

**Centre for Conflict Resolution
Department of Peace Studies**

**Bradford Non-Lethal Weapons Research Project
(BNLWRP)**

Research Report No. 5

**Neil Davison
Nick Lewer**

May 2004

The Bradford Non-Lethal Weapons Research Project (BNLWRP)

The BNLWRP was established at the Centre for Conflict Resolution, Department of Peace Studies in 1995. The project's key objectives are to:

- Review and describe non-lethal weapons (NLWs), which are being developed and deployed.
- Identify and track defence and related research institutes involved in the development and manufacture of NLWs.
- Follow doctrine and policy debates related to the use of NLWs.
- Monitor the operational use of NLWs;
- Examine the impact of NLWs on international laws, arms treaties and conventions.
- Highlight the ethical questions that surround the research, development, deployment and use of such weapons.

Project Staff and Contact Details:

Directors: Dr. Nick Lewer, Professor Malcolm Dando

Project Co-ordinator: Mr. Neil Davison

Research Associate: Mr. Tobias Feakin

Address: Centre for Conflict Resolution, Department of Peace Studies,
University of Bradford, Richmond Road, Bradford, BD7 1DP, United
Kingdom.

Tel: +44 (0)1274 23 5551

Fax: +44 (0)1274 23 5240

E-mail: N.Davison@bradford.ac.uk

**Bradford Non-Lethal Weapons Research Project
(BNLWRP)**

Research Report No. 5

**Neil Davison
Nick Lewer**

May 2004

CONTENTS

The Bradford Non-Lethal Weapons Research Project	ii
Selected NLW Publications by BNLWRP Staff	v
Acronyms	vii
1. Introduction and Commentary	1
2. Organisation Focus: <i>U.S. Department of Defense</i>	7
3. Technologies	16
3.1. Kinetic Energy	16
3.2. Barriers and Entanglements	17
3.3. Electrical	17
3.4. Acoustic	20
3.5. Directed Energy	21
3.6. Riot Control Agents & Malodorants	23
3.7. Combined Technologies	24
3.8. Delivery Systems	25
4. Weapons Focus: <i>Biochemical Weapons</i>	27
- <i>Neil Davison, BNLWRP.</i>	
5. International Law and Human Effects	35
- <i>Discussion Paper – Robin Coupland, ICRC.</i>	
6. Interviews	39
- <i>Professor Theodore Stanley, Director, Anesthesiology Research Laboratories, University of Utah.</i>	
- <i>Mr. Parker Ferguson, Senior Scientist, OptiMetrics, Inc.</i>	
7. Bibliography Update	42
8. Conferences	44
References	46

Selected Publications by BNLWRP Staff

Lewer, N. and Davison, N. (2004) *Overview of Non-Lethal Weapons*. Presentation to a seminar, organised by The Geneva Forum, entitled: "Non-Lethal" Weapons: Emerging Technologies and their Consequences for International Law. 11 March 2004, Palais des Nations, Geneva, Switzerland. Available online at:

http://www.brad.ac.uk/acad/nlw/research_reports/

Davison, N. and Lewer, N. (2003) *BNLWRP Research Report No. 4*. Centre for Conflict Resolution, Department of Peace Studies, University of Bradford. Available online at:

http://www.brad.ac.uk/acad/nlw/research_reports/

Lewer, N. (2003). 'Non-lethal weapons: operational and policy developments'. *The Lancet*, Vol.362, Supplement1, pp.20-21.

Dando, M. (2003) *The Danger to the Chemical Weapons Convention from Incapacitating Chemicals*. CWC Review Conference Paper No.4, Department of Peace Studies, University of Bradford.

Lewer, N (Ed) (2002) *The Future of Non-Lethal Weapons. Technologies, Operations, Ethics and Law*. London: Frank Cass.

Lewer, N.(2002). 'New Technology: Non-Lethal Weapons'. In: Taipale, I (Ed). *War or Health? A Reader*. London: Zed Books, pp 173-180.

Feakin, T. (2001) *BNLWRP Research Report No. 3*. Centre for Conflict Resolution, Department of Peace Studies, University of Bradford. Available online at:

http://www.brad.ac.uk/acad/nlw/research_reports/

Lewer, N. and Feakin, T. (2001) Perspectives and Implications for the Proliferation of Non-Lethal Weapons in the Context of Contemporary Conflict, Security Interests and Arms Control. *Medicine Conflict and Survival*. Vol. 17, No. 3, July-Sept., pp. 272-286.

Dando, M (Ed) (2000) *Non-Lethal Weapons: Technological and Operational Prospects*. London: Jane's Publishing.

Lewer, N. (2000) 'Benign Intervention and Non-Lethality: Wishful Thinking For The 21st Century', In: Dando, M (Ed). *Non-Lethal Weapons: Technological and Operational Prospects*. London: Jane's Publishing.

Lewer, N & Schofield, S. (1999) 'Non-Lethal Weapons and Peacekeeping', In: Ramsbotham, O and Woodhouse, T (Eds). *Encyclopedia of International Peacekeeping Operations*. Oxford: ABC-Clio Press, pp.177-179.

Lewer, N. (1999). 'Non-Lethal Weapons' In: *World Encyclopedia of Peace*. Oxford: Pergamon Press.

Lewer, N. (1999). 'Objections To Weapons of Less Destruction', *The Futurist*, October, pp.39-40.

Lewer, N. (1998) *BNLWRP Research Report No. 2*. Centre for Conflict Resolution, Department of Peace Studies, University of Bradford. Available online at: http://www.brad.ac.uk/acad/nlw/research_reports/

Lewer, N. (1997) *BNLWRP Research Report No. 1*. Centre for Conflict Resolution, Department of Peace Studies, University of Bradford. Available online at: http://www.brad.ac.uk/acad/nlw/research_reports/

Lewer, N. & Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction? Military Strategies and Technologies for 21st Century Conflict*. London: Zed Books.

Lewer, N & Schofield, S.(1997) 'Non-Lethal Weapons for UN Military Operations'. *International Peacekeeping*, Vol.4, No.3, Autumn 1997, pp.71-93.

Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's.

Lewer, N. (1996). 'Non-Lethal Weapons - A New Dimension', *Bulletin of Arms Control*, No.23, September.

Lewer, N. (1995) 'Non-Lethal Weapons', *Medicine and War*, Vol.11, No.2, pp.78-90.

Acronyms

ABW	Advanced Biological Warfare agent
ACPO	Association of Chief Police Officers (U.K.)
ACTD	Advanced Concept Technology Demonstration (U.S. Military)
ADS	Active Denial System
AEP	Attenuating Energy Projectile
AFRL	Air Force Research Laboratory (U.S. Air Force)
APL	Advanced Polymer Laboratory, University of New Hampshire
ARDEC	Army Research and Development Engineering Command (U.S.)
ARL	Applied Research Laboratory, Pennsylvania State University
ATL	Advanced Tactical Laser
ATM	Anti-traction materials
BNLWRP	Bradford Non-Lethal Weapons Research Project
BTWC	Biological and Toxin Weapons Convention
BW	Biological Weapons
BZ	3-quinuclidinylbenzilate
CAS	Clear-A-Space Device (aka Multi-Sensory Grenade)
CCAC	Close Combat Armaments Center (U.S. Army)
CCW	Convention on Certain Conventional Weapons
CDC	Centers for Disease Control and Prevention (U.S.)
CFR	Council on Foreign Relations (U.S.)
CNS	Central Nervous System
CS	Ortho-chlorobenzalmalononitrile / tear gas
CW	Chemical Weapons
CWC	Chemical Weapons Convention
DARPA	Defence Advanced Research Projects Agency (U.S. DOD)
DBBL	Dismounted Battle Space Lab (U.S. Army)
DE	Directed Energy
DIA	Defense Intelligence Agency (U.S. DOD)
DIP	Discriminating Irritant Projectile
DOD	Department of Defense (U.S.)
DOJ	Department of Justice (U.S.)
DOMILL	DSAC Sub-Committee on the Medical Implications of Less-lethal Weapons.
DSAC	Defence Scientific Advisory Council (DSAC) (U.K.)
DSTL	Defence Science and Technology Laboratory (U.K.)
ECBC	Edgewood Chemical and Biological Center (U.S. Army)
EURCOM	European Command (U.S. Military)
FAS	Federation of American Scientists
FOI	Freedom of Information
HEAP	Human Effects Advisory Panel
HECOE	Human Effects Center of Excellence
HENLM	Hand-emplaced Non-Lethal Munition
HEPAT	Human Effects Process Action Team
HERB	Human Effects Review Board
HIDA	High Intensity Directed Acoustics
HPM	High Power Microwave
ICRC	International Committee of the Red Cross
ILEF	International Law Enforcement Forum
ITS	Intelligent Transport Systems (U.K. ACPO)
INIWIC	Inter-Service Non-Lethal Weapons Instructor Course (U.S. Marine Corps)
INLDT	Institute for Non-Lethal Defense Technologies, Pennsylvania State University
IWC	Inhumane Weapons Convention
J-UCAS	Joint Unmanned Combat Air Systems (U.S. DARPA)

JFCOM	Joint Forces Command (U.S. Military)
JNLWD	Joint Non-Lethal Weapons Directorate (U.S.)
KE	Kinetic Energy
LRAD	Long Range Acoustic Device
LVOSS	Light Vehicle Obscurant Smoke System
MCRU	Marine Corps Research University at Pennsylvania State University
MDS	Mobility Denial System
MSG	Multi-Sensory Grenade
NAS	National Academy of Sciences
NATO	North Atlantic Treaty Organisation
NAVSEA	Naval Sea Systems Command (U.S. Navy)
NDIA	National Defense Industrial Association
NIJ	National Institute of Justice (U.S.)
NIO	Northern Ireland Office (U.K.)
NLCS	Non-Lethal Capability Sets (U.S. Military)
NLMM	Non-Lethal Mortar Munition
NLW	Non-Lethal Weapon
NSWC[DD]	Naval Surface Warfare Center [Dahlgren Division] (U.S. Navy)
NTAR	Non-lethal Technology and Academic Research symposium
OC	Oleoresin Capsicum
OICW	Objective Individual Combat Weapon
OLDS	Overhead Liquid Dispersion System
OOTW	Operations Other Than War
PAVA	Synthetic Oleoresin Capsicum (OC)
PCA	Police Complaints Authority (U.K.)
PELT	Pulsed Energy Laser Testbed
PEP	Pulsed Energy Projectile
PM-CCS	Project Manager – Close Combat Systems (U.S. Army)
PSDB	Police Scientific Development Branch (U.K.)
PSNI	Police Service of Northern Ireland (PSNI)
PUCS	Precision Urban Combat System (U.S. DARPA)
PVAB	Portable Vehicle Arresting Barrier
RAP	Ring Airfoil Projectile
RCA	Riot Control Agent
RDT&E	Research, Development, Testing and Evaluation
RGES	Running Gear Entanglement System
SOCOM	Special Operations Command (U.S. Military)
SSRI	Serotonin selective reuptake inhibitor
T3BL	Training and Training Technologies Battle Lab (U.S. Army)
TACOM	Tank-automotives and Armament Control (U.S. Army)
TTO	Tactical Technology Office (U.S. DARPA)
UAV	Unmanned Aerial Vehicle
USAMPS	US Army Military Police School
Vle	Variable lethality enforcement weapon
VLNLG	Vehicle Launched Non-Lethal Grenades
VMADS	Vehicle Mounted Active Denial System
VSS	Vehicle Stopping System
XREP	Extended Range Electronic Projectile

1. INTRODUCTION AND COMMENTARY

Reports from the Northern Ireland Office and the Council on Foreign Relations

Two recent detailed reports, by the U.K Northern Ireland Office (NIO) - January 2004¹ and the U.S. Council on Foreign Relations (CFR) - February 2004², provide further insights into current policy and technology developments in the U.K. and U.S.

The NIO report is the 4th and final report of a U.K wide Steering Group set up by the Secretary of State for Northern Ireland in Summer 2000, with the objective:

To establish whether a less potentially lethal alternative to baton rounds is available; and to review the public order equipment which is presently available, or could be developed, in order to expand the range of tactical options available to operational commanders.³

In her foreword to the report Jane Kennedy, Minister of State for Northern Ireland notes that:

Despite a protracted and international search for a commercially available product, we have been unable to find anything that meets the criteria of an acceptable, potentially less lethal alternative to the baton round currently in service which provides an effective capability that does not expose officers and the public to greater risk in violent public disorder.⁴

The NIO Report has sections looking at the Defence Science and Technology Laboratory (DSTL) programme on the development of less lethal technologies (particularly the Attenuating Energy Projectile and the Discriminating Irritant Projectile); commercial off the shelf product evaluations and update (12 Gauge Sock Round Assessment); Water Cannon; the U.K. use of less lethal technologies (with a focus on L21A1 baton rounds, CS sprays and the Taser). The report also contains a section entitled 'The Management of Conflict' which discusses the dynamics of crowd behaviour. For a critical response to the NIO report see that from Dr. Brian Rappert.⁵

The CFR report provides a strong endorsement for non-lethal weapons. A key finding states:

Wider integration of nonlethal weapons into the U.S. Army and Marine Corps could have reduced damage, saved lives, and helped to limit the widespread looting and sabotage that occurred after the cessation of major conflict in Iraq. Incorporating NLW capabilities into the equipment, training and doctrine of the armed services could substantially improve U.S. effectiveness in conflict, post-conflict, and homeland defense.⁶

Interestingly, in describing the nonlethal capability sets (NLCS) which have been deployed in Kosovo and Iraq, and which help to provide a continuum of force between "don't shoot" and "shoot"⁷, the CFR seems to distinguish between NLWs (rubber balls [grenades and shotgun munitions], bean bags, riot shields, Tasers, net entanglers, and caltrops), and equipment such as flash-bang grenades, laser dazzlers, and bullhorns of which it states "*It is important to note that these are not weapons but non-lethal capabilities*"⁸

The CFR recommends expanded deployment of NLWs in the armed services, longer ranges for non-lethal payloads using precision delivery and fusing systems, and further development of millimetre-wave area-denial system (HPM weapons such as VMADS) and the advanced tactical laser (ATL). The report also argues for the need to have a bigger Joint Non-Lethal Weapons Directorate (JNLWD) or a new Non-lethal Joint Program Office (NLJPO) and for

closer links with the Joint Forces Command (JFCOM). In the opinion of the authors the JNLWD should also have more access into classified programmes throughout all branches of the armed services so as not to duplicate non-lethal development initiatives.

To stimulate incorporation of NLWs throughout the U.S. Armed Services the CFR advocates two approaches: (1) top-down planning in the Defense department and (2) creation of demand for these [NLWs] weapons from the field as personnel gain experience with prototype equipment.⁹ They argue there is a need for the top-level military and civilian leadership to be educated about NLW capabilities, not only for warfighting and peacekeeping, but also in ‘homeland defence in isolating a hot zone in the aftermath of a biological attack’¹⁰

We will be referring again to both the NIO and CFR publications in other sections of this report.

US DOD FY 2005 Budget

In giving a boost to the budget for non-lethal weapons the U.S. Department of Defense increased funding from around \$25 million in FY 2003 to \$44 million in FY 2004. No such increase is planned for 2005 as the FY 2005 budget proposes that funding for the programme remains at around \$44 million.¹¹ The CFR Task force wants to invest further in the non-lethal programme, and has suggested a seven fold increase for the Joint Non-lethal Weapons Directorate (JNLWD) on the FY 2005 level to \$300 million per annum, pointing out that this is still less than \$1 for every \$1,000 spent on defence.¹²

Operational NLWs

Interest in, and development of, NLWs continues. Some prototypes of the newer technologies are beginning to be field tested (such as the LRAD acoustic weapon) and others (such as VMADS) appear to be close to this stage. But generally it is the first and second generation NLWs that are still in operational use. This is due to many factors including an uncertainty from the military about the real utility of NLWs in combat. One of these is of course the quick development of counter-measures by opposition forces. As the CFR report notes:

The question remains: Where do the Department of Defense (DOD) and the armed forces stand on the road to acquiring and integrating these capabilities? We found little evidence that the value and transformational applications of nonlethal weapons across the spectrum of conflict are appreciated by the senior leadership of the Department of Defense. Despite successes on the small scale, NLW have not entered the mainstream of defense thinking and procurement.¹³

As noted in previous BNLWRP reports, key areas where NLWs are could be extremely useful for the military in combat operations (as opposed to peacekeeping and post-conflict peacebuilding) are situations where combatants and non-combatants have been deliberately mixed, and where military equipment and forces have been placed in civilian areas. There is also a need for a greater ‘stand-off’ capability, and it is in this area that UVs (air, ground, and sea) have huge potential.

Iraq

Six Non-Lethal Capability Sets (NLCS) have been deployed in Iraq by the US military. They consist of a variety of basic, commercially available non-lethal weapons. The Taser has also been issued to some troops. More recently the Long Range Acoustic Device (LRAD) was deployed for use in crowd control. (For further information see the subsequent sections of this report – ‘Organisation Focus’ and ‘Technologies’.)

Writing in *The Scotsman* on 1 May 2004 the editor of the newspaper *Iraq Today* set out his views in an opinion piece: “How US can escape its quagmire in Iraq.” He advocates increased use of non-lethal weapons rather than lethal force in order to decrease current tensions.¹⁴ NLWs in Iraq have also been in the news for negative reasons. One of the US soldiers involved in the abuses of prisoners held at Abu Ghraib kept a diary of events that occurred there. Published excerpts from his diary include the following observation: “A prisoner with a clearly visible mental condition was shot with non-lethal rounds for standing near the fence singing when a lesser means of force could have been used.”¹⁵

International Law Enforcement Forum (ILEF)

The report on *the 2004 International Law Enforcement Forum (ILEF) on Minimal Force Options and Less Lethal Technologies*, gives an insight into current police thinking on non-lethal weapons. The 2-day ILEF meeting was an invitation only event hosted by the Police Scientific Development Branch (PSDB) at their Langhurst site in Sussex on 3 and 4 February 2004. It was attended by representatives from the PSDB, UK police force, Association of Chief Police Officers (ACPO), Northern Ireland Office, Police Service of Northern Ireland (PSNI), Defence Science and Technology Laboratory (Dstl), Advanced Research Laboratory at Pennsylvania State University (US), Los Angeles Police Department, as well as officials from police forces in the Republic of Ireland, Canada, Norway, Finland, Sweden, and New Zealand. The report of the meeting was published in April 2004 by the Institute of Non-Lethal Defense Technologies (INLDT) at Pennsylvania State University, who co-ordinate the forum.¹⁶

Paul Acres, Chief Constable of the Herefordshire Constabulary and Chair of ACPO’s Conflict Management Sub Committee, gave the keynote address. He is responsible for the development of national guidance and policy on the use of non-lethal/less-lethal weapons by UK police. He pointed out that non-lethal weapons are not a substitute for lethal force and that threats from firearms will be countered by officers armed with firearms. His address noted that the Home Office now has a formal Code of Practice on ‘Police use of Firearms and Less Lethal Weapons’ that requires each police force to have a senior officer responsible for NLW/LLW. The full Code of Practice document is available on the PSDB web site.¹⁷ Incidentally it was announced in March 2004 that the PSDB is being expanded to provide scientific and technical support to all Home Office departments and it will be renamed the Home Office Scientific Development Branch (HOSDB) later in the year.¹⁸

Paul Acres also pointed out a specific characteristic of the use of NLW/LLW in the UK:

Because the UK has a predominantly unarmed police force any additional use of force option may be seen as an increase in our weaponry rather than an attempt to reduce the use of force used. ...Where

officers are permanently armed, less-lethal options will perhaps more readily be seen as an attempt to reduce the level of force.¹⁹

This is an important difference between the UK and the US, which has an armed police force faced with a heavily armed civil society where private gun ownership is commonplace. There are, therefore, limits to the relevance of the US doctrine for NLW/LLW use for the UK police.

There were four main workshops at the forum that illustrate the main topics of interest to these law enforcement professionals: Developing and Populating the Less-Lethal Weapons Database; Determining Effectiveness and Injury Potential; Optimizing Tactics, Training and Use; and Specifying Definitions, Standards, & Testing.

The PSDB have developed an 'International Less-Lethal Weapons Database', which will contain information sources on various aspects of NLW/LLW including technologies, operational use, and injury data. There were debates at the forum about controlling access to the database but it appears that it will be made publicly available, although non-police users may have to pay for access. The forum want to encourage sharing of data on NLW/LLW between police forces and the military internationally. There is currently an electronic ILEF forum hosted by Penn State and funded by the US National Institute of Justice (NIJ) to discuss issues relating to NLW/LLW but access is restricted to law enforcement practitioners.²⁰

Discussions of effectiveness and injury potential noted that it was difficult to assess effects due to reliance on 'animal and cadaver data' rather than human testing. The participants agreed that there was 'an acceptable level of injury' but that the definition "...is still illusive, since there are a host of political, community, economic and social issues influencing this definition."²¹ They recommended data exchange in this area and the development of an injury model.

With regard to tactics, training and use of NLW/LLW, the forum participants expressed concern that the NLW/LLW development was driven by the manufacturers rather than the users. Discussing the variety of NLW/LLWs in use across the US and elsewhere, they recognised that "...only a small percentage of these devices could be described as being consistent, accurate effective and acceptable less-lethal weapons."²² They recommended that operational requirements should be articulated to manufacturers.

As seems common in discussions of future non-lethal weapons, the Star Trek 'phaser' did not escape attention:

While military and law enforcement had struggled to articulate the ideal less-lethal candidate, the standard which has become the 'virtual bench mark' had been introduced into the public psyche by a futuristic television series in the 1960s – The Star Trek "phaser" is seen as being the ideal. However, the group considered that if the "phaser" was ever available for introduction it would require very tight guidelines to prevent misuse. It was also acknowledged that if the police service had such an effective less-lethal weapon, the incidence of use would increase significantly.

It would seem that law enforcement professionals, like the military seek an ideal weapon that would have variable effects from stun to kill.

With regard to guidelines for use of NLW/LLW, the report notes that participants were concerned that these weapons will be confined to a use of force continuum and that a preferred model for their use should be more ‘situational’ allowing “...the appropriate option to be selected at the appropriate time.”²³ The participants also noted the possibility that deployment of NLW/LLW might aggravate a given situation rather than resolve it.

The forum discussed the importance of definitions and standards in this area. The ILEF Electronic Operational Requirements Group (EORG) was tasked with developing a set of international or national standards that “...should consider including levels of incapacitation in some form and establishing or defining levels of effectiveness...”²⁴ Their initial efforts are included in an appendix to the ILEF report. The report notes: “...developing standards for effectiveness may be illusive, due to the variability of the human anatomy, its condition, and the context of operational use.”²⁵

The ILEF meeting report also includes a brief description of the recent activities of the Human Effects Advisory Panels (HEAPs) at Pennsylvania State University that “...examine different aspects of less-lethal weapons and their interaction with the human body.”²⁶ Since the previous ILEF meeting these HEAPs have assessed a variety of NLW/LLWs including the US military’s pulsed energy projectile (PEP). (The Joint Non-Lethal Weapons Directorate (JNLWD) sponsors these panels.) Current work includes:

HEAPs for the characterization of NLWs, the Area Denial System (ADS), and a Riot Control Agent Comparison Study. Future work includes an assessment of selected animal models, a variety of non-lethal weapons education initiatives, a tactical acoustic reconnaissance projectile, and an in-depth examination of the Sturdivan Deterrence Model.

The ‘Non-Lethal’ Debate

The debate over the definition of ‘what is a non-lethal weapon?’ continues. For example the CFR report takes the line that:

In a sense, “nonlethal weapons” is a misnomer...And there is no requirement that NLW be incapable of killing or of causing permanent damage. Moreover, the ideal NLW would be a system with continuously variable intensity and influence, ranging from a warning tap to a stunning blow to a lethal effect.²⁷

Such an approach to NLWs certainly raises alarm with some analysts. Dual use weapons, which have a rheostatic function from ‘gentle’ to ‘lethal’, may mean that opponents would find it difficult to know what degree of force is to be used against them. This, of course, has implications for their own response. The ‘lethal’ - ‘non-lethal’ divide, with respect to weapons, is taken further in the discussion paper provided by Dr Robin Coupland later in this report. One addition to the definition for NLWs, which would set tighter parameters, is to include the elements of *reversibility of effects, with no permanent deleterious change to the victim (whether physical, physiological or psychological)*.

The impact of non-lethal technologies on international law and conventions will be addressed elsewhere in this report (see also previous BNLWRP publications²⁸).

Public Access to NLWs

A quick search on the internet reveals that NLWs are even more readily accessible. Weapons for home use (self-defence) are becoming both cheaper and more sophisticated. The forthcoming X26c Taser referred to later in the report is one example of this.

Bradford NLWRP Seminar – Autumn 2004

We are planning a one-day seminar in September, which will focus on ‘NLWs and Community Policing’ with a U.K. regional focus in West Yorkshire. Topics to be covered will include: perceptions of the public of NLW use; impact of NLW use on local communities during riot management and other law enforcement situations; the operational experience of police on the ground; policy implications; police training; non-lethal technologies; civil liberties (including social control aspects) and human rights implications. Further details to follow.

2. ORGANISATION FOCUS: U.S. DEPARTMENT OF DEFENSE

This section of the report summarizes the current funding, development, and fielding of NLWs by the US military. It draws upon information from the US Department of Defense (DOD) fiscal year 2005 budget proposals (February 2004), the Council on Foreign Relations (CFR) report on NLWs (February 2004), and the recent *DARPA Tech 2004 Symposium* (March 2004). It also incorporates information from presentations to the *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition* (September 2003) and the *Joint Non-Lethal Weapons Program Industry Day* (November 2003), which are now available online.²⁹

Main Actors and Future Priorities

On 4 November 2003 the DOD held the *Joint Non-Lethal Weapons Program Industry Day* in Arlington, Virginia to build connections with those in industry interested in the development of non-lethal weapons. A presentation at the industry day, entitled “Opportunities for Industry”, by the Director of the JNLWD, Colonel David Karcher, gives an overview of the main actors in the ‘DOD NLW Community’.³⁰ These organisations are listed in *Table 1* on the next page.

Another presentation from the Joint NLW Program’s Technology and Programs Panel points out that NLWs thus far have been limited to non-lethal adaptations for existing weapons platforms including kinetic energy, flash-bang, and riot control agent munitions and grenades, as well as short range electrical stun devices and barrier systems. It goes on to say that the next step is to develop longer-range systems with ‘scalable’ effects (lethal to non-lethal).³¹ As we pointed out in our last report, these two elements are major drivers for future NLW development in the US military.³²

A presentation at the NDIA conference, *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*, by a representative from the Infantry Center emphasises similar trends for NLW development for the US Army, such as the development of longer-range weapons.³³ It also ‘talks’ of a move away from kinetic energy and riot control agents (RCAs) towards directed energy (DE) weapons in the longer term with the eventual aim of developing man-portable DE weapons. Another presentation entitled “Non-Lethal Technologies for a Transforming Force: Current to Future Capabilities” gives a US Army perspective on NLW development and describes some of the departments involved.³⁴ The main organisations are the US Army Military Police School (USAMPS), which develops combat applications for NLWs and carries out training in the use of these weapons; The Project Manager – Close Combat Systems (PM-CCS) at Picatinny Arsenal, which is responsible for establishing and fielding Army NLWs³⁵; and the Close Combat Armaments Center (CCAC), TACOM-ARDEC, also at Picatinny, which coordinates the Army’s non-lethal technology development.

Table 1:
*Main Actors in the US DOD NLW Programme*³⁶

Name	Service / Organisation	Location	Web
Joint Non-Lethal Weapons Directorate (JNLWD)	Marine Corps	Quantico, VA	http://www.jnlwd.usmc.mil/default.asp
Inter-Service Non-Lethal Weapons Instructor Course (INIWIC)	Marine Corps	Fort Leonard Wood, MO	http://mcdetflw.tecom.usmc.mil/INIWIC/INIWIC.asp
Marine Corps Systems Command (MarCorSysCom)	Marine Corps	Quantico, VA	http://www.marcorsyscom.usmc.mil/
Marine Corps Research University (MCRU) at Penn State	Marine Corps / Penn State University	State College, PA	http://www.mcru.org/home.htm
Non-lethal Technology Innovation Center (NTIC)	University of New Hampshire	Durham, NH	http://www.unh.edu/ntic/
Air Force Research Laboratory (AFRL) - Human Effectiveness Directorate	Air Force	Brooks AFB, San Antonio, TX	http://www.he.afrl.af.mil/
Human Effects Center of Excellence at AFRL	Air Force	Brooks AFB, San Antonio, TX	http://www.he.afrl.af.mil/
Air Force Research Laboratory (AFRL) – Directed Energy Directorate	Air Force	Kirtland AFB, NM	http://www.de.afrl.af.mil/
US Air Force Security Forces	Air Force	Lackland AFB, San Antonio, TX	http://afsf.lackland.af.mil/
US Army Research Laboratory	Army	Adelphia, MD	http://www.arl.army.mil/main/Main/default.cfm
Tank-automotives and Armament Control - Armament Research, Development & Engineering Center (TACOM-ARDEC)	Army	Picatinny, NJ	http://w4.pica.army.mil/PicatinnyPublic/index.asp
Aberdeen Test Center	Army	Aberdeen, MD	http://www.atc.army.mil/
Training and Training Technologies Battle Lab (T3BL)	Army	Fort Dix, NJ	http://www.dix.army.mil/
Dismounted Battle Space Battle Lab (DBBL)	Army	Fort Benning, GA	http://www.benning.army.mil/
Maneuver Support Battle Lab	Army	Fort Leonard Wood, MO	http://www.wood.army.mil/MSBL/
US Army Military Police Corps (USAMPS)	Army	Fort Leonard Wood, MO	http://www.wood.army.mil/usamps/default.htm
Naval Sea Systems Command (NAVSEA)	Navy	Washington, D.C.	http://www.navsea.navy.mil/
Naval Surface Warfare Center (NSWC), Dahlgren Division	Navy	Dahlgren, VA	http://www.nswc.navy.mil/
US Joint Forces Command (USJFCOM)	Department of Defense	Norfolk, VA	http://www.jfcom.mil/index.htm
Defense Advanced Research Projects Agency (DARPA)	Department of Defense	Washington, D.C.	http://www.darpa.mil/
Homeland Defense	Department of Defense	Washington, D.C.	http://www.defenselink.mil/specials/homeland/

Shortly before the Industry Day the Joint Non-Lethal Weapons Directorate (JNLWD) had issued a solicitation notice calling for research and development proposals for 'next generation' non-lethal weapons. Guidelines for suitable technologies were stated as follows:

...non-lethal counter-personnel technologies should have the following characteristics: universal effect, quick human effect onset time (less than 90 seconds), ideally has a human effect duration of between 10-60 minutes; temporarily renders target incapable (incapacitated) or unwilling (deterred or dissuaded) to continue aggressive action; and is difficult to countermeasure, and can be stored for at least 5 years...non-lethal counter-material technologies should have the following characteristics: universal effect, minimal collateral human effects, be reversible or require minor repair...³⁷

Although not part of the military, it is worth noting here that the US Department of Justice (DOJ) also issued a solicitation calling for proposals on non-lethal weapons for law enforcement in January 2004. Areas of interest cited were as follows:

- Vehicle Immobilization.
- Area Denial of Personnel.
- Force-On-Target Enhancement.
- Electromuscular Device Modeling.
- Less-Lethal Device-Induced Injury Data.³⁸

Currently available NLWs

NLWs have been deployed already by the US military in the form of non-lethal capability sets (NLCS). These sets consist of commercially available riot control equipment such as: hand batons; shields and protective equipment; OC cartridges, canisters, grenades, and dispensers; rubber, wood, and bean bag projectiles; stingball grenades; flash-bang rounds; bullhorns; and caltrops. The full list of items in the NLCS is given in Appendix A of the Council on Foreign Relations report.³⁹ According to the report approximately 80 of these NLCS have been deployed by the US Army and Marine Corps over the past 5 years and they have been used in both Kosovo and Iraq.⁴⁰ Currently the Army is thought to have 18 of these sets whilst the Marine Corps have around 50.⁴¹ Whilst the Army deployed six sets during the recent conflict in Iraq, the CFR report points out that there has only been limited use of these. Each Army set is designed to equip a force of up to 200 soldiers.⁴² A presentation by Kevin Swenson of the JNLWD to the *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition* shows that the NLCS are currently deployed at various locations including the US, Kosovo, Bosnia, Iraq, Kuwait, and Guantanamo Bay, Cuba.⁴³ Recently the US Marine Corps started a programme to integrate non-lethal weapons into the US European Command (EURCOM).⁴⁴

The CFR Appendix lists other NLWs that are commercially available: (For further details of these technologies see previous BNLWRP reports as well as the technology sections later in this report).⁴⁵

OTHER COMMERCIAL OFF-THE-SHELF NLW CAPABILITIES

- a. Taser – causes electromuscular disruption to incapacitate personnel
- b. Lightweight shotgun system (LSS)
- c. High-intensity directed acoustics (HIDA)
- d. OC pepperball rounds
- e. X-Net – man-portable or pre-emplaced
- f. Tactical unmanned ground vehicle (TUGV) non-lethal payloads
- g. MK 19 non-lethal short-range munition⁴⁶

Emerging and Future NLWs

The CFR Appendix also lists weapons currently in the Acquisition Program, Advanced Concept Technology Demonstrations (ACTD), and Development Programs of the Joint Non-Lethal Weapons Program (JNLWP). These are reproduced below. (Most of the NLWs listed have been discussed in previous BNLWRP Reports⁴⁷).

JOINT NON-LETHAL WEAPONS PROGRAM (JNLWP) ACQUISITION PROGRAM

- a. 66-mm vehicle launched non-lethal grenades (VLNLG)
- b. Mobility denial system (MDS)
- c. Clear a space distract/disorient (CAS D/D) – distracts or disorients
- d. Hand-emplaced non-lethal munition (HENLM) – passive infrared (IR) trigger sensors and two Taser subassemblies
- e. Non-lethal mortar munition (NLMM)
- f. Objective individual combat weapon (OICW) non-lethal rounds – non-lethal airburst munition to burst at a precise location.

ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS (ACTD)

- a. Active denial system (ADS) – millimeter wave energy
- b. Advanced tactical laser (ATL)

JNLWP DEVELOPMENT PROGRAMS

- a. Pulsed-energy projectile (PEP)⁴⁸

Other technologies under development are mentioned in a presentation by Kevin Swenson, at the *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*, entitled ‘Joint Non-Lethal Weapons Program Update’. The Running Gear Entanglement System (RGES) for stopping propeller driven watercraft is being used by the US Coast Guard. He also refers to studies of a thermobaric NLW munition and anti-swimmer technology by the US Special Operations Command (SOCOM) and the US Navy respectively.⁴⁹ The Air Force is also involved in the effort to develop ‘Non-Lethal Diver Deterrence’, as can be seen in the FY 2005 budget documentation.⁵⁰ Swenson lists a number of envisaged ‘technology challenges’ for the Joint Non-Lethal Weapons Program (JNLWP):

JNLWP Technology Challenges

- Separate combatants from non-combatants
- Deter human shields
- Clear a facility without entry
- Long-range, instantaneous, effective incapacitation
- Counter-Material & Counter-Capability missions
- Understand individual and crowd behaviors
- Counter-Swimmer Operations
- Understand human effects to NL stimuli⁵¹

Fiscal Year 2005 DOD Budget

On 2nd February 2004 the Department of Defence (DOD) sent its fiscal year 2005 budget proposal to the US Congress.⁵² Funding for the Non-Lethal Weapons Program, overseen by the Joint Non-Lethal Weapons Directorate (JNLWD), under this proposal is set to remain around \$44 million for 2005. The budget documentation reiterates the aim of the programme:

This project covers non-lethal weapon (NLW) systems which are those systems that by their design, do not inflict fatal or permanent injuries. Instead, these systems are designed to stun, incapacitate, or hinder movement of individuals, crowds, or equipment. The availability of NLWs allows commanders less than lethal options, particularly in urban warfare and military operations other than war, i.e., peacekeeping, humanitarian assistance and disaster relief, as well as special operations.⁵³

The proposal, which covers Research, Development, Testing and Evaluation (RDT&E) for the Joint Non-Lethal Program is summarised in *Table 2* below:

Table 2:
*Summary of US Joint Non-Lethal Weapons Program FY 2005 RDT&E Budget*⁵⁴

Activity	FY2005 \$millions
Oversight, administration and support of the Joint NLW Program	1.550
Evaluation of NLWs to get user feedback.	0.645
Modeling and simulation of NLWs; Data collection on NLW effectiveness.	1.612
Pursuit of new technology through industry, academia and government laboratories.	1.040
Objective Individual Combat Weapons – development of non-lethal airburst munitions.	1.505
Program support for each service’s coordination and oversight of the Joint NLW Program	1.149
Non-lethal mortar development	1.075
Non-lethal technology innovation initiative at a network of academic institutions.	0.500
Active Denial System (ADS) – continued development, evaluation and testing.	4.857
Advanced Tactical Laser (ATL) – continued development.	0.538
Mobility Denial System (MDS) – continued evaluation, analysis and testing.	0.140
Studies and analysis – medical; human effects; acceptability; emerging technologies.	6.117
Exploration and evaluation of technical NLW solutions for crowd control and area denial.	6.090
NLW system development and design to provide ‘fieldable’ non-lethal technologies.	11.548
NATO study on NLW effectiveness; Identification of emerging NLW capabilities.	1.300
Pulsed Energy Projectile (PEP) – continued development; human effects characterization.	3.225
Selection and testing of commercial products that may meet military requirements.	0.430
TOTAL	43.321

Specific NLW systems allocated continued funding for 2005 include the Active Denial System (ADS), Advanced Tactical Laser (ATL), Pulsed Energy Projectile (PEP), and non-lethal munitions and mortars. These will be discussed in more detail in the individual technology sections of this report. Background information on these systems can be found in our previous research report.⁵⁵ The largest allocation is \$11.5 million assigned to the development of new NLWs, but no specific details are given. The actual text describing this category in the budget documentation, which we have ‘translated’ for the above table, read:

System development and design of technology development downselected items to proceed into the acquisition cycle to provide NL technology solutions to critical joint mission tasks.⁵⁶

The 2005 budget document also notes that for fiscal year 2004 the US Congress had awarded an extra \$1 million for a research programme at the Marine Corps Research University (MCRU) (Penn State University acts as the MCRU under contract with the Marine Corps) to:

...assist in the cross comparison of technology, human effects and long term programatics of several new initiatives and the independent technical assessment of Joint NLWs.⁵⁷

There are no funds allocated in the proposal for 2005 to continue this activity at the MCRU.

The overall JNLWD strategy as stated in the budget documentation combines efforts to develop new NLW technologies with those to modify commercially available products for more near-term non-lethal ‘capabilities’. The Navy, and more specifically the Marine Corps, manages funding for the Joint NLW Program through the JNLWD, which then allocates funding to specific armed services. There is additional funding for particular non-lethal weapons development projects allocated in the budget proposals for the Army, Air Force, Special Operations Command (SOCOM), and Defense Advanced Research Projects Agency (DARPA).

The Air Force budget proposal features continued technology development and applied research projects on high power microwave (HPM) weapons, both wideband and narrowband technologies, to degrade electronics. Included is the continued development of millimetre wave non-lethal ‘active denial’ technologies.⁵⁸

The Army proposal allocates continued funding to the Intelligent Munitions System, which incorporates non-lethal munitions and systems.⁵⁹

According to its budget proposal the Special Operations Command (SOCOM), which oversees the Advanced Tactical Laser (ATL) development, is spending \$51.5 million on the ATL during 2004 and plans to spend a further \$28.6 million in 2005.⁶⁰

DARPA is allocating significant funding to several projects focusing on the development of unmanned aerial vehicles (UAVs) for lethal, non-lethal, surveillance, and sensing purposes. There is also funding proposed of \$4 million in 2005 for a new project with relevance to non-lethal weapons, the Precision Urban Combat System (PUCS) programme. According to the budget documentation this programme:⁶¹

*...will develop and validate a suite of advanced lethal and non-lethal precision and area capabilities for use by joint dismounted forces in urban combat operations. ... Example technologies include: precision munitions with greatly improved accuracies (centimeters), individual area effect munitions with greater range and flexibility, sensors with the capability to detect hidden human targets, improved weapon sights and weapon enhancements to provide greater accuracy and Identification of Friend or Foe, multi spectral designation / marking systems for improved flexibility and covertness, deterring or incapacitating agents, precision demolitions, hands-free weapons, and robotic applications.*⁶² [emphasis added]

One of the aims of this project appears to be the development of more discrete non-lethal weapons.

The Marines have a separate ‘funding line’ for procurement of NLWs for Operations Other Than War (OOTW) emerging from the JNLWD or from the commercial market. For 2005 \$1.5 million has been allocated to procure various items including the following:

- NLW Capability Sets – The items in the sets are procured from the commercial law enforcement market
- 66mm Light Vehicle Obscurant and Smoke System (LVOSS) – modified vehicle-mounted smoke grenade launcher to deliver CS grenades, sting ball grenades, and flash/bang rounds.
- ‘Hasty Barrier Construction Tools’
- Portable Vehicle Arresting Barrier (PVAB)
- Anti-Traction Material – also known as the Mobility Denial System (MDS)
- Multi-Sensory Grenade (MSG) – also known as the Clear-A-Space Device.⁶³

The CFR report from February 2004 recommended a sevenfold increase of the JNLWD annual budget from \$43.4 million in FY 2004 to around \$300 million in order for the US military to develop and field more NLWs.⁶⁴ It also deemed the staffing levels at the JNLWD inadequate. (There are currently 19 members of staff). According to the report, "...the services have identified \$70 million in desired concept development beyond the \$24.3 million budget [in 2003] of the JNLWD."⁶⁵ As part of the discussion of insufficient resources available for NLW R&D the report notes that "Virtually all the DOD's NLW research and development (R&D) is being funded by the JNLWD program budget."⁶⁶ This is perhaps a little misleading since, as can be seen from the FY 2005 budget materials, a significant amount of money is being spent by other services on non-lethal related technologies. For example, during 2004, Special Operations Command is spending \$51.5 million, i.e. more than the total JNLWD budget, on the continued development of the Advanced Tactical Laser (ATL).⁶⁷ The ATL is a high-energy laser that would be lethal if used against humans but has been billed by the JNLWD as a potential anti-materiel non-lethal weapon. Funding of technologies with potential non-lethal applications by other services is particularly relevant to the development of directed energy (DE) weapons, where there is the desire to create weapons systems that can have variable effects from lethal to non-lethal.

To obtain the FY 2005 Budget documentation for the Joint Non-Lethal Weapons Program visit the following site: (The document is a 'line item', BA4 75, under Research, Development, Test, and Evaluation, Navy (RDTEN))

http://navweb.secnav.navy.mil/pubbud/05pres/db_u.htm

For other budget documentation discussed, please refer to the references at the end of this report.

DARPA Tech 2004

At the *DARPA Tech 2004 Symposium* (9-11 March 2004), the Director of the Precision Urban Combat System (PUCS) programme (mentioned above) in DARPA's Tactical Technology Office (TTO) emphasised the role of NLWs in future urban combat operations, where there will be the need to discriminate between combatants and non-combatants. He argued that:

In many cases our goals can be achieved by influencing our adversaries without the use of lethal force. We need to develop new and innovative ways to legally and justly apply nonlethal force and effects based operations in urban environments.⁶⁸

Speculating on concepts that might enable non-lethal incapacitation in urban environments he asked:

Are there ways to deliver radio frequency or optical energy in a point or netlike fashion to subdue one or many potential threats - for a period of seconds to minutes? Is it possible with adjustable power, multiwavelength, modulated high power light emitting diode based systems to dazzle or distract potential threats to stun them or disorient them?⁶⁹

He continued:

Is it possible to develop free flying projectile tasers to electrically subdue an adversary?

How small can we make these tasers? ... Could soldiers or Marines deploy electromagnetic dragnets to immobilize large numbers of potential combatants in a populated remote urban zone?⁷⁰

Later he pointed out that the need for remotely delivered area denial techniques:

Can we develop projectile deployed foams or glues which greatly expand once emplaced - effectively denying threat mobility? Can we develop electromagnetic techniques to deny structures and urban avenues of approach which are unattended and affordable and controllable in range and scope?⁷¹

A representative of DARPA's Special Projects Office also gave a presentation stressing the importance of urban operations in future warfare. With regard to NLWs, he said that DARPA wants to develop rapidly deployable barrier systems and is exploring the use of "...hardening foam that expands rapidly to block a door, portal or roadway."⁷² He also discussed the development of slippery materials in this context, citing the need for materials that would work on dirt or gravel as well as smooth surfaces. He mentioned HPM devices, including the development of a "high intensity electromagnetic pulse generator" to short electrical circuits in improvised bombs for example. However, he noted that size and space requirements are a problem and the existing equipment requires a truck to carry it.

Strategic Use of NLWs: Defense Science Board

The Defense Science Board, an advisory committee to the DOD, published a report in February 2004 entitled 'Defense Science Board Task Force on Future Strategic Strike Forces'. One of their conclusions advocated non-lethal weapons for strategic use:

Non-lethal effects directed at the physiological or psychological functions of specific individuals or the populace. Applications of biological, chemical, or electromagnetic radiation effects on humans should be pursued. R&D into sophisticated psychological operations designed to change the minds of individuals or the populace is needed. Techniques could include projection of sounds and images to specific points in space. The Joint Non-lethal Weapons Program Directorate should broaden its tactical and operational focus to consider the strategic applications and associated treaty issues of non-lethal weapons.⁷³

The authors recommended some non-lethal payloads for the future (see *Table 3* on the next page) including incapacitants or 'calmatives' (See: Weapons Focus: Biochemical Weapons in this report)

The Strategic Planning Guidance for 2006, currently being drafted by the Department of Defense, reportedly calls for a variety of new capabilities including "...a larger stable of non-lethal weapons."⁷⁴

Table 3:
*Strategic Payload Concepts*⁷⁵

Topic: Disable	Purpose	Notes
Calmatives	Neutralize individuals	<ul style="list-style-type: none"> • Calmatives might be considered to deal with otherwise difficult situations in which neutralizing individuals could enable ultimate mission success • The principle technical issue is the balance between effectiveness (i.e., the targets are truly “calmed”) and margins of safety (i.e., avoiding overexposure and resulting fatalities of neutral bystanders) • The treaty implications are significant
Directed energy	Neutralize Individuals	<ul style="list-style-type: none"> • Lasers or high-power microwaves (HPM) provide an effective less-than-lethal capability against dismounts • The HPM approach termed “active denial” may be used to produce an autonomic burning response in the targeted individual • Laser devices may be used at lower powers to dazzle eyesight or burn the skin or objects • Existing treaties may limit some aspects of the these
Topic: Dissuade	Purpose	Notes
Psychological operations	Influence an adversary’s Behavior	<ul style="list-style-type: none"> • In the near term, we have the ability to manipulate speech/audio and still and video images • In the mid term we could pursue such capabilities as directed audio beams • In the far term we could pursue capabilities such as holograms that could remotely project an image in a room

3. TECHNOLOGIES⁷⁶

This section (a) highlights non-lethal technology developments and policy related issues since Report No.4 was published in December 2003, and; (b) identifies less recent sources we have not previously referred to which we think contribute to these elements. Readers are directed to previous reports and publications for a more thorough description of NLWs.⁷⁷

3.1. KINETIC ENERGY

L21A1 Baton Round

The dangers of the ricochet potential of L21A1 baton round was noted by the U.K. Home Office Minister for Crime Reduction, Policing and Community Safety (Ms Hazel Blears) in a written Ministerial statement. The Sub-Committee, Defence Scientific Advisory Council (DSAC) has recommended:

Users should be made aware that the L21A1 baton rounds can ricochet in some circumstances with high energy, and that the presence of obstacles and of personnel other than the intended target should form part of their risk assessment in the decision to fire the weapon.

A desire for a reduction of the ricochet potential should be stated in the research and operational requirements of future kinetic energy weapon systems, and be evaluated experimentally.⁷⁸

According to Jane Kennedy, Security Minister for Northern Ireland, no baton rounds have been fired in Northern Ireland since September 2002⁷⁹, although there have been a number of discharges on the mainland during period 2002-2004.⁸⁰ The Patten Report notes that, compared with the older L5A7, whilst the L21A1 was more accurate ‘the probability of ricochet within the normal operational range of batons’ was higher.

The development of an Attenuating Energy Projectile (AEP) to replace the L21A1 plastic baton round was noted in our BNLWRP No.4. This crushable impact round is expected to be ready for deployment before Summer 2005.

Meanwhile a Canadian company claims to have developed a safer rubber bullet that does not harden at low temperatures, attracting interest from US law enforcement agencies.⁸¹

‘Dual Use’ Lethal/Non-lethal Guns

We have already mentioned that the military and police want weapons that have varying effects or can be switched from lethal to non-lethal modes. Many existing non-lethal projectiles can be fired from standard lethal weapons systems such as 12 gauge shotguns. The US Army have recently developed a ‘Lightweight Shotgun’ that can be attached underneath a standard automatic rifle or used as a stand alone weapon. The system can fire lethal or non-lethal rounds and has already been deployed in Afghanistan.⁸² The Idaho National Engineering and Environmental Laboratory of the US Department of Energy has designed a weapon on a similar principle that combines an automatic rifle with a shotgun that can fire lethal or non-lethal rounds, such as beanbags.⁸³

An Australian company is developing a handgun called the Variable lethality enforcement (Vle) weapon.⁸⁴ The gun, currently at the prototype stage, has an electronic rather than mechanical mechanism that will fire bullets more rapidly. It is worthy of note here because the company is planning to develop the weapon so that it can be "...rapidly switched between lethal and less-than-lethal fire."⁸⁵ Apparently it has a talking interface to alert the user which mode it is in.⁸⁶

Water Cannon

The decision to purchase six RCV9000 water cannon vehicles from the Belgian Company Somati for the U.K. PSNI was made in the summer of 2002.⁸⁷ Operational deployment was only to be authorised after the results of a medical evaluation by DSAC Sub-Committee on the Medical Implications of Less-lethal Weapons (DOMILL) had been published. On 16 March 2004 Jane Kennedy, announcing the publication of the medical statement and ACPO guidance⁸⁸ which allows the PSNI to make use of their water cannon said:

I welcome the publication of the medical statement and the ACPO guidance which now enable PSNI to use the water cannon purchase last year. While I hope their use will be unnecessary, the availability of water cannon provides PSNI with another option to deal with public disorder and may defer the point where police have to deploy baton rounds.⁸⁹

3.2 BARRIERS AND ENTANGLEMENTS

Superintendent Jim Hammond of the Sussex Police (and Deputy Chair of the Intelligent Transport Systems (ITS) working group), reported that ACPO are starting to research a system which will remotely immobilise a stationary vehicle, and also gradually reduce the speed of a moving one to zero. However new legislation would be needed to give police powers to stop vehicles remotely.⁹⁰

Vehicle barrier systems currently available include the Portable Vehicle Arresting Barrier (PVAB), used by the US military, and the X-Net produced by UK company, QinetiQ. (QinetiQ was established in 2001 when the activities of the Defence Evaluation and Research Agency of the Ministry of Defense were spilt between it and the MoD's Defence Science and Technology Laboratory (Dstl)). Another system, called the Vehicle Stopping System (VSS), is marketed by Markland Technologies.⁹¹

3.3 ELECTRICAL

'Shockrounds'

The MDM Group Inc. is continuing research into 'ShockRounds'.⁹² These are rubber bullets that discharge an electrical shock on impact, which the manufacturer claims is capable of immediately incapacitating a person at a ranges up to 100 metres. This compares to 40 metres for most 'traditional' rubber bullets. Unlike most other stun munitions it does not need to be connected by a wire to the firing weapon. 'ShockRounds' use the 'piezoelectric effect' to generate a high voltage charge. Because only low kinetic energy impact is required to

discharge the voltage, it is stated that less harmful damage should occur to the target. Development is also underway to apply this technology to metal bullets.

Taser

The popularity of the Taser continues and reports for its planned and actual operational use regularly appear in the international media. Questions still remain over its effects on human health. The incidents given below are only illustrative of the operational use of this weapon.

Police Forces

In the UK Police criticised concerns voiced by Amnesty International (related to health effects and human rights issues – See BNLWRP Research Report No. 4⁹³) on the 12 month operation trial of the M26 Taser, which began April 2003⁹⁴. The police argued that the weapon was only being used by specially trained officers in situations where a conventional firearm might otherwise be used, and that the trial was being rigorously scrutinised and evaluated. “Human rights abuses of all kinds, including those mentioned by Amnesty International, are to be deplored, but it is not helpful to link this trial by the British Police Service with unconnected incidents abroad.”⁹⁵

Taser trials by UK Police Forces have continued.⁹⁶ The trial period has now ended⁹⁷ but there has not yet (as of 1 May 2004) been an official announcement by the Association of Chief Police Officers (ACPO) as to the future of the Taser in the UK. Some reports cite the police as saying the trials have been a success,⁹⁸ others suggest that the trial period has been extended.⁹⁹ A presentation to the *2004 International Law Enforcement Forum (ILEF) on Minimal Force Options and Less-Lethal Technologies* (3 & 4 February 2004) by Chief Inspector Martyn Perks of the ACPO Firearms Secretariat entitled *Operational Use of the L21A1 and Taser* seems to indicate the latter. It featured two slides on “The Future of the Taser Trial” stating:

- Taser to be made available to all forces for use where there is a firearms authority.
- Extended trial in current five forces where officers are facing violence of such severity that their use of force is necessary to protect themselves or the public.

It would appear that, prior to a decision on the future of the Taser in the UK, it will now be deployed more widely. Also within the five forces involved in the trial it may be used outside the original guidelines that authorised its use only in situations where firearms could be deployed.

The experience of U.S Myrtle Beach Police Department, Georgetown County Sheriff’s Office showed the deterrent effect of the X26 Taser. On the six occasions when it was deployed during their testing period a spokesman said “The suspects calmed and surrendered once they noticed the laser pointed at them or after they were warned that the officer was armed with the stun gun.”¹⁰⁰

Again in the U.S., the Phoenix the Police Department, for example, now has 1,556 Taser weapons. Data released by them indicates a drop of 54% in shootings by officers using conventional firearms during 2002 (when Tasers were introduced) as compared with 2001 (when they shot 28 people killing 13). In 2003 the Phoenix police fired their Tasers 354

times, up from 148 times in 2002. As reporter Robert Nelson asked “So, now are our cops Taser happy? I imagined getting whacked for a parking ticket”. The Phoenix police responded “We’ve created strict guidelines on when the things can be used. The gun itself records each incident and the officer must complete a separate report for each firing. We don’t treat this thing as a new toy”.¹⁰¹ Over 4,000 police departments in the US are now using the Taser.¹⁰²

A discussion is taking place as to whether police officers who may be equipped with the Taser should experience a shock themselves before they are permitted to carry and use it.¹⁰³

Anti-Terrorist

Interest in Taser use by ‘sky marshals’ to deal with terrorist situations continues. As well as deployment by airlines in Europe, the Middle East and the U.S., Australian anti-terror units may also soon be equipped with the weapon. “It is the logical tool because dead terrorists don’t talk” an air marshal source was reported as saying.¹⁰⁴ In response to U.S. fears over another air hijack, many flights into the U.S. now carry armed guards. The *Guardian* reported that between two and six armed officers are currently operating on flights between France and the U.S., and police sources were quoted as saying that officers only carried non-lethal weapons including stun guns.¹⁰⁵

Military Forces

The effectiveness of a Taser was noted by the U.S. 800th Military Police Brigade in Iraq during trouble with high value detainees (prisoners of war). After the prisoners saw a demonstration of the Advanced M26 version ‘they moved away, they got in line’. Amnesty International called on the U.S. and its Allies to stop using the Taser until its medical effects were more fully understood, and to ensure that human rights were not being abused. A counter argument by James Lewis of the Center for Strategic and International Studies in Washington called such a demand misguided. “If the choice is between an M16 and a Taser, which would we have them use?”¹⁰⁶

Schools

In the U.S. a Putnam County School District Resource Officer used a Taser four times to subdue a 14-year-old female student after she had become violent in a classroom. Police Chief Captain Rick Ryan was reported as saying that it did not matter whether the person on whom the Taser was used was 14 or 40. If the person showed violence toward an officer then “we’re going to take the minimum action necessary to bring that person under control”.¹⁰⁷

Self-Defence

Taser have also developed the Taser X26c for self-defence purposes. The capabilities of this version of the weapon differ from the standard X26 used by police officers. The X26c, due for production in September 2004, will be able to deliver 15 pulse discharges per second for up to a 60 second period, as compared with the police issue of 19 pulse discharges for 5 seconds. This extended capacity (although using less energy) is designed so that the user has longer to escape to safety whilst the assailant is incapacitated.¹⁰⁸ According to the company it is legal to carry any of Taser’s electrical weapons without a permit in 43 US states.¹⁰⁹

Wireless

In March Taser announced that they are continuing development of a wireless version of their electrical weapons called the Extended Range Electronic Projectile (XREP), whose recent research and development has been funded by the US Office of Naval Research.¹¹⁰ The company expect to carry out R&D for at least another 18-24 months before the system is ready for manufacture.

Health Effects

Anticipating the success of the Taser Trial and its introduction to UK police forces, Bleetman et al. published a paper in the March 2004 issue of the *Emergency Medicine Journal* entitled *Introduction of the Taser into British policing. Implications for UK emergency departments: an overview of electronic weaponry*.¹¹¹ Bleetman and Steyn also co-authored a literature review of the health effects of electronic weaponry in 2003 on behalf of Taser International Inc., which concluded “The medical risks of electronic weaponry compare favourably with those of more conventional methods of controlling non-compliant and violent subjects.”¹¹² The recent paper discusses the effects of electricity on the human body and addresses the medical implications of the introduction of the Taser in the UK. The paper concludes that although there is no independent medical literature on the effects of the Advanced Taser, “It seems that the device is essentially safe on healthy people.”¹¹³ However the paper does note: “Until clinical experience with this new device is published, it is only possible to draw general conclusions about the relative safety of this device.” The authors discuss a number of ways in which the Taser might cause injury including: potential dysfunction of heart pacemakers; the risk of Taser barbs hitting vulnerable areas such as the eyes, mouth, genitalia, and perhaps large blood vessels in the neck and groin; the potential for burns if used in combination with CS spray, which the Taser can ignite; and the potential for indirect injury resulting from uncontrolled falling after being ‘tasered’.

3.4 ACOUSTIC

The American Technology Corporation’s Long Range Acoustic Device (LRAD) which has been called by the company ‘The Sound of Force Protection’, and whose development we noted in BNLWRP Report No.4, has now been acquired by the U.S. Marines for use in Iraq. According to a report by CNN, the 1st Marine Expeditionary Force and the 3rd Marine Aircraft Wing will be deploying the weapon in the province of Al Anbar.¹¹⁴ The report also claims that the device has been used on some ships since Summer 2003. According to one article an American Technology Corporation acoustic device has also been used in Afghanistan.¹¹⁵ William Arkin, commenting on how this acoustic weapon has been introduced, says that:

...the U.S. is making a huge mistake by trying to quietly deploy a new pain-inducing weapon without first airing all of the legal, policy and human rights issues associated with it.

And referring back to the ban on blinding laser weapons in 1995 by the U.S. Secretary of Defense, Arkin continues:

So shouldn’t we have a similar discussion about high-intensity sound, which can cause permanent hearing loss or even cellular damage? The new megaphone being deployed in Iraq can operate at 145 decibels at 300 yards,

according to American Technology, well above the normal threshold for pain. The company posits a scenario in which Al Qaeda terrorists would run screaming from caves after being subjected to a blast of high decibel sound from the devices, their hands covering their ears. But in Baghdad or other Iraqi towns, where there are crowds and buildings, the sick and elderly, as well as children, are likely to be in the weapons range.¹¹⁶

The device is likely to be used for crowd control, area denial of personnel, at checkpoint operations, and for clearing buildings.¹¹⁷ For a considered view of the potential of acoustic weapons see papers by Jauchem et al¹¹⁸ and Altmann.¹¹⁹

Another company, Universal Guardian Holdings, has developed a device called the Acoustic Defender. The company claims that can give warning messages at up to 1,000 yards can be used as a non-lethal weapon to “debilitate an intruder at ranges from a few feet to 150 yards.”¹²⁰

It is worth noting that the CFR report expressed scepticism over the utility of acoustic NLWs:

...intense acoustic sources have thus far been found wanting, in that they expose our own troops to damaging sound levels when they are used to project sound to disable or repel opposing forces at a distance.

3.5 DIRECTED ENERGY

A senior UK police officer, who heads ACPO’s Working Group on Police Use of Firearms, recently gave *Jane’s Police Review Magazine* his vision for the future of non-lethal weapons:

What we would like in the future is a Star-Trek-style phaser that, perfectly safely, temporarily switches someone’s brain off so that officers move in.¹²¹

The UK *Guardian* newspaper joked:

Presumably, Mr Arundale does not have the type 4 phaser in mind, a medium-sized version that could be attached to vehicles, or the type 5 a starship-mounted weapon.¹²²

Active Denial System (ADS)

The US military’s millimetre wave Active Denial System (ADS), although not as capable as a Star Trek phaser, is vehicle mounted in its current version (VMADS).¹²³ The DOD’s fiscal year 2005 budget states that the Joint Non-lethal Weapons Directorate will be spending a further \$4.8 million on continued “evaluation, testing, and target assessment” of the ADS in 2005.¹²⁴ This follows \$4.4 million being spent on the system during 2004. The US Air Force are also involved in the development of active denial technologies and plan to spend \$4.6 million on this programme in 2005.¹²⁵ Their contribution will include support of testing the current ground-based system and development of an airborne version.

The Council on Foreign Relations (CFR) report argued that the VMADS could be helpful in certain situations but that countermeasures were conceivable:

...countermeasures might proliferate in the form of aluminium-foil umbrellas, perforated with small holes to allow for visibility but able to block the penetration of the millimeter waves from the VMADS [Vehicle Mounted Active Denial System].¹²⁶

Recently it emerged that Raytheon Corporation, who are manufacturing two prototypes of the VMADS under contract with the Air Force Research Laboratory,¹²⁷ will have them ready for field testing in May 2004.¹²⁸

High Power Microwave (HPM)

The CFR report suggested that weapons targeting electrical systems might be a solution to "... the clear need for means short of invasion and destruction to discourage state tolerance or support for terrorist activities", as they put it.¹²⁹ In the report they state they were unable to obtain access to any such weapons programmes that may exist in the US military.

The DOD fiscal year 2005 budget documents for the Air Force indicate a substantial programme to develop such high power microwave (HPM) weapons. \$14.6 million is being spend on applied research in this area during 2004 with \$15.5 million proposed for 2005.¹³⁰ Moreover the Air Force's 'Advanced Technology Development (ATD)' programme on 'High Power Microwave Technology' will spend \$8.3 million in 2004 and \$11.5 million in 2005.¹³¹ The latter programme represents technologies that are closer to being fielded and includes the millimetre wave ADS, which is funded from this budget. Part of the programme description is as follows:

This project develops high power microwave (HPM) generation and transmission technologies that support a wide range of Air Force missions such as the potential disruption, degradation, damage, or destruction of an adversary's electronic infrastructure and military capability. These targeted capabilities include local computer and communication systems, as well as large and small air defense and command and control systems. In many cases, this effect can be generated covertly with no collateral structural or human damage.¹³²

In 2004, for example, the Air Force plans to "Conduct additional ground-based, field experiments demonstrating effectiveness of air delivered HPM munitions."¹³³

Lasers

Pulsed Energy Projectile (PEP)

The 2005 DOD Budget for the JNLWD also outlined continued investment of \$3.2 million in the Pulsed Energy Projectile (PEP) to:

Explore the development of laser hardware and extensive human effects characterization research and to continue refinement of bio-effects characterization and optimisation of lasers.¹³⁴

As described in our last report, the PEP produces a laser-induced plasma at the surface of the target person to exert its effects.¹³⁵

A seemingly related project emerged in January 2004 when the US Air Force Research Laboratory announced a research partnership with Ionatron Inc. to develop "Laser Induced Plasma Channel Technology."¹³⁶ An Ionatron press release in March 2004 stated that they

have developed and tested a directed energy technology for use as a NLW to stop vehicles or degrade electronics and that an additional aim was to develop the technology for use as a NLW to ‘stun’ people. The release also mentioned that Ionatron “...recently secured several US Government contracts and had its technology funded as a line item in the 2004 DOD Defense Budget.”¹³⁷ This collaborative project is perhaps part of the broader development programme on pulsed energy lasers as non-lethal weapons. Two presentations at the *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition* pictured an artist’s impression of a hand-held directed energy weapon. The Pulsed Energy Laser Testbed (PELT) is the name given to this long-term Air Force development programme.¹³⁸

Advanced Tactical Laser(ATL)

The ATL is given some funding through the Joint Non-lethal Weapons Program with \$0.5 million allocated in the Budget documentation for 2005.¹³⁹ However, as already mentioned, it is receiving heavy investment from its main sponsor, the Special Operations Command (SOCOM), which is spending \$51.5 million in 2004 and plans to spend \$28.6 million in 2005.¹⁴⁰ A recent paper authored by specialists in the US Air Force suggested that the ATL prototype should be completed in 3 to 5 years from now.¹⁴¹

One of the main recommendations in the CFR report relates to the ATL:

Via more aggressive funding and technical support, advance the development of other concepts such as the advanced tactical laser – which shows promise for use against equipment – along with the advent of nonlethal payloads that home on a laser spot.¹⁴²

The CFR endorsement of the ATL programme is in stark contrast to the US National Research Council (NRC) report in 2003 that was doubtful of the utility of the ATL for non-lethal weapons purposes.¹⁴³

3.6 RIOT CONTROL AGENTS & MALODORANTS

Riot Control Agents (RCAs)

The Fourth Patten Report from the Northern Ireland Office (NIO) gives the rationale behind the introduction of CS sprays to the Police Service of Northern Ireland (PSNI). CS sprays were introduced to police forces in England as early as 1996 and will be deployed in Northern Ireland as of Summer 2004.¹⁴⁴

A recent study authored under contract to the US Department of Justice (DOJ) addresses ‘Deaths in Police Confrontations When Oleoresin Capsicum is Used’.¹⁴⁵ Based on the 63 case studies it concludes:

There is no evidence that O.C. as used by law enforcement officers in confrontational situations is a total or contributing cause of death, except when preexisting asthma (or disease-narrowed airways) is present.¹⁴⁶

Malodorants

The Patten report summarises U.K. research into the use of malodorants as NLWs. It concludes:

Chemical and toxicological information has been obtained for a variety of chemical compounds, however the effectiveness of any of these chemicals as a malodorant for police use has not been determined. At present insufficient information is available to allow the recommendation of a specific chemical for further study. Before any malodorant agent could be deployed or used operationally it would have to undergo rigorous medical testing as with any other chemical irritant agent.¹⁴⁷

Malodorants have been moved to 'Category C' by the Police Scientific Development Branch (PSDB), which means they will carry out no further research unless there are "significant advances in the available technology." The report goes on to say, "...malodorants do not appear to offer any tactical advantage over existing incapacitants already available to the police."¹⁴⁸

The CFR report notes that malodorants are 'probably classed as riot control agents' and notes that they could not therefore be used in warfare. However, the report immediately contradicts itself:

However, police forces in the United States have begun to use foul-smelling materials (gelled essence of skunk) to prevent the occupation of vacant buildings; it would likely be acceptable to do the same in a theater of war, even if the treatment prevented the entry of combatants as well as civilians.¹⁴⁹

The report on the recent International Law Enforcement Forum (ILEF) also includes a discussion of malodorants. The participants in the forum apparently expressed disappointment that "...malodorants have not been pursued as vigorously as other technologies."¹⁵⁰

3.7 COMBINED TECHNOLOGIES

Reportedly, two new combined NLW systems have been developed by Universal Guardian Holdings.¹⁵¹ The Cobra StunLight is a combination high-intensity light source and chemical irritant dispenser with a reported range of 21 feet. Another system is the Python Projectile Launcher, described as a 'non-lethal semi-automatic pistol' which uses US Navy patented frangible projectiles that break on impact. Similar to the PepperBall System (see previous BNLWRP research report) the patent covers projectiles with six different payloads: "PAVA or OC powder, Olfactory Stimuli, Inert Liquid, Glass Shattering, Marking, and Kinetic Impact."¹⁵²

The US military is spending \$0.8 million on the Clear-A-Space device (also known as the Multi-Sensory Grenade) in 2004, which will be may be ready for deployment soon since no further R&D funding has been allocated for 2005.¹⁵³ It is currently in the Joint Non-Lethal Weapons Directorate's 'Acquisition Program'.

3.8 DELIVERY SYSTEMS

Non-Lethal Munitions

The MK-19 non-lethal munition, which is a 40mm ‘telescoping projectile’, is scheduled for fielding by the US Army in 2006. The initial payload will likely be rubber balls but it is apparently suitable for other payloads. For more information see the presentation on this munition to the *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*.¹⁵⁴

Other US military projects discussed in our previous report receive continued funding in the FY 2005 budget.¹⁵⁵ \$1.5 million is allocated to The Objective Individual Combat Weapons (OICW) programme to:

Continue development of NL munitions for the “next generation” combat weapon that will exploit the ability to air burst munitions with NL payloads at longer ranges than existing systems.¹⁵⁶

In addition, the 81mm Non-Lethal Mortar programme will receive \$1.1 million for the continued development of mortars for delivery of non-lethal payloads at extended ranges.

The Army is also developing non-lethal munitions as part of its Intelligent Munitions System. The programme is described as “...an integrated system of effects (lethal, non-lethal, anti-vehicle, anti-personnel, demolitions), software, sensors/seekers and communications.”¹⁵⁷ NLWs are increasingly being integrated into the US Army’s weapon systems. See the web site of the US Army’s Project Manager – Close Combat Systems (PM-CCS).¹⁵⁸

The authors of the 2004 CFR report point out that non-lethal munitions could provide the stand-off capability the military desires by enabling remote delivery of various payloads. They note:

What is sought in this regard is the ability to send out in a discriminating fashion, preferably semi-automatically, containers with multiple rubber balls, dye cartridges, or whatever is in use, so that they will explode at a specified height above the crowd and project the NLW as desired. To clear a large crowd in other than combat situations, tear gas would also be a tool of choice, and such submunition systems would be helpful in that case as well as in the comparable domestic riot control actions.¹⁵⁹

[Note: the Chemical Weapons Convention prohibits the use of riot control agents as a method of warfare.]

They also suggest the use of a system of sub-munitions to spread slippery anti-traction materials (ATM) over a large area to deny access to a given area.

Unmanned Vehicles

Unmanned Aerial Vehicles (UAVs) such as the Predator and Global Hawk were have been used by the US military in the recent conflicts in Afghanistan and Iraq for surveillance purposes. In addition, the US Marines are reportedly taking the Dragon Eye UAV to Iraq soon.¹⁶⁰ There is, however, the desire to develop UAVs that can deliver weapons including non-lethal payloads. In the US, the Defense Advanced Research Projects Agency (DARPA) are leading development efforts in this area through the Joint Unmanned Combat Air Systems

Program (J-UCAS).¹⁶¹ \$41.4 million is being spent on the J-UCAS programme in 2004 with the aim of developing:

...unmanned combat capabilities for high threat Suppression of Enemy Air Defense (SEAD); Intelligence, Surveillance, and Reconnaissance (ISR); Electronic Attack (EA); and related strike missions...¹⁶²

4. WEAPONS FOCUS: *BIOCHEMICAL WEAPONS*

Neil Davison

Project co-ordinator, Bradford Non-Lethal Weapons Research Project

Definitions

In the last BNLWRP report we discussed the development of incapacitating chemicals as ‘non-lethal’ weapons and the debates surrounding both their lethality and legality.¹⁶³ Here we expand this discussion of agents whose definitions fall somewhere in between that of a ‘traditional’ chemical agent (e.g. nerve, blood, and blister agents) and a ‘traditional’ biological agent (e.g. bacteria, viruses, and rickettsia). In this context Pearson’s CBW Spectrum is a useful concept (see *Table 4*):

Table 4:
*The CBW Spectrum*¹⁶⁴

Classical CW	Industrial Pharmaceutical Chemicals	Bioregulators Peptides	Toxins	Genetically Modified BW	Traditional BW
Cyanide Phosgene Mustard Nerve Agents	Aerosols	Substance P Neurokinin A	Saxitoxin Ricin Botulinum Toxin	Modified/ Tailored Bacteria Viruses	Bacteria Viruses Rickettsia Anthrax Plague Tularemia
<p>The diagram shows a horizontal spectrum with six columns. Three horizontal arrows with double-headed ends are positioned below the table. The top arrow is labeled 'Biological and Toxin Weapons Convention' and spans from the 'Toxins' column to the 'Traditional BW' column. The middle arrow is labeled 'Chemical Weapons Convention' and spans from the 'Industrial Pharmaceutical Chemicals' column to the 'Toxins' column. The bottom arrow is labeled 'Poison' and spans from the 'Classical CW' column to the 'Toxins' column. A horizontal arrow labeled 'Infect' spans from the 'Genetically Modified BW' column to the 'Traditional BW' column.</p>					

It is toxic agents in the mid-spectrum, where there is overlap between the legal prohibitions of the Chemical Weapons Convention (CWC) and those of the Biological and Toxin Weapons Convention (BTWC), that Wheelis terms “biochemical weapons”.¹⁶⁵ Incapacitating chemicals such as the fentanyl derivative used during the siege of a theatre in Moscow in late 2002 would fall into the theoretical ‘Industrial Pharmaceutical Chemicals’ category and, as toxic chemicals, are covered by the CWC alone. However, due to advances in biotechnology and new methods of drug discovery, there is increasing blurring of the superficial boundaries between this category and that of ‘Bioregulators’ and ‘Toxins’. As Wheelis points out, the analogues of bioregulators and toxins are covered by the BTWC. He argues, therefore, that synthetic chemical analogues (i.e. drugs) that bind to the same specific binding sites on proteins in the body as the corresponding natural ligands are also covered. The significance of this ‘double coverage’ is that would-be developers of such agents should not be able to exploit the loophole in the CWC that permits the use of certain chemicals for “law enforcement including domestic riot control purposes.” This is particularly important

given the scientific and technological developments that would facilitate any offensive programme to develop such novel agents designed to incapacitate or to kill.

The Issue of Lethality

Before addressing the relevant science and technology it is worthwhile to revisit the issue of lethality. As discussed in the last BNLWRP report¹⁶⁶, currently available incapacitating agents and associated delivery systems exclude them for being used for their stated purpose as ‘non-lethal’ weapons since they have comparable lethality to some conventional weapons.¹⁶⁷ For the same reason they cannot be termed riot control agents (RCAs), defined by the CWC as:

Any chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which *disappear* within a short time following termination of exposure. [emphasis added]¹⁶⁸

As mentioned in other sections of this report, the reversibility of effects may be seen as a key aspect of any non-lethal weapon targeted at humans. However a model developed by the Klotz et al suggests that no existing agents would be able to perform this role and that it is unlikely a new agent would be sufficiently safe.¹⁶⁹

Others are more optimistic about the future of incapacitating agents despite the events in Moscow in late 2002 when Russian authorities ended the siege of a theatre using an aerosolised fentanyl derivative, most likely carfentanyl¹⁷⁰, with devastating results. (120 of the 800 hostages died as a result of exposure to the agent and many survivors needed hospital treatment.¹⁷¹) An anaesthesiologist (*Note: see ‘Interviews’ section of this report*), with a professional interest in this area, contributed an editorial to the *European Journal of Anaesthesiology* in early 2003. Recognising the risk of using fentanyl and other opioids as ‘non-lethal’ incapacitants, (a major side effect is respiratory depression), he noted:

However, remarkable progress has been made in the techniques to deliver immobilizing agents and in the development of safer, faster-acting potent compounds of extremely short duration in the last decade. Much of this work is either privileged or currently not available to the public and therefore unpublished.¹⁷²

For the sake of argument, let us assume that this classified or commercial proprietary research has solved the problem of combining high potency with a high safety-margin. Furthermore imagine this work has overcome the very significant obstacle of developing a biochemical agent that can be delivered in a safe and reversible but incapacitating dose to all individuals in a given area, notwithstanding the differences in age, size and health of those individuals and the problems of uneven concentrations and cumulative intake of the agent.¹⁷³ Some would argue that such an agent would be an acceptable addition to military arsenals or riot control stockpiles as a non-lethal weapon. However, the issue of lethality is a distraction. Agents designed to incapacitate rather than kill have been a common feature of several past offensive chemical and biological weapons programmes and there is no reason why new weapons agents should be placed in a privileged ‘non-lethal/less-lethal’ category that aims to exempt them from restrictions under the CWC and BTWC.

The glycolate agent BZ, a psychoactive compound that interferes with acetylcholine transmission in the central nervous system (CNS), was weaponized by the US in the 1960’s

as part of their chemical weapons programme.¹⁷⁴ There are also reports that the Former Soviet Union developed a derivative of BZ as an incapacitating weapon¹⁷⁵ and Iraq's chemical weapons programme is thought to have incorporated a glycolate compound known as Agent 15.¹⁷⁶ Biological agents have also been considered for use as incapacitating rather than lethal weapons. In describing Soviet doctrine for use of biological weapons Ken Alibek pointed out that:

Operational biological weapons were intended for use against deep military targets about 100 to 150 kilometers behind the front lines, such as rear services and reinforcements. These agents, such as tularemia, brucellosis, glanders, and Venezuelan equine encephalomyelitis (VEE), would not generally kill soldiers, but would incapacitate them and thereby make it easier to destroy an enemy's defenses.¹⁷⁷

The intent behind the use of these agents was not necessarily to kill but to incapacitate. That this incapacitation might be followed up with lethal (conventional) force, however, is a possibility for any such agent.¹⁷⁸ BZ is listed as a Schedule 2 toxic chemical under the CWC, tularaemia is considered a Category A biological agent by the US Centers for Disease Control (CDC), and brucellosis, glanders, and VEE are Category B agents.¹⁷⁹ There are no calls to introduce any of these as non-lethal or less-lethal weapons. If new biochemical agents are developed under the guise of non-lethal incapacitation it is likely that they will soon appear on similar threat lists. There have already been warnings of this 'double-edged sword'.¹⁸⁰

Science and Technology

There is concern over the potential use of bioregulators as weapons in warfare or by terrorists. A paper in late 2001 stated that these organic compounds "...are capable of regulating a wide range of physiologic activities..." and if used as weapons "... could potentially cause profound systemic effects on multiple organ systems."¹⁸¹ Bioregulators of concern discussed in the paper included cytokines, eicosanoids, neurotransmitters, hormones, and plasma proteases. Neurotransmitters mediate chemical transmission in the nervous system through their interactions with specific receptors. In the central nervous system (CNS) these neurotransmitter-receptor interactions have a major role in regulating consciousness, mood, anxiety, perception, and cognition. *Table 5* below gives some of the potential effects of neurotransmitters employed as weapons:

Table 5:
*Bioregulators and their clinical effects*¹⁸²

Bioregulator Category	Agent	Clinical Effects
Neurotransmitters	Catecholamines	Consciousness, mood alterations, anxiety, hypertension, tachycardia, and sexual dysfunction.
	Amino acids	Effects on learning, memory, cognition, and pain sensitivity.
	Neuropeptides	Effects on cognition and sensory processing.

Neurotransmitters are of particular interest for this discussion because their sites of action, i.e. neuronal receptors, are the same as proposed ‘non-lethal’ incapacitating agents (or calmatives as they are sometimes known). Neurotransmitters are the naturally occurring ligands but these receptors can also be bound by synthetic chemical analogues (i.e. drugs). A report from The Applied Research Laboratory at Pennsylvania State University, who work closely with the US military’s Joint Non-Lethal Weapons Directorate (JNLWD), entitled *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*, states that potential ‘calmatives’ are “...compounds known to depress or inhibit the function of the central nervous system.”¹⁸³ Arguing that potential calmatives might include “...sedative-hypnotic agents, anesthetic agents, skeletal muscle relaxants, opioid analgesics, anxiolytics, antipsychotics, antidepressants and selected drugs of abuse”, the authors identified a number of drug classes acting on specific CNS receptors as candidate agents (see Table 6 below):

Table 6:
Potential ‘calmatives’,¹⁸⁴

Drug Class	Site of Action
Benzodiazepines	GABA receptors
Alpha ₂ Adrenergic Receptor Agonists	Alpha ₂ -adrenergic receptors
Dopamine D3 Receptor Agonists	D3 receptors
Selective Serotonin Reuptake	5-HT transporter
Serotonin 5-HT _{1A} Receptor Agonists	5-HT _{1A} receptor
Opioid Receptors and Mu Agonists	Mu opioid receptors
Neurolept Anesthetics	GABA receptors
Corticotrophin-Releasing Factor	CRF receptor
Cholecystinin B receptor antagonists	CCKB receptor

Alpha₂-adrenergic receptors, for example, are known to play an important role in sedation and work by the US military during the 1990’s to develop α₂ adrenergic agonists as weapons for the non-lethal weapons program has been documented.¹⁸⁵ μ opioid receptors are bound by opioid analgesics, such as fentanyl and derivatives, the effects of which were seen in Moscow. The CCK-B receptor is linked to anxiety and whereas the authors suggest CCK-B antagonists as potential calmatives, agonists have been shown to induce panic attacks.

The ‘classical’ neurotransmitter serotonin (5-HT) is widely distributed in the nervous system seems to have a role in various aspects of human behaviour including sleep, mood, anxiety and aggression. Studies in humans and animals have shown that increased serotonergic function is associated with decreased aggressive behaviour and vice-versa.¹⁸⁶ Studies with monkeys have lead to other conclusions: “It is clear that serotonin does not simply inhibit aggression; rather, it exerts a controlling influence on risky behavior, which includes aggression.”¹⁸⁷ A potential ‘calmative technique’ the Penn State authors suggest is the use of a selective 5-HT_{1A} receptor antagonist, to “...reduce symptoms of anxiety in an individual or individuals and promote a calmer and more compliant behavioral state.”¹⁸⁸

One of the overall recommendations made in the Penn State report was the formation of partnerships between weapons developers and the pharmaceutical and biotechnology industries in order to identify new incapacitants. The implications of such partnerships are considerable in terms of the emergence of new agents acting on these or other receptors in the central nervous system. The reasons for this are two-fold. Firstly, there is already a significant research focus in the pharmaceutical industry to develop more effective drugs to treat a variety of mental illnesses, and many of the receptor targets, as we have seen, are the same as those of interest to incapacitant developers. Secondly there have been considerable advances in recent years of mechanisms for discovery and screening of new compounds. In addition, as noted in a paper from 2002, “It is apparent that the past decade has brought an enormous increase in knowledge about the pharmacology and structural biology of receptors.”

Wheeler has discussed the main technologies leading a ‘revolution in the drug discovery process’: combinatorial chemistry, genomics, microarrays, proteomics, toxicogenomics, and database mining.¹⁸⁹

In his 2002 paper he summarised the implications thus:

Currently, new compounds are generated in large numbers by combinatorial methods and assayed for potential activity by ultra-high-throughput screening techniques. In the future, genomic and proteomic methods ... will encourage increasing use of computer modeling techniques to identify new drugs. These same scientific developments will also rapidly deepen our understanding of physiological processes in both healthy and diseased states. This understanding will provide the necessary knowledge base for identifying new drug targets and for predicting the consequences of interfering with their normal functioning.¹⁹⁰

A UK Background Paper on Scientific and Technological Developments relevant to the BTWC from the 2001 Review Conference had reached a similar conclusion:

In the future, bioinformatics linked with high throughput methods for proteome and genome analysis, such as microarrays, will increasingly allow the rapid targeting of biological macromolecules for any purpose, peaceful or otherwise.¹⁹¹

Earlier this year (2004) a new piece of software was announced to further speed up drug discovery. Reportedly it “...can screen 10 million molecules per day for their potential drug interaction with a model of the biological target molecule.”¹⁹²

Even without future advances, the ability to misuse these technologies for harmful purposes is already present. Dando’s test for neurotransmitter-receptor systems is to ask the following question:

In regard to neurotransmitters where there is some good reason to suspect that there could be interest in abuse, have chemicals with specific actions on specific receptor sub-types been developed?¹⁹³

As he shows in his paper and as we have seen earlier in this analysis, the answer is yes.¹⁹⁴

Current Military and Police Interest

The US military’s research in this area is co-ordinated by Joint Non-Lethal Weapons Directorate (JNLWD). It is currently unclear the level at which research and development is

ongoing. However, a major recommendation of the 2003 report on non-lethal weapons (NLWs) science and technology, produced by the Naval Studies Board of the US National Academy of Sciences (NAS), was for increased research on incapacitating chemicals, or ‘calmatives’, and their delivery systems.¹⁹⁵ The report indicated that ‘calmatives’ are now being studied at the US Army Edgewood Chemical Biological Center (ECBC) after a “...lull in R&D for 10 years”.¹⁹⁶

The Sunshine Project has obtained a number of documents on the US programme through Freedom of Information (FOI) requests.¹⁹⁷ Recently they obtained several research proposals by the US Army Edgewood Research, Development and Engineering Center (ERDEC) (now Edgewood Chemical Biological Center (ECBC)) dated 1994 to develop ‘calmatives’ and ‘immobilizing’ agents.¹⁹⁸ Their fate is unclear but, as the Sunshine Project notice points out, a company named OptiMetrics, Inc., which subsequently employed the author of those proposals, won a contract with the Department of Defense in early 2000 to carry out the first phase of a study to assess incapacitants for use in military and law-enforcement applications.¹⁹⁹ This phase, which is now complete,²⁰⁰ is described in the contract solicitation as follows:

Phase I studies will consist of a Front End Analysis comprising the following elements: review existing data on the candidate agents; define scenarios of use and operational parameters; conduct range finding toxicological animal tests, and correlate results with those from previous studies.²⁰¹

Meanwhile, objectives listed in the JNLWD’s Technology Investment Project for ‘Front End Analysis of Non-Lethal Chemicals’ for the fiscal year 2001/02 included:

- Identify advances in the pharmaceutical industry and elsewhere for potential non-lethal applications
- Conduct military user workshops to identify range of desired operational effects
- Create a searchable database of potential candidates
- Provide a list of promising candidates to Judge Advocate General’s office for preliminary legal review²⁰²

There is no reason why the US should be the only state interested in such weapons development. As events in Moscow illustrated, Russia clearly has a programme in this area and so may other countries. A Russian paper given to the 2nd *European Symposium on Non-Lethal Weapons* in 2003 addressed future perspectives for the use of NLWs in Europe, including ‘calmatives’:

Some experience of gas application in dramatic conditions of terrorists [sic] attack was gained in Moscow in 2002, when 800 hostages were seized in a big concert hall. The main problem now is how to assess an impact of chemicals on a big crowd of civilians and terrorists between them in a concrete scenario and real conditions of application.²⁰³

The paper then speculates about the future:

There has been significant success in the chemistry of calmatives, although the restriction of individual dosage is very important. There is still no perfect tranquillizing agent, but the problem of safety can be solved by the succeeding or simultaneous application of calmative and antidote. This can minimize potential fatality.²⁰⁴ (*Note: see ‘Interviews’ section of this report.*)

The UK currently appears to be less interested in incapacitant development if we are to judge by the latest report of the Northern Ireland Office (NIO) Steering Group investigating

alternatives to the baton round for policing. Work on calmatives by the Police Scientific Development Branch (PSDB) has been downgraded from Category B to Category C. The latter category is defined as including "...technologies that were not considered of immediate interest or importance."²⁰⁵

For now their conclusion states "... that use of calmatives in policing situations would not be a straightforward process."²⁰⁶ It continues:

The decision to use any drug whether intended to induce a state of calm or complete unconsciousness requires knowledge of a subject's medical history, particularly the use of any prescribed or non-prescribed medication and any relevant medical conditions. There would also be considerable responsibility in terms of immediate and post-incident aftercare.²⁰⁷

The caveat given is that:

PSDB will continue to monitor this area, focussing on international research programmes and future developments in delivery methods and potential tranquilising agents.²⁰⁸

As for the UK military, the Ministry of Defence and the US Department of Defense have collaborated on non-lethal weapons, including related wargaming,²⁰⁹ through a 5-year Memorandum of Understanding signed in February 1998.²¹⁰ With regard to 'calmatives', a 2000 report of this collaboration illustrates the well-known differences in the UK and US interpretations of the Chemical Weapons Convention (CWC).²¹¹ The UK would consider any use of 'calmatives' or riot control agents (RCAs) in warfare as a violation of the CWC. The same document also sheds light on the US strategy for avoiding scrutiny of military research on these types of agents:

If there are promising technologies that DOD [Department of Defense] is prohibited from pursuing, set up MOA [Memorandum of Understanding] with DOJ [Department of Justice] or DOE [Department of Energy].²¹²

This year there have been mixed messages emerging from within the US as regards the future of these types of biochemical weapons. The Council on Foreign Relations 'Independent Task Force' on non-lethal weapons published a report in February 2004 recommending the following course of action for the US (at least in relation to military use of such weapons²¹³):

Take measures within the organizations of the CWC and the BWC, in the UN Security Council, and in the North Atlantic Treaty Organization (NATO) and other military organizations to put teeth into the promised response to any use in warfare of CW or BW agents, lethal or nonlethal, in order that U.S. forbearance in such use would indeed result in a world in which legitimate governments did not develop, possess, or use lethal or nonlethal BW or CW in the theaters of conflict.²¹⁴

The Pentagon's Defense Science Board (DSB) appears to take a different view, however. Their task force report on 'Future Strategic Strike Forces', also published in February 2004, concludes that the US military should consider "Non-lethal effects directed at the physiological or psychological functions of specific individuals or the populace", adding, "Applications of biological, chemical, or electromagnetic radiation effects on humans should be pursued."²¹⁵ In the section on 'strategic payload concepts' the authors set out their views on the future of incapacitating agents:

- Calmatives might be considered to deal with otherwise difficult situations in which neutralizing individuals could enable ultimate mission success

- The principle technical issue is the balance between effectiveness (i.e., the targets are truly “calmed”) and margins of safety (i.e., avoiding overexposure and resulting fatalities of neutral bystanders)
- The treaty implications are significant²¹⁶

Conclusion

In 2003 three analysts from the US Defense Intelligence Agency (DIA) authored a paper entitled *Biotechnology: Impact on Biological Warfare and Biodefense*.²¹⁷ They warn of future advanced biological warfare (ABW) agents “...rationally engineered to target specific human biological systems at the molecular level.” They conceive that weapons designers of the future will be able engineer agents that produce a range of effects “...including death, incapacitation, neurological impairment.” Bioregulator-type agents are perhaps one such ABW. A paper in 2002, *An Evaluation of Bioregulators as Terrorism and Warfare Agents*, argued, “They are a potential new class of weapons that can damage the nervous system, alter moods, trigger psychological changes and even kill.”²¹⁸ The DIA authored paper also suggests that because ABWs could be designed to have a wide range of effects they “...will expand options for employment significantly and ultimately may decrease the current threshold for the use of biological warfare.”²¹⁹

It is worth remembering that the Soviet biological weapons effort, ostensibly halted as early as 1992, included programs to develop bioregulators as weapons to replace classical chemical weapons.²²⁰ Indeed, the authors of the 2002 review of bioregulators argue that “Some of these compounds may be potent enough to be many hundreds of times more effective than traditional chemical warfare agents.”²²¹

Research into biochemical weapons under the auspices of non-lethal weapons development threatens to accelerate these proposed futures by legitimising work in this area that has so far been seen as prohibited by the BTWC and the CWC. The Council of Foreign Relations report on non-lethal weapons fortunately recognised this very significant danger:

Nonmilitary research in biology and medicine will lead to understanding that can greatly facilitate the development, production, and use of lethal and largely nonlethal chemical and biological agents. But NLW-focused research will hasten the day that such materials are available not only to the United States but also to those who would use them against us.²²²

As a possible way to avert these consequences Mark Wheelis has suggested a new international convention prohibiting the non-consensual manipulation of human physiology for other than legitimate medical purposes.²²³

5. INTERNATIONAL LAW AND HUMAN EFFECTS

DISCUSSION PAPER

What's in a name? At a recent meeting organised by the Geneva Forum ²²⁴ Nick Lewer and Neil Davison summarised the key technologies and issues covered in BNLWRP Report No.4. Also contributing to the panel was Robin Coupland (International Committee of the Red Cross (ICRC) Legal Division) who gave a thought provoking presentation outlining concerns raised by the development and deployment of NLWs from the perspective of humanitarian law. Part of the subsequent discussion related to the very terms 'lethal' and 'non-lethal'. The paper below gives a useful summary of ICRC's analysis of the problems associated with defining this (non-lethal) class of weapon. It was originally presented to the 19th Workshop of the Pugwash Study Group on the Implementation of the Chemical and Biological Weapons Conventions, Oegstgeest, Netherlands 26-27 April 2003.

"Calmatives" and "Incapacitants": Questions for international humanitarian law brought by new means and methods of warfare with new effects? ²²⁵

**Robin M. Coupland FRCS,
Medical Adviser, Legal Division, International Committee of the Red Cross**

This paper attempts to answer two questions:

1. What can an ICRC field surgeon bring to a legal debate on new means and methods of warfare with new effects?
2. The future seems to promise weapons which carry a minimal chance of killing the victim: wouldn't it be best to promote their use?

In answering these two questions, further questions arise for specialists who might be looking at the future intersection of the international law of arms control and disarmament and international humanitarian law.

1. What can an ICRC field surgeon bring to a legal debate about new weapons and methods of warfare with new effects?

The physical effects of weapons with which a field surgeon is most familiar are those resulting from force applied to the human body by explosions or projectiles, i.e., blast, bullets or fragments. Can we take these effects as a kind of reference point for consideration of new weapons and methods of warfare which might exert their effects in a different manner? We might be able to predict the effects on the proportion of the wounded who are civilians when a new munition which employs a particularly large or widespread explosion is used in a populated area. We might also be able to predict the effects on an individual combatant of a bullet which carries an explosive charge or a new rifle which fires more bullets at higher velocity. Likewise, the effect on whole populations of the widespread availability of small arms are comprehensible. But what about an eye-attack laser, or a foam which sticks the

people to the ground and to each other or, as is apparently being researched, the means to alter brain function with electromagnetic waves.

The precise effects of such weapons - when used for real - in terms of mortality and residual disability or civilian deaths and injuries are not known with any certainty. But in contrast to weapons which injure by missile or explosive force, few medical people would recognise, let alone be able to treat such unusual effects. A few months ago, the above list of examples would have included calmatative agents or aerosolized anaesthetic agents but now we have quite a good picture of what happens when such weapons are used following the events in the Moscow theatre siege last October.

There are important implications of the distinction between weapons which injure by explosive and projectile force and weapons which injure by other means. In relation to the legal notions of superfluous injury or unnecessary suffering, indiscriminate effect and public abhorrence, Article 36 of 1977 Protocol I Additional to the 1949 Geneva Conventions reads: *“In the study, development, acquisition or adoption of a new weapon, means or methods of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.”* Surely, among the questions which should be asked when making this determination are: What is the mechanism of injury? Will the effects be recognisable? Will the effects be treatable? Will the effects be permanent? Does the weapon lend itself to cause indiscriminate effect? Is there something fundamentally abhorrent about the weapon and its effects? What are the effects of combining it with other weapon systems?

The reality is that the effects on people of a new weapon or method of warfare may be neither understood nor recognised by medical people. If they are not understood by medical people, are they likely to be understood by soldiers or, for that matter, designing engineers and diplomats or even, dare one say, lawyers? If these effects are not well understood, how are judgments about legality to be made in light of the prohibition on "superfluous injury or unnecessary suffering"? Is it not apparent that when the weapon or method of warfare in question does *not* injure by explosive force or projectiles, particularly careful multidisciplinary review is necessary to ensure its conformity with international law? In brief, when conducting a legal review of a new weapon or method of warfare, has the reviewer asked him or herself: Have I really thought through all the implications of its deployment?

2. The future seems to promise weapons which carry a minimal chance of killing the victim: wouldn't it be best to promote their use?

There is increasing interest in "non-lethal" weapons. The use of such weapons is foreseen for the full spectrum of both police and military activities: that is, from riot control to hostage release to international armed conflict. My comments today address mainly, but not exclusively, the use of "non-lethal" weapons in armed conflict.

The ICRC has a policy of referring to "non-lethal" weapons in quotation marks and as "so-called non-lethal weapons" in speech. The reason for this is that this class of weapon has not been adequately defined. No weapon when used and as a function of its design carries a zero risk of mortality among its victims. The same could be said for "lethal" weapons; no weapon, when used in battle and as a function of its design carries a 100% mortality. Lethality is a function of not only the design of a weapon but also how that weapon is used and the

vulnerability of the victims. For reference, of people injured in battle by a Kalashnikov about 20% eventually die. The mortality associated with being injured by a hand grenade in an open area is about 10%. So when people talk about "non-lethal" weapons, it is not clear what is being referred to because it is not clear what a lethal weapon is. Any weapon has the capacity to kill; much depends on the context in which it is used. It is pertinent that 14 people died in the Sarin gas attack on the Tokyo subway whilst 45 survivors were proven to have been intoxicated. These figures provide comparable mortality figures to the use of a fentanyl-like agent in vapour form in Moscow last October.

The distinction between weapons which injure by explosive force and those which injure by other means is important. The weapons in the "non-lethal" category cause their effects on both sides of this distinction. For example, a rubber bullet causes its effects on humans by projectile force; by contrast, an eye-attack laser causes its effect by electromagnetic energy and a calmativ agent is simply a chemical agent. With respect to this last example, it is important to note that as a principle of pharmacology, the only difference between a drug and a poison is the dose; this means the effects of a calmativ or incapacitant chemical agent will also depend on its means of delivery together with the environment in which it is delivered. Furthermore, to deliver an "effective" dose from a military perspective involves, inevitably, some people receiving a dangerous if not lethal dose.

It would be unwise to deny that "non-lethal" weapons may offer advantages for both military and police actions and could, theoretically, lead to a reduction of deaths under certain circumstances. Nevertheless, the legality of their use must still be reviewed. Whatever the weapon, whatever its purported effect and whether or not it is labeled "non-lethal," the ICRC is of the opinion that a "non-lethal" weapon, from the perspective of international humanitarian law, should be considered as any other weapon. There is nothing in international law that says "non-lethal" weapons fall in their own distinct category which excuses them from legal scrutiny. In fact two have already been prohibited in warfare; namely, blinding laser weapons and riot control agents. There has even been talk of "non-lethal" biological weapons the development and production of which would be a clear violation of the Biological Weapons Convention. The Moscow theatre event revealed a provision in the 1993 Chemical Weapons Convention which requires urgent review. The gas in question, if used in armed conflict, would have been a violation of this treaty; article 2.9d permitted its use for "law enforcement including domestic riot control." Publicly, governments have expressed little if any concern about this. The spectre of toxicity being re-employed on the battlefield advances by one very significant and dangerous step.

When the ICRC has recommended legal review of each individual "non-lethal" weapon according to a States obligation under article 36 there is sometimes a regrettable and hasty assumption that we recommend a ban on all so-called "non-lethal" weapons. Questioning the classification or legality of certain such weapons has often led to a response "Well, I suppose you'd prefer we kill people!" or even on one occasion "So, the Red Cross thinks its better to kill people than to blind them." To bring this debate to a more rational level, it is useful to consider what would happen if the perfect non-lethal weapon really existed. That is, a beam or energy form is deployed without risk of any permanent effect which can incapacitate its victim by simply eliminating all movement of the body for, say, 30 minutes from the instant of attack. Even this throws up some critical questions for international lawyers. Imagine a soldier entering an area in which enemy combatants have been incapacitated; they are standing or lying still with their weapons at hand with their eyes fixed on the sky. There is limited visibility. How will the attacking soldier, when rushing into attack, know his enemy

has been incapacitated? The most likely scenario is that the soldier will shoot because he or she is trained to do so reflexly in battle. In other words, being incapacitated could simply serve to increase the vulnerability to attack by conventional weapons. "Non-lethal" weapons could cause increased mortality because of increased vulnerability. This is not such an unrealistic projection. It is a possibility that as a result of non-lethal weapons being used on the battlefield, the battlefield could become more lethal. Article 36 refers weapons means *and methods* and so one presumes that combinations of weapons would also have to be assessed in the legal review. As mentioned above, a question for a lawyer undertaking a legal review even of a "non-lethal" weapon is this: Even if the weapon in question is not prohibited and is labeled "non-lethal" have I really thought through all the implications of its deployment?

But isn't vulnerability and, importantly, soldiers recognising the opponents vulnerability at the very core of international humanitarian law? Is, in projected case described above, the incapacitated soldier wounded and *hors de combat*? There would be no obvious sign of injury; he or she would not be bleeding from a gaping wound. Does the incapacitated soldier intend to surrender? He or she will be unable to show signs of such an intention to anyone approaching. Therefore, the deployment of "non-lethal" weapons on the battlefield is a question which requires serious consideration in terms of international humanitarian law; not so much because there needs to be law regulating their use but more because there may be confusion about which law offers protection to this new category of vulnerable person. Another major concern in relation to "non-lethal" weapons is that their proponents propose they be used by soldiers against civilians when necessary. Does this not risk undermining a fundamental customary international law: that civilians shall be spared attack?

There are, inevitably, many other linked issues that should be considered prior to deployment of "non-lethal" weapons. Examples are: their proliferation; an "arms race of countermeasures;" the possibility of a lower threshold of use; and the perceptions of those attacked and their most likely response.

In his "Art of War," written 2000 years ago, Sun Tsu said "Those who are not thoroughly aware of the disadvantages in the use of arms cannot be thoroughly aware of the advantages in the use of arms." This paper argues that when lawyers are considering weapons and methods of warfare, that realistic and multidisciplinary consideration is given to the effects or purported effects on the victims. Furthermore, the ICRC would argue that the effects should be the starting point of legal deliberations because it is, ultimately, the prevention and limitation of certain effects of weapons and methods of warfare that are at the core of the 1949 Geneva Conventions and their 1977 Additional Protocols.



6. INTERVIEWS

This new section of the report features occasional interviews with experts in various aspects of non-lethal weapons. For the first interview, on 4 February 2004, we talked to **Professor Theodore Stanley**, Director of the Anesthesiology Research Laboratories at the University of Utah, U.S. In our second interview, on 23 April 2004, we talked to **Mr. Parker Ferguson**, Senior Scientist at OptiMetrics, Inc. We asked for their views on the use of an incapacitating chemical agent during the Moscow theatre siege in late 2002 and their thoughts on the future of such agents.

There follows a summary of the main points made by Professor Stanley during our discussion:

Moscow Siege, October 2002

The tactic employed by the Russian government could have been more effective (i.e. less deaths) had the medical support been better informed and employed more quickly.

The events in Moscow have opened up the potential for this area of research (i.e. incapacitating/immobilizing chemicals) to be explored in much greater depth. It would not be surprising if a number of countries were conducting more detailed and renewed research as a result.

The Future

The majority of the research in this area is not available publicly due to governmental classification and company proprietary issues. Much research is likely to remain secret since it may have both offensive and defensive applications and therefore the potential for misuse.

Recent and current research in this area is focussing on improving delivery mechanisms for these compounds and developing more potent, faster acting, safer compounds.

As regards delivery mechanisms: mucosal delivery by means of ‘wet’ material or cloth might be an alternative to aerosol delivery.

As regards agents: compounds that act of different receptor systems (than that of carfentanyl – likely used in the Russian incident) may prove to be effective incapacitating/immobilizing agents.

There follows a summary of the main points made by Mr. Ferguson during our discussion:

Work on incapacitants has never been very popular with either the military or politicians. For the military it is hard to judge their effectiveness and therefore it is difficult to integrate such weapons into wargames. For politicians there are a number of considerations including, of course, the Chemical Weapons Convention (CWC).

Non-lethal

‘Non-lethal’ chemicals could be divided into three categories:

1. Irritants – RCAs
2. ‘Calmatives’ – affecting mental processes. e.g. valium
3. Incapacitating agents – physical incapacitation/immobilization. e.g. fentanyl derivatives.

Moscow Siege, October 2002

The agent used in Moscow would have been extremely potent due to the size of the auditorium. (If an agent required a high concentration it would be difficult to fill the space rapidly enough.) In Moscow it could have been one of three classes of compound, which would have been the only ones with sufficient potency.

1. Fentanyl derivatives – e.g. carfentanil or sufentanil
2. Oripavines – e.g. the wildlife tranquilizer etorphine (M99), trade name immobilon.
3. Benzimidazoles – e.g. etonitazene (these compounds are similar to the core structure of morphine)

The top choice would be a fentanyl derivative because of the proven extreme potency and demonstrated effectiveness as an aerosol.

The Future

One of the main technical difficulties with designing incapacitants is finding an agent that is highly potent but also has a sufficiently high safety margin. In the future weapons developers may look to the following:

Mixed payload – addition of a compound to reduce the side effects of the main incapacitating agent. (e.g. fentanyl derivative/naloxone mixture – naloxone is an antidote for opioid overdose). Clinicians commonly use mixtures of compounds to both increase the effectiveness of an anaesthetic and reduce its side effects.

Pharmaceutical Industry – countries that are interested in developing incapacitants may follow publications in the pharmaceutical industry to look out for new developments.

Currently there is no one class of compounds that ‘fits the bill’. They all have their shortfalls. e.g. Ketamine is relatively safe and has a quick ‘knockdown’ time but it is less potent than the ideal agent and a side effect is hallucinations. New compounds are likely to present similar problems. If a compound is extremely potent it will tend to have a poor safety ratio. If a compound has a good safety ratio it will tend to have a long onset time or not be sufficiently potent.

Any development programme would have to be a consistently well-funded and well-supported effort since development times are lengthy. The state involved would have to be less worried about the treaty implications under the CWC. In the US, for example, there are very divergent opinions about the interpretation of the CWC’s prohibitions. Public opinion would also be a factor.

Further reading:

See the 'Weapons Focus: *Biochemical Weapons*' section of this BNLWRP report.

Stanley (2003) Human immobilization: is the experience in Moscow just the beginning? *European Journal of Anaesthesiology*. 20, pp. 427-8.

Horizon: The Moscow Theatre Siege. BBC Two (UK Television), Thursday 15 January 2004, 9pm. Transcript available here:
<http://www.bbc.co.uk/science/horizon/2004/moscowtheatretrans.shtml>

7. BIBLIOGRAPHY UPDATE

Abrams, M. (2003) The Dawn of the E-Bomb. *IEEE Spectrum Online*.

Available here:

<http://www.spectrum.ieee.org/WEBONLY/publicfeature/nov03/1103ebom.html>

Allison, G, Kelley, P & Garwin, R. (2004). *Nonlethal Weapons and Capabilities*. Report of an Independent Task Force Sponsored by the Council on Foreign Relations, New York.

Available here: http://www.cfr.org/pdf/Nonlethal_TF.pdf

Daoust, I & Coupland, R & Ishoey, R. (2002). 'New Wars, New Weapons?. The Obligation of States to Assess the Legality of means and methods of Warfare'. *International review of the Red Cross*, Vol.84, N°846, pp.345-363.

Hughes, Ed (Editor) (2004) *Report of the Third International Law Enforcement Forum on Minimal Force Options and Less-Lethal Technologies*. International Law Enforcement Forum.

Available here: http://www.nldt.org/documents/2004_ilef_report.pdf

Isenberg, D. (2003). *U.S. Chemical 'Non-Lethal' Weapons in Iraq: A Violation of the Chemical Weapons Convention?* Basic Occasional paper on International Security Policy No.4, Basic, March.

Available here: <http://www.basicint.org/pubs/Papers/BP44.htm>

Jarman, N. (2004). *Nothing Happened? A Review of Public Order During The Summer of 2003*. A Report for the Northern Ireland Policing Board.

Jussila, J & Normia, P. (2004). 'International Law and Law Enforcement Firearms'. *Medicine, Conflict and Survival*, Vol.20, No.1. pp.55-69.

Northern Ireland Office (2004) *Patten Report Recommendations 69 and 70 Relating To Public Order Equipment. A Research Programme Into Alternative Policing Approaches Towards The Management of Conflict*. Northern Ireland Office, U.K., January 2004.

Available here: <http://www.nio.gov.uk/pdf/batonrep2004.pdf>

Proceedings of the *Open Forum on the Chemical Weapons Convention: Challenges to the Chemical Weapons Ban*, 1 May 2003, The Peace Palace, The Hague, The Netherlands. Harvard Sussex Program on CBW Armament and Arms Limitation (HSP).

Available here: <http://www.sussex.ac.uk/spru/hsp/OpenForumCWC.pdf>

Rappert, B (2004). 'A Framework for the Assessment of Non-Lethal Weapons'. *Medicine, Conflict and Survival*, Vol.20, No.1. pp.35-54.

Available here: <http://www.ex.ac.uk/~br201/Research/Publications/201mcs04.pdf>

Rappert, B. (2004) 'Moralizing Violence: Debating the Acceptability of Electrical Weapons' *Science as Culture* 13(1): 3-35.

Available here:

http://www.ex.ac.uk/~br201/Research/Publications/CSAC_13_1_01LORES.pdf

Rappert, B. (2003). 'Health and Safety in Policing'. *Social Science and Medicine*, Vol.56, No.6, pp.1269-1278.

Available here: <http://www.serve.com/pfc/policing/rappert.htm>

Wright, S. (2004) The politics of pain. *Science & Public Affairs*, March 2004. London: The British Association.

8. CONFERENCES

Conference Report

International Law Enforcement Conference (ILEC)

5 February 2004

Royal Society of Arts, London, U.K.

The Northern Ireland Office hosted a 1-day conference at the Royal Society of Arts in London on 5 February 2004 to which representatives from various NGO's were invited. It was organised to coincide with the release of the Northern Ireland Office (NIO) Steering Group Phase 4 report.²²⁶ The theme of the conference was Article 2 of the UN Basic Principles on the Use of Force and Firearms:

Governments and law enforcement agencies should develop a range of means as broad as possible and equip law enforcement officials with various types of weapons and ammunition that would allow for a differentiated use of force and firearms.²²⁷

It is also worth noting Article 3, which states:

The development and deployment of non-lethal incapacitating weapons should be carefully evaluated in order to minimize the risk of endangering uninvolved persons, and the use of such weapons should be carefully controlled",

And Article 4, which states:

Law enforcement officials, in carrying out their duty, shall, as far as possible, apply non-violent means before resorting to the use of force and firearms. They may use force and firearms only if other means remain ineffective or without any promise of achieving the intended result.²²⁸

The morning session was given over to presentations including contributions from ACPO and the Northern Ireland Policing Board amongst others. During the afternoon there were three brief syndicate sessions on general topics related to the police use of force: 'The police approach to violent individuals endangering themselves or others'; 'The police approach to serious crowd disorder involving individuals engaged in potentially life-threatening action'; and 'Issues associated with the use of force and international Human Rights principles'.

This conference followed a private 2-day meeting of the *2004 International Law Enforcement Forum (ILEF) on Minimal Force Options and Less Lethal Technologies*, discussed earlier in this report. A report of the ILEF meeting has been published by the Institute of Non-Lethal Defense Technologies (INLDT) at Pennsylvania State University and is available to download from their website:

http://www.nldt.org/documents/2004_ilef_report.pdf

http://www.nldt.org/documents/2004_ilef_presentations.pdf

Recent Conference Proceedings and Presentations

The Non-lethal Technology and Academic Research Symposium V (NTAR V)

5-6 November 2003

<http://www.ntar.sr.unh.edu/PublicSchedule.shtml>

(Some presentations available online)

2003 Joint Non-Lethal Weapons Program Industry Day

4 November 2003

<http://www.dtic.mil/ndia/2003Joint/>

(Presentations available online)

2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition

9-11 September 2003

http://www.ndia.org/Content/NavigationMenu/Meetings_and_Events/Past_Events/2003_Mines_and_Demolitions_3500.htm

(Presentations available online)

Forthcoming Conferences

Non-Lethal Defense VI

Planning for November 2004

For more information contact the National Defense Industrial Association (NDIA):

<http://www.ndia.org/>

3rd European Symposium on Non-Lethal Weapons

May 2005

<http://www.non-lethal-weapons.com/sy03index.html>

(Call for papers will be posted online in May 2004.)

References

- ¹ Northern Ireland Office (2004) *Patten Report Recommendations 69 and 70 Relating To Public Order Equipment. A Research Programme Into Alternative Policing Approaches Towards The Management of Conflict. Phase Four Report*. Northern Ireland Office: U.K. This is the fourth report prepared by the steering group led by the Northern Ireland Office, in consultation with the Association of Chief Police Officers. Phase 1, 2, 3 and 4 reports available from: <http://www.nio.gov.uk/issues/policing.htm>
- ² Allison, G, Kelley, P & Garwin, R. (2004). *Nonlethal Weapons and Capabilities*. Report of an Independent Task Force Sponsored by the Council on Foreign Relations, New York. The Council for Foreign Relations describes itself as an independent, national membership organisation, non-partisan centre. Report available from: http://www.cfr.org/pdf/Nonlethal_TF.pdf
- ³ Northern Ireland Office (2004) *op. cit.*, p. 5.
- ⁴ Northern Ireland Office (2004) *op. cit.*
- ⁵ Rappert, B (2004) *Response to Patten Report Recommendations 69 and 70 Relating to Public Order Equipment Report – Fourth Report*. Available from: <http://www.ex.ac.uk/~br201/Research/Publications/Phase%20IV%20comments.htm>
- ⁶ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit*
- ⁷ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p.2.
- ⁸ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ⁹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 6.
- ¹⁰ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p..34.
- ¹¹ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*. Available from: http://navweb.secnav.navy.mil/pubbud/05pres/db_u.htm (Document is a 'line item', BA4 75, under Research, Development, Test, and Evaluation, Navy (RDT&E,N))
- ¹² Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ¹³ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p.8.
- ¹⁴ Fattah, H (2004) How US can escape its quagmire in Iraq. *The Scotsman*, 1 May 2004. Available from: <http://thescotsmen.scotsman.com/international.cfm?id=493982004>
- ¹⁵ The Guardian (2004) 'I asked for help and warned of this but nobody would listen'. *The Guardian*, 1 May 2004. Available from: <http://www.guardian.co.uk/Iraq/Story/0,2763,1207452,00.html>
- ¹⁶ Hughes, Ed (Editor) (2004) *Report of the Third International Law Enforcement Forum on Minimal Force Options and Less-Lethal Technologies*. International Law Enforcement Forum. Available from: http://www.nldt.org/documents/2004_ilef_report.pdf
- ¹⁷ Home Office (2003) *Code of Practice on Police Use of Firearms and Less-Lethal Weapons*. Home Office: UK. Available from: <http://www.homeoffice.gov.uk/crime/guncrime/publications/>
- ¹⁸ Home Office (2004) *New, broader role for PSDB*. Home Office: UK. Available from: <http://www.homeoffice.gov.uk/crimpol/police/scidev/news/items/newrole.html>
- ¹⁹ Hughes, Ed (Editor) (2004) *op. cit.* p. 53.
- ²⁰ Hughes, Ed (Editor) (2004) *op. cit.*
- ²¹ Hughes, Ed (Editor) (2004) *op. cit.* p. 34.
- ²² Hughes, Ed (Editor) (2004) *op. cit.* p. 37.
- ²³ Hughes, Ed (Editor) (2004) *op. cit.* p. 43.
- ²⁴ Hughes, Ed (Editor) (2004) *op. cit.* p. 48.
- ²⁵ Hughes, Ed (Editor) (2004) *op. cit.* p. 21.
- ²⁶ Hughes, Ed (Editor) (2004) *op. cit.* p. 13.
- ²⁷ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p.14
- ²⁸ Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ²⁹ *2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*, National Defense Industrial Association (NDIA). Presentations available from: http://www.ndia.org/Content/NavigationMenu/Meetings_and_Events/Past_Events/2003_Mines_and_Demolitions_3500.htm
- 2003 Joint Non-Lethal Weapons Program Industry Day*, National Defense Industrial Association (NDIA). Presentations available from: <http://www.dtic.mil/ndia/2003Joint/index.html>
- ³⁰ Karcher, D. (2003) *Opportunities for Industry. Presentation to 2003 Joint Non-Lethal Weapons Program Industry Day*. Available from: <http://www.dtic.mil/ndia/2003Joint/kar.ppt>
- ³¹ *Joint Non-Lethal Weapons Program Technology and Programs Panel (2003) Presentation to 2003 Joint Non-Lethal Weapons Program Industry Day*. Available from: <http://www.dtic.mil/ndia/2003Joint/tech.ppt>

-
- ³² Davison, N. and Lewer, N. (2003) *Bradford Non-Lethal Weapons Research Project (BNLWRP): Research Report No. 4*. Department of Peace Studies, University of Bradford. Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ³³ Burns, F. (2003) Infantry Center Presentation. *Presentation to the 2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*. Available from: http://proceedings.ndia.org/3500/Burns_NDIA_Brief.ppt
- ³⁴ Cline, J. (2003) Non-Lethal Technologies for a Transforming Force: Current to Future Capabilities. *Presentation to the 2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*. Available from: http://proceedings.ndia.org/3500/Cline_NL_NDIA.pps
- ³⁵ US Army, Project Manager Close Combat Systems (PM-CCS), web site: <http://ccsweb.pica.army.mil/index.htm>
- ³⁶ Karcher, D. (2003) Opportunities for Industry. *Presentation to 2003 Joint Non-Lethal Weapons Program Industry Day*. Available from: <http://www.dtic.mil/ndia/2003Joint/kar.ppt>
- ³⁷ US Navy (2003) *Solicitation Notice – Non-Lethal Weapons*. FBO Daily Issue of November 02, 2003 FBO #0705. Available from: <http://www.fbodaily.com/archive/2003/11-November/02-Nov-2003/FBO-00463183.htm>
- ³⁸ National Institutes of Justice (2004) *Less Lethal Technologies Solicitation*. Available from: <http://www.ncjrs.org/pdffiles1/nij/sl000638.pdf>
- ³⁹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, Appendix A
- ⁴⁰ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 1.
- ⁴¹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 13.
- ⁴² Cline, J. (2003) *op. cit.*
- ⁴³ Swenson, K. (2003) Joint Non-Lethal Weapons Program Update. *Presentation to the 2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*. Available from: http://proceedings.ndia.org/3500/Swenson_NL_NDIA.pps
- ⁴⁴ Parrish, K. (2004) OPFOR teams with Marines on a mission: MARFOREUR visits ETC to host NATO NLW conference. *Training Journal*, Spring 2004. Available from: <http://www.grafenwoehr.army.mil/7ATC/nlw-full.htm>. Or PDF from: <http://www.taser.com/pdfs/nlwarticle.pdf>
- ⁴⁵ Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ⁴⁶ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, Appendix A
- ⁴⁷ Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ⁴⁸ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, Appendix A
- ⁴⁹ Swenson, K. (2003) *op. cit.*
- ⁵⁰ Air Force FY 2005 President's Budget (2004) *Department of the Air Force Fiscal Year 2005 Budget Estimates: Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume III*. <http://www.saffin.hq.af.mil/FMB/pb/2005/rdtande/RDT&E%20FY05%20PB%20Volume%203.pdf>
- ⁵¹ Swenson, K. (2003) *op. cit.*
- ⁵² Department of Defense (2004) *News Release: Fiscal 2005 Department of Defense Budget Release*. Available from: <http://www.defenselink.mil/releases/2004/nr20040202-0301.html>
- ⁵³ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ⁵⁴ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ⁵⁵ Davison, N and Lewer, N (2003) *op. cit.*
- ⁵⁶ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ⁵⁷ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ⁵⁸ Air Force FY 2005 President's Budget (2004) *Department of the Air Force Fiscal Year 2005 Budget Estimates: Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume I*. Available from: <http://www.saffin.hq.af.mil/FMB/pb/2005/rdtande/RDT&E%20FY05%20PB%20Volume%201.pdf>
- ⁵⁹ Army FY 2005 President's Budget (2004) *Army Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume II, Army Appropriation Budget Activities 4 and 5A*. Available from: <http://www.asafm.army.mil/budget/fybm/FY05/rforms/vol2.pdf>
- ⁶⁰ SOCOM FY 2005 President's Budget (2004) *SOCOM Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries*. Available from: http://www.defenselink.mil/comptroller/defbudget/fy2005/budget_justification/pdfs/rdtande/SOCOM.pdf
- ⁶¹ DARPA FY 2005 President's Budget (2004) *DARPA Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries*. Available from: http://www.defenselink.mil/comptroller/defbudget/fy2005/budget_justification/pdfs/rdtande/DARPA.pdf
- ⁶² *Ibid.* See also DARPA's Tactical Technology Office (TTO) web site: <http://www.darpa.mil/tto/>

-
- ⁶³ Navy FY 2005 President's Budget (2004) *Procurement: Marine Corps: Operations Other than War*. Available from: http://navweb.secnav.navy.mil/pubbud/05pres/db_u.htm (Document is a 'line item', PMC BA2 13, under Procurement, Marine Corps.)
- ⁶⁴ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 2.
- ⁶⁵ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 17.
- ⁶⁶ *Ibid.*
- ⁶⁷ SOCOM FY 2005 President's Budget (2004) *op. cit.*
- ⁶⁸ Tousley, B. (2004) Precision Urban Combat. *Presentation given to the DARPATech 2004 Symposium March 9-11, 2004, in Anaheim, California*. Available from: <http://www.darpa.mil/DARPAtech2004/pdf/scripts/TousleyScript.pdf>
- ⁶⁹ *Ibid.*
- ⁷⁰ Tousley, B. (2004) *op. cit.*
- ⁷¹ Tousley, B. (2004) *op. cit.*
- ⁷² Benda, P. (2004) Assured Urban Operations. *Presentation given to the DARPATech 2004 Symposium March 9-11, 2004, in Anaheim, California*. Available from: <http://www.darpa.mil/DARPAtech2004/pdf/scripts/BendaScript.pdf>
- ⁷³ Defense Science Board (2004) *Defense Science Board Task Force on Future Strategic Strike Forces*. Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics: Washington D.C. Available from: <http://www.acq.osd.mil/dsb/fssf.pdf>
- ⁷⁴ Sherman, J. (2004) Pentagon Readies New Planning Points. *DefenseNews.com*, 3 May 2004. See: <http://www.defensenews.com/>
- ⁷⁵ From: *Ibid.*
- ⁷⁶ **Products listed or described in this report are not endorsed by the BNLWRP.**
- ⁷⁷ Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ⁷⁸ House of Commons Hansard Written Ministerial Statements for 8 January 2004 (pt1), The United Kingdom Parliament. See <http://www.parliament.the-stationary-office.co.uk/>; Northern Ireland Office (2004) *Patten Report Recommendations 69 and 70 Relating To Public Order Equipment. A Research Programme into Alternative Policing Approaches Towards The Management of Conflict*. Northern Ireland Office, U.K., p. 119.
- ⁷⁹ BBC News Online (2004) Progress on baton alternative. *BBC News*, 29 January 2004. Available from: http://news.bbc.co.uk/1/hi/northern_ireland/3441557.stm
- ⁸⁰ Northern Ireland Office (2004) *op. cit.*, pp.61-62.
- ⁸¹ Cox, B. (2004) Rubber bullets – not so lethal. *University of Western Ontario News*. Available from: http://communications.uwo.ca/western_news/feature.html?listing_id=7313
- ⁸² Kennedy, H. (2004) Lightweight Shotgun Deploys to Afghanistan. *National Defense Magazine*. Available from: <http://www.nationaldefensemagazine.org/article.cfm?id=1344>
- ⁸³ Idaho National Engineering and Environmental Laboratory (2004) *INEEL-designed firearm gives officers valuable seconds during engagements*. INEEL Press Release, 10 February 2004. Available from: <http://newsdesk.inel.gov/contextnews.cfm?ID=497>
- ⁸⁴; Metal Storm web site: http://www.metalstorm.com/12_odwyervle/prototype.html
- ⁸⁵ *Ibid.*
- ⁸⁶ Baker, J. (2004) Lethal Weapon. *The Age*, 26 March 2004. Available from: <http://www.theage.com.au/articles/2004/03/26/1079939827815.html>
- ⁸⁷ Northern Ireland Office (2004) *op. cit.*, pp. 51-60.
- ⁸⁸ House of Commons Library. Deposited Papers List. 04/632 03.03.04 Northern Ireland Office I. DSAC sub-committee on the medical implications of less lethal weapons (DOMILL): statement on the medical implications of the use of the Somati RCV9000 vehicle mounted water cannon. II. ACPO guidance on the deployment and use of water cannon. NIO/DSAC/ACPO. 2004. Baroness Amos written statement 16.03.2004; Kennedy/Jane written statement 16.03.2004 . http://edm.ais.co.uk/deposited/dep_list.html
- ⁸⁹ Northern Ireland Office, Press Archives. 16 March 2004.
- ⁹⁰ ACPO (2003) ACPO Press release, 22 December 2003. Available from: http://www.acpo.police.uk/news/2003/q4/Car_immob.html
- ⁹¹ Markland Technologies web site: <http://www.marklandtech.com/vss.html>
- ⁹² Shockrounds web site: <http://www.shockrounds.com/shock/p2.html>
- ⁹³ Available from: <http://www.bradford.ac.uk/acad/nlw/>
- ⁹⁴ See also BNLWRP Report No.4: http://www.brad.ac.uk/acad/nlw/research_reports/
- ⁹⁵ ACPO (2003) ACPO Press Release, 2 December 2003. Available from: http://www.acpo.police.uk/news/2003/q4/taser_and_amnesty_Int.html .

- ⁹⁶ For a detailed description of the Taser, operational guidelines, and accountability mechanisms for U.K. Police Forces see: the Northern Ireland Office (2004) *Patten Report Recommendations 69 and 70 Relating To Public Order Equipment. A Research Programme Into Alternative Policing Approaches Towards The Management of Conflict. Phase Four Report*. Northern Ireland Office: U.K., pp.67-112.
- ⁹⁷ BBC News Online (2004) Police complete stun gun trials. *BBC News Online*, 19 April 2004. Available from: <http://news.bbc.co.uk/1/hi/england/lincolnshire/3638301.stm>
- ⁹⁸ Bagnall, S. (2004) Police stun gun is here to stay. *IC North Wales*, 16 April 2004. Available from: http://icnorthwales.icnetwork.co.uk/news/regionalnews/tm_objectid=14152718&method=full&siteid=50142&headline=police-stun-gun-is-here-to-stay-name_page.html
- ⁹⁹ Scunthorpe Telegraph (2004) Stun Gun Trials to be Extended. *Scunthorpe Telegraph*, 20 April 2004. Available from: <http://www.thissscunthorpe.co.uk/displayNode.jsp?nodeId=56019&command=displayContent&sourceNode=56018&contentPK=9643107>
- ¹⁰⁰ Gailliard, K. (2004) 3 Strand Police Agencies Will Get Taser Stun Guns. *The Sun News*, 15 February 2004. <http://www.myrtlebeachonline.com/mld/sunnews/>
- ¹⁰¹ Nelson, R. (2004) Gun Shy. *Phoenix New Times*, 12 February 2004. Available from: <http://www.phoenixnewtimes.com/issues/2004-02-12/nelson.html/1/index.html>
- ¹⁰² Kershaw, S. (2004) As Shocks Replace Police Bullets, Deaths Drop but Questions Arise. *The New York Times*, 7 March 2004.
- ¹⁰³ Janin, M (2004) 'Shock Treatment'. *Police. The Law Enforcement Magazine*. Available from: http://www.policemag.com/t_cipick.cfm?rank=89364
- ¹⁰⁴ *Sunday Times (Australia)* (2004) 4 January 2004. <http://www.sundaytimes.news.com.au/>
- ¹⁰⁵ Webster, P. (2004) Terror suspect turned out to be a Welsh insurance agent. *The Guardian*, 3 January 2003. Available from: http://www.guardian.co.uk/uk_news/story/0,3604,1115281,00.html
- ¹⁰⁶ Shachtman, N. (2003) U.S. issuing troops more 'non-lethal' weaponry. *Chicago Tribune*, 11 December 2003. Available from: <http://www.globalsecurity.org/org/news/2003/031211-nonlethal-weaponry.htm>
- ¹⁰⁷ Thomas, J. (2004) Authorities: Taser used to subdue student. *The Palatka Daily News*, 8 January 2004. <http://www.palatkadailynews.com/>
- ¹⁰⁸ Taser web site: <http://www.taser.com/>
- ¹⁰⁹ *Ibid.*
- ¹¹⁰ TASER International, Inc. (2004) *TASER International, Inc. Announces Wireless Extended Range Electronic Projectile (XREP) Technology*. Press Release, 8 March 2004. Available from: http://biz.yahoo.com/prnews/040308/lam027a_1.html
- ¹¹¹ Bleetman, A., Steyn, R., and Lee, C. (2004) Introduction of the Taser into British policing. Implications for UK emergency departments: an overview of electronic weaponry. *Emergency Medicine Journal*. Vol. 21, No. 3, March.
- ¹¹² Bleetman, A. and Steyn, R. (2003) *The Advanced Taser: a Medical Review*. Taser International Inc.: Scottsdale, AZ. Available from: <http://www.taser.com/pages/printeddocs/safetymedical.html>; [Also see BBC News Online (2001) Doctor backs police stun guns. *BBC News Online*, 11 September 2001. Available from: <http://news.bbc.co.uk/1/hi/uk/1537484.stm>]
- ¹¹³ Bleetman, A., Steyn, R., and Lee, C. (2004) *op. cit.*
- ¹¹⁴ CNN (2004) Troops get high tech noisemaker. *CNN.com*, 3 March 2004. Available from: <http://www.cnn.com/2004/TECH/ptech/03/03/sonic.weapon.ap/>
- ¹¹⁵ Miller, C. (2004) Can a Crying Baby Stop a Riot? *Law Enforcement Technology* (03/04) Vol. 31, No. 3, P. 8. <http://www.nlectc.org/justnetnews/04012004.html#story21>
- ¹¹⁶ Arkin, W. (2004) The Pentagon's Secret Scream: Sonic Devices That Can Inflict pain – Or Even Permanent Deafness – Are being Deployed. *Los Angeles Times*, 7 March 2004.
- ¹¹⁷ ABC News Online (2004) US to send acoustic weapon to Iraq. *ABC NewsOnline*. 9 March 2004. Available from: <http://www.abc.net.au/news/newsitems/s1062457.htm>
- ¹¹⁸ Jauchem et al. (2003). The Potential Use of High Intensity Acoustics for Non-Lethal Applications. Abstract of presentation to the 2003 Non-lethal Technology and Academic Research Symposium (NTAR V). Available from: <http://www.ntar.sr.unh.edu/PublicSchedule.shtm>
- ¹¹⁹ Altmann, J. (2001) Acoustic Weapons: A Prospective Assessment. *Science and Global Security*, Vol.9, pp.49-121.
- ¹²⁰ Universal Guardian Holdings, Inc. (2004) *Universal Guardian Holdings Announces Strategic Plans to Increase Focus in Non-Lethal Defense Products*. Press Release, 1 March 2004. Available from: http://biz.yahoo.com/bw/040301/15481_1.html

- ¹²¹ Wilson, J. (2004) Forget the truncheon, police chief would prefer phaser guns. *The Guardian*, 14 February 2004. Available from: <http://www.guardian.co.uk/crime/article/0,2763,1148106,00.html> & find original article
- ¹²² *Ibid.*
- ¹²³ See BNLWRP Report No.4: http://www.brad.ac.uk/acad/nlw/research_reports/
- ¹²⁴ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ¹²⁵ Air Force FY 2005 President's Budget (2004) *Department of the Air Force Fiscal Year 2005 Budget Estimates: Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume I*.
- ¹²⁶ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*, p. 25.
- ¹²⁷ US Air Force (2003) *Solicitation Notice – Active Denial System*. FBO Daily Issue of April 08, 2004 FBO #0864. Available from: <http://www.fbodaily.com/archive/2004/04-April/08-Apr-2004/FBO-00560837.htm>
- ¹²⁸ Wichner, D. (2004) Tucson, Ariz., Firm to Send Nonlethal, Disabling Weapon to U.S. Army. *The Arizona Daily Star*, 8 April 2004. Available from: <http://www.miami.com/mld/miamiherald/business/national/8388788.htm>
- ¹²⁹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ¹³⁰ Air Force FY 2005 President's Budget (2004) *Department of the Air Force Fiscal Year 2005 Budget Estimates: Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume I*.
- ¹³¹ *Ibid.*
- ¹³² *Ibid.*
- ¹³³ *Ibid.*
- ¹³⁴ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ¹³⁵ See BNLWRP Report No.4: http://www.brad.ac.uk/acad/nlw/research_reports/
- ¹³⁶ US Air Force (2004) Research Agreement Signed. AFRL, USAF Press Release, 14 January 2004. Available from: <http://www.de.af.mil/News/2004/04-02.html>
- ¹³⁷ Home & Garden, Inc. (2004) U.S. Home & Garden Completes Merger With Ionatron. Press Release, 18 March 2004. Available from: http://home.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&newsId=20040318005355&newsLang=en
- ¹³⁸ Burns, F. (2003) *op. cit.*; Swenson, K. (2003) *op. cit.*
- ¹³⁹ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ¹⁴⁰ SOCOM FY 2005 President's Budget (2004) *SOCOM Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries*.
- ¹⁴¹ Lamberson, D., Duff, E., Washburn, D., Holmberg, C. (2004) Whither High-Energy Lasers? *Air & Space Power Journal*, Spring 2004. Available from: <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj04/spr04/lamberson.html>
- ¹⁴² Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ¹⁴³ As discussed in BNLWRP Report No. 4. See: National Research Council (2003) *An Assessment of Non-lethal Weapons Science and Technology*. Washington D.C.: National Academies Press. Available from: <http://www.nap.edu/books/0309082889/html>. Also available to download in pdf format from the Federation of American scientists web site at: http://www.fas.org/bwc/nas/nas_non_lethal.pdf
- ¹⁴⁴ Northern Ireland Office (2004) *op. cit.* For criticism of this process see: Rappert, B (2004) *Response to Patten Report Recommendations 69 and 70 Relating to Public Order Equipment Report – Fourth Report*. Available from: <http://www.ex.ac.uk/~br201/Research/Publications/Phase%20IV%20comments.htm>
- ¹⁴⁵ Petty, C. (2004) *Deaths in Police Confrontations When Oleoresin Capsicum is Used*. US Department of Justice funded grant final report. Available from: <http://www.ncjrs.org/pdffiles1/nij/grants/204029.pdf>
- ¹⁴⁶ *Ibid.*
- ¹⁴⁷ Northern Ireland Office (2004) *op. cit.*
- ¹⁴⁸ Northern Ireland Office (2004) *op. cit.*
- ¹⁴⁹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ¹⁵⁰ Hughes, Ed (Editor) (2004) *op. cit.* p. 42.
- ¹⁵¹ Universal Guardian Holdings, Inc. (2004) *op. cit.*
- ¹⁵² Universal Guardian Holdings, Inc. (2004) *op. cit.*
- ¹⁵³ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ¹⁵⁴ Dindl, F. (2003) 40mm MK19 Non-Lethal Short Range and Long Range Ammunition. *Presentation to the 2003 Mines, Demolitions, and Non-Lethal Weapons Conference & Exhibition*. Available from: http://proceedings.ndia.org/3500/Dindl_NL_NDIA.pps
- ¹⁵⁵ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.
- ¹⁵⁶ Navy FY 2005 President's Budget (2004) *RDT&E - Non-Lethal Weapons Program*.

- ¹⁵⁷ Army FY 2005 President's Budget (2004) *Army Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries, Volume II, Army Appropriation Budget Activities 4 and 5A*.
- ¹⁵⁸ US Army, Project Manager Close Combat Systems (PM-CCS), web site: <http://ccsweb.pica.army.mil/index.htm>
- ¹⁵⁹ Allison, G, Kelley, P & Garwin, R. (2004) *op. cit.*
- ¹⁶⁰ Jontz, S. (2004) Marines to take popular Dragon Eye to Iraq. *Stars and Stripes*, 23 January 2004. Available from: <http://www.estripes.com/article.asp?section=104&article=19212&archive=true>
- ¹⁶¹ Francis, M. (2004) J-UCAS Program Office. *Presentation given to the DARPATech 2004 Symposium, March 9-11, 2004, in Anaheim, California*. Available from: <http://www.darpa.mil/DARPATech2004/pdf/scripts/FrancisScript.pdf>
- ¹⁶² DARPA FY 2005 President's Budget (2004) *DARPA Research, Development, Test and Evaluation (RDT&E): Descriptive Summaries*.
- ¹⁶³ Davison, N. and Lewer, N. (2003) *Bradford Non-Lethal Weapons Research Project (BNLWRP): Research Report No. 4*. Department of Peace Studies, University of Bradford. Available from: http://www.brad.ac.uk/acad/nlw/research_reports/
- ¹⁶⁴ Pearson, G. (2002) Relevant Scientific And Technological Developments For The First CWC Review Conference: The BTWC Review Conference Experience. *CWC Review Conference Paper No.1*. Department of Peace Studies, University of Bradford. Available from: <http://www.brad.ac.uk/acad/scwc/cwcrep/cwcreps.htm>
- ¹⁶⁵ Wheelis, M. (2002) Biotechnology and Biochemical Weapons. *The Nonproliferation Review*. Volume 9, Number 1. Available from: <http://cns.miis.edu/pubs/npr/vol09/91/91whee.htm>
- ¹⁶⁶ Davison, N. and Lewer, N. (2003) *op. cit.*
- ¹⁶⁷ Klotz, L., Furmanski, M., Wheelis, M. (2003) *Beware the Siren's Song: Why "Non-Lethal" Incapacitating Chemical Agents are Lethal*. Washington D.C.: Federation of American Scientists (FAS). Available from http://www.fas.org/bwc/papers/sirens_song.pdf
- ¹⁶⁸ *Chemical Weapons Convention*. Text available at: <http://www.opcw.org/>
- ¹⁶⁹ *Ibid.*
- ¹⁷⁰ Stanley, T. (2003) Human immobilization: is the experience in Moscow just the beginning? *European Journal of Anaesthesiology*. 20, pp. 427-8.
- ¹⁷¹ This figure may have been higher, see Walsh, P. (2003) Families claim death toll from gas in Moscow siege kept secret. *The Guardian*, 18 October 2003. Available from: <http://www.guardian.co.uk/international/story/0,3604,1065611,00.html>
- ¹⁷² Stanley, T. (2003) *op. cit.*
- ¹⁷³ We discussed this in our last report based on the following paper: Federation of American Scientists Working Group on Biological Weapons (2003) *Position Paper: Chemical Incapacitating Weapons Are Not Non-Lethal*. Washington D.C.: Federation of American Scientists (FAS). Available from: http://www.fas.org/bwc/papers/pp_chemical_incapacitants.pdf
- ¹⁷⁴ Ketchum, J. and Sidell, F. (1997) Incapacitants. In: *Textbook of Military Medicine: Medical Aspects of Chemical and Biological Warfare*. Washington D.C.: Office of the Surgeon General, Department of the Army.
- ¹⁷⁵ MacKenzie, D. (2002) Russian gas may be secret crowd-control weapon. *New Scientist*, 28 October 2002. Available from: <http://www.newscientist.com/news/news.jsp?id=ns99992974>
- ¹⁷⁶ Dando, M. (2002) Future Incapacitating Chemical Agents: The Impact of Genomics. In: *Lewer, N (Ed) (2002) The Future of Non-Lethal Weapons. Technologies, Operations, Ethics and Law*. London: Frank Cass.
- ¹⁷⁷ Alibek, K. (1999) Biological Weapons In The Former Soviet Union: An Interview With Dr. Kenneth Alibek. *The Nonproliferation Review*. Volume 6, Number 3. Available from: <http://cns.miis.edu/pubs/npr/vol06/63/alibek63.pdf>
- ¹⁷⁸ In Moscow there were reports that many of the hostage-takers were executed by Russian Special Forces whilst unconscious. [See: BBC News (2002) How special forces ended siege. *BBC News*, 29 October 2002. Available from: <http://news.bbc.co.uk/1/hi/world/europe/2363601.stm>]
- In Vietnam, where the US military used the riot control agent CS gas in large quantities, its effects were to enhance rather than reduce lethal force. [See: Allison, G, Kelley, P & Garwin, R. (2004). *Nonlethal Weapons and Capabilities*. Report of an Independent Task Force Sponsored by the Council on Foreign Relations. New York. Available from: http://www.cfr.org/pdf/Nonlethal_TF.pdf]
- ¹⁷⁹ The Centers for Disease Control and Prevention (CDC) in the United States categorises various biological agents as posing a threat to US national security. There are three categories: A, B & C. Category A agents are considered to pose the greatest threat. See: <http://www.bt.cdc.gov/agent/agentlist-category.asp>
- ¹⁸⁰ See for example: Coupland, R. M. (2003) Incapacitating chemical weapons: a year after the Moscow theatre siege. *The Lancet*, Vol. 362, p. 1346; Wheelis, M. (2003) "Nonlethal" Chemical Weapons: A Faustian Bargain. *Issues in Science and Technology*. Spring 2003. Available from: <http://www.nap.edu/issues/19.3/wheelis.htm>;

-
- Meselson, M. and Perry Robinson, J. (2003) 'Non-Lethal' Weapons and Implementation of the Chemical and Biological Weapons Convention. *20th Pugwash Workshop Study Group on the Implementation of the CBW Conventions: The BWC Intersessional Process towards the Sixth Review Conference and Beyond*. Geneva, Switzerland, 8-9 November 2003. Available from <http://www.pugwash.org/reports/cbw/cbw20/cbw20-meselson-robinson.htm>
- ¹⁸¹ Kagan, E. (2001) Bioregulators as Instruments of Terror. *Clinics in Laboratory Medicine*. Vol. 21, No. 3. pp. 607-18
- ¹⁸² From: Kagan, E. (2001) *op. cit.*
- ¹⁸³ Lakoski, J., Bosseau Murray, W., and Kenny, J. (2000) *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*. College of Medicine, Applied Research Laboratory, The Pennsylvania State University. Available from: http://www.nldt.org/documents/calmativ_e_report.pdf
- ¹⁸⁴ From: Lakoski, J. et al. *op. cit.*
- ¹⁸⁵ Dando, M. (2002) *op. cit.*
- ¹⁸⁶ Feldman, R., Meyer, J, and Quenzer, L. (1997) Serotonin. *In: Principles of Neuropsychopharmacology*. Sunderland, MA: Sinauer Associates. pp. 345-89.
- ¹⁸⁷ Carlson, N. (2001) Emotion. *In: Physiology of Behavior*, 7th Edition. Boston: Allyn and Bacon. pp. 339-70.
- ¹⁸⁸ Lakoski et al. (2000), *op. cit.*
- ¹⁸⁹ Wheelis, M. (2002) *op. cit.*
- ¹⁹⁰ Wheelis, M. (2002) *op. cit.*
- ¹⁹¹ United Nations (2001) *UK Background Paper on New Scientific and Technological Developments Relevant to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction*. BWC/CONF.V/4/Add.1. United Nations: Geneva. Available from: <http://www.opbw.org>
- ¹⁹² National Science Foundation (2004) *Virtual Screening Lab Zeroes in on New Drugs*. National Science Foundation News Tip, 16 March 2004. Available from: <http://www.nsf.gov/od/lpa/news/04/tip040316.htm>
- ¹⁹³ Dando, M. (2003) The Danger to the Chemical Weapons Convention from Incapacitating Chemicals. *CWC Review Conference Paper No.4*, Department of Peace Studies, University of Bradford.
- ¹⁹⁴ *Ibid.*
- ¹⁹⁵ National Research Council (2003) *An Assessment of Non-lethal Weapons Science and Technology*. Washington D.C.: National Academies Press. Available from: <http://www.nap.edu/books/0309082889/html>
- ¹⁹⁶ *Ibid.*
- ¹⁹⁷ See: The Sunshine Project web site (Incapacitating and Anti-Material (Bio)Chemical Weapons): <http://www.sunshine-project.org/incapacitants/>
- ¹⁹⁸ Sunshine Project (2004) *The Return of ARCAD*. The Sunshine Project News Release, 6 January 2004. Available from: <http://www.sunshine-project.org/publications/pr/pr060104.html>
- ¹⁹⁹ *Ibid.*
- ²⁰⁰ Ruppe, D. (2002) United States: U.S. Military Studying Nonlethal Chemicals. *Global Security Newswire*, 4 November 2002. Available from http://www.nti.org/d_newswire/issues/2002/11/4/7s.html
- ²⁰¹ Department of Defense (2000) *CBD 26 Phase I Selections from the 00.1 Solicitation*, Department of Defense SBIR Awards 2000. Available from: <http://www.nttc.edu/resources/funding/awards/dod/2000sbir/001cbd.asp>
- ²⁰² US Joint Non-Lethal Weapons Directorate (2003) *Front End Analysis for Non-Lethal Chemicals*. Available from: <http://www.sunshine-project.org/incapacitants/jnlwdpdf/feachemical.pdf>
- ²⁰³ Klochikhin, V. L., Pirumov, V.S., Putilov, A.V., Selivanov, V.V. (2003) The Complex Forecast of Perspectives of NLW for European Application. *Proceedings of the 2nd European Symposium on Non-Lethal Weapons, May 13-14 2003*, European Working Group on Non-Lethal Weapons, Germany.
- ²⁰⁴ *Ibid.*
- ²⁰⁵ Northern Ireland Office (2004) *Patten Report Recommendations 69 and 70 Relating To Public Order Equipment. A Research Programme Into Alternative Policing Approaches Towards The Management of Conflict. Phase Four Report*. Northern Ireland Office: U.K. Available from: <http://www.nio.gov.uk/pdf/batonrep2004.pdf>
- ²⁰⁶ *Ibid.*
- ²⁰⁷ Northern Ireland Office (2004) *op. cit.*
- ²⁰⁸ Northern Ireland Office (2004) *op. cit.*
- ²⁰⁹ *US/UK Non-Lethal Weapons/Urban Operation Wargame*, US Marine Corps web site: <http://www.wargaming.quantico.usmc.mil/Programs/USUKNLW.cfm>
- ²¹⁰ House of Commons (2001) *Non-lethal weapons, House of Commons Hansard Written Answers for 10 Apr 2001 (pt 9)*. House of Commons: UK. Available from: <http://www.parliament.the-stationery-office.co.uk/pa/cm200001/cmhansrd/vo010410/text/10410w09.htm>

-
- ²¹¹ *US/UK Non-Lethal Weapons (NLW)/Urban Operations Executive Seminar, 30 November 2000, London, UK.* Report available on The Sunshine Project web site: <http://www.sunshine-project.org/incapacitants/jnlwdpdf/usukassess.pdf>
- ²¹² *Ibid.*
- ²¹³ Note: the report does not discuss law enforcement use of such agents.
- ²¹⁴ Allison, G, Kelley, P & Garwin, R. (2004). *Nonlethal Weapons and Capabilities*. Report of an Independent Task Force Sponsored by the Council on Foreign Relations. New York. Available from: http://www.cfr.org/pdf/Nonlethal_TF.pdf
- ²¹⁵ Defense Science Board (2004) *Report of the Defense Science Board Task Force on Future Strategic Strike Forces*. Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics. Department of Defense, Washington D.C. Available from: <http://www.acq.osd.mil/dsb/fssf.pdf>
- ²¹⁶ *Ibid.*
- ²¹⁷ Petro, J., Plasse, T., and McNulty, J. (2003) *Biotechnology: Impact on Biological Warfare and Biodefense. Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*. Vol. 1, No. 3. pp. 161-8.
- ²¹⁸ Bokan, S., Breen, J., Orehovec, Z. (2002) An Evaluation of Bioregulators as Terrorism Warfare Agents. *The ASA Newsletter*. ASA 02-3, Issue No. 90. Available from: <http://www.asanltr.com/newsletter/02-3/articles/023c.htm>; also see Bokan, S. (2004) A new breed of weapons – turning the body against itself. *Resilience*. Issue 1, Spring 2004.
- ²¹⁹ Petro et al. (2003) *op. cit.*
- ²²⁰ Davis, C. (1999) Nuclear Blindness: An Overview of the Biological Weapons Programs of the Former Soviet Union and Iraq. *Emerging Infectious Diseases*. Vol. 5, No. 4. pp. 509-12. Available from <http://www.cdc.gov/ncidod/EID/vol5no4/pdf/davis.pdf>
- ²²¹ Bokan, S. et al. (2002) *op. cit.*
- ²²² Allison, G. et al. (2004) *op. cit.*
- ²²³ Wheelis, M. (2003) "Nonlethal" Chemical Weapons: A Faustian Bargain. *Issues in Science and Technology*. Spring 2003. Available from: <http://www.nap.edu/issues/19.3/wheelis.htm>
- ²²⁴ The Geneva Forum web site: <http://www.geneva-forum.org/>. The BNLWRP Presentation given to the Geneva Forum is available online at: http://www.brad.ac.uk/acad/nlw/research_reports/
- ²²⁵ **The paper was presented by Robin Coupland at the 19th Workshop of the Pugwash Study Group on the Implementation of the Chemical and Biological Weapons Conventions, Oegstgeest, Netherlands 26-27 April 2003. Reproduced with permission of the author.**
- ²²⁶ Northern Ireland Office (2004) *op. cit.*
- ²²⁷ United Nations (1990) *Basic Principles on the Use of Force and Firearms by Law Enforcement Officials*. United Nations: Geneva. Available from: http://www.unhchr.ch/html/menu3/b/h_comp43.htm
- ²²⁸ *Ibid.*