, the LOST named after the two German chemists Lommel and Steinkoff, As it is known that first use of this gas was in shells during the First World War, in future Wars aerial dissemination was likely to be of some importance. Spraying could be very effective. Mustards may be used in shells where the intention is to convert some of the liquid to vapour and some to liquid droplets to contaminate ground and to produce severe skin effects. Mustards are particularly useful as they

---

6. Chemical Warfare in South-east Asia and Afghanistan, Report to the Congress from Secretary of State, Alexander M. Haig, Jr., March 22, 1982, United States Department of State : Special Report Number 98, p.7.

7. Cookson and Nottinggham, No. 3, p.2Ø3.

penetrate clothing, even rubber.[8] They are almost ideal defensive agents. Substantial stocks of mustard are still held in the arsenals of the superpowers, and the mustard gas has been used in the Iran-Iraq War[9].

Nitrogen mustards are the most offensive amongst the vesicants. And the most marked effects of these are on the lymphatic and haemopoietic tissues. There are also arsenical vesicants, consisting lewisite and the Dicks.[10] The vesication is the same but complications arise due to arsenic poisoning.

Incapacitating Agents:

Incapacitating agents may be placed in two categories. First is physical incapacitants[11] and second is psychotomimetric agents.[12] These agents affect the central rather than the peripheral actions of the body.

Physical incapacitants are picturesquely referred to as the 'on the floor agents', sometimes known as the physio

---

8. Brig. Gen. J.H. Rothschild, Tommorow' Weapons, (New York, 1969), p.38.

9. Report of the Specialists Appointed by the Secretary General to investigate Allegations by Islamic Republic of Iran Concerning the Use of Chemical Weapons, 26 March 1984, S/16433, p.11.

10. Cookson and Nottingham, No. 3, p.209.

11 ibid., p.205.

12 ibid., p.209.

chemicals. Many abnormal bodily conditions can be induced by chemical means. Heat stroke or exhaustion can be accomplished by Tri-iodothyronine, a material isolatable from salmonella cultures, DNP,DNOC, etc., while orthostatic hypotension, inability to remain standing without fainting, is caused by Monoamine oxidase inhibitors such as 2 Phenyliso Propylhydrazine, 2-imidazoline hydrochloride. Muscular hypotonia, i.e., inability to operate many of the voluntary muscles is a characteristic of the organophosphorous esters that they cause loss of control of voluntary muscle function. In some cases, this may result in a paralysis of the flaccid type. This is separable from the high lethality characteristic of some of these compounds. Triorthocresyl phosphate is an example. There are some agents which will produce muscular tremors. The tremor causing agents 'tremorine' and 'oxotremorine' are of chemical weapons interest.

Other effects of interest include laxation, for which an agent has been developed, physiological blindness and vomiting. the Americans have extensive stockpiles of the gas B2. It is more likely to be used in counter-insurgency operations or against guerrillas. Its effects are those of an auticholinergic psychoto-mimetric drug. It is a solid which can be dispersed in aerosol form and takes effect within half an hour. During the first four hours the victim may experience a parched nose, mouth and throat, dry flushed skin, headaches, vomiting, blurred vision and dizziness. He may stagger or stumble about, speaking in

slurred voice or mumbling incoherently. During the next four hours, he may feel disoriented, experience visual and auditory hallucinations and lose his memory. Usually these effects are temporary, but victims, receiving a similar dosage, may not respond in indentical fashion. Over the next day or two, the behaviour of some could remain random and unpredictable, even in some cases maniacal, before gradually returning to normal within about four days.[13]

Psychotomimetric agents are sometimes known as pychochemicals. Psychochemicals are associated in the public mind with war without death. It is unfortunate that this ideal is a long way from realisation. For to many people the terms 'psycho gas' and 'incapacitant' are synonymous. This is considered more a weapon of public relations than of war. The reason for their popularity is that their effects can be demonstrated in the laboratory and these quickly wear off. Any agent which is powerful enough to produce these effects in small enough quantities for chemical weapon use will be almost certainly lethal in doses under field conditions. The other main reason for their popularity is their effectivity in very small doses. One bomber could carry enough doses of LSD 25 to incapacitate the population of the whole world. However, this does not make it a weapon. This gas is capable of neutralizing a population, one which makes its victims incapable of realising

---

13 ibid., p.207.

what they are doing for hours but which, once the effect wears off, leaves no permanent injury. It might be possible to direct such gases against entire cities, preparing the way for their seizure without damage to the buildings and with no harmful effect on the population.[14]

The US Department of State has asserted that the symptoms reported from Afghanistan and Kampuchea indicated that a highly potent, rapid-acting incapacitant chemical was being employed by the Soviet and Vietnamese forces.[15]

Nerve Agents:

But it is with the advent of nerve agents that the classic arguments for and against chemical warfare are largely invalidated. These substances changed the application of chemical warfare from the tactical to the strategic. Previous applications in this field had been restricted to tactical situations in which two armies used these weapons locally to gain a military advantage. The ineredible toxicity of the nerve agents makes it feasible to attack populations. Organophosphorous poisoning, which is caused by them, is due to their inhibition of certain enzymes of the nervons system, amongst which is acetylcholinesterase some dehydrogenases and pseudochlinesterase

---

14. ibid., p. 212.

15. Haig Report, No. 6, p.7.

are also affected. Stored as liquids, the nerve agents may be dispersed as a cloud of vapour or as a spray of liquid droplets. Should the agent penetrate the body, either by inhalation or by percutaneous absorption, it will react with several enzymes but principally with acetylcholinesterase after it has performed its function of transmitting nerve impulses. Very low dosages will cause running nose, tightness of the chest, dimness of vision and contraction of the eye pupils. At higher dosages the symptoms will progress through difficulty in breathing to drooling and excessive sweating, nausea, vomiting, cramps, and involuntary defecation and urination, twitching, jerking and staggering headache, confusion, drowsiness, coma, convulsions and finally death. These symptoms, will appear much more slowly from skin dosages than from respiratory dosages will kill in one to fifteen minutes and, although lethal dosages absorbed through the skin could kill as quickly, death from percutaneous absorption of nerve agent may be delayed from one to two hours.[16] The victims of a sub-lethal exposure will probably recover within a few days, but some may suffer irreversible damage to the central nervous system because of anoxaemia.

There are two classes of nerve agents. There are the G Agents and the V Agents. Tabun is the least toxic of the G-Agents considered for warfare use. Its toxicity is twenty times

---

16. SIRRI, The Problem of Chemical and Biological Warfare, (Stockholm, 1973], Vol.2, pp. 52-53.

that of phosgene, one of the major lethal gases available in World War II. Sarin and Soman are other more powerful G-Agents. All of these agents, in addition to being effective by inhalation, are effective through the skin. It had been found that by altering the solution in which the agent is disseminated, the percutaneous toxicity and effectiveness through the lungs may be enhanced.

Even more toxic than the G-Agents are the V-agents which were reputedly discovered in Britain in the 195Øs. They act as rapidly as the G-Agents, if inhaled, but they act much faster through the skin and are more effective in smaller dosages. The V-agents can be dispersed in aerosols as a direct contact hazard, especially on exposed skin, or as a persistent indirect hazard, contaminating the ground, vegetation and equipment. They possess a volatility similar to that of a heavy motor oil. There are two standardized agents, VE and VX. VX has been stockpiled by the United States. If applied directly to the skin, VX in minute quantities can incapacitate or kill. It can also kill by permeating ordinary summer combat clothing and boots.[17] To create short-term respiratory hazards, VX would have to be disseminated as a fine aerosol, as it lacks the volatility to provide a lethal field concentration of weapons. A coarse liquid spray would be highly effective for ground contamination or skin

17. ibid., pp.42-43.

attack, but would not be a respiratory hazard unless the spray included very fine droplets. If disseminated at about 300 kilograms per square kilometre, VX could persist as a skin-contact hazard over several days or weeks, depending on the weather.[18] Thus, the V-Agents are several hundred times more toxic than the most lethal chemical weapons before the advent of the nerve gases. They are about 200 times as toxic percutaneously as mustard gases, and about 300 times as toxic through the lungs.

Toxins:

Another category, of chemical warfare agents, is of toxins. Though usually produced by living organisms, toxins are classified as chemical substances because they are inanimate and cannot multiply. As they are more easily controlled and faster acting than microbiological agents, they have a greater potential military utility.[19] Numerous toxic substances exist in nature. Some are produced by bacteria including botulinal toxin A, the most poisonous substance known, and Staphylococcal enterotoxin B, which is not normally lethal but which can incapacitate temporarily by causing a sudden and severe bout of food poisoning. Others are produced by marine organisms such as

---

18. M. Meselson and J. Perry Robinson, "Chemical Warfare and Chemical Disarmament", Scientific American, Vol. 242, No. 4, (1980), p.35.

19 United Nations General Assembly, No. 1.

saxiotoxin, a lethal toxin generated by certain algae, by fungi such as aflatoxin and the trichothecene mycotoxins, by castor beans like ricin, by poisonous plants and by venomous snakes, insects and spiders. As the development, production and stockpiling of these agents are proscribed under the Biological And Toxic Weapons Convention (1972) and their use banned effectively under the Geneva Protocol (1925), the allegations of toxin usage, even of the comparatively less potent, tricothecene mycotoxin, in Afghanistan, and South-East Asia, aroused considerable controversy.

Anti-plant agents have also been used in chemical warfare. These are agricultural chemicals which act in different ways upon plant life and vegetation. Some act as defoliants, causing the leaves of a plant to fall prematurely while herbicides are effective in poisoning the plant so that it dies. The defoliants are employed with the intention of removing leaves from the trees. The distinction between the two is one of degree. The effects of defoliants depend on the strength of solution used. Of two concentrations the defoliants may act to stimulate growth in lower concentration. In higher concentrations they may act as selective weed-killers, particularly against broad leaved plants. It is only in this restricted sense that they are selective. In higher concentrations still, they cause the death of other plants.

The dessicants dry out the tissues of a plant, so leaving its leaves brittle, shrivelled, and more easily, though not invariably, detached by the wind or rain. Some chemicals also act as soil sterilants, preventing or retarding the growth or regrowth of plants by chemical treatment of the soil.[20]

Several anti-plant agents have been used in chemical warfare, including the phenoxy acids, picloram and cacodylic acid. The phenoxy acids may be used in the form of salts which are soluble in water or in the form of esters which are soluble in oil. Although the choice for a specific application will depend upon the desired characteristics such as solubility, volaticity and melting point, the esters of 2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) were found to be particularly effective against woody vegetation in the Vietnam war. They were mainly absorbed by foliage of leaves and acted as growth regulators upon the plants affected. Their action which is usually rapid, may spread throughout the plant and involve absorption by the roots, A plant's reaction to 2,4-D or 2,4,5-T, depending on the special. concentration of agent, could result in an abnormal production of buds or roots and an excessive growth of tissues. A plant may die from the disruption and plugging of its vuscular tissues.[21]

---

20. SIPRI, No. 16, pp. 36-37.

21. F.M. Asthon and A.S. Crafts, Mode of Action of Herbicides, (New York, 1981), 2nd. edn., p. 302.

Another compound used in Vietnam was picloram (4-amino-3,5,6-trichloropicolinic acid). A plant growth regulator, like the phenoxy acids, it is an extremely mobile compound which can be readily absorbed by both leaves and roots. Compared with 2,4,-D, picloram is much more mobile, better able to penetrate roots, and more toxic to plants. Moreover, it is persistent in soils, allowing itself to be used as a soil sterilant under some conditions, whereas the persistence of 2,4-D and 2,4,5-T in soil is limited to only a few weeks.[22]

While cacodylic acid is not a plant growth regulator but acts as an uncoupler, preventing a plant from using the products of its metabolism for growth and tissue maintenance. An arsenic compound acts as a contact herbicide and is rendered rapidly ineffective in soil. Only slightly toxic to humans, its main effects on plants are to stop growth, attack membrane integrity, and cause drying, yellowing and eventually death. Other agents could be employed specifically as soil strerilants, including bromacil and monuron. While bromacil could be used either in dust formalations or in aqueous or fuel oil solutions, monuron would be generally employed in dust formulations of its trichloroacetate salt.[23]

---

22. ibid., p.428.

23. World Health Organisation, Health Aspects of Chemical and Biological Weapons. Report of a WHO Group of Consultants, (Geneva, 197Ø), p.56.

The Precursors:

The Precursors constitute another major component of chemical weapons. A precursor plays an important role in determining the toxic properties. It is used in one of the chemical reactions at the final stage of formation of the super-toxic lethal chemical. It is new only in minimal quantities for permitted purposes.[24]

Chemical Munitions:

To deliver a payload of bulk solid or liquid agent, and then to disseminate it in a form which utilizes the toxic properties of the agent most effectively chemical munitions are required. There are three basic methods of dispersing chemical agents from a munition-explosion, vaporisation and pressure. The explosive method, in which the heat and pressure from a high-explosive charge to disperse the payload is used, is vigorous and simple but it does not produce a good control of particle size. Definitely, it is useful when liquid contamination and a rapid build up of vapour concentration are required. Chemical filled projectiles, such as mortar or artillery shells, may be fused to detonate either at ground level or at a predetermined height above the ground. The ratio of the weight of chemical filling to

---

24. Conference on Disarmament Document, CD/1033, Report of the AD HOC Committee on Chemical Weapons to the Conference on Disarmament, 10 August 1990.

weight of explosive burster will determine whether the agent is disseminated predominantly as a vapour or as a liquid. Formerly, such munitions were not suitable for disseminating solid agents unless the payload comprises a very fine powder, since some powders tended to agglomerate under storage or under the influence of the explosive, and the milling of toxic substances into micron-sized powders was both difficult and dangerous. But techniques have been developed to overcome these problems-the addition of anti-agglomerates such as colloidal silica to the payload and the micro-encapsulation of each powder particle in a special coating to protect it from the stresses of explosive dissemination. Explosive weapons, capable of dispersing solid particulates, are now mass-produced, notably the hand grenades used by American Police forces for disseminating CS.[25]

A burning-type munition is used to disseminate a solid or liquid chemical agent by vaporisation. Once the substance has been vaporised by heat, it is ejected into the atmosphere. Whereupon it cools rapidly and recondenses into aerosol droplets or solid particles. This method is employed in some grenades, especially, the irritant agent weapons used by police forces to disperse C.S. smokes for the purposes of riot control. In these grenades, the agent is mixed into a pyrotechnic composition so that it can be ignited by a fusing mechanism and then distilled

---

25. SIPRI, No. 16, p. 74.

into the atmosphere as it burns.[26] Although burning-type munitions produce uniform sized particles, they have two principal disadvantages, they disseminate the agent relatively slowly and their clouds, at least initially, are visible.[27]

Pressure devices have some advantages over both bursting-type and burning-type munitions. They produce a more controllable droplet size than explosive munitions and disseminate the agent more rapidly than do vaporization methods but not as rapidly as the explosive munitions. The agent may be forced out into the atmosphere under pressure through a fine nozzle, by the expansion of a gas, such as liquid carbon dioxide, or by compressed air from within the cylinders. Some aeroplane spray tanks operate on a similar basis, notably the 52ØØ apparatus retained by the Germans during the Second World War, but often these do not use any pressure to eject the agent. Some spray tanks merely discharge their agent and rely upon gravity to disperse it, as the agent, once released, experiences the shearing effect of the air blast and is broken up into very fine droplets which drift with the wind. To ensure that the droplets land upon the intended target area in the required density, and are not too small to be effective, aerial spraying is normally conducted at comparatively low altitudes and at low air speeds.

---

26. C. Bruce Sibley, Surviving Doomsday, (London, 1977), p. 37.

27. Rothschild, No. 8, p.74.

Higher altitude spraying is possible, especially in the meterological conditions which may exist at night or in early morning but it is less reliable.[28]

Formerly aerial spraying was regarded as a reasonably economical and effective method of dispersing a chemical agent accurately over large target areas. During the Second World War, most of the principal belligerents possessed forms of spray apparatus.

During the First World War all three types of chemical munitions were developed and employed. Initially, hand grenades were used but their range was limited to about twenty-five or thirty yards, and frequently exposed the users as much as the enemy to the gases released. Rifle grenades were employed next, but their range was also limited to about 200 to 250 yards.

In January 1915, the Germans experimented unsuccessfully with gas shells on the Russian Front, though later the first major gas attack was launched.

Cylinder operations, though, had many disadvantages as methods of attack. They required a laborious and labour-intensive preparation; the cylinders were cumbersome to carry, had to be installed at night as there were no practical means of denying enemy observation of the front line trenches, and then

---

28. A.M. Prentiss, Chemicals in War, (New York, 1937), pp. 520-1.

had to remain in the parapet until a favourable wind appeared. Infantry loathed the task of bringing the cylinders forward for their installation by the specialist gas units. Nor did they appreciate the presence of the cylinders in the forward trenches as accidents and losses occured from leaks, from bursting cylinders, and from the enemy response to a cylinder attack, namely, a hail of sharpnel and high explosive shells. Cylinder operations were also weather dependent. The attacks were always unpredictable as they depended upon the speed and direction of the wind. Cylinders, finally, gave the enemy more warning of an impending attack than shelling or mortar-fire. Even if the attacks were mounted at night, the emission of gas was accompanied by a high-pitched hissing sound which was distinctly audible at a distance of 275 yards. Nevertheless, the early identification of a cylinder cloud could be advantageous in some circumstances, especially if the enemy responded to its gas alarms and became preoccupied with, and hampered by, its own protective measures.

In the aftermath of the First World War, efforts were made to correct some of the defects and deficiencies of the chemical shell. The introduction of time-and-percussion super quick fuses greatly enhanced the ability of artillery gas shells to disseminate there billings. These fuses enabled the gas shell to be fired like sharpnel for overhead and ground bursts, and the

superquick action ensured that the shell would burst on the surface of the ground and not in the bottom of the crater.[29]

By the Second World War many of the belligerents concentrated upon mustard or mustard compounds and irritant agents as their principal fillings with a view to using artillery for the purposes of ground contamination and harassment.

In the post-war American shell fillings, the principal payloads have been nerve agent or mustard. In the M121 series of 155 mm projectiles, the Americans have adopted the German technique, employed in the Double Yellow cross shell of 1918, of applying a massive HE Charge to shatter the payload. When detonated by a proximity or time fuse for an air burst, the nerve gas is dispersed in a cloud of small droplets and, in the case of sarin, will vaporise quickly.

The Livens projector was also specially designed for chemical warfare. Designed by captain F.H.Livens, the projectors used in active service ranged from 2 feet 9 inches to 4 feet in length. They were installed just behind the front-line trenches in batteries of twenty.[30] Once the projectors were dug in upto their bottom lip at an angle of 45 degrees and on a base plate to prevent undue sinking, their charges and bombs were inserted, and

---

29. ibid. p.495.

30. ibid., p. 364.

the charges connected up in batteries of twenty with outside wires connecting them to an exploder. The exploders connected to all the batteries were placed in a central position for convenience of control. The longer projectors had a range of about 17ØØ yards.

But projectors had two principal disadvantages. In the first place, the installation was immensely laborious. A trench had to be dug for each battery and filled in upto the muzzles of the weapons; bombs, weighing about 6Ø pounds and containing 3Ø pounds weight of gas, ad to be loaded, and the electric detonating wire had to be strung. Secondly, once installed, the projectors could only fire at the predetermined target - they could not be adapted to the conditions of more mobile warfare which began to emerge towards the end of the war. On the other hand, the Livens projector possessed substantial advantages over cylinders as a means of attack. Easily constructed, the projectors could be produced in vast numbers and could be filled with various substances. As the projectors could be installed behind the front-line, materials could be brought forward and the weapons prepared in daylight if the enemy could not observe the site. Unlike the cylinder, the Livens projector was not weather-dependent and gave the enemy only a few seconds' warning of an attack. Above all, the projector could create sudden massive field concentrations of agent over large target areas - an achievement which neither mortar nor artillery units could emulate without immense effort.

Toxic smoke candles were another wartime invention, although they were never used in the First World War. They were discovered accidently by the British during their investigation of diphenylchlorarsine (DA), which the Germans had been using as a filling in their Blue cross shells.

A 'thermo-generator' candle was soon designed whereby the DA and the heating mixture were replaced in separate compartments within a tin weighing two or three pounds. Foulkes recommended that the thermo-generator, or 'M' device as it came to be called, should be employed on a massive scale in a surprise attack, involving hundreds of thousands of candles being set alight, as a means of opening the road for our infantry in the minimum of time, without any warning and practically without loss.[31]

The toxic smoke candle differed fundamentally from the standard smoke candle, or the slightly larger and less portable smoke pot, which had been used extensively during the war for the purposes of screening the assembly and movement of troops. It could produce vast clouds which possessed the advantages of extensiveness, pervasiveness and duration of cylinder-gas clouds.[32]

---

31. Maj. Gen. C.H. Foulkes, Gas! the Story of the Special Brigade, (Edinburgh, 1934), p. 252.

32. A.M. Prentiss, No. 28, p.665.

As the candle was in a solid from, it was safer than the cylinders, precluding the problems of leakage or of dangerous pressures in front line operations. It was also simpler logistically; it was always assembled and ready to use, never needed to be returned to the rear for refilling, and was much more mobile as several candles could be carried by each soldier. On the other hand, as a larger number of candles was required per foot of front, there was little gain in respect of the material carried to the front.[33] The Japanese used toxic smoke candles in their operations against China.

Mustard, king of the war gases during the First World War, required certain ammunitions for its maximized effects. The Germans constructed bulk contamination vehicles, fitted with pressure nozzle attachments, which could spray a belt 700 metres long and 22 metres wide with a contamination of 100 grams per square metre. They also devised an indigenous concept, known as the Bodenkugeln, by which glass bulbs charged with gas could be concealed in ground in a chessboard pattern, with some two to three per square metre. Spraying mines or land mines are still a highly efficient means of spreading ground contamination with persistent agents.

Guilio Douhet, writing in 1921, maintained that aerial gas attacks would become a logical and inevitable aspect of

---

33. ibid., p. 415.

strategic bombing. Each represented a revolution in warfare - the aeroplane on account of its strategic mobility and ability to attack the enemy homeland, and poison gas because of its area lethality.[34] There were two basic methods of disseminating gas from aircraft: spray apparatus, either based upon pressure or non - pressure as a mode of release, and bombs.

The typical chemical bomb of the Second World War had a large streamlined container with a central HE burster, liquid chemical filling, fin assembly, and fuse. It could be altered in various respects to improve the area coverage and aerosolisation of relatively non-volatile agents, such as tabun and mustard.

Although the cluster bomb designs of the Second World War were a considerable improvement upon the single unit bombs, they did not fully exploit the potential of the highly toxic agents. Several new munitions were designed in the post-war period to minimise the degree of over-dosage in one locality. In the first place, 'bomblets' were developed to ensure that they became subjects to magnus lift forces, that is, by designing spherical, and not cylindrical, bomblets with small vanes around their outer surfaces, horizontal motion could be imparted to them after their ejection from the cluster unit. As a consequence, the glide path through the air of such a cluster would broaden and the area of their impact would become considerably greater.

---

34. G. Douhet, The Command of the Air, D. Ferrari, trans (New York, 1942), 2nd edn., p. 182.

Secondly, bomblets could be designed as small rockets so that, when activated, they would spin out like a pin wheel disseminating their contents over as broad an area as possible. Thirdly, bomblets could be disseminated in an off-target attack, across the wind and upwind of the target area. By ejecting a string of bomblets along the line of flight path, the bomblet dispenser can create an intense upwind source of the agent. Bombs, like the American MK-116 Weteye bomb, have also been designed which release an aerosol spray on detonation.

The BLU - 8Ø B Bigeye bomb is the latest aerial munition which has been designed by the United States. It is an aerosol spray bomb.

The quest for more mobile delivery systems, capable of greater area coverage, was also reflected in the improvements of ground-based weaponry. The multiple rocket launcher, which was designed shortly before the outbreak of the Second World War as a mobile equivalent of the Livens Projector, was ideally suited to chemical warfare.

Chapter II

APPLICATIONS : STRATEGIC, TACTICAL AND HISTORICAL

STRATEGIC APPLICATION:

Strategic applications of chemical weapons are their use against targets distant from any batllefield.[1] These applications of chemical weapons include both large-scale use against civilian targets, and small-scale localized use in sabotage and other irregular operations. Strategic applications can be envisaged for chemical weapons both before and after belligerents declare or openly acknowledge that they are at war. During the former period whether it is succeeded by overt war or not, chemical weapons might be considered to lend themselves to covert strategies of subversion or economic warfare covertly. They might continue to be used for sabotage, demoralization and attrition. Overtly, anti-plant or anti animal agents might be used on a large scale against an enemy's farm lands or industrial crop cultivations. Antipersonnel agents might be exploited for mass-casualty effects among civilians. While this might not serve any constructive strategic purpose, it might nonetheless attract a failing belligerent intent on vengeance at any lost.

---

1. SIPRI, The Problem of Chemical and Biological Warfare, (Stockholm, 1973), Vol. II, p. 142.

Tactical Applications:

Applications of chemical weapons in theatre operations are known as tactical application. As early as 1978, Joseph D. Douglass concluded that chemical weapons have a unique place in the family of modern batllefield weapons in that they only effect living creatures. They wound and kill without materials and implements of destruction. He, further, views that by standards of military effectiveness, chemical weapons may be compared to low calibre nuclear weapons.[2] Moreover, Field Manual 100-5 of the United States treats chemical weapons on a par with other weapons. It states that when properly employed in mass and without warning, chemical fires can cause high casualities among poorly trained or poorly equipped troops; degrade the effectiveness of weapons, vehicles and command posts by causing their operators to wear protective equipment : restrict the use of weapons, supplies and equipment by contamination; disrupt rear area operations and troop movement ; and enhance the effects of other fire support by solving enemy movement; reduce the speed, cohesion, and freedom of movement of enemy formations; restrict or deny the use of key terrain, force the enemy to undertake decontamination operations, thereby producing fresh targets for chemical or other fire support means[3].

---

2. J.D. Douglass, Jr., "Chemical Weapons : An Imbalance of Terror", Strategic Review, Vol. 10, No. 3, (1982), p.40.

3. Ernard Geissler, Biological and Toxin Weapons Today, (Oxford, 1986), p.76.

Chlorine might be chosen to attack a concentration of enemy troops on terrain; friendly forces would desire to traverse or occupy immediately following the attack. Casualties among unprotected personnel would be produced almost immediately and the agent would rapidly dissipate.

Mustard might be chosen to attack a logistical facility or depot when long-term interference with operations is desired and near-term friendly occupation of the facility is not anticipated. Similarly, a persistent agent like mustard can be used simply to contaminate terrain, a key avenue of approach, a main supply route, on an observation point thereby exacting a price in the form of casualities or encumbering protective measures from those who might wish to occupy or traverse the site in question.

The amplification of the threat is continuing with the advent of nerve agents which are potentially useful in antipersonnel, material contamination, and terrain denial roles.

The principal advantages of chemical weapons over potential alternatives are their psychological impact or shock effect, the difficulty of defending against them, and their persistency. The shock effect of chemical weapons is significant and offers a potential for decisive results when they are first used. Their shock effect at the tactical level will diminish with each subsequent attack. Their advantage over conventional

high explosives in this respect holds only as long as they maintain a degree of uniqueness greater than a particular HE weapons capable of producing comparable results. [4]

Chemical weapons are area coverage weapons. Compounding the area coverage capability is the difficulty of detecting them.[5] The inability to provide early warning results in defensive measures which are themselves debilitating. Again, compounding the difficulty of detecting toxic chemical agents is their pervasiveness. Chemical anti-plant agents facilitate target acquisition and aerial reconnaissance, and to diminish the risk of ambush.[6]

The toxic agents are search weapons. When released into the air, they move with the wind and as they move, they penetrate shelters, buildings, dugouts and other types of fortifications, seeking enemy personnel. This characteristics is important because modern military doctrine advocates the broad dispersal of field troops to avoid presenting nuclear targets.[7]

Beginning in the late 197Øs, North Atlantic Treaty Organisation (NATO)started to overhaul its defensive posture for

---

4. Hugh Stringer, Deterring Chemical Warfare : US Policy Option for the 199Øs, (Washington, 1986), p.7.

5. ibid., p. 7.

6. ibid., p.8.

7. Brig. Gen. J.H. Rothschild, Tomorrow's Weapons, (New York, 1964), p.22.

chemical warfare in response to evidence, based on equipment captured during the 1973 Yom Kippur war, indicating a high degree of Soviet preparedness for chemical warfare.[8] There are two basic elements of NATO doctrine. First, a no first use policy on chemical weapons, which requires that NATO forces must be able to withstand an enemy attack with chemical weapons, and a commitment to forward defense whereby NATO forces cannot yield territory even if it has been contaminated. NATO's deterrent is based upon a mix of offensive and defensive capabilities, including a limited stock of chemical munitions. Its offensive deterrent rests upon the American stockpile of chemical weapons. NATO has renounced the option of initiating the use of chemical weapons. It seeks to deter recourse to such weapons by its strategy of flexible response. The alliance does not possess a chemical retaliatory capability, but the United States and France retain limited offensive chemical forces which could retaliate if NATO incurred a chemical attack.

Soviet military doctrine stresses the elements of surprise, high speed of advance and maneuovre as well as massive firepower as the cardinal and immutable principles of its military strategy. Moscow has adopted a Blitzkrieg-type strategy to compensate for the weaknesses of its industrial base. Swift and decisive victory is also required to avoid political fissures

---

8. M.R. Hamm, "Deterrence, Chemical Warfare and Arms Control", Orbis, Vol. 29, No. 1, Spring 1985, p. 132.

at home and in the East European satellite countries, which might be engendered by a protracted war of attrition. M. Hoeber and Joseph D. Douglass, Jr., observed that "for the major Soviet concerns or targets in the event of either a conventional or a nuclear war in Europe chemical weapons offer important advantages that complement rather than duplicate the effectiveness of both conventional and nuclear weapons, and recommends their use in both contexts".[9]

Dr. Thomas J. Welch, Deputy Assistant to the Secretary of Defense, stated that the Soviets would employ chemical agents which are now integrated as a supporting and complementary element of fire support in conventional or nuclear operation to exploit their combat multiplying effect against specific targets anywhere throughout the entire depth of NATO defences.[10]

General Fredirick J. Kroesan and his group of twenty retired senior officers concluded that the Soviet Armed Forces could have 'innumerable opportunities' for using chemicals selectively in attack.[11] Given the balance of forces in central

---

9. A.M. Hoeber and Joseph D. Douglass, Jr., "The Neglected Threat of Chemical Warfare", International Security, Vol. 3, No. 1, Summer 1978, p. 62.

10. T.J. Welch, Answer to Senator S. Nunn in Hearings before the Committee of Armed Services, Department of Defense, Authorization for Appropriation for Fiscal Year 1986, 99th Congress, First Session, (28 Feb. 1985), p. 1556.

11. Gen. F.J. Kroesan, et.al, Chemical Warfare Study : Summary Report, IDA Paper, (Bethedsa, February 1985), pp. 3-4.

Europe, and NATO's reliance upon the port arrival airfields and assembly areas would seem to be a tactical imperative. Same position would be felt in the situation of attacks against NATO's airfields and nuclear delivery capabilities. The employment of Chemical weapons employment serves all purposes.[12]

Once the nuclear deterrence has failed, and war erupts, the Soviets can calculate that a one-sided use of chemical weapons may secure a military advantage, especially if it can assist in suppressing NATO's theatre nuclear capabilities at no additional risk.[13]

A chemical response by NATO might pose more problems for the Soviets. Its perceived significance would depend upon the chemical capabilities which are in, or which can be deployed in, the European theatre and upon the willingness of NATO's governments to approve retaliation in kind. NATO's response, whether based upon a like-for-like chemical exchange, or aerial bombardment of second and third echelon forces, or even attacks across the whole front, will be considered a serious threat by the Soviets if it is thought likely to reduce their speed of advance and restrict their batllefield mobility.[14]

---

12. Stringer, No. 4, p. 56.

13. A.M. Hoeber, The Chemistry of Defeat : Asymmetries in US and Soviet Chemical Warfare Postures, (Cambridge, 1981), p.65.

14. ibid. p.57.

Whatever the perceived utility of chemical weapons in Europe, their possible usefulness may be even greater in other potential military theatres, particularly in the Third World. In counter-insurgency operations, chemical weapons can serve as instruments of terror and demorlisation penetrating the sanctuaries of guerrillas and possibly inducing mass flight by unprotected civilians and soldiers. As a weapon of mass destruction, chemicals may be a means by which a smaller state seeks to redress the military imbalance with a larger and potentially hostile neighbour. Chemical weapons may also provide a cheap alternative to nuclear weapons or a temporary stage in the development of a nuclear weapons capability as the role of a 'poor man's atomic bomb'.[15]

With the rise of terrorism on a global scale, there is a possibility of terrorists using chemical weapons. The use or threatened use of chemical weapons is certainly one method by which terrorists can seek to maximise their shock impact, gain widespread publicity and sow the seeds of fear and trepidation. More calculating terrorists, though, may prefer chemical weapons to either biological weapons or toxins because of their stability, controllability, and ease of production and dispersal.

HISTORICAL APPLICATION

The recognition of the effective use of poisoned arrows; the employment of the gas sulphur dioxide by the Spartans; the

---

15. E.M. Spiers, Chemical Warfare, (London, 1986), p. 180.

fighting of with smoke screens, incendiary devices and toxic fumes by the Indians in the epic battles, though without any historicl fact; the use of arsenic smokes during the Sung dynasty; Thucydidian details of the seige of Plataea at the Peloponnesian War and so on in the ancient period promote the idea that the use of chemicals in war has a very long history In the widdle ages, too, there have been reports of the use of chemicals. The Turkish attack on Belgrade was repulsed by an alchemist who prepared a poisonous mixture. At the end of the nineteenth century, the Boer War witnessed the use of picric cid in artillery shells by the English. "Once on the ground, the shells released an explosive gas known as Lyddite. The shells were not very effective" as writes Hersh.[16]

In real sense, the period between 1915 and the end of the First World War demonstrated noticeable use of Chemical weapons in battle. Both sides made constant use of Phosgene, chlorine, mustard gas and many less toxic agents showing disrespect to an international disarmament on the use of gas shells between the Boer War and the outbreak of First World War. as Hersh informs, "About 17,ØØØ chemical troops were employed by the allies and their enemies and 1.3 million casualties, including 91.ØØØ deaths, were attributed to gas warfare. The U.S. forces were not involved in gas attacks until February 25,

---

16. Seymour M. Hersh, Chemical and Biological Warfare, (London, 1968), pp.3-4.

1918, when they were hit by German Phosgene shells. The first offensive use of gas by the United States was against the Germans in June 1918".[17]

The lethal cloud of chlorine gas by the Germans on the French lines at ypres is considered the first use of gas in the First World War by most of the military historians. The use of hand and rifle grenades filled with tear gas in 1914 was started by the French at the earlier stage. A new type of blister gas named 'Lewisite', that could quickly blister the skin and penetrate the body, was developed by the United States by the end of the War.

The Geneva Protocol, signed in 1925, was openly violated only once before the Second World War when Italy used mustard gas against Ethiopia also a Japanese attack on China had been alleged.

During the Second World War, Japan, a non-signatory to the 1925 Geneva Protocal, was accused on numerous occasions of employing gas in its war against china. although there was absence of large-scale gas warfare in the Second World War, Yet it claimed more than 6ØØ lives. Again, Hersh tells, "Eighty three sailors were killed and 534 seriously injured when German aircraft bombed a United States cargo ship loaded with

---

17. ibid, p.5.

approximately 1ØØ tons of 1ØØ pound mustard bombs in early December, 1943. The incident was classified top secret until 1959."[18] Later on, even in New Guinea use of poisonn gas on American troops by the Japanese had been alleged by one of the army officers, though no one was killed in the incident.

China along with others blamed the United States of using chemical weapons in the Korean War of early 195Ø's, though it went unconfirmed.

According to the Newsweek, by the end of November 1961, American special warfare troops had started training Vietnamese fliers how to spray "Communist held areas with a chemical that turns the ricefields yellow, killing any crop being grown in rebel strongholds.[19]

On 17 August 1967 a despatch from Danag said Marine helicopter gunships dropped thousands of gallons of combination tear-nausea gas on a suspected communist position, the first use of gas this way in vietnam.

There are so far only three instances in which it is alleged that the Vietcong have used gas. The first was in november 1966. The American forces, pushing deep into the jungle north of Saigon in pursuit of a Vietcong division, found large

---

18. ibid , p.7.

19. The Newsweek, 7 January, 1962, p.16.

quantities of suppliers including Chinese-made tear gas grenades. A U.S. infantry patrol reported that the Vietcong had used tear gas against them. A US military spokesman said that 1,200 gas grenades were bound in a dump 65 miles north west of saigon.[20]

Two month later, in another sector 20 fleeing members of the Vietcong were reported by the US command to have used what appeared to be riot control gas against pursuing American troops. This was the second time that the Americans had accused the Vietcong of retaliating with gas, but apparently, it had no serious effect and there were no American casualities. Two of the Vietcong were reported to have been killed, which suggests that the gas helped the rest get away.[21] One more allegations was on July 1968, when the B.B.C announced that a gas had been used against the Americans Which had caused them to vomit blood.

The first allegation of poison gas being used in the Yemen began to appear in 1963, with a Sunday Telegraph report on 16th June.[22] The Times on 9 January 1967 reported: twelve Ilushin heavy bombers attacked Katar, near Sada, with poison gas, killing more the 125 persons. It was believed that 600 gas bombs had been shipped from China as direct aid to the republican regime. Some 120 people wire in hospital in a critical

---

20. The Times, London, 12 November 1966.

21. The Times, London, 18 January, 1967.

22. The Sunday Telegraph, 16 June 1963.

condition, including it were said, more than 5Ø blinded soldiers.[23]

On 2nd February, The Times carried a long article by Nocolas Herbert reporting an attack on the village of Kitaf in the early hours of the morning of January, 5, 1967.

On May 11, 1967, the ICRC delegation in Jidda received appeals for assistance from the villages of Gadafa and Gahar in the Wadi Herran, in the South Western Jayf. According to these appeals a proportion of the inhabitants of these villages had been poisoned by gas dropped from raiding airplanes. Some hours later this news was confirmed by representatives of the Yemen royalists and the Saudi Arabian authorities who requested to ICRC delegation to go immediately to the assistance of the victims.

Chemical weapons were used in the Iran-Iraq War. The first use reportedly took place in 1981 but their employment on a significant scale started only in 1984. Iraq was accused of having used mustard gas, cyanide, and possibly other chemicals in its efforts to halt large-scale Iranian offensives. The report of a U.N. fact-finding team, published in May 1987, indicated that a new quality of chemical warfare had been reached. Chemical weapons were reportedly used more and more against the civilian population, notably Kurdish civilians. Evidence of this new

---

23. The Times, London, 9 January 1967.

quality of chemical warfare were incidents at Sardasht in 1987 , and Halabja in 1988. Evidence obtained clearly pointed to Iraq as the state which had used chemical weapons.[24]

In between October 1984 and November 1985 allegations were levelled against Indonesian forces in East Tinor, Nicaraguan forces against Contra goerrilla forces; Salvadorean armed forces in the Eastern Salvador; Vietnamese forces operating against Khmer resistance forces in the Thai Kampuchean border region; Thai forces firing into Kampuchea; Soviet forces in Afghanistan; Iraqi forces in the Gulf war; and Angolan forces against UNITA positions.[25]

While in 1986, Ethiopia, Iraq, Iran, Soviet Union, Vietnam, Angola, Chad, Libya and Nicaragua were knows as chemical weapons users,[26] in 1987, implicated countries were vietnam, Iran, Iraq and Libya.[27]

---

24. SIPRI Year Book 1986, World Armaments and Disarmament (Stockholm, 1986), p. 162.

25. ibid., p. 161.

26. SIPRI Year Book 1987, World Armaments and Disarmament (Stockholm, 1987), p.106.

27. SIPRI Year Book 1988, World Armaments and Disarmament (Stockholm, 1988), p.106.

Chapter III

DISARMAMENT AND ARMS CONTROL NEGOTIATIONS

The Historical Background:

Ancient customs condemn the use of poison or poisoned weapons in war or the use of weapons causing unnecessary suffering. During the second half of the nineteenth century this custom was codified in a number of international conventions. The declaration of St. Petersburg of 1868 and Brussels Convention of 1874 prohibited the employment of poison and poisoned weapons. Those efforts continued at the International Peace Conferences conducted later at the Hague.

The treaty of peace with Germany concluded at Versailles on 28 June 1919, stated that the use of asphyxiating, poisonous or other gases and all analogous liquids, materials or devices being prohibited, their manufacture and importation were strictly forbidden in Germany. A similar provision was contained in other peace treaties, like the treaty of Neuilly, Treaty of Trianon, Treaty of Severs, etc.

On 17 May 1920 during the fifth session of the Council of the League of Nations, the British representative raised the problem of the use of poisonous gas in warfare. The Permanent Advisory Commission, constituted by the Council on 19 May 1920, at its second session, arrived at the conclusions that the

employment of gases is a fundamentally cruel method of carrying on war, it would be useless to seek to restrict the use of gases in wartime by prohibiting or limiting their manufacture in peace time, and the prohibition of laboratory experiments was out of the question. The Council, however, condemned the use of gas. Later on, an appeal was also made to the scientific men of the world to publish their discoveries in poison gas.

Geneva Protocol:

On 17 June 1925, the following text of the Protocol was approved by the conference:

The undersigned Plenipotentiaries, in the name of their respective governments.

Whereas the use in war of asphyxiating poisonous or other gases; and of all analogous liquids, materials or devices, has been justly condemned by the general opinion of the civilized world; and

Whereas the prohibition of such use has been declared in treaties to which the majority of powers of the world are parties, and

to the end that this prohibition shall be universally accepted as a part of international law, binding alike the convenience and the practice of nations;

Declare: that the High Contracting Parties, so far as they are not already parties to treaties prohibiting such use, accept this prohibition, agree to extend this prohibition to the use of bacteriological methods of warfare and agree to be bound as between themselves according to the terms of this declaration.

The High Contracting Parties will exert every effort to induce other states to accede to the present Protocol. Such accession will be notified to the Government of the French Republic, and by the latter to all signatory and acceding powers, and will take effect on the date of the notification by the Government of the French Republic.

The present Protocol will come into force for each signatory power as from the date of deposit of its ratification, and, from that moment, each power will be bound as regards other powers which have already deposited their ratification.[1]

Post-Geneva Protocol period:

At the League's Disarmament Conference in 1932-33, several proposals for chemical disarmament were put forward for the prevention of development and production of chemical weapons in peacetime, and the destruction of existing stockpiles. A special committee of the conference was established for this purpose. Members also considered the definition of chemical

1. Geneva Protocol, cited in, SIPRI, The Problem of Chemical and Biological Warfare (Stockholm, 1971), vol. 4.

weapons, the monitoring of compliance with a ban, and sanctions to be applied in case of violations. A draft disarmament convention submitted by Britain in March 1933 reflected a number of these considerations. It provided for the prohibition of use of chemical weapons in war, also with regard to non-parties to the treaty; permitted the use of chemical weapons for retaliatory purposes; and stated that chemical weapons must not be developed at any time, including tear gas and incendiary devices.[2]

Having reached no concrete result, the Disarmament Conference recessed in January 1936 and failed to reconvene due to rising tensions in Europe and the outbreak of the Second World War in 1939. It resulted, however, in a thorough consideration of many important aspects related to chemical disarmament and some questions discussed are still relevant in today's negotiations on the projected chemical weapons convention.

After Second World War:

Developments in the chemical weapons domain went largely unnoticed by the public worldwide due to the rising focus on nuclear weapons. Chemical weapons, along with biological and nuclear weapons, were classified as weapons of mass destruction by the United Nations Commission for Conventional Armaments, a subsidiary body of the U.N. Security Council which functioned

---

2. ibid., pp. 35-43.

from 1947 to 195Ø, in 1948.[3] A resolution of the UN General Assembly, adopted on 24 January 1946, demanded the elimination of atomic weapons and of all other major weapons adaptable to mass destruction.[4] But the discussion in international fora, including the United Nations, during the 195Øs and the first half of the 196Øs. remained inconclusive. Proposals for general and complete disarmament put forward at this time included provisions on chemical weapons, but were never seriously examined.

In October 1954, the Federal Republic of Germany foreswore the right to produce or stockpile on its territory chemical weapons along with biological and nuclear weapons. This was a prerequisite for joining the Western European Union (WEU) and. later NATO. Under this agreement, the Federal Republic of Germany accepted international verification measures including on-site inspection,[5] a unique obligation at that time.

It was the use of chemicals on a large scale by the United States in Vietnam which again, brought the question of chemical warfare to the forefront and placed it on the international arms control agenda. A resolution by the UN

---

3 ibid., p.158.

4. United Nations General Assembly, A Resolution on Elimination of Weapons of Mass Destruction, 41(I), 24 January 1946.

5. United Nations, The Projected Chemical Weapons Convention : A Guide to the Negotiations in the Conference on Disarmament (New York, 199Ø), p.15.

General Assembly which included herbicides in its definition of chemical warfare was passed in 1969 by a significant majority of votes in favour.[6]

Another reaction to the use of chemicals in Vietnam was a UN General Assembly resolution proposed by Hungary in 1966. It called for the strict observance of the Geneva Protocol, and invited all states to ratify or accede to the protocol.[7] The resolution, however, stopped short of condemning the United States.

As a consequence of the renewed attention to the problem of chemical warfare, the Eighteen-Nation Committee on Disarmament (ENDC) placed the issue on its provisional agenda in 1968 under the heading "Non-Nuclear Measures".[8] In 1969, for the first time, the question of chemical weapons was put on the agenda of the UN General Assembly.

Following a request by the UN General Assembly in 1968, the UN Secretary-General appointed a group of experts to study the effects of chemical weapons. The report of the group was published in 1969 and was discussed in the ENDC. It was

---

6. U.N. Doc., A/Res/2662(XXV), A Resolution Adopted by the General Assembly on Questions of Chemical and Bacteriological (Biological) Weapons, 7 December 197Ø, 1919th plenary meeting.

7. United Nations, No. 5, p.17.

8. Disarmament Conference Doc., ENDC/227, Non-Nuclear Measures, (Geneva, 1968), p.18.

intentionally written in a style understandable to non-experts. It stated that all chemical and biological weapons, including tear gas and herbicides, should be covered by the Protocols and that a comprehensive ban should be negotiated.[9]

Another important document, published in 1970 as a contribution to efforts for chemical disarmament, was the World Health Organisation (WHO) report on health aspects of the use of chemical weapons.[10] Its emphasis was on public health and the approach was therefore different compared to the report by the UN Secretary-General. It was of a more technical nature and was directed primarily at public health and medical authorities. Still, the conclusions were essentially the same as those of the UN report.

In addition to seeking a total ban on chemical weapons, many countries thought that it was necessary to strengthen the Geneva Protocol of 1925. International pressure to ensure universal adherence to the Protocol was growing and a number of General Assembly resolutions were passed. These calls were particularly addressed to the United States, the only great power

---

9. United Nations General Assembly, Report of the Secretary-General on Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, A/7575, (New York, 1969).

10. World Health Organisations Document, Health Aspects of Chemical and Biological Weapons, Report of a WHO Group of Consultants (Geneva, 1970).

not yet a party to the agreement. On 25 November 1969, the US president issued a statement which contained the following elements: [11]

(a) It reaffirmed the renunciation by the United States of the first-use of lethal chemical weapons.

(b) It extended this renunciation of first-use to incapacitating chemicals.

(c) It announced that the Geneva Protocol would be submitted to the US Senate for advice and consent to ratification.

Later on, it became clear that tear gas and herbicides were not covered by this announcement. The statement of 25 November also contained a declaration favouring biological disarmament by the United States. On 14 February 1970, the United States additionally renounced the offensive preparation and use of toxins for war purposes. The ratification of the Geneva Protocol by the United States was, however, not achieved until 1975 because the Senate Foreign Relations Committee demanded ratification without reservations. The administration, on the other hand, sought to exclude riot control agents and herbicides. The main argument for not covering these substances under the Protocol was that they were widely used for domestic purposes, like riot control and agriculture. The use of

---

11. Office of the White House Press Secretary, Press release, 26 November 1969.

chemicals which existed in large quantities in many countries could not be prohibited effectively. Another reason, sometimes given, was that the use of irritants could lead to fewer casualties, including those on the enemy's side.

Arguments used by advocates of the prohibition of these substances for war purposes were that "there is no clear demarcation between irritant agents and other chemicals. The military use of tear gas is different from its civil use. Irritants are often employed to increase the effectiveness of other weapons".[12]

In 1969, a UN General Assembly resolution put forward a formal definition of chemical weapons. It included irritant agents and herbicides. It was adopted with 80 votes in favour, three against and 36 abstentions.[13]

Though the United States ratified Geneva Protocol and the resolution of the dispute over irritants and herbicides strengthened the authority of the Geneva Protocol; it was done with some reservation. The reservation of the United States read". that the said Protocol shall cease to be binding on the Government of the United States with respect to the use in war of

---

12. United Nations, No. 5, p. 17.

13. U.N. Doc., A/RES/2603, A(XXIV), A Resolution Adopted by the General Assembly on the Report of the First Committee, 21 Jan 1970, 1836th plenary meeting.

asphyxiating, poisonous or other gases, and of all analogous liquids, materials, or devices, in regard to an enemy state if such state or any of its allies fails to respect the prohibition laid down in the Protocol."[14] However, the problem of formal reservations to the Protocol and especially the question of how to deal with allegations of infraction of the agreement remained.

Since the end of the 196Øs, the question of a comprehensive ban on chemical weapons received increasing attention in the ENDC and its successor the Conference on Chemical Disarmament (CCD). One of the principal issues was the possible separation of chemical weapons with a view to the development of a legal instrument for their prohibition.

The socialist group and many non-aligned members of the ENDC/CCD, on the other hand, opposed a separate agreement on biological weapons. The socialist group tabled a draft convention banning chemical as well as biological weapons. It was the problem of verification which had a decisive impact. The United States and the United Kingdom were of the view that the military value of biological weapons was inferior to that of chemical weapons.

The socialist countries were, at that time, opposed to intrusive verification techniques, notably international on-site

---

14. The Times, London, 28 December, 1969.

inspections which were demanded by Western States. On 16 December 1971, the UN General Assembly commended the draft treaty on biological weapons. A considerable number of States expressed fear that the conclusion of the Biological Weapons Convention would not be followed by a Chemical Weapons Convention (CWC). Therefore, strong commitments related to further negotiations on a Chemical Weapons Convention were expressed in the text of the Biological Weapons Convention.[15]

The group of socialist countries presented a draft treaty in 1972. It was modeled after the Biological Weapons Convention and was comprehensive in scope. It included a ban on the development, production and stockpiling of chemical weapons and provided for the destruction of existing stockpiles. It, however, did not contain any provisions on international verification measures except for a last resort mechanism involving the UN Security Council and consultations among the parties. This lack of specific international verification of compliance was unacceptable to most Western countries.

Japan tabled a draft convention in 1974. It was a framework for an agreement rather than a full-fledged draft

---

15. U.N. Doc., A/2826 (XXIV), A Resolution Adopted by the General Assembly on Convention on the Prohibition of the Development , Production and Stock-piling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 2Ø22 ND plenary meeting, 16 December, 1971.

treaty.[16] It proposed a ban on chemical weapons, based on the prohibition of identified chemicals which could be used for chemical warfare. Japan held the view that agreement on a prohibition of all relevant substances and full verification measures, to assure non-production of chemical warfare, could not be reached at once. Therefore, it proposed an approach which was to enable the parties to leave certain substances exempt from the ban until further agreement, especially on verification, was reached. Two options for an annex to the treaty were proposed. Option A would suspend the application of the treaty to certain chemicals. Option B would permit exemptions by listing only those chemicals which could not be exempted. The parties would be free to decide on these provisional measures. The exemptions would be gradually increased. A widening of the scope of the chemical weapons convention, i.e., the application of the non-production regime to more chemicals, would take place as verification methods were improved. Hence, an initially partial ban would gradually become comprehensive. The treaty was to be verified by an international verification agency. Verification activities would include international on-site inspections and other investigations to resolve questions of compliance. They could be carried out upon request by a party or the verification organisation.[17]

---

16. SIPRI Year Book 1975, World Armaments and Disarmament (Stockhlm, 1975), p. 426.

17 ibid., p. 428.

In 1976 a draft convention was submitted by the United Kingdom. It provided for a ban on the development, production, acquisition, or use of chemical weapons, and for their destruction or conversion. The ban was to be implemented according to a phased programme agreed to by a consultative committee. Production facilities would be closed and dismantled. A consultative committee would oversee verification activities under the treaty. The draft included provisions on on-site inspections to assure the non-production of chemical weapons. However, no clear definition of chemical weapons was given and verification measures were not explained in detail. The British proposal therefore provided only a framework for a draft treaty.[18]

After a joint initiative at the Brezhnev-Nixon summit of 1974, bilateral talks on chemical weapons between the United States and the Soviet Union were held from 1976 to 1980. They were suspended in 1980 as a result of deteriorating East-West relations. Some modest achievements were made in the late 1970s when the two countries expressed a common position on some issues. The results of the bilateral effort were recorded in two joint reports to the CCD, in 1979, and in 1980. One of the most important agreements was the common view that the future

---

18. Conference of the Committee on Disarmament, CCD/520, Report to the United Nations General Assembly and to the United Nations Disarmament Commission, 3 September 1976, Geneva, p. 1.

convention should be comprehensive in its scope, banning the development, production and stockpiling of chemical weapons, and providing for their destruction. This seemed to put an end to tendencies to conclude a partial ban on chemical weapons as a first step or, as proposed in the Japanese draft, to conclude a partial ban with certain provision for its expansion into a more comprehensive one.[19]

The first Special Session of the UN General Assembly devoted to Disarmament (SSOD-I) which took place in 1978, stated in its final document that a treaty on chemical weapons was one of the most urgent tasks for multilateral disarmament negotiations. SSOD-II and SSOD-III, which were held in 1982 and 1988 respectively, were unable to reach consensus on any specific course of action as far as chemical weapons are concerned. However, SSOD-III provided a platform for statements on national chemical weapons policies, and some proposals for strengthening the Geneva Protocol of 1925 were made.

Throughout the 1970s , the positions on the question of verification remained far apart. International verification, particularly mandatory on-site inspection, was viewed by western countries as a prerequisite for the conclusion of a comprehensive treaty. The socialist countries, on the other hand, regarded

---

19. The United Nations, Disarmament Year Book, 1979, (New York, 1980), vol. 4, pp. 225-29.

national means of verification as the principal tool to ensure compliance with the treaty. In their joint report submitted to the Conference on Disarmament (CD) in 1979,[20] the Soviet Union and the United States recorded an agreement on a combination of national and international measures and the possibility of on-site inspections upon request. According to the view of the socialist countries, requests for on-site inspections could be accepted or refused by the requested state. On-site inspections were therefore thought to be of a voluntary nature. No agreement could be reached on more intrusive verification. The deterioration of East-West relations, in the late 197Øs, made efforts to arrive at a compromise even more difficult.

Some progress was made when the Soviet Union, during SSOD II in 1982, put forward a document on basic provisions for a chemical weapons convention.[21] For the first time, it agreed to systematic on-site inspections to verify the destruction of chemical weapons stockpiles and to monitor the production of super-toxic lethal chemicals at a single small-scale production facility. Agreement on the latter had been reached with the United States during bilateral talks. There was, however, no mention in the Soviet proposal of international verification of

---

2Ø. Committee on Disarmament Document, CD/48, Joint-United States Report on Progress in the Bilateral Negotiations on the Prohibition of Chemical Weapons, 7 August 1979, Geneva, p. 5.

21. The United Nations, Disarmament Year Book, 1982 (New York, 1983), vol. 7, p. 162.

the non-production of chemical weapons or mandatory on-site inspections upon request.

In April 1984, the United States tabled a draft convention for a comprehensive ban on chemical weapons. One of its main features was the approach to verification which was called "open invitation". This term referred to the possibility, provided for in Article X of the draft, to request on-site inspections in government facilities of any party. The parties would not have the right to refuse these inspections. Requests could be made anytime, by any party, and the requested party would be notified 48 hours in advance. To avoid discriminating against states which had no or only small private chemical industry, those provisions were amended in April 1986 to include any facility used for the provision of goods and services to the government of a party.[22]

Some doubts about the term "any where" remained. The Soviet Union and some other delegations repeatedly argued that the United States provide a proper response to the question of precisely which facilities would be covered by Articles X and XI of the US proposal. The Soviet Union sought to cover all private installations, not only those connected with state orders. This would include facilities belonging to US transnational corporations, no matter where they are located.

---

22. Summit Communique, 21 November 1985.

The Fourth Amendment to the US Constitution prohibits unreasonable searches and seizures. The US proposal was drawn up with this law in mind. Article X of the draft which provides for challenge inspections without the right of refusal by the requested party would cover government, military and other facilities where searches were thought to be reasonable. These inspections could only be initiated by a Fact-Finding Panel to be established under the treaty. Two western and two socialist countries plus one non-aligned country would be the members of this panel. The Soviet Union and the United States would be among them.

Article XI of the US draft treaty provided for adhoc inspections with the right of refusal by the requested party. Such inspections would cover all facilities. The right to refuse inspections requested, according to article XI, would take into account the right of private parties to refuse searches of premises without good cause.

Even though some points in the US proposal remained unclear or controversial, "anytime, anywhere, without the right of refusal" approach to verification has since been considered by the United States and other western countries as a necessary means of verifying compliance with a comprehensive treaty. The socialist countries and some non-aligned states, on the other hand, were at that time very critical of this approach. Their

position changed only in the second half of the 198Øs, notably in 1987.

However, the US draft treaty had a long-lasting impact on the negotiations. Many of its provisions were included in the 'rolling text, [23] which now provides the basic structure a chemical weapons convention. The "rolling text", the continuously updated version of the joint preliminary and non-obligatory draft convention on chemical weapons, is being negotiated in the Ad Hoc committee on chemical weapons. Reflecting the preferences of delegations to the confrence on Disarmament at the end of each session, it is included in the report of the Ad Hoc committee to the Conference on Disarmament (CD), and in the report of the latter to the UN General Assembly. If there is consensus on the wording of a provision it is includied in the rolling text. If there is more than one proposal for a provision, or if a specific provision is objected to by one delegation or more, it may be included in brackets. In addition, reservations, objections, or clarifications are registered in footnotes.

In 1981, eighteen elements for the preliminary draft treaty were developed. In 1982, there were proposals of twenty four such elements by the chairman of the Ad Hoc Working Group, and in 1984, the basic structure of the rolling text was established. It was based on a draft treaty submitted by the

---

23. United Nations, No. 5, p.63.

United States in the same year. Apart from minor changes, like changing of the title of the article VI from "Permitted Activities Not Prohibited By the convention", the article VIII from "Consultative committee "to the "organization" and the article from "Assistance" to "Assistance And Protection Against Chemical Weapons", the structure agreed to in 1984 has remained unchanged as far as the main body of the rolling text is concerned. The Annexes to the preliminary draft which contain technical and other details have been modified considerably and new annexes have been added. This was the consequence of substantive revisions of and additons to the contents of the Articles.

It is proposed to refer to the principle of "Undiminished Security" of any state or group of states. This principle means that the security of a stat which ratifies the CWC must not be diminished by this step. It refers in particular to the security of the parties during the transition period. Article I of the "rolling text" contains general provisions. It holds that the parties to the CWC must not develop, produce, acquire, otherwise, stockpile, retain or transfer chemical weapons, or assist, encourage or induce anyone to engage in activities prohibited by the CWC. They undertake not to use chemical weapons and will destroy all chemical weapons stockpiles and production facilities under their jurisdiction or control. These provisions reflect an understanding, reached in 1979/8Ø ,

that the CWC is to be comprehensive in scope. Agreement on the destruction of all chemical weapons stockpiles and production facilities, without the right to convert them to peaceful use, was achieved in 1988. Morever, there was limited agreement on the definition of basic terms used in the rolling text, this is chemical weapons, precursors, and key precursors for chemical weapons, chemical weapons production facilities, etc. But certain questions like prohibition of the preparation of use of chemical weapons; ban on the use of chemical weapons; the principle of undiminished security; and jurisdiction and control, remain to be solved.

A second series of bilateral talks on chemical weapons between the United States and the Soviet Union started with the Geneva summit of 1985, and in the wake of a rapidly improving East-West political climate. These talks, which began in 1986, dealt with the proliferation of chemical weapons, and problems of verifying a comprehensive ban. The renewed bilateral efforts of the two most important possessors of chemical weapons gave fresh impetus to the multilateral process. After an interruption due to the change of the administration in the United States, and the ensuing foreign policy review, bilateral negotiations were resumed in June 1989.

Despite the submission of the US draft convention, and the establishment of the basic structure of a joint draft treaty by the Conference on Disarmament in 1984, progress during 1984/85

was modest. The question of whether chemical weapons stockpiles and production facilities must be destroyed or could be converted to permitted use was not resolved. The issuses like, How to deal with binary chemical weapons and how to include a ban on the use of chemical weapons in the scope of the treaty, making it compatible with the corresponding obligation expressed in the Geneva Protocol, remained controversial. There was only limited agreement on the definition of basic terms. Other outstanding issues were the declaration of the location of chemical weapons stockpiles and production facilities, the verification of non-production of chemical weapons and the concept of "challenge inspection".

As to the declaration of the location of chemical weapons' stocks, there are two positions: (a) they must be declared within 30 days after the entry into force of the convention and (b) there would be no declaration until just prior to destruction.

There was no agreement on how to prevent the misuse of the chemical industry for banned chemical weapons purposes. Western countries and some members of the Group of Twentyone, stated that, high and medium risk chemicals could be identified in lists, and that the intrusiveness of international verification would depend on the level of risk posed to the objectives of the convention by the listed chemicals and facilities producing or consuming them. The socialist group, on

the other hand, proposed to ban the production of methylphosphorous compounds for commercial purposes because these substances were used for the production of nerve agents. This would prevent the production of precursors for certain nerve agents in the commercial industry. This proposal was rejected by the western countries. They argued that this solution would interfere too much with the commercial production for peaceful purposes.

Despite all these differences, especially on the basic approach to verification, agreement on the structure of the text, established in 1984, helped to lock in the results achieved so far, and hence provided an overview of the progress made, and the outstanding issues.

Questions such as the elimination of stockpiles and production facilities, including the order of destruction and methods of comparing stockpiles and production facilities, were considered. Verification of non-production of chemical weapons received impetus from a Swedish proposal for the comprehensive elaboration of regimes for different categories of chemicals to be covered by the treaty.[24]

Sweden proposed to place the relevant chemicals into

---

24. Committee on Disarmament Documents, CD/632, A Paper by Sweden on a Comprehensive Approach for Elaborating Regimes for Chemicals in a Future Chemical Weapons Convention, 20 August 1985 (Geneva), pp. 1-5.

three categories according to the risk they posed to the objectives of the convention. Risk meant the likelihood that they could be used, or were being used, for chemical weapons purposes. Production limits and verification would apply to each category of chemicals. In principle, this approach is still used in the text. A number of other proposals on the question of non-production were put forward in 1985 as well.

The question of an international organization to be established under the future treaty received increasing attention. The United Kingdom submitted a proposal to this effect.[25] Guidelines for a national system of implementation of the treaty were proposed. Agreement in principle was reached to include the use of chemical weapons in the scope of the convention. But one question was not solved entirely. It refered to the relationship of the convention to the Geneva Protocol of 1925, and to different views concerning the scope of the Protocol. There was some agreement on the prohibition of the transfer of chemical weapons and procedures to be applied to the transfer of other super-toxic lethal chemicals.

The 1986 Conference on Disarmament sessions began in a rather optimistic atmosphere. A proposal on verification was put forward by the United Kingdom[26] It constituted an important step

---

25. The United Nations, Disarmament Year Book, 1985 (New York, 1986), vol. 1Ø, p. 319.

26. The United Nations, Disarmament Year Book, 1986 (New York, 1987), vol. 11, pp. 244-45.

toward a consensus on challenge inspections. It indicated that a compromise on this issue might be possible. Work also focussed on lists of chemicals on the basis of which specific verification measures would be defined. Precursors of chemical warfare agents, and chemicals which are commercially produced in large quantities but could be used for chemical warfare purposes were considered in detail.

Discussions were held on verification measures to be applied to super-toxic lethal chemicals and key precursors and facilities producing or consuming them. Different views on how to identify relevant chemicals persisted. It was recognized, however, that the principal approach to the verification of non-production would be the exchange of data, and that same chemicals and facilities would require more intrusive verification measures than others.

Disagreement on how to deal with chemical weapons production facilities remained, but there was consensus that all activities at these facilities stopped immediately after the chemical weapons convention entered into force. Facilities would be declared within thirty days and would be destroyed within ten years. An important development with regard to the declaration of chemical weapons stockpiles was that the Soviet Union declared its willingness to deliver these declarations within thirty days after the treaty has entered into force for it. It also stated that it was prepared to make a timely declaration of its chemical

weapons production facilities. It would ensure the cessation of production, develop procedures for destroying the corresponding industrial base, and proceed, soon after the chemical weapons convention has entered into force, to the destruction of chemical weapons stockpiles under international on-site surveillance.

The new US programme for the production of binary chemical weapons led to controversial debates in the Conference on Disarmament. The socialist group demanded an explicit ban on binary chemical weapons. This was refused by most western countries.

Major developments in 1987 were related to the change in the Soviet Union's position on verification. This led to agreement on long-standing western demands in this context. The new Soviet position and improving East-West relation resulted in progress on the following outstanding issues. The provisions on the verification of declarations, the destruction of chemical weapons and chemical weapons production facilities, and the non-production of chemical weapons were further developed. It was agreed that chemical weapons must be destroyed without the right to divert the chemicals to peaceful use, and there was almost consensus that the location of chemical weapons stockpiles would have to be declared upon entry into force of the convention. Procedures to verify the destruction of chemical weapons were largely agreed upon.

The focus of attention began to shift somewhat from the military/security issues to industrial questions, that is, the verification of non-production of chemical weapons in the civil chemical industry. Progress was made on the annexes to Article VI. They contain the verification procedures to be applied to listed chemicals and the facilities producing or consuming them. As far as institutional aspects are concerned, guidelines for an international inspectorate were elaborated. These guidelines would define general rules governing on-site inspections carried out by inspectors of the international verification organisation to be established under the chemical weapons convention.

The order of destruction of chemical weapons that is, the problem of how to ensure a balanced destruction of existing stockpiles so as to guarantee the security of all parties to the treaty, remained unresolved. There was no consensus on provisions concerning chemical weapons production facilities. The lack of agreement on a definition of the latter was, among other things, responsible for the limited progress on this issue.

During 1987 and 1988, model agreements to guide the elaboration of facility attachments, once the convention is in force, were developed. These facility attachments would, inter alia, set out facility-specific verification procedures and define what has to be declared. Provision on assistance to victims of a chemical weapons attack, and provisions on economic

and technical cooperation were considered without concrete results.

Despite the impetus received from the Paris conference on chemical weapons, held in January 1989, and the intensification of negotiations in the Ad Hoc Committee on chemical weapons, the first part of the 1989 session of the Conference on Disarmament did not result in significant progress. Additional verification procedures to complement systematic and challenge inspections were proposed by the Federal Republic of Germany and the United Kingdom. These proposals were made in an effort to solve the problem of facilities which are capable of producing chemical weapons but are not subject to declaration and monitoring under the non-production provisions of the treaty. They were discussed but the outcome was inconclusive.

At the end of the 1989 session of the Conference on Disarmament, some progress on a bilateral level was made. The United States and the Soviet Union agreed to a set of detailed procedures for on-site inspections on challenge. The work was said to have drawn on experience with the Intermediate Range Nuclear Forces Agreement. Some results were achieved on the order of destruction of existing chemical weapons stockpiles. The United States representative to the Conference on Disarmament, stated in a press interview that there was agreement on the levelling out of stockpiles by the eighth year of the total ten year destruction period. During the last two years,

each party concerned would destroy its remaining chemical weapons.

The United States president, George Bush, in a speech before the UN General Assembly on 25 September 1989, put forward a three-point proposal.[27] He proposed that the United States and the Soviet Union destroy more than eighty per cent of their stockpiles even before the chemical weapons convention was concluded. This could begin immediately, once the agreement on the verification of destruction was reached. Ninety eight per cent of the stockpiles of the two countries would be destroyed within eight years after a multilateral convention entered into force, provided the Soviet Union joined the treaty. All chemical weapons stocks would be eliminated by the end of the tenth year if all states capable of producing chemical weapons signed the multilateral treaty.

The Soviet Union welcomed the proposal of United States but offered to go further and accept the following obligations before the chemical weapons convention concluded - the two sides should stop the production of chemical weapons. This would be subject to international verification. They should, on a bilateral basis, reduce radically or destroy totally all chemical weapons stockpiles as a step towards a multilateral treaty. They should also renounce the use of chemical weapons under all

---

27. International Herald Tribune, 26 September 1989.

circumstances. The latter would imply a withdrawal of American U.S. reservations to the Geneva Protocol The Soviet Union did not accept the American proposal to destroy the remaining two per cent of the stockpiles only if all chemical weapons - capable states have joined the multilateral treaty. The United States responded that it was against the total destruction of chemical weapons before the entry into force of a multilateral treaty because this would negatively affect the motivation of other states to join the convention. It also refused to stop the production of chemical weapons.

During a meeting, in September 1989, between the US Secretary of State and the Soviet Foreign minister, a Memorandum of Understanding on a bilateral verification experiment and an exchange of data on existing chemical weapon capabilities was signed.[28]

In mid-September 1989, the US administration reportedly decided to modify its position, held since 1984, and proposed to permit the production of chemical weapons even after a multilateral treaty has entered into force.

In December 1989, during the US-Soviet summit off the coast of Malta, the US President reportedly stated that he would not seek permission of the continuation of chemical weapons

---

28. The Times of India, (New Delhi), 26 September 1989.

production under the convention, if the Soviet Union accepted his proposal made in the United Nations General Assembly in September 1989.[29]

Secretary of State James Baker announced on May 20,1990 that the United States and the Soviet Union had concluded an agreement to destroy chemical weapons.[30]

George Bush announced, on 14 May 1991, a ban on theuse of American Chemical Weapons for any reason and ordered the destruction of those weapons existing in the United States arsenal. He issued a statement saying that he was taking the action to demonstrate the United States commitment to banning chemical weapons. He called upon the Conference on Disarmament in Geneva to work continuously on reaching a chemical weapons convention which has been under negotiation for several years without reaching an agreement.[31]

"We are formally forswearing the use of chemical weapons for any reason, including retaliation against any state, effective when the convention enters into force and will propose that all states follow suit", President Bush said in a statement issued by the White House.[32]

---

29. International Herald Tribune, 9 October 1989.

30. The Times of India, New Delhi, May 21, 1990.

31. The Times of India, New Delhi, May 15, 1991.

32 ibid.

On May 15, 1991, United States proposed elimination of Israeli nuclear weapons in West Asia, if chemical weapons of Arab countries were eliminated.[33]

Chemical Weapons Free-Zone:

Another means to prevent the spread of chemical weapons and possibly to promote the conclusion of a comprehensive and universal ban on chemical weapons are the formally agreed Chemical Weapons-Free Zones. Such zones have been proposed for several regions including Central Europe, West Asia, the Balkans, Latin America, the Pacific region, South-East Asia, the Korean Peninsula and Africa.

The most prominent proposal has been the Chemical weapons - Free Zone in Central Europe. The idea was first discussed in sessions of the Pugwash chemical warfare study group during the 197Øs and a proposal was included in the 1982 report of the Independent Commission on Disarmament and Security in Europe. In 1985, this proposal was transformed into on outline agreement between the ruling socialist Unity Party of the German Democratic Republic and the opposition Social Democratic Party of the Federal Republic of Germany. The proposed chemical weapons-free zone was to include Belgium, the Union Soviet Socialist Republics, the German Democratic Republic, the Federal Republic

---

33. The Times of India, New Delhi, May 16, 1991.

of Germany, Luxembourg, the Netherlands, Poland and other states, if possible. The parties to the proposed agreement would clear their territory of chemical weapons; keep it free of these weapons; forswear the production or acquisition of chemical weapons, and prohibit other states from stationing or producing chemical weapons on their territory or transferring these weapons through their territory. The proposal met with predominantly negative reactions by most western countries.[34]

Australian Group:

The Australian group that includes all the members of the European Economic Community in addition to the United States, Australia, Canada, Japan, New Zealand among others, set up in 1987, has been busy at work on devising a regime of export controls. It has identified a "core list" of nine chemicals and another warning list of some forty odd chemicals which must not be exported. Curbs are left to individual countries and it is understood that such restraint would be exercised on a country specific basis.[35]

---

34. SIPRI Year Book 1988, World Armaments and Disarmament, (Stockholm, 1988), pp.115-16.

35. The Times of India, New Delhi, 5 December, 1989.

Chapter IV

PROBLEMS OF ARMS CONTROL AND DISARMAMENT

Inspite of the fact that continuous efforts have been made to eliminate Chemical Weapons, we are still witnessing a chemical arms race. This problem involves a number of issues.

While China, France, the UK, and the USSR became parties to the Geneva Protocol within a few years after its signing, the U.S. government, which initiated and pushed through the Protocol, did not ratify it for long. Moreover, many states have not become party to the Protocol and those who have done so, have expressed certain reservations. Many states which later ratified or acceded to the Protocol qualified their adherence to it by two -fold reservations - that the Protocol was binding on the state making the reservation only in its relations with the parties to it; and that it would cease to be binding on the state making the reservation against an enemy state if the latter's armed forces or allies failed to respect the prohibitions laid down in the Protocol.

Although the Geneva Protocol banned the use of chemical weapons, it permitted the development, production, stockpiling and transfer of these weapons. This further aggravated the problem, since there is a continuance of chemical weaponry, possessor nations will devise several arguments to use it when it

is needed.[1]

Also, the proceedings of different conferences were marked by a conflict of interests between the weapon-producing countries and the non-producers. The latter considered regulations concerning trade in arms to be a restriction putting them in a position of inequality, unless restrictions were imposed upon the manufacturers of weapons. The non-producers felt that such a measure would not only prove unjust, leaving the have-nots without means of defence, but would be unrealistic as long as chemical arms remained legal means of warfare. Hence, they insisted on the prohibition of production, or at least of the use of those weapons, and expressed the desire to include the ban in a binding international agreement. Another important demand has been security guarantees to be given. There are similar differences between the haves and have-nots in the course of negotiations on the non-proliferation of nuclear weapons. The principle involved was, roughly speaking, the same.

Also, as suggested by Liddel Hart, a nuclear power, faced by a conventional attack which it could not contain by conventional means, may use chemical weapons defensively in order to achieve a pause, rather than resort quickly to nuclear weapons.[2] By acquiring additional non-nuclear weapons, and

---

1. Edward M. Spiers, Chemical Warfare, (London, 1980), p.175.

2. B.H. Liddel Hart, Deterrence or Defense : A Fresh Look at the West's Military Position, (London, 1960), p.45.

and thus additional steps in the escalation ladder, a country may avoid the need to resort to nuclear weapons at once, but, in doing so, it may reduce or increase the effectiveness of its nuclear deterrent, depending on how the enemy looks at it Deterrence is subjective. The enemy may be more frightened by the knowledge that a country has nothing but nuclear weapons than it is by the prospect that the country can use first strike capability.[3] Since the big powers, can mobilize only limited forces against any one lesser power without neglecting other areas, and since those forces may not always be well suited to overcoming the type of opposition put up by that lesser country, a military temptation to use chemical weapons is not difficult to visualize.[4]

Even middle powers, which possess in varying degrees the capacity to produce chemical weapons, delivery systems and defenses, do not enjoy the protection of a superpower, or have little confidence in it, may see military advantages in possessing chemical weapons in order to raise the cost of attack to the enemy, that is, to help deter the enemy from invasion, and in order to prevent the enemy from feeling tempted to use chemical weapons. To achieve either form of deterrence, the possession of chemical weapons must be made public, or, at least,

---

3. ibid.

4. John Tower, "The Politics of Chemical Deterrence", Washington Quaretely, Vol. 5, (Spring 1982), p. 37.

a convincing hint of possession must be conveyed to the potential enemy. Besides, a middle power may think of chemical weapons for overwhelming an opponent in a surprise attack and, as defensive weapons, for use if other defenses fail. Both these uses benefit from surprise, the achievement of which will be made easier if the weapons are produced and held in secret.[5]

Domestically, the authorities in weak countries would be likely to contemplate chemical warfare only in extreme circumstances. These are against guerrillas when they are geographically separated and once an internal struggle has become savage; against neighboring countries in a desperate attempt to defeat them, to stave off defeat or to conduct a scorched earth policy.[6]

Otherwise, generally, in these countries chemical weapons are considered as 'poor man's atom bomb'. So these are preferred.

Besides, there is the adding up effect. Those big nations, which believe they have interests and commitments in many parts of the world which they must defend or support, will have military plans and military aid plans for a large and varied array of contingencies. In a number of these plans an argument

---

5. SIPRI, The Problem of Chemical and Biological Warfare, (Stockholm, 1971), Vol. V, p.98.

6. ibid., p.99.

may be made for the use of chemical weapons of one kind or another.

It is propagated that chemical weapons are less inhumane than other weapons because they could be militarily effective without killing a large number of people, and cause injuries that are as disabling as those caused by any other weapon but which their victims were more likely to survive. Gas casualties suffer less from their injuries than do other types of battle casualty as regards both immediate effects and, if they do not die, chronic after-effect. It is also argued that a gas may developed which, instead of asphyxiating or burning people, may put them to sleep or otherwise incapacitate them for a while. The function of irritant agents is not to produce casualties among the enemy but to decrease a combat unit's capabilities in fire-power and manoevre. The weapons may be used, for instance, to upset the aim and coordination of the enemy's fire or to force him out of protective cover.

Military laboratories also come in the way of successful arms control efforts. These military laboratories, after doing research and searching new chemical agents, lobby for these weapons. And often these laboratories get them included in the countries' weaponry.

The aim of disarmament is to stop the actual or potential possession of weapons, and specialized inputs that go

into them, without stopping the possession of peaceful products. Absolute prohibition of possession is possible only where the weapon or input has no civilian use or if the civil use is sacrificed for the sake of disarmament. With chemical armaments this raises a number of problems. Some chemical weapons and billed apparatus in final form, tear gas grenades and crop spraying systems in aircraft filled with herbicide, are used also for civil purposes. Some chemical agents that can be used in weapons, for example, phosgene and hydrogen cyanide, are also used on a large scale as industrial inputs. Thus there are 'dual purpose' chemical products, capable of being put to both military and civil use. The production and possession of both of these can be only limited, not prohibited, if civil use of them is to be unimpaired.[7]

Moreover, defensive research is usually considered to require the production of small quantities of chemical agents, single purpose as well as dual purpose, and it is likely to include the search for possible new agents, the testing of them to see if they are potent operationally, and so on Defensive research is then indistinguishable from offensive research, including some phases of development, that is, it comprises not just a search for possible agents but also the more intensive study of their toxicity and of other properties that make them suitable as chemical warfare agents. It is often asserted that

---

7. ibid., p.106.

research cannot be outlawed since it is a part of science, usually regarded as a sacrosanct activity.[8]

Generally speaking, chemical factories, especially dyeworks and factories connected therewith, can be very quickly adapted to the manufacture of poisonous gasses. In the dye industry many of the intermediates themselves are poisonous chemicals which are capable of immediate use in chemical warfare, while others are intermediates for manufacture of chemical agents. As a general rule, chemical warfare agents are similar in composition to commercial chemicals and are made by similar processes. The raw materials for the chemical warfare agents are commercial products, and the commercial uses of the more important of these raw materials are well developed. The time required for adaptation depends on the state of the chemical industry or factory and the nature of the gas to be made. Although a country with a large chemical industry would be able to begin quality production of chemical warfare agents in a very short time, the determining factor probably would be the production of special containers for war use of chemical warfare agents rather than the conversion or employment of chemical plant for the production of such agents. However, for emergency use simple types of containers can easily be improvised.

---

8. ibid., p.112.

In practice, it is impossible to prevent or hinder chemical factories from being used for the production of poisonous gases in peacetime. It will in any case always be impossible to gain any knowledge of discoveries and to prevent the study of poisonous substances in the laboratories.

Besides, it would always be difficult to discover the intentions of a state wishing to direct its chemical industry towards warlike purposes. The fact that a government intervened in the management of chemical industry was not sufficient to prove bellicose intentions. Only when a government had substances which had been prepared for its own account and which were believed to be exclusively suitable for chemical warfare, could it be called upon to prove the legitimacy of its action. It would be more difficult if it confined itself to ordering the preparation, not of toxic substances themselves, but only of half-finished products in current industrial use, which were of a similar nature.

The phenomenon of action-reaction is also applicable in the context of chemical weapons arms race. Seeing its tactical utility for a particular operation, defensive of offensive, many countries do not hesitate in possessing or developing chemical agents and this leads to possession of chemical weapons by other hostile countries. And the arms race continues incessantly.

Another major area of concern, for controlling of

chemical arms, has been the verification procedure. There seems to be a consensus that they should not be overly intrusive, and that the interests of the chemical industry should be safeguarded at least to the same extent as the interests of the nuclear industry are protected under the International Atomic Energy Agency's safeguards system. There may be a possibility of evasion. Thus, for example, abuses in the case of dual-purpose agents, which are produced in very large quantities, cannot be excluded. Dealing with the components of binary weapons poses even greater problems. Manufacture of items unconditionally forbidden could continue at undeclared facilities. Stocks of warfare agents could be illicitly retained, if not with the intention of eventually using them, then at least with the object of avoiding costly and hazardous destruction operations. At the present time, it is very unlikely that all states would agree to open to inspection all their installations that could possibly conceal such stocks.[9]

The whole question of verification is of much greater importance to smaller and weaker nations than to the great powers, because the former do not possess a wide choice of weapons available for retaliation against possible chemical aggression, and may lack protection against such aggression. A possibility of lodging complaints of violations and of having them investigated by some international body may give some re-

---

9. Spiers, No.1, p.188.

assurance, if impartial enquiries, including on-site inspection when necessary, are initiated promptly without hindrance or discrimination. But against it should be borne in mind the possibility that some countries may have no means to collect evidence about clandestine production or stockpiling by other countries.

These uncertainties can be attenuated and reasonable assurance of compliance might be provided if a prohibition could be imposed. It is true that laboratory research is not subject to direct supervision, but development may be detected at the stage of field testing. The use of remote sensing devices mounted on satellites can be useful to detect such testing but such devices have not proved feasible.

One of the techniques of verification is technical inspection. This includes all actions which seek to examine the substantive aspects of a activity involved in the achievement of chemical warfare capability. The principal problem with technical inspection is the level of intrusion required. Either there must be a selection of the type and number of specialization characteristics used or a mechanism must be created which can trigger authorization for on-the-spot, detailed physical technical inspection of any such characteristic.

Economic monitoring is an indirect verification technique. Whereas technical inspection involves a search for

the physical means of achieving a capability economic monitoring is concerned with the records created in the process of achieving a capability. Economic monitoring can be either active or passive. Active economic techniques would ordinarily require the creation of records which could be used to verify inputs and outputs associated with specified activities. Passive economic techniques are less restrictive and also less definitive. They would normally require monitoring of the information contained in records created in the normal course of operations. Thus active methods seek to prevent chemical warfare activities, whereas passive methods potentially provide warning only. to the extent that warning of violations is a disincentive to conducting an activity, both methods provide disincentives.

In theory, economic monitoring can be applied to any activity associated with development of a chemical warfare capability, but its practical application is probably more limited. There can be circumstances such that the relationship between the size of the activity being monitored and the size of similar activities in an economy, together with the distinctiveness of one activity from another, severely reduces the ability of economic monitoring to identify banned activities. For example, the size of the chemical research activity in an industrialized nation, combined with the close similarity between research directed toward normal activity and agent development activity, would make economic monitoring an ineffective technique for controlling research.

Economic monitoring is only effective in the areas of production, transportation, and storage, since the characteristics of these activities require accurate records.

Improper intelligence techniques are also responsible for inadequate verification. Intelligence techniques encompass a broad range of methods which include both technical as well as economic approaches. The various intelligence techniques differ primarily in the way the methods are employed, for example, clandestinely, rather than in the type of methods or techniques which might be used.

Systematic international on-site inspection, involving a routine presence without any element of suspicions, can build confidence in the regime established by the convention. The number of inspectors can be reduced by the on-site emplacement of chemical and physical instruments, capable of monitoring the destruction process. These devices would have to be operationally reliable, serviced by international inspectors, and protected by tamper-proof seals, containers and television cameras. The degree of intrusiveness can also be minimized in verifying the non-production of chemical weapons. The plants which produce key precursors for super-toxic agents can be monitored by random on-site inspections. Organized by the consultative committee, these inspections will involve an agreed number of visits, following an irregular pattern with limited advanced warning. The inspectors will seek to ensure that the

quantities of chemicals produced and stockpiled meets the declared quota and that the plant has not been modified so that it can produce chemical warfare agents. They can correlate their data with information gleaned from satellite surveillance and from the monitoring of effluent air and water by instruments some distance from the plant. But all these methods have not made much headway.[10]

There is also lack or effective machinery for dealing with the infringements. There is no sole neutral authority to establish the fact. If the establishment of the infringement is left to the state against which it is alleged to have been committed, it will be attended by no safeguards. Without going so far as to suppose that a state desirous of employing chemical weapons, will, in order to provide a semblance of justification for its conduct, accuse its adversary of having had recourse to that prohibited arm, one may simply fear a mistake on the part of the military over-ready to jump to conclusions. They may impute to chemical weapons the asphyxiating effects produced by the normal combustion or detonation of ordinary explosives or by some other course. But even if the establishment of the infringement is based on fact, it will be lacking in authority if it is effected by the actual victim. It is to the latter's interest that the establishment of the infringements, designed as it is to

---

10. SIPRI, The Problem of Chemical and Biological Warfare, (Stockholm, 1971), Vol.IV, p.23.

produce moral, legal and political effects, should be conducted under desirable conditions of impartiality, so that it will carry conviction with all governments and public opinion. The solution found for the specific question of infringements of the prohibition to use chemical weapons must be in harmony with the general system of sanctions laid down in the convention.

The issue of sanction is also one of the stumbling block in the path of chemical disarmament. The only effective sanction, from the technical point of view, which can prevent a state from violating its undertakings in connection with the prohibition of chemical weapons consists in the possibility of immediate reprisals by the same chemical means. The fear of such reprisals would probably be sufficient to prevent any state from resorting to chemical warfare. The more forcible the reprisals envisaged, the more effective would be their preventive force. All states in possession of a chemical industry should therefore undertake to put at the disposal of any state which is attacked by gas, the raw materials, chemical products and means of operation necessary for reprisal.[11]

Between two countries which are hostile and partly closed to one another, the politicians on either side may feel that they cannot, in the absence of special arrangements, obtain all the facts they may want from the other countries. So

---

11 ibid., p.130.

suspicions of cheating may arise, unless special measures in the form of a verification system are introduced in order to provide more information. This has been the essence of the problem of inspection and disarmament. The lack of trust and information which gives rise to demands for a verification system is also the obstacle to its introduction.

Decision making and budgeting for such sensitive subjects as chemical warfare are subject to complete secrecy in some countries and partial secrecy in others. The scrutiny, of published policy documents, debates and military budgets, is therefore of limited value now, providing information only for some countries. Even where chemical warfare is mentioned in a budget, separate figures may not be given. Expanding volume of scientific literature at a very rapid rate poses problem for literature surveillance.

Offensive training in chemical warfare will be extremely difficult to distinguish from defensive training, since what is required of most troops is the same, that is, on ability to continue fighting when chemical warfare agents are in use.

Besides, the low level of technological involvement for chemical weapons is responsible for their spread and continuous production. Any country which has a little bit of technology can harness many chemical agents.

C O N C L U S I O N

Thus the whole discussion on the topic, chemical weapons and arms control, throws light on several trends and features which have emerged out of the development of chemical weapons and efforts to eliminate and contain these weapons.

Under the 1987 Defence Authorisation Act, the U.S. government gained the authority it had been seeking to produce chemical weapons. This was viewed as an abandonment of a defacto moratorium that had been placed since 1969. The Reagan administration's position was that there was urgent need to modernise the United States' stocks in view of Soviet improvements in the field. Two types of weapons were to be acquired-the M687 155mm artillery projectile for spreading the agent GB (Sarin), a non-persistent nerve gas and Bigeye a 500 lb (227 Kg) bomb for spraying agent VX, persistent nerve gas.

By the end of 1986, the Pentagon had both the production capacity and the funding for manufacture of at least 100,000 rounds of the new nerve gas artillery ammunition, a quantity comparable to the existing non-binary stockpile in West Germany. It had a provision, though restricted till october 1987, for 500 Bigeyes. In Europe, despite talk of a NATO chemical deterrent, stocks are under the control of the United States and France.

The Iraqi use of the chemical weapons has brought out the fact that it is relatively easy to make such weapons but controlling their spread is difficult. Second, the proliferation of surface-to-surface missiles had added a significant dimension to the threat, following the revelation that Saudi Arabia has acquired the 2,500 km range CSS-2 missiles from China and Saudi Arabia had asserted that there was no plan to use nuclear warheads on the missiles. One inference from this is that the system may have chemical warheads. The possession of surface-to-surface missiles by some 17 third world countries and the relative ease of manufacturing chemical warheads have according to some western analysis, added another dimension to the arms race.

For long the world has viewed the ban on chemical weapons as an accomplished fact even while it is known that such weapons existed in the armouries of a number of countries. The confirmation and condemnation by the U.N. Security council of the use of such weapons by Iraq has given cold comfort to those who view the proliferation of and tendency to use this "poor man's atomic bomb" as potentially the most disturbing development in recent times. However charges that Libya or some other third world country was about to go chemical obscure the reality that the bulk of the existing stockpiles and capability for chemical warfare lies with advanced countries, and many alleged possessors have been supplied plant and equipment these very countries.

In recent years, also, Geneva Protocol has been violated several times. Each country has developed its own logic to justify the stockpiling, development and possession of chemical weapons. Sometimes it takes the humanitarian form, sometimes it takes some tactical shape, often it is manifested in economical terms and sometimes it is considered as strategically relevant.

The slow but distinct movement in the area of arms control in recent past characterised by the INF Treaty, the serious negotiations on the START and other issues have helped focus attention on chemical weapons problem. The recent offer of Bush to eliminate chemical weapons from the stockpiles of the United States and its allies after the Soviet President had already committed to so, may poves the way for a chemical weapons disarmament. But these efforts need certain problems to be overcome, certain prerequisites to be fulfilled and certain preconditions to be met. The experience of Iran in its war with Iraq is something that the international community cannot forget. Since 1984, there have been reports, subsequently confirmed in quite graphic detail, that Iraq had used chemical weapons. Victims affected by chemical attacks were taken to hospitals all over Europe. Nevertheless, the Security Council only condemned Iraq but did not take any additional steps to eliminate the Threat of chemical weapons.

One of the major obstacles remaining is the issue of the order for destruction of the stocks. In 1985 China put forward a

formula of balanced destruction of stocks to ensure that no party gained military advantage during the process, but the formula was found to be too complex to be usable. The USSR proposed another formula for balancing destruction while Mexico and Argentina would prefer the most dangerous weapons to be destroyed first. France has, of course, put forward the idea of a security stockpile.

The most important criterion in verification analysis is reliability. Analytical methods must give results capable of holding up to a challenge. The instrumentation required is expensive and there is need to go beyond a single analytical technique. If a monitoring analysis suggests traces of a banned chemical, the result needs to be confirmed by at least one independent technique.

There are other outstanding issues as well - the issue of what chemical or devices which could be used for chemical warfare, the dual purpose status of herbicides poses a problem as does that of tear gas to CS gas. The need for a precise definition may be handled by establishing agreed schedules specifying chemicals subject to different verification regimes. Similarly, there is no agreed definition of a chemical weapons facility. Monitoring dual purpose chemicals poses much greater difficulties as they are produced in vast quantities at many cites in a host of countries. Among such chemicals are Phosgene, hydrogen cyanide and cyanogen chloride and non-toxic chemicals,

like ethylene and ethylene oxide, which could be precursors for mustard gas.

Some of the inspection techniques used for verifying non-production could be applied to these bulk chemicals but, arguably, it may only be practical to require a declaration of all facilities producing these chemicals above a pre-arranged quantity together with their civil uses. Underpinning this provision, and all elements of a verification system, must be safety net of verification by challenge. Separate from the routine inspection procedures, this regime would seek to deter states-parties from evading their obligation under the convention, to clearify ambiguous situation, settle disputes, allay suspicions of non-compliance; and to provide advance notice of any breaches of the convention. To be implemented, this regime would require agreement upon the machinery for carrying out a challenge or an adhoc on-site inspection; the criteria for effective verification; the basis for requesting a challenge inspection; the rights and obligation of a challenged state; and the action to taken in the event of a refusal.

The degree of intrusiveness could also be minimised in verifying the non-production of chemical weapons. The plants which produce key precursors for super-toxic agents could be monitored by random on-site inspection organised by a consultative committee. These inspections can involve an agreed number of visits, following an irregular pattern with limited

advanced warning. The inspectors should seek, to ensure that the quantities of chemicals produced and stockpiled at the facility, not the declared quota, and that the plant had not been modified so that it can produce chemical warfare agents. They can correlate their data with information gleaned from satellite surveillance and from the monitoring of effluent air and water by instruments some distance from a plant. In arranging such inspection to minimise industrial fears, the current national and international inspections of the highly competitive pharmaceutical industry can be taken as a model.

Ultimately the declaration of certain categories of information will be the key to any effective method of verification. It should enable on-site inspections to be directed in a relatively precise, cheap and unintrusive manner.

APPENDIX

Table States known to have been past possessors or repositories of chemical weapons*

Australia	Italy
Canada	Japan
China	Kenya
Czechoslovakia	Nigeria
Egypt	Poland
France	Singapore (Straits Settlements)
Germany	South Africa
Hungary	Soviet Union
India	United Kingdom
Indonesia (Netherlands East Indies)	United States

* Meaning, roughly, 1940–60. In some cases stocks of chemical weapons remain but have most probably deteriorated to the point of uselessness. This list is, in all probability, incomplete.
Source: SPRU, Sussex/Harvard Information Bank on CBW.

Table . . US holdings of lethal chemical weapons: estimates from open sources

Item		Number held	Short tons of chemical fill
Munitions now obsolete, deteriorated beyond repair or for weapons no longer in service			
115-mm rockets		480 000	2 500
115-mm gun rounds, land-mines, leakers and unrepairables		320 000	1 400
Bulk agent held for filling new or re-usable munitions			
1-ton drums of non-persistent nerve agent GB		5 700	4 300
1-ton drums of persistent nerve agent VX		2 300	1 800
1-ton drums of mustard gas (persistent)		14 000	12 600
Persistent-agent munitions for ground weapons			
For in-service but obsolescent weapons			
4.2-in mortar rounds, mustard filled		470 000	1 400
105-mm howitzer rounds, mustard filled		480 000	700
For modern in-service weapons:			
155-mm howitzer rounds, mustard filled		300 000	1 700
155-mm and 8-in howitzer rounds, VX filled		300 000	950
Non-persistent-agent munitions for ground weapons			
For in-service but obsolescent weapons:			
105-mm howitzer rounds, GB filled		900 000	750
For modern in-service weapons:			
155-mm and 8-in howitzer rounds, GB filled		200 000	850
155-mm howitzer rounds, binary GB	*Planned*[a]	*1 200 000*	*5 100*
Aircraft munitions			
For in-service but obsolescent weapons:			
2000-lb spraytanks, VX filled		900	630
For modern in-service weapons:			
500-lb and 750-lb bombs, GB filled		13 000	1 300
500-lb spraybombs, binary VX	*Planned*[b]	*44 000*	*4 100*

[a] In 1983, the Army's acquisition objective for the 155-mm GB2 projectile had been 410 000 rounds. That, however, would have been the objective for equipment of US forces only. Subsequent acquisition targets allowed for the equipment of European NATO forces as well. In March 1984, the Congress was told by the Army that 'the current stockpile of GB artillery munitions represents approximately 20 per cent of our identified requirement' and that the shortfall would be met by acquisition of the 155-mm GB2 round.

[b] The 1985 acquisition objective

Source. Estimated from collated data published by the US Defense Department.

Table . Soviet chemical weapons as displayed during the visit to the Shikhany testing facility

Type/calibre	Agent	Ammunition (kg)	Agent fill (kg)
Tube artillery			
122 mm	Sarin	22.2	1.3
122 mm	Thickened Lewisite	23.1	3.3
130 mm	Sarin	33.4	1.6
130 mm	VX	33.4	1.4
152 mm	Sarin	40	2.8
152 mm	VX	42.5	5.4
Rocket artillery			
122 mm	Sarin	19.3	3.1
122 mm	VX	19.3	2.9
140 mm	Sarin	18.3	2.2
240 mm	Sarin	44.3	8.0
Close combat weapon			
Hand grenade	CS	0.25	0.17
Chemical bombs			
100 kg	Mustard/Lewisite	80	28
100 kg	Mustard/Lewisite	100	39
250 kg	Sarin	233	49
Tactical missile warheads			
540 mm	VX	436	216
884 mm	Thickened VX	985	555
Spray tanks			
250 kg	Thickened Soman	130	45
500 kg	Mustard/Lewisite	280	164
1500 kg	Mustard/Lewisite	963	630

Source: Conference on Disarmament document CD/789, 16 Dec. 1987.

Table The chemicals on the Australian Group lists

Chemical Abstracts Service registry number and name		Applicable schedule under the CWC[a]
Core export control list		
111–48–8	Thiodiglycol	(Schedule 2)
10025–87–3	Phosphoryl chloride	Schedule 3
756–79–3	Dimethyl methylphosphonate	Schedule 2
676–99–3	Methylphosphonyl difluoride	Schedule 1
676–97–1	Methylphosphonyl dichloride	Schedule 2
868–85–9	Dimethyl hydrogen phosphite	Schedule 3
7719–12–2	Phosphorus trichloride	Schedule 3
121–45–9	Trimethyl phosphite	Schedule 3
Warning list		
7719–09–7	Thionyl chloride	Not listed
3554–74–3	N-methyl-3-piperidinol	(Schedule 2)
96–79–7	2-N,N-diisopropylaminoethyl chloride	Schedule 2
5842–07–9	2-N,N-diisopropylaminoethyl mercaptan	Schedule 2
1619–34–7	3-quinuclidinol	Schedule 2
7789–23–3	Potassium fluoride	Not listed
107–07–3	2-chloroethanol	Not listed
124–40–3	Dimethylamine	Not listed
78–38–6	Diethyl ethylphosphonate	Schedule 2
2404–03–7	Diethyl N,N-dimethylphosphoramidate	Schedule 2
762–04–9	Diethyl hydrogen phosphite	Schedule 3
506–59–2	Dimethylammonium chloride	Not listed
1498–40–4	Ethylphosphonous dichloride	Schedule 2
1066–50–8	Ethylphosphonyl dichloride	Schedule 2
753–98–0	Ethylphosphonyl difluoride	Schedule 1
7664–39–3	Hydrogen fluoride	Not listed
76–89–1	Methyl benzilate	(Schedule 2)
676–83–5	Methylphosphonous dichloride	Schedule 2
96–80–0	2-N,N-diisopropylaminoethyl alcohol	Schedule 2
464–07–3	Pinacolyl alcohol	(Schedule 2)
57856–11–8	Substance QL[b]	Schedule 1
122–52–1	Triethyl phosphite	Schedule 3
7784–34–1	Arsenic trichloride	Schedule 2
76–93–7	Benzilic acid	Schedule 2
15715–41–0	Diethyl methylphosphonite	Schedule 2
6163–75–3	Dimethyl ethylphosphonate	Schedule 2
430–78–4	Ethylphosphonous difluoride	Schedule 2
753–59–3	Methylphosphonous difluoride	Schedule 2
3731–38–2	3-quinuclidone	Not listed
10026–13–8	Phosphorus pentachloride	Not listed
75–97–8	Pinacolone	Not listed
151–50–8	Potassium cyanide	Not listed

[a] According to the 'rolling text' in Conference on Disarmament document CD 782, 26 Aug. 1987.

[b] 2-N,N-diisopropylaminoethyl ethyl methylphosphonite.

Source: SPRU, Sussex/Harvard Information Bank on CBW.

BIBLIOGRAPHY

Published Primary Sources:

Blake, R. (ed.), The Private Papers of Douglas Haig 1914-1919 (London: Eyre & Spottiswoode, 1952).

Conference of the Committee on Disarmament, A Report to the United States General Assembly and the United States Disarmament commission, CCD/520, 3 September, 1976 (Geneva).

Committee on Disarmament, Report of the AD HOC Committee on Chemical Weapons, CD/1033, 10 August, 1990 (Geneva).

Committee on Disarmament, Joint USSR-United States Report on Progress in the Bilateral Negotiations on the Prohibition of Chemical Weapons, CD/48, 7 August, 1979 (Geneva).

Committee on Disarmament, A Paper by Sweden on a Comprehensive Approach for Elaborating Regimes for Chemicals in a Future Chemical Weapons Convention, CD/632, 20 August, 1985 (Geneva) .

Congress, First Session, Welch, T.J. Answer to Senator S. Nunn in Hearings Before the committee of armed services, Department of Defence, Authorization for Appropriation of fiscal year 1986, 28 February, 1985.

Kroesen, Gen. F.J. et. al., Chemical Warfare Study: Summary Report, IDA Paper (Bethesda, Maryland: Institue for Defense Analyses, February 1985).

The National Defence Institute of Sweden, Chemical Warfare Agents (Stockholm: National Defence Research Institute, 1983).

United Nations General Assembly, Report of the Secretary-General on Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use, A/7575 (New York: United Nations, 1 July 1969).

United Nations General Assembly, Chemical and Bacteriological (Biological) Weapons Report to the Secretary-General, A/36/613, 20 November 1981.

United Nations Security Council, Report of the Mission Despatched by the Secretary-General to investigate allegations of the use of chemical weapons in the conflict between the Islamic Republic of Iran and Iraq, S/17911, 12 March 1986.

United Nations General Assembly, A Resolution on the Elimination of Weapons of Mass Destruction, 41 (I) 24 January 1946.

United Nations General Assembly, A Resolution adopted on Questions of Chemical and Bacteriological (Biological Weapons, A/Res/2662 (XXV), 7 December 197Ø.

United Nations General Assembly, A Resolution on the Report of the first Committee, A/Res/26Ø3, A (XXIV), 21 January 197Ø.

United Nations General Assembly, A Resolution on Convention on the Prohibition of the Developmnet, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, A/2826 (XXIV), 16 December 1971.

United Nations, The Projected Chemical Weapons Convention: A Guide to Negotiations in the conference on Disarmament, 199Ø.

United Nations General Assembly, Chemical and Bacteriological (Biological Weapons Report of the Secretary-General, A/37/259, 1 December 1982.

United Nations Security Council, Report of the Specialists appointed by the Secretary-General to investigate allegations by the Islamic Republic of Iran concerning the use of chemical weapons, S/16433, 26 March, 1984.

United States Arms Control and Disarmament Agency, Soviet Noncompliance (Washington, DC, 1 February 1986).

United States Department of State, Chemical Warfare in Southeast Asia and Afghanistan. Report to the Congress from Secretary of State Alexander M. Haig Jr. 22 March 1982, Special Report N. 98.

World Health Organisation, Health aspects of chemical and biological weapons: report of a WHO group of consultants (Geneva, 197Ø).

Books

ASHTON, F.M. and CRAFTS, A.S., Mode of Action of Herbicides (New York: John Wiley, 1981).

AULD, Maj. S.J.M., Gas and Flame (New York: Doran, 1918).

BELLAMY, I. and BLACKER, C.D. (eds), The Verification of Arms Control Agreements (London: Frank Cass, 1983).

BONDS, R. (ed.), The Soviet War Machine (London: Purnell, 1977).

BRENNAN, D.G., Arms control and Disarmament: American view and Studies (London: Cape, 1961).

BROWN, F.J., Chemical Warfare: a study in restraints (Princeton: Princeton University Press, 1968).

COOKSON, J. and NOTTINGHAM, J., A survey of Chemical and Biological Warfare (London: speed & Ward, 1969).

DOUHET, G., The Command of the Air (New York : Coward-McCann, 1942).

EDMONDS, Brig-Gen. J.E. et al., History of the Great War: Military Operations (London: Macmillan, 1928-47).

ERICKSON, J., HANSEN, L. and SCHNEIDER, W., Soviet Ground Forces: an Operational Assessment' (London: Croom Helm, 1986).

FOULKES, Maj-Gen. C.H., 'Gas!' The Story of the Special Brigade (Edinburgh: Blackwood, 1934).

FRIES, Brig.-Gen. A.A. and WEST, Maj. C.J., Chemical Warfare (New York: McGraw-Hill, 1921).

GEISSLER, E. (ed.), Biological and Toxin Weapons Today (Oxford: Oxford University Press, 1986).

HABER, L.F. The Poisonous Cloud Chemical Warfare in the First World War, (Oxford: Oxford University Press, 1986.

HARRIS, R. and PAXMAN, J., A Higher Form of Killing: the secret story of gas and germ warfare (London Chatto & Windus, 1982).

HERSH, S.M. Chemical and Biological Warfare (Indianapolis: Bobbs-Merrill, 1968).

HESSEL, F.A., Chemistry in Warfare (New York: Hastings House, 1940).

HOEBER, A.M., The Chemistry of Defeat: Asymmetries in US and Soviet Chemical Warfare Postures (Cambridge, Mass.: Institute for Foreign Policy Analysis, 1981).

HORN, Maj.-Gen. C.Von, Soldiering for Peace (London: Cassell, 1966).

JACCHIA, E. (ed.), Chemical Warfare in Soviet Military Doctrine (Rome: Centro Di Studi Strategici, 1985).

LEFEBURE, V., The Riddle of the Rhine: Chemical strategy in Peace and War (London: Collins, 1921).

LEWY, G., America in Vietnam (New York: Oxford University Press, 1978).

LIDDELL HART, B.H., A History of the First World War 1914-1918 (London: Faber & Faber, 1934).

_____, Deterremce or Defense : A Fresh Look at the West's Military Position (London: Faber and Faber, 1960.

LIVINGSTONE, N.C. and DOUGLASS Jr., J.D., CBW: The Poor Man's Atomic Bomb (Cambridge, Mass.: Institute for Foreign Policy analysis, 1984.

MARTELLI, G., Italy Against the World (London: Chatto and Windus, 1937).

MATTHEWS, H., Eyewitness in Abyssinia (London: Secker & Warburg, 1937).

MILLER, D.M.O., KENNEDY, Col. W.V., JORDAN J. and RICHARDSON, D., The Balance of Military Power (London: Salamander, 1981).

MURPHY, S., HAY, A. and ROSE, S., No Fire No Thunder (London: Pluto Press, 1984).

NEIL, Robert O' and SCHWARTZ, David N, ed. Hedley Bull on Arms Control, (Essex: Macmillan, 1987).

NEILANDS, J.B., ORIANS, G.H., PFEIFFER, E.W,. VENNEMA, A. and WESTING, A., Harvest of Death: Chemical Warfare in Vietnam and Combodia (New York: Free Press, 1972).

POTTER, W.C. (ed.), Verification and Arms Control (Lexington, Mass.: Lexington Books, 1985).

PRENTISS,A.M., Chemicals in war (New York: McGraw-Hill, 1937).

BOBINSON, J.P.P., Chemical and Biological Warfare Developments: 1985 (Oxford: Oxford University Press, SIPRI CBW Studies no.6, 1986).

ROSE, S. (ed.), CBW Chemical and Biological Warfare (London: Harrap, 1968).

ROTHSCHILD, Brig.-Gen. J.H. , Tomorrow's Weapons (New York: McGraw-HIll, 1964).

SCHELLING, Thomas C. and HALPERIN, Morton H., Strategy and Arms Control, (Washington, Pergamon-Brassey, 1985).

SCHMIDT, D.A., Yemen: The Unknown War (London: The Bodley Head, 1968)).

SEAGRAVE, S., Yellow Rain: A Journcy Through the Terror of Chemical Warfare (London: Sphere Books, 1981).

SIBLEY, C. Brvice, Surviving Doomsday (London: Sphere Books, 1977).

SNOW, E., Scorched Earth (London: Gollancz 1941).

SPIERS, E. M., Chemical Warfare (London: Macmillan, 1986).

STARR, R.F. (ed.), Arms Control Myth Versus Reality Standford: Hoover Institution Press, 1984).

Stockholm International Peace research Institute, The Problem of Chemical and Biological Warfare, vol. I, The Use of CB Weapons (1971), vol.2, CB Weapons Today (1973), vol.3, CBW and the Laws of War (1973), vol.4, CB Disarmament Negotiations, 192Ø-7Ø (1971), vol. 5, The Prevention of CBW (1971), vol.6, Technical Aspects of Early Warning and Verification (1975).

Stockholm International Peace Research Institute, Chemical Disarmament: some problems of verification (Stockholm, 1973).

Stockholm International Peace Research Institute, World armaments and Disarmament year Books 1975-199Ø (London: Taylor & Francis).

Stockholm International Peace Research Insstitute, Chemical Warfare in Iraq-Iran War (Stockholm, May 1984).

STORELLA, M.C., Poisoning Arms Control: The Soviet Union and Chemical/Biological Weapons (Cambridge, Mass.: Institue for Foreign Policy Analysis, 1984).

STRINGER, Col. H.L., Deterring Chemical Warfare: U.S. Policy Options for the 1990s (Cambridge, Mass.: Institute for Foregn Policy Analysis, 1986).

Thomas, Ann Van W. and THOMAS, Jr. A.J., Legal Limits on the Use of Chemical and Biological Weapons (Dallas: Texas Southern Methodist University Press, 1970).

THUILLER, Maj.-Gen. sir H.F., Gas in the next war (London: Geoffrey Bles, 1939).

TRAPP, R. (ed.), Chemical Weapon Free Zones? (Oxford: Oxford University Press, SIPRI CBW Studies No.7, 1987).

United Nations, The United Nations Disarmament Yearbook (10 Vols) (New York, United Nations, 1976-82).

VEDDER, E.B., Medical Aspects of Chemical warfare (Baltimore: Williams & wilkins, 1925).

VIGOR, P.H., Soviet Blitzkrieg Theory (London: Macmillan, 1983).

WAITT, Brig.-Gen, A.H., Gas Warfare: the Chemical Weapons Its Use and Protection Against It (New York: Duell, Sloan & Pearce, 1942).

WILCOX, F.A., Waiting for an Army to Die (New York: Vintage Books, 1983).

WILKINSON, P., Terrorism and the Liberal State (London: Macmillan, 1986).

Articles :

ADELMAN, K., 'Chemical Weapons: restoring the Taboo', Orbis, vol. 30, no. 3, Fall 1986.

ANDERSON, J. and VAN ATTA, D., 'How Russia Fights with Posison and Plague', Readers' Digest, October 1986.

BARTLEY, R.L. and KUCEWICZ, W.P., 'Yellow Rain' and the Future of Arms Agreements', Foreign Affairs, vol. 61, no. 4, Spring 1983,

COLE, L.A., 'Yellow Rain or yellow journalism?', Bulletin of the Atomic Scientists, vol. 40, no.7, August/September 1984.

DOUGLASS Jr., J.D., 'Chemical Weapons: An Imbalance of Terror', Strategic Review, vol.k 10, no.3, Summer 1982.

_____, 'The Expanding Threat of Chemical- Biological Warfare: A Case of US Tunnel Vision', Strategic Review, vol. XIV, no. 4, Fall 1986.

DOUGLASS, Jr., J.d., and LUKENS, H. Richard, 'The Expanding Arena of Chemical-Biological Warfare', Strategic Review, vol.12, No. 4, Fall 1984.

Erickson, J., 'The Soviet Union's Growing Arsenal of Chemical Warfare', Stratewgic Review, vol.7, no.4, Fall 1979.

FLOWEREE, C.C., 'Chemical Weapons: A Case Study in Verification', Arms Control Today vol. 13, no.3, April 1983.

HAMM, M.R., 'Deterrence Chemical Warfare and Arms Control', Orbis, vol. 29, no. 1, Spring 1985.

HOEBER, A. and DOUGLASS Jr. J.D., 'The Neglected Threat of Chemical Warfare', International Security, vol. 3, no.1, Summer 1978.

KALVEN, J., 'Yellow Rain: the Public evidence', The Bulletin of the Atomic Scientist, vol. 38, no. 5, May 1982.

KAPLAN, M.M., 'Another View', The Bulletin of the Atomic Scientists, vol. 39, November 1983.

KARSH, E., 'The Iran-Iraq War: A Military Analysis', Adelphi Papers, no. 220, Spring 1987.

KING, J.H., 'The Comprehensive Chemical Weapons Ban', Arms Control Today, vol. 16, no.6, September 1986.

KRUEGER, A.W., 'Credible forward defence vital for NATO-Gen. von Sandrart', Jane's Defence Weekly, 2 March 1985.

LORD, C., 'Re-thinking on-site inspection in Us Arms Control Policy', Strategic Review, vol.XIII, No.2, Spring 1985.

MESELSON, M., 'Chemical and Biological Weapons', Scientific American, vol. 222, May 197Ø.

MESELSON, M. and ROBINSON, J.P.P., 'Chemical Warfare and Chemical Disarmament', Scientific American, Vol. 242, no. 4, April 198Ø.

MIETTINEN, J.K., 'Chemical Warfare and Arms Control Crisis and Concern', Bulletin of Peace Proposals, vol. 114, no.3, 1983.

ROBERTS, B., 'Chemical Proliferation and Policy', The Washington Quarterly, vol. 8, no.1, Winter 1985.

ROBINSON, J.P. P.,'Chemical Weapons and Europe', Survival, vol.XXIV, no.1, January/February 19i82.

ROBINSON, J.P.P., 'Disarmament and other options for Western policy-making on chemical warfare', International Affairs, vol.63, no.1, winter 1986/1987.

ROBINSON, J.P.P., GUILLEMIN, J. and MESELSON, M., 'Yellow Rain: the Story Collapses', Foreign Policy, no.68, Fall 1987.

SPIERS, E.M., 'Gas and the North West frontier', The Journal of Strategic Studies, vol.6, no.1, December 1983.

TERRILL, Jr., W.A., 'Chemical Weapons in the Gulf War', Strategic Review, vol. XIV. no.2, Spring 1986.

Tower, John, 'The Politics of Chemical Deterrence', Washington quarterly, vol.5, no.1, Spring 1982.

VACHON, G.K., 'Chemical Weapons and the Third World', Wsrvival, vol. 26, no.2, March APpril 1984.

VOAS, J., 'The arms control Compliance debate', Survival, vol.XXVIII. no.1, January/February 1986.

News papers

The International Herald Tribune (Paris).

The TimesPs, (London).

The Times of India (New Delhi).

The Indian Express (New Delhi).

The Hindu (Madras).