January 21, 2002

The Secretary to the Steering Group
Room 4.25, Block B
Castle Buildings
Stormont
Belfast BT4 3SG

Re: Response to December 2001 Patten Report Recommendations 69 and 70 Relating to Public Order Equipment Report

Dear Steering Group,

I am a social scientist at the University of Nottingham. During the last few years I conducted research regarding the assessment of 'non-lethal' or 'less-lethal' weapons used by military and police forces. Much of that has centred on CS sprays deployed in Britain, of which I will say more later. I welcome the opportunity to be able to comment on the Phase 2 Report of the Steering Group.

Let me start by acknowledging the scope and breath of the analysis conducted. As an initial stage and broad overview of the range of less-lethal technologies, the report is quite substantial. I look forward to further publications from the Group regarding the detailed technical assessment of various weapons. The points that follow, therefore, are intended in the spirit of constructive commentary.

The Limitations of Medical and Technical Assessments

Much of the Phase II report is dedicated to predictive assessments of various less-lethal technologies. I await further particulars on these assessments before making detailed comments. At this stage, the general focus has some justification. Yet, such predicative evaluations are just one part of ensuring the appropriate deployment of less-lethal weapons. Like any technology, with these weapons there is the potential for unforeseen risks that no amount of precaution can completely avoid. Medical and technical assessments, no matter how rigorous, cannot in and of themselves guarantee the acceptability of weapons in practice. Surveillance procedures need to be in place to monitor deployments and police forces need to adopt their tactics and technology depending on experiences.

I am sure, in general terms, most would agree with such sentiments. So far though, the focus of the Steering Group has been on *technical* innovations rather than *institutional* reforms. The latter though are required to achieve a reliable understanding of effects within police forces and to make these transparent to the public. Therefore, I hope the Steering Group will devote time to detailing the post-approval procedures necessary to assess the effects of whatever weapons it advocates

as part of the review process. In my opinion, based on research regarding the introduction of CS sprays in England and Wales (see below), this would require organisational reforms in the way the use of force reports, injuries, and compensation claims are monitored and made available to police forces and the public.

To elaborate, each type of weapons carries with it different demands in relation to monitoring. Members of the Committee might well find of interest a recent article by physicians in southern California that discusses a number of the problems associated with assessing the injuries sustained by kinetic weapons. Although this article focuses on a particular type of impact projectile (i.e. the bean bag) I believe it raises a number of general points about the potential for underestimating injury and the need for more robust assessments systems than might be envisioned. As another example of institutional change, in relation to CS sprays the Police Complaints Authority recommended all police forces should record injuries to the public in use of force reports. I gather this suggestion has not been adopted. I also understand that forces differ in whether they monitor levels of the irritant in officers' sprays in order to be able to determine the amount used in encounters. With regard to the baton round, Patten Report recommendation 71 suggested wherever possible a camera recording be made of incidents involving plastic baton round. Visual recording could be introduced in a variety of less-lethal deployments. To take yet another example, I gather one of the latest versions of the TASER (M26) has an onboard computer that records the time and date of every firing so that police agencies can monitor usage patterns. Obviously such information could be quite helpful for a whole range of purposes. Yet, in practice, there are questions about what procedures would be in place to make use of the information and who would have access to it. Will the Steering Group comment on such procedural measures?

(As somewhat of an aside, there are also more detailed issues about the technical particulars of such monitoring mechanisms that could be clarified by the Steering Group. I am not sure, and I do not think it is widely known, whether usage for the TASER is recorded when there is no probe cartridge attached and it effectively operates like a stun gun.)

The Strategic Audit Framework

I found the framework a rather useful starting point for flagging up a range of issues associated with less-lethal weapons. Based on previous correspondence with members of the West Mercia Constabulary, I gather it will be used to suggest possible questions rather than functioning as a tool for detailed auditing purposes. I look forward to seeing how, in practice, the Steering Group makes use of the framework in later reports. An initial danger as I see it, is that because of time and resource pressures the framework acts as a checklist for which brief answers are given to quite complex questions rather than as a tool for in-depth probing of issues. A systematic application of the framework would indeed be a demanding task, but one I think would go some way to enhancing the conclusions reached.

Given the uncertainties associated with the framework, I will restrict my comments at this time to two further observations. First, question 2.3.4 asks if there is an

international perspective to the ethical and cultural issues associated with particular weapons. I would like to draw attention to one such consideration. Members of the Steering Group will no doubt be aware of the concerns expressed by groups such as Human Rights Watch about the misuse of electrical weapons in certain countries. The utility of these devices in this regard relates to the lack of physical remarks they leave on the body and the corresponding difficulty of substantiating claims about mistreatment. For purposes of export controls from the UK, electrical devices such as the TASER are classified by the DTI as instruments of torture. While the possibility exists of the misuse of this class of technology in any country, my interest in bringing up this topic is to ask what the Steering Group thinks the potential implications of the deployment of such devices in UK would be in relation to other countries where the possibility for police abuse is much greater. What sort of precedent might their deployment here mean for attempts to establish international controls elsewhere?

Second, it strikes me that the answers given to many of the ethical and social questions in the framework crucially hinge on the particular remit given to the deployment of weapons. So, the framework asks if community impact assessments have been conducted. But the attitude expressed by any community survey is going to depend on what situations particular weapons are justified as appropriate. So, would the devices be meant for routine policing, held in ARVs or something else? Until such operational issues are clarified, I think it would be quite difficult to address the questions raised.

These points relate to another question I had about the intended scope of the recommendations of the Steering Group. In discussing operational needs, the report almost exclusively focuses on public dis/order, this in the sense of crowd control. Yet, it would seem some of the conclusions are meant to apply to routine policing as well. Could the Steering Group clarify the range of situations it feels its review of public order equipment is intended to cover. In this regard, for instance, the non-availability of a personal hand held incapacitant for officers in Northern Ireland is identified as a major requirement gap. Yet, I assume such devices would not be intended for crowd control purposes. If the report covers all aspects of policing, does the Steering Group feel that it has given sufficient consideration to routine policing requirements? In relation to the incapacitant example in particular, I was struck by the lack of discussion about this given in the report. The conclusion is merely stated rather than given any specific attention. An analysis of the issues at stake could include consideration of the likely firing ranges of the sprays based on experiences in Britain. Such a review might suggest, for example, the need for sprays more appropriate in close quarter situations (say under one meter) than the current version used on the mainland.

Less-Lethal Chemical Sprays

Following on from these points about the sprays, I wish to take issue with the account of incapacitant sprays given in pages 122-4. I have conducted research into the evaluation of the sprays and have come to a rather different set of conclusions about their safety and the rigorousness of the evaluation procedures in place. Appendix A

contains a copy of a paper that deals with these concerns. The argument is quite detailed, but basically it draws three conclusions:

* The pre- and post- trial safety testing of CS sprays has been minimal;
* Major recommendations of the Himsworth Committee have not been followed;
* Inadequate measures are being taken to guard against associated risks.

I hope you will consider the paper and feedback any comments. I feel I have presented the situation as honesty as I can, but given the secrecy and uncertainty associated with the regulation of sprays, it is entirely possible some points are in need of revision. I am open to making any necessary revisions. The paper has been sent to various individuals in the Home Office, PSDB, DoH, individual police forces, etc., but I have so far received few comments.

The basic point I would make here is that, while strictly not inaccurate, many of the statements made in pages 122-124 are less than adequate. Take the statement made in relation to the choice of MIBK as the solvent, that 'it is acknowledged that there have been one or two reports suggesting that MIBK is not the ideal solvent, and that it might carry risks that another solvent might not…Further work has continued in Britain assessing the suitability of alternative solvents, and the steering group has had access to that research.' Let me make several observations:

* There were two such reports conducted by experts at Porton Down;
* Beyond merely saying MIBK was not ideal, these studies stated it was not acceptable;
* Taken as individual studies, the importance of these publications might be seen as limited. If, for instance, there had been a number of other relevant studies conducted as part of the approval process then the importance of the two Porton Down studies could be rightly downplayed. According to answers given in Parliamentary correspondence I have obtained, though, these were two of the three main health evaluations undertaken about the sprays for some time after their approval. As suggested in my paper, the third was of qualified importance for assessing CS *sprays*. Because details of the approval process for the spray had not been made public though, it was impossible to situate the Porton Down reports and understand their importance.
* As far as I am aware, work on alternatives solvents has been taking place since 1996. It seems remarkable that, to date, no such replacement has been found. It would be quite helpful if the Steering Group could detail what progress has been made over the last five years in this regard and what this might mean for the uptake of the sprays in Northern Ireland.

Further points could be raised about the solvent and other statements made in pages 122-124. The way the Committees on Toxicity, Mutagenicity, and Carcinogenicity review was cited in the report and the implications it has had for members of the public and officers to take grievances forward are key topics. For now, I refer you to my paper, which addresses such issues in detail.

The discussion of chemical incapacitants raises other, more general, but related issues. In its reports the Himsworth Committee made two major procedural recommendations regarding chemical less-lethal technologies: the research relevant to decisions should

straight away be published in the open scientific press and chemical agents should be regarded more akin to drugs than weapons. Related to these points, in evaluating chemical non-lethals, it would be helpful if the Steering Group could comment on i) whether it considers these Himsworth recommendations as still valid and ii) how it interprets them. I am aware, that in relation to the evaluation of PAVA sprays, just what constitutes 'akin' to a drug has been a topic of some debate. I gather that discussion has centred around whether 1971 or current standards of drug testing are deemed the proper ones for regulation. Yet, as far as I am aware, whatever decision has been taken on this matter has not been made public. It would be helpful if the Steering Group could be explicit about the standards being used in its evaluation.

Openness

As a follow-on point from the discussion of the sprays, I would urge the Steering Group in its later technical evaluation to make the evidential basis of decisions as well as the criteria and processes for making those decisions as transparent as possible. These should be made clear to those individuals, such as police chiefs, who will be expected to make deployment decisions on the basis of such evaluations.

In furthering transparency, for the future technical and medical assessment outlined in the report, it would be valuable for the Steering Group to make public the details of members of the committees. I assume from the report that these committees will primarily consist of individuals from the PSDB and DSAC, though other expertise will be sought as necessary. More clarification would be helpful along with details of any possible conflicts of interest.

Finally, let me raise two other issues. First, the report is almost completely lacking in its discussion about the range of tactics associated with particular technologies. Yet, certainly this is an important issue in assessing the likely health effects, etc. of less-lethals in public order situations. What commentary will there be on such issues in the future? Second, pages 20-24 discussed a survey of officers in the UK. The difficulty for officers to estimate engagement distances was noted as well as varying perceptions of risk and safety. In what are these observations though being incorporated in technical requirements for less-lethals? For instance, by seeking kinetic weapons with a relatively low kinetic impact energy at distances below those in which they are supposed to be fired. Also, it was stated the results of the survey were going to be published in due course. Could you specify what this means in more detail. Is the survey being produced as an academic piece or will a policy report be published? When might either of these take place?

I look forward to hearing from you and receiving a copy of the next phase report.

Yours sincerely,

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Appendix A

HEALTH AND SAFETY IN POLICING: LESSONS FROM THE REGULATION OF CS SPRAYS IN THE UK

Brian Rappert

Abstract – Recent years have seen the introduction of a wide range of weapons for police forces around the world intended to minimizeminimise injuries incurred in officer-public encounters. In 1996, police forces in England and Wales began trials of CS incapacitant sprays. This article reviews the claims and counterclaims surrounding the medical implications of the sprays with a view to asking how the uncertainties associated with them have been handled in the regulation process. This analysis casts considerable doubt on the robustness of the precautions taken and demonstrates a continuing failure for relevant government agencies to respond and learn from problems identified. Drawing on wider literature regarding the health implications of risky technologies, iIt further asks what policy lessons the case of the CS sprays holds for the regulation of weaponry at an international level.

Key words – regulation, CS (o-chlorobenzylidene malononitrile), police, weapons, policy process

INTRODUCTION

The use of wWeapons by security forces poses major health concerns. Those health professionals and social scientists writing about the effects of weapons typically consider them in relation to specific military conflict situations (e.g., Coupland, 1996; 1999). In thea civilian context, few studies have been done of the health effects of such technology beyond the case of firearms in police-public encounters. In the United Kingdom, organizations such as the Police Complaints Authority are responsible for monitoring the complaints arising from the police use of force and these are sometimes considered in relation to alternative technologies and their health implications (e.g., batons, see Police Complaints Authority, 1998). Yet, in part due to questions of access, few studies have been undertaken by social scientists of the robustness of the procedures in place for managing the medical risks associated with weapons. Over time though, the collective effects of the use of force in police-civilians encounters can result in significant health problems for both parties.

The need to examine the regulation and effects of weapons in policing contexts

situations has intensified in recent years because of the introduction of a wide range of new force technologies. To resolve conflict situations encountered by police officers during their duties, most countries have attempted to employ so-called 'non-lethal' or 'less-lethal' weapons with the aimed ofat minimising the risk of injury to both officer and assailant, while providing an effective means of restraint. TAmong the range of existing non-lethal weapons deployed by police officerss include kinetic energy weapons such as rubber bullets and plastics bullets; incapacitant chemicals in spray, aerosol and gas forms (e.g. 'tear gas'); and vehicle mounted water cannons. In addition, there is an active search to develop the next generation of non-lethal weapons for routine and public order policinge as well as military applications such as peacekeeping missions. Today, there is widethe range of non-lethal anti-personnel weapons under research in the US and Europe including calmative agents that induce fatigue or sleep, chemical and physical entanglers (e.g., launchable nets) for immobilizing individuals, acoustic blasters, hand-held liquid projectile weapons that function as miniature water cannons, and directed energy microwave weapons that cause body temperatures to rise (Omega Foundation, 2000; Bennetto, 2001; Kettle, 2001).

The development of such technology is supported by international agreements. The United Nations Basic Principles on the Use of Force and Firearms by Law Enforcement Officials encourage law enforcement agencies to develop new, 'carefully evaluated and controlled' non-lethal weapons in order to decrease the risk of death or injury from more conventional force options such as firearms or batons. What 'carefully evaluated and controlled' mean in practice though is not specified. There are then pressing questions about the regulatory framework in place for assessing and monitoring the effects of police weapons. This paper examines than management of uncertainty and disagreement in relation to one case study: the deployment of CS (o-chlorobenzylidene malononitrile) incapacitant sprays in the United Kingdom.

In general, various procedures and regulations exist to protect particular workforces and the public at large from health risks associated with innovations (Richardson et al., 1982; McVeigh & Wheeler, 1992). Among these measures include economic incentives, legal codes, administration procedures (e.g., licensing), and self-regulation (see Hawkins & Hutter, 1993). Few of these controls are relevant to the case of non-lethal weapons, which are often evaluated by policing agencies traditionally concerned with questions of operational effectiveness. For instance, in the case the British CS sprays, they eventually became justified as part of attempts to adhere to health and safety workforce standards (i.e., Police [Health and Safety] Regulations 1999 and the Police [Health and Safety] Act 1997). These standards require employers to minimise the reasonably foreseeable effects of workplace equipment that affect health and safety. Standard and well-worn regulatory procedures are in place for handling such concerns. In the case of police self-defence and restraint equipment, however, a special exemption was given. The safety of such devices has been primarily a matter for the UK Home Office that did not have established evaluation procedures in place to follow. This lack of regulatory framework is indicative of the state of existing procedures in Europe and the US regarding policing weapons (Omega Foundation, 2000). With the increasing interest in such

technologies though, this situation is arguably becoming inappropriate.

The case of weaponry intended for civilian contexts provides a somewhat uncharted area for examining how decisions about the regulation of health effects are governed by public and private agencies. In the absence of national or international frameworks there are pressing questions about how such technology ought to be regulated. In the case of the CS sprays a somewhat half-hearted policy has been pursued. The justifications given for the safety of the sprays have drawn on rhetoric regarding the regulation of pharmaceutical drugs, though licenses have not been required nor have licensing procedures been followed.
This paper examines such issues in relation to one case study: the deployment of CS (o-chlorobenzylidene malononitrile) incapacitant sprays in the United Kingdom. The case of CS sprays provides an instance to examine how health uncertainties and disagreements are managed. This paper argues that inadequate measures have been taken to guard against the associated risks associated with these devicesis technology. Arguably the deployment of the CS sprays has brought various risks to the police and members of the public that could have been avoided.

Following the work of John Abraham (1995, 1998), it this paper advances a critical analysis on the basis of regulatory agencies failing to meet the standards of rigour they have declared for themselves. While not suggesting manufacturers or government officialsthose with regulatory agencies in the Home Office and elsewhere have misled, acted dishonestly or in 'bad faith', it is argued here that the organisational structures in place have provided a less than adequate regime for assessing the effects of the sprays. The justifications given for the safety of CS sprays to the police and members of the public have drawn on rhetoric regarding the regulation of pharmaceutical drugs, though this has arguably not manifested itself in practice. This paper contends that the development of non-lethal weapons merits further attention by those interested in the intersection of health and regulatory issues.

The argumentThis paper is divided into five sections. The next section provides a description of the design and methodology employed. This is followed by a background discussion about the introduction of the sprays in British police forces. The fourth and most substantial section examines the claims and counterclaims surrounding the effects of the sprays vis-à-vis the regulatory measures in place. This is considered with regard to pre- and post-trial safety testing as well as the surveillance mechanisms for monitoring the effects of the sprays in practice. The final section offers a number of policy lessons. It is argued that despite recent attempts in the UK to open up scientific regulatory decision-making procedures to greater scrutiny, secrecy is still pervasive in some areas and this has had an arguably detrimental effect on the quality of the decisions made.concluding thoughts. Further reflections are offered for the control of policing weapons in an international context.

DESIGN AND METHODOLOGY

The introduction of CS sprays has been one of the most significant developments in

relation to the use of force by British police officers in the last two decades. Given the majority of officers in mainland UK are not equipped with firearms, the introduction of the sprays has attracted quite a significant amount of public attention. This has led to a number of individuals and organizations commenting on the merits of the devices. As will be illustrated, much of the discussion of the sprays has been conducted against a general backdrop of limited information. As such, general statements about the sprays need to be scrutinised in some detail.

The case study approach adopted in this paper allows for a thorough consideration of the claims and counterclaims surrounding the effects of the sprays. This enables one to see how limited and conditional evaluative statements about their effects have been transferred between police, legal and media domains. As is argued here, the uncertainties and disagreements associated with the sprays have not simply resulted from scientific unknowns but many have also been the consequence of instead derived from inadequate and confused regulatory procedures as well as a lack of transparency.

In addition to a review of published medical literature, government-related research, journalistic accounts and other sources, 3427 semi-structured interviews were conducted during 2000-1. Interviewees have been instrumental providedto the author within providing a range of documentation that, while being ostensibly 'public' in character, would be difficult to access otherwise. Although much of the data collected in the interviews is not explicitly presented in this paper, the responses given were vital in being able to formulate and validate the argument given below. Only after a number of years since the sprays' introduction has it become possible to piece together a comprehensive picture of the regulation procedures undertaken.

This paper is only concerned with a limited range of the effects of the weapons: those related to their direct health implications for users and recipients. There have been questions raised about the indirect effects of the sprays, such as whether their use has resulted in an escalation of force by the police. Still other operational concerns have been made in relation to the use of the sprays on children and others (Hansard, 2000). While these are important issues, they are beyond the scope of this paper (however, see Rappert, 20021). Operational questions about the use of the sprays are only considered in so far as they are relevantbear toon assessments of their health implications. Furthermore, this paper is only concerned with the first five years of the spray's deployment (April 1996-2001). At the time of writing, much deliberation is still taking place within the UK about the relative merits of non-lethal weapons and it is likely to continue for some time. A consideration of these initial years though, provides an illustration of the range of safety tests and monitoring mechanisms established. These will provide the information on health effects that will inform future discussions.

INTRODUCTION OF CS SPRAYS

Much of the recent impetus for the adoption of incapacitant sprays began in the early 1990s when individuals in the British police began pressing for the adoption of

personal incapacitant sprays. A wide variety of such devices had been used in the US and continental Europe for a number of years. The introduction of a spray was thought to be able to reduce the number of assaults on officers, help minimizeminimise injuries to officers and members of the public, and forestall the routine arming of the British pPolice. The search for an incapacitant spray represented the latest in a series of technological innovations intended to aid officers; other initiatives had included new side-handled new batons for routine policing and, shields for public order disturbances, and handcuffs. Later the sprays were justified as part of the response to the incorporation of the police into health and safety legislation, including the Police (Health and Safety) Regulations 1999 and the Police (Health and Safety) Act 1997.

In 1995 the decision was taken by Home Office on advice from its Police Scientific Development Branch (PSDB) to adopt a 5 percent (weight/volume) CS (o-chlorobenzylidene malononitrile) spray. The common name of 'CS' derives from the two chemists who first synthesised it, Corson and Stoughton. Variants of CS sprays have existed for more than twenty years, though their use in the United States and continental Europe has been eclipsed recently by the growing popularity of oleoresin capsicum-related ("pepper") sprays. Like most other chemical sprays, the British version it consists of three components, in this case the primary chemical agent (CS), a liquid solvent (methyl isobutyl ketone [MIBK]) and a propellant gas. The French Gendarmerie had used the 5 percent spray formulation since the late 1980s and it was therefore deemed to be safe. The sprays were believed to provide an effective incapacitant option whose effects would significant reduce within 15 minutes of exposure.

Initial internal testing of sprays began in early 1995, but was called off due to a number of serious injuries to officers who later ended up claiming compensation (Patton 1998). In March 1996 operational trials began in England and Wales. In August 1996, one month before the end of the trials, the Home Office approved the incapacitant. Then Home Office minister Michael Howard stated that they represented a 'dramatic improvement in police protective equipment...presenting no serious risk to health' (quoted from PCA, 2000, p. 1). The current Labour government later reaffirmed such sentiments. As then Home Office Minster Alun Michael said "CS spray has been scientifically tested to a level similar to that which would be required for a new pharmaceutical drug, and there is no evidence that it poses any significant threat to human health" (BBC News, 1998). To allaey fears of their widespread use, the sprays were only supposed to be employed in highly specific contexts and specific waysproscribed ways for the defence of members of the police and the public or in handling highly dangerous situations. In addition, officers and police doctors were supposed to provide aftercare for recipients and pay particular attention to certain population groups (e.g., those with contact lenses, asthmatics).

Much debate has taken place on the short and long term health implications of the sprays. Before the trial began, CS itself was associated with a variety of acute effects including a severe burning discomfort, excessive lacrimation lachymation (production of tears), cough, erythema, dyspnoea and sometimes blepharospasm (involuntary eye

winking). It is associated with conditions such as bronchospasm (constriction of airways) in asthmatics. The possible chronic effects have been and are less well known.

The Himsworth Committee conducted the most comprehensive public study of CS after the 1969 Derry riots. In light of widespread use of CS smoke grenades (so-called 'tear gas'), the Committee investigated possible negative effects. The overall conclusion was that:

> Our considered assessment of the hazards of using CS smoke is, therefore, that, despite the extreme discomfort that follow inhaling this, it is only under quite exceptional circumstances that exposure doses of inhaled CS could be received that might cause serious injury or death; and that, in conditions of civil operations, with disciplined troops and police, it is highly improbable that such circumstances could occur (Himsworth Committee 1971, p. 48).

While generally supportive of the relative safety of CS smoke or aerosol against healthy persons in an open space, the Committee acknowledged limitations in knowledge about CS. Noting the uncertainties and speculative character of much of the evidence, it recommended that "...if the competent authorities feel it justifiable to release a chemical agent for use in civil circumstances, the medical and scientific research relevant to this decision should straight away be published in the appropriate scientific journals so that informed medical and scientific opinion may assess the situation for itself" (*ibid*., p. 48). It further recommended such chemical agents should be regarded more akin to drugs than weapons. Today, the approval process for licensed drugs varies internationally, but it generally consists of four phases: Phase I tests for toxicity and safety in order to determine what constitutes a safe starting dose for later phases; Phase II consists of evaluations of safety and efficacy in a small sample target population; Phase III evaluates the comparative efficacy of a drug against existing treatments or placebos in a much larger sample; and 'Phase IV' consists of post-approval monitoring of adverse reactions to a drug as it is prescribed. While the exact meaning of what 'akin to a drug' entails is a matter of some disagreement (see below), arguably any such process would consist of the pre-approval testing of known risks and the post-approval monitoring of effects.

Since the time of the Himsworth Committeen, CS (primarily in a smoke or gas form) has been linked with permanent but non-lethal lung damage at a comparatively low dose (Jason-Lloyd, 1991), prolonged coughs and shortness of breath, heart failure and hepatocellur damage (Hu et. al, 1995) and those with aneurysms and those of an older age groups here particularly at risk (Ballantyne et. al, 1976).

THE EVALUATION OF CS SPRAYS -- "PROTECTING BY SCIENTIFIC UNDERSTANDING"

In light of the history of the research into CS, let us now turn to a consideration of CS

sprays in particular. This section examines the debate surrounding their medical effects. Throughout the initial operational trials and since, constant reassurances have been made by officials that the recommendations of Himsworth have been followed and the sprays are relatively benign. This section assesses the basis of such claims. Following the basic procedures in place for the approval of drugs, it does so by examining both the preliminary safety testing of the sprays, their trials and the post-approval surveillance mechanisms in place. An examination of these issues casts substantial doubt on statements that the approval process for CS sprays has been akin to that of a pharmaceutical drug.

Safety Testing and Research Reviews

To begin with the spray fell outside the jurisdiction of the Medicines Control Agency, the organisation responsible for granting drug approval in the UK and monitoring adverse reactions. Because of this and the failure of the Home Office to elaborate the types of tests carried out pre-approval, the basis for safety claims has been unclear. This uncertainty, in part, contributed to disputes about the merits of the sprays.

Various grounds for concern have been made in the medical literature about the experienced or potential effects of the sprays. These raise pressing questions about the exact nature of the tests done. It can be noted initially that the effects of CS depend on the dosage received and the method of its dissemination. A key point is that *sprays* entail far higher levels of irritant exposure than *aerosols* and lead to additional skin and eyes problems. As a simple means of distinguishing these two, the former spreads liquid and gas particles (e.g., as from a water sprayer for plants) while the latter disseminates mainly gaseous particles (e.g., as from a hairspray aerosol can). Thus many criticisms of the British CS spray have related to its specific product specifications. Jones (1997) has argued that the 5% CS concentration is far too high and much confusion has resulted due to equating the effects in spray and aerosol application forms. The French made spray was given a specification in the UK which demanded that it be a 5% solution and release 5 centilitres of fluid per burst which compares with US versions which contain a 1% solution and release a 1% burst. This means anyone targeted in the UK receives 25 times more irritant that in the US. Gray (1997) argued the sprays would not be used in situation imagined by the Himsworth Committee, and suggested that its supportive conclusions about the effects of CS were not applicable. In combination the effects of CS and MIBK were said to potentially be quite severe. Little research, for instance, exists about the carcinogenic potential of repeated exposures to the spray combination in relation to the skin and airways.

Besides these considerations, other worrying issues were raised during the time of the initial introduction of the sprays. While the French Gendarmerie has not systematically monitored the effects of its spray, cases of severe dermatitis and extensive blistering lasting for several days have been attributed to CS sprays in France (Pareix-Spake et. al, 1993; Trevisick, 1996). In a report in 1996, the West Midlands Health and Safety Advice Centre called into question the safety of the sprays. The Centre foundCiting the manufacturer's documentation that claimed "In

effect, the solution used has been retained for its harmlessness to the skin, mucous membranes and especially the eye" (WMHSC, 1996, p. 3) quite dubious, the Centre argued the manufacturer's information could "be regarded as disingenuous" (*ibid*.). Among other potential effects, the report cited the possibility for chemical sensitisation and chromosomal damage (see Schmid & Bauchinger, 1991).

Still, despite such concerns it was repeatedly argued that the sprays were safe. No public statements, however, had been given out pre- or post- trial regarding the basis for such statements. Thus critics of the sprays were left openly wondering about such procedures and therefore the legitimacy of the critical medical commentary made in relation to the rigour of official tests (e.g., Wadham, 1996).

Drawing on Parliamentary questions and correspondence (Jowell, 1999; Boateng, 1999ab) it is now possible to describe the extent and nature of testing on which safety claims were based. The pre-trial scientific assessment consisted of three strands: a) expert opinion (not formal research) from the Chemical and Biological Defence Establishment (Porton Down) on the likely toxicity of the combination of MIBK and CS; b) Department of Health (DoH) advice on the safety of MIBK based on "data available in standard toxicological reference books" (Jowell, 1999); and c) a Porton Down review of riot control options. The latter was complied for Jill Tan of the Police Scientific Development Branch and evaluated CS against other agents for use in personal aerosol canisters (Rice & Jugg, 1994). As stated "The aim of this report is to review the readily available information regarding the toxicology of CS in the context of its use as an incapacitant delivered from small, personal pressurised canisters as a liquid *aerosol*" (emphasis mine). In focusing attention on aerosols the review would appear to have limited relevance for sprays or conflated them with aerosols. The review further specified the need to monitor those exposed to heavy doses of CS for some time. Although solvent options were not considered in any detail, the report did note in passing that while methylene chloride (MC) was (and still is) the solvent for CS canisters in the British military service, it was believed to be too hazardous for a civilian context.

As cited in *support* of the research process behind the sprays in Parliamentary correspondence (Boateng, 1999ab; Jowell, 1999), two further Porton Down studies were commissioned *after* the trials began. The studies were initiated following internal police training sessions with the CS sprays mentioned above that resulted in injuries including "delayed symptoms commencing approximately six hours after exposure and lasting for several days" (Rice et al., 1996). Only after Parliamentarian requests were both studies placed in the House of Commons Library in 1997 along with the 1994 Porton Down report and thus accessible to Members of ParliamentPs, Lords and select others. The first study (*A Review of the Toxicology of Methyl Iosbutyl Ketone and Methylene Chloride*) was completed in July 1996 (the month before formal Home Office approval) and compared the toxicity of MC and MIBK for use in *aerosol* devices. MIBK exposures were associated with nausea, headaches, respiratory irritation and at high exposures can cause vomiting and diarrhoea. Although MC was ruled out due to health concerns, the study concluded that it posed a "significantly reduced risk" compared to MIBK. The authors "strongly

recommended that any future trials of hand-held aerosol devices... should contain MC rather than MIBK." In 1998 it was reported that the DoH overrode this conclusion (Gillian & Evans, 1998, p. 1), yet former Home Office Secretary Michael Howard was reported not to have any knowledge of the review (Clark, 1998, p. 1).

In 1997 a second study ('*A Literature Review of Solvents Suitable for the Police CS Spray Device'*) reviewed available literature on the toxicity of possible solvents for *aerosol* devices, taking into account classified research conducted on CS at Porton Down and in the United States. The authors concluded that "...it is possible to exclude a number of potential solvents on the basis of their toxicology. Several of these solvents are either confirmed or suspected carcinogens with associated mutagenic potential and clearly do not represent safe alternative solvents; we can, therefore, excluded methyl isobutyl ketone [MIBK]..." (Rice et al., 1997, p. 7). The review recommended that di(propylene glycol) and polyethylene glycol were the only acceptable known solvent options.

Shortly before the 1997 study was leaked to the media in November 1998 and in response to persistent criticisms of the sprays (see below), in October of that year the DoH Department of Health referred the safety of the sprays to its Committees on Toxicity (COT), Mutagenicity and Carcinogenicity for a review of existing research. The review was supposed to enable the first independent assessment, even in light of the DoH's prior involvement in the approval of the sprays. The review considered CS, MIBK, and the combination of the two in the existing spray form. After numerous delays, almost a year later the committees led by COT found "the *available* data did not, in general, raise concerns regarding the health effects of CS spray itself...It must be noted that no comprehensive investigation of the effects of CS spray in humans was available, nor has there been any systematic follow-up of individuals who have been sprayed with CS spray" (DoH COT et al., 1999, p. 11 – emphasis in original). The Committee further "noted the sparsity of data on the combination of CS dissolved in MIBK. There are no data available on the metabolism, kinetics, acute toxicity, or skin irritancy of CS when administered in MIBK solution." Concerns were expressed for those suffering from asthma, chronic obstructive airways, hypertension, or other forms of cardiovascular disease. The potential for dermatitis from multiple exposures was also acknowledged. All of the Committees' conclusions were based on the use of the sprays in accordance with the operational guidelines, though no attempt was made to determine whether this was the case. Given numerous uncertainties about effects, they suggested that follow-up studies be conducted on those sprayed to see if delayed effects did take place. At the time of writing, those studies have not started. , Tthis is despite the identification of delayed symptoms before the trial in 1996 as mentioned above.

In a press release the Home Office welcomed the committees'DoH findings and said the report supported their position that there was "no reason to prevent the police service from using CS spray" (Home Office 1999). Although the 1996 and 1997 Porton Down studies formed central planks of the government safety research process, neither were analysed or acknowledged. Little has been said about these Porton Down reports in public. In July 1999 the Home Office did comment that the

1997 study was only a 'theoretical' exercise (BBC, 1999). If accurate this raises questions about why the study was commissioned at all. TIn an interview with the author, the new new Scientific Secretary director of the COT (now under the Food Standards Agency) appointed since the report indicated that the committee has a policy of not drawing the conclusion of literature reviews and instead seeks to analyse 'primary' research material (Benford, 2001). Yet, despite this there are commercial studies cited in the Porton Down reports that were not cited in the 1999 COT study. Given that the findings of the 1996 Porton Down report were overridden by the DoH, the 1997 study was downplayed while theand 1994 study referred to CS aerosols rather than sprays, it appears there is little research that can justify the safety statements made since the CS sprays' introduction regarding the rigorousness of the testing.

Monitoring of operational use

Because of the uncertainties, unknowns, and questions raised by the review of the safety research above, the provisions made for monitoring the operational use of the sprays become all the more important in terms of justifying the benign effects of the sprays. As already suggested, little systematic information exists about their implications and what is available offers grounds for concern.

The official operational trials began in March 1996 and involved approximately 4,000 officers in 16 forces. The analysis of the trials of the spray, *A Rreview of Ppolice Ttrials of the CS Aaerosol* [sic] *Iincapacitant* (Kock & Rix, 1996), found a relatively acceptable risk of injury from CS spray for officers and the public. It did determine though that 78% of officers in trials experienced some amount of cross contamination due to problems of aiming the sprays, the dispersion caused by the chemicals persistence of CS (e.g., on recipients clothing), and the release of pressured gas particles in addition to the spray liquid. Overall the review indicated that officers perceived a marked reduction in assaults and a greater safety due to the deployment of the sprays. Based on assumption that the sprays were safe, officers viewed them favourably.

The findings suffered from a number of significant limitations. The review did not monitor the duration of effects or delayed complications, despite the Home Office being aware of the possibility of such reactions because of the pre-trial use of the sprays (see as well Gregory & Knill, 1998). The review was also unable to comment on the effects of multiple exposures. Figures from the trial indicated the average officer holding the sprays would use it once every 32 months and be exposed to some degree to the CS and MIBK mixture every six months because of cross contamination. This would suggest that the deleterious effects from multiple exposures would only arise after some time. In addition, while spray carrying police officers perceived a reduction assaults against them, force data does not suggest that possession of the sprays led to any noticeable reduced assaults.

The health conclusions of the trial review stand in sharp contrast to a number of other studies. In 1996 a *Dispatches* television programme surveyed a sample of those sprayed during the trials and found two-thirds suffered from skin blistering and breathing difficulties three days after exposure (Trevisick, 1996). Only 2 of the 34 people interviewed reported recovering in the 15 minutes time period. The study also found the sprays used quite frequently outside of the guidelines established to ensure their safety: few verbal warnings were issued, two-thirds of recipients were sprayed below one metre (and thus exposed to an increased risk of eye damage), only one-third were promptly moved away from area after use, no one was questioned as to whether or not they wore contact lensess even though this was associated with increased health risks in the guidelines, and finally only one in six were given information on after care.

Various grounds have been raised for not only doubting the adherence compliance of officers withto the operational guidelines, but the quality of the after care advice give to officers. The 1996 CS spray guidelines stated: '…The person who has been sprayed should be removed to an uncontaminated area where they can be exposed to cool fresh air. This will permit the CS particles to be blown off the body' (ACPO, 1996, p. 6). As pointed out by Jones (1998), while this advice may be appropriate for those exposed to CS aerosol or smoke devices, such prescriptions are inappropriate for sprays as large amounts of chemicals are disseminated through sprays and these are left deposited on the skin. In this case, CS particles will not simply blow away but must be physically or chemically removed. Further precautions are thus needed than those traditionally associated with CS in other forms. Despite the differences between CS in spray and aerosol/smoke forms, the two have been frequently confused in debates about the merits of the sprays (as in Yih, 1995; Fraunfelder, 2000).

With a limited knowledge of the testing done and due to concerns about the sprays' operational deployment, in July of 1998 the medical journal *The Lancet* called for a moratorium on their use until the further details were published regarding the basis for evidence about the sprays' safety (The Lancet, 1998). Those with experience of CS sprays in US subsequently refuted the reservations expressed by *The Lancet* (Blaho & Winbery 1998), even though these claims were made in relation to a different spray formulation with a significantly reduced concentration. Due to the sorts of uncertainties and known problems identified with the sprays, Northamptonshire and Sussex police chiefs have so far refused to introduce them and their uptake by Scottish police forces (who were not part of the original trials due to safety concerns) remains patchy.

A variety of studies into the operational effects of the sprays since 1996 have established additional grounds for concern. The National Poisons Information Service (London) has observed delayed severe skin reactions from CS sprays (Euripidou, 2000) consistent with those witnessed by Ro and Lee (1991). Instances of ocular damage (Gray, 2000) and delayed drying, flaking, and blistering (Worthington and Nee 1999) have also been documented. One officer who experienced multiple exposures was reported as suffering from allergic sensitisation and no longer able to work (Jenkins, 1999).

Such concerns have come along side ofwith repeated claims about the questionable uses of the sprays. Kossoff (1998) claimed the mentally ill persons, pensioners and children have all been on the receiving end of the sprays, in situations that posed little threat to police officers. The Police Complaints Authority (2000) has conducted an analysis of the operational use of the sprays. In an examination of a limited range of complaints against the police in one year, it found significant deviations from the original guidelines designed to minimise safety risks and evidence of the spray being used in situations for which it was not intended. In its report, the PCA recommended in the future all police forces should record injuries to the public in use of force reports. This has not taken place. The devolved governance of the UK police means that what information is held varies significantly across forces. Even if injuries were recorded, unless that data included delayed effects the results would be of limited utility in evaluating CS sprays. TOrganisations under the National Poisons Information Service plays a surveillance role with regard to this sort of chemical technology, but they the centres under this organisation only work as a responsive service for hospitals and are not in a position to evaluate the overall safety of the sprays. Individual accident and emergency departments do not collect data on injuries from police CS sprays (or any incapacitant sprays more generally) in a manner that is available for analysis.

Since the time of the PCA report, officers have received new spray *guidance* (rather than previous *guidelines*) has been issued to officers regarding the appropriate use of the spraysthat gives greater latitude for use of the sprays. There are two major changes that give greater latitude in the spray's scope of deployment. The first is that the basic rationale for the legitimate use of the sprays has gone from self-defence of officers and members of the public to the perception of violence. The second is that the guidance given is meant to be suggestive to officers and forces, rather than being binding or prescriptive.

Due to potential for long term problems arising from multiple exposures and the high rate of cross-contamination, the most at risk individuals from the sprays are police officers. Unfortunately no centrally held public information exists on the number of legal proceedings started by the public or officers involving CS sprays (Boateng, 1999c). In the absence of such data, it is difficult to know how large the health problem might be. Various stories of police and public settlements have been made in the media (see, e.g., Langley, 2000, The Guardian, 2001).

There is reason though, to think that the number of such cases is likely to be artificially low due to the advice given to officers and local Police Federation officials regarding the legitimacy of claims. A Memorandum written by the legal firm that represents officers states that they are no reasonable prospects for sueingsuing the police on the basis of the sprays being 'unsafe' (Care, 2000). The memorandum draws on the 1999 COT report and a 1983 study of CS to support this position. It quotes from the COT report that 'There was no evidence of mutagenicity, carcinogenicity or tetatogencity. It was considered that the available data did not, in general, raise concerns regarding the affects [sic] of CS spray itself'. However, no

mention is made of the conclusion of the COT regarding the 'sparsity' of data on CS and MIBK as a spray. No mention is made of the recommendation of the report to establish information on delayed effects and the failure to introduce follow-up studies. Neither of the critical Porton Down reviews mentioned above are cited. Throughout the memorandum, CS sprays are referred to as CS aerosols and evaluated in terms of the potential effects of CS rather than CS sprays.

Certain steps have been taken to minimisze the health effects posed by the sprays for the police. To familiarize officers with the effects of the sprays and to prepare them for cross-contamination, during training sessions officers are exposed to the sprays. Initial pre-trial training tests involved officers being sprayed directly in the face, as this is standard procedure for using the sprays against members of the public. After a number of serious injuries, the training policy moved from the policy of direct to 'indirect' exposure. The 1996 Guidelines state that exposure "should be achieved without spraying the irritant directly into an officer's face" (ACPO, 1996, p. 4). In practice, this means trainee officers walk on a patch of ground that has been sprayed. According to the Home Office Police Policy Directorate (1998), only a 3 percent rather than a 5 percent spray is used for the purposes. In addition, training sprays contain MC as a solvent rather than MIBK. While these steps might reduce hazards associated with the sprays, they also reduce the likelihood that possible problems associated with exposures to CS sprays would become obvious to central police management.

The possibilities for unintentional effects extend beyond those involved in the immediate encounter. Due to the lingering effects of CS, custody officers, medical practitioners, and others must take precautions in handling people and material exposed. An internal study undertaken by Sussex police force in early 1998 identified a number of problems experienced with the sprays in other forces including food contamination, hospital ward contamination and several individuals being taken off operational duties because of exposure to CS spray (Gregory & Knill, 1998).

What numbers areThe statistical information publicly available suggests the use of the sprays varies considerably, but that on average they are used infrequently, no doubt owing to considerations surrounding cross contamination (see Clarke, 1999). While this may minimise the extent of health problems, it also means the negative effects associated with multiple exposures will only become apparent over many years. As the discussion above indicates, nothing approaching the 'yellow card' scheme for monitoring adverse reactions of pharmaceutical drugs exists in the case of CS sprays. Few formal mechanisms have been in place for determining the effects of the sprays since the initial trial assessment.

The speed and type of advice given on decontamination procedures betrays the lack of urgency that characterises much of the control of the sprays. After nearly five years of use, guidelines issued by Police Scientific Development Branch in late 2000 suggested using sodium metabisulphite as a decontaminant for vehicles and buildings, a possibility first identified for buildings and humans in 1991 (Jones, 1991). Other aspects of the monitoring process give similar grounds for concern. Quality control

checks on the sprays obtained in response to journalist activities under the UK 'Open Government' Code noted significant variations in the concentration of CS (up to 6.8% weight/volume—see Wright & Evans, 1999), later deemed "operationally insignificant" (Michael, 1998).

DISCUSSION AND RECOMMENDATIONS

In response to persistent criticisms about the potential and experienced effects of CS sprays, officials in the UK have given constant reassurances about their safety and the robustness of the mechanisms enacted. Much of the force of these reassurances has stemmed from making reference to the controls in place for monitoring the safety of pharmaceutical drugs. As has been argued in this paper though, statements to the effect that the sprays have been or are regulated in a manner similar to that of a pharmaceutical drug are highly questionable. These rely on dubious assumptions about the tests done for CS and MIBK a) on their own and b) not in a spray application form. Instead of a thorough research protocol, approval of the sprays was largely based on expert opinion that was later determined to be inaccurate wanting by the same experts and while claims about the safety of CS and MIBK together have been based on a 'sparsity' of information. The existing state of surveillance mechanisms in place foster little in the way of understanding about the risk for long term implications.

Policy choices are often made in situations of uncertainty and disagreement, where the costs and benefits of particular options are not always known in advance (Burch & Wood, 1989). The history of the assessment of riot control-related chemical agents is one that has seen significant reversals of safety evaluations (Evans, 2000). What matters in such circumstances is whether organisations take proper initial precautions and learn from their experiences (see Lindblom & Woodhouse, 1993). The past and current regulatory regimes surrounding CS sprays in question afford little reason for assuming either conditionscondition are is being met. The extent to which the more long term and severe effects related to multiple exposures will manifest themselves is uncertain. While the use of weapons by the police is never risk free, governing agencies should do all that is *reasonably* possible to ensure the safety of such equipment. An examination of the case of CS sprays reveals a failure to do so.

This discussion section asks what lessons can be learned from this case. There are a number of characteristics about the debate that are worth reiterating. Much confusion has taken place regarding the distinction between CS in smoke, aerosol, and spray forms. Individuals commenting on the merits of the devices have often talked past one another due to this and other differences between incapacitants. For instance, commenting on the appropriateness of the sprays, Lord Williams (1998) argued, "...CS has been scientifically evaluated to a level similar to that which would be required for a new pharmaceutical drug and has been found not to present any significant threat to human health". What is noticeable about this statement is that it refers to CS itself rather than the CS sprays in question. As the discussion above indicates, this sort of criticism can be made regarding much of the debate about the

sprays. Moreover, this case illustrates how a series of authoritative studies (e.g. Himsworth, [1971]; Rice & Jugg, [1994]; DoH, [1999]) can influence a debate, but also how the interpretation given to these is open to question.

The characteristics of the CS spray debate are surprisingly similar to those found for Bovine Spongiform Encephalopathy (BSE) and variant Creutzfeldt-Jakob Disease (vCJD) BSE/vCJD in the UK. A recent public inquiry into BSE/vCJD (Phillips, 2000) found inadequate and untimely department response measures, unclear risk implications being stated from research, a lack of proper surveillance procedures, a non-overt decision-making process and an unshakeable belief human life was not threatened. As with the BSE, the absence of substantial indicators noting immediate and severe negative consequences has been taken as an indication of safety and while potential critical signs have been marginalized. The result in the case of BSE was avoidable suffering, the disruption of a major industrial sector of society and a substantial loss in public confidence.

In response to this and other scientific controversies in recent years, government agencies have reappraised the manner in which scientific endeavours should be regulated and how technical advice ought to be handled. Much critical commentary has been made of the British "culture of secrecy" and "bunker mentality" in relation to policy decision-making processes. In the past the overall British government system for the regulation of risky environmental and medical technologies was characterised by trust-based procedures. Arguably this situation limited the public accountability of officials (Jasanoff, 1991). According to government officials, this situation is said to have changed now. Former Trade and Industry Secretary Steven Byers (2001), for instance, called for open and transparent policy making with regard to risky technologies, where uncertainties are shared with the public.

There are major questions though about how such sentiments can and should be realiszed in practice. The case of CS sprays raisesd problematic concerns about the 'public' character of knowledge. As indicated above, while decision- making procedures and information about the sprays were supposed to be made 'public' in character, what counts as public is aambiguous matter for negotiation. While this article is based on the most up-to-date material available in the public domainEven years after the initial introduction, the original justifications for adopting the spray are still unclear. There is a need for greater transparency with regard to deliberations within the Home Office and elsewhere regarding the merits of such technologies. Had the basis of CS sprays' approval been made public knowledgewidely known when approval was given (as recommendedation by Himsworth, 1971), this would have no doubt led to further and varied questions being raised as well as calls for more rigorous surveillance procedures than those enacted. The case of the sprays has been characterised by a slow trickle of information that has not been evaluated together in systematic fashion.

Unfortunately, there appears little reason to believe this general situation will change in the near future. The recently passed Freedom of Information Act places a variety of restrictions regarding the basis of Ministerial decision making and in matters of

public safety (see Campaign for Freedom of Information 2001) that mean it would have made little difference to the case of CS sprays had it been operating from the start of their use. This paper suggests that such qualifications are ill placed.

The need for more transparent decision-making processes is also evident in the current development of so-called second-generation incapacitant sprays in the UK. In response to persistent uncertainties and various health concerns, individual police forces such as Surrey, Hertfordshire, Northamptonshire and Sussex have initiated research into alternative incapacitants. Currently, the Sussex police force is leading such initiatives. In April 2001 it began trials of spray called PAVA, a synthetic form of oleoresin capsicum or 'pepper spray'. Despite the PAVA spray passing numerous safety tests carried out on advice from Porton Down (Jenkins, 1999), the Home Office and Police Scientific Development Branch have failed to approve the spray for the trials. The debate between Sussex and the Home Office has hinged on the question of what it means to regulate something 'akin' to a drug.
It should be clear that this a matter of some considerable debate.

While this paper has focussed on a particular incapacitant device in a specific setting, its implications are more general. As stated in the introduction, the last few years have witnessed seen increasing attention to the class of non-lethal weapons as tools for resolving disputes about the use of force by the police. Despite such developments and the somewhat long standing use of some non-lethal weapons, there are no international standards or agreed procedures for determining the safety of such devices (Omega Foundation, 2000). Instead individual countries and police forces have been left to their own devices in determining what is safe or unsafe. The lack of transparency and secrecy also limit the ability of organizations to learn from each other. In countries such as the US where there is a plethora of different companies marketing a wide range of chemical incapacitants and other weapons, police forces and control agencies are highly reliant and persuaded by the (sometimes questionable) safety advise given by manufacturers (Doubet, 1997; Allen, 2000). In countries such as the UK that do not posses such an extensive private sector, decisions are often taken by particular regulatory bodies that are still reliant on somewhat wanting sources. The CS sprays taken up in much of England and Wales had been used by the French Gendarmerie for a number of years (though the much larger French police use PAVA sprays), but there appears to have be little in the way of systematic research or monitoring into the health effects of the sprays in France (Trevisick, 1996).

Given this international situation, devising proper procedures for the regulation of this weaponry is a daunting task. Systems for the regulation of risky technologies are not always transferable between different international contexts (Jasanoff, 1991). The limitations of the risk assessment and control procedures in place for chemical non-lethal weapons in the UK and Europe could hardly been said to be unique to these technologies (Klapp, 1992). Assessments procedures for risk in the control of industrial toxic chemicals and medical technologies, for instance, have been found wanting on many of the same grounds discussed in this paper. The reasons for this vary by country and are dependent on particular social and historical contexts (see Kammen and Hassenzahl, 1999).

Yet despite this diversity, arguably a central lesson that has come from the study of such innovations is the importance of the distribution of the burden of proof for safety (Thornton, 2000). Ensuring that the onus for safety in the first instance rests with manufactures is a basic step in improving the intelligence of policy-making processes (Monroe & Woodhouse, 1986). In relation to non-lethal weapons, this general prescription has application across a number of settings. In countries such as the US where there are a plethora of different companies marketing a wide range of chemical incapacitants and other weapons, police forces and control agencies are highly reliant on and persuaded by the (sometimes questionable) safety advice given by manufacturers (Doubet, 1997; Allen, 2000). In countries such as the UK that do not posses such an extensive private sector, decisions are often taken by particular regulatory bodies that are still reliant on inadequate commercial data about such products and their effects. One way of correcting this situation would be the introduction of binding licensing health and safety requirements for manufactures.

As social scientists examining the regulation of pharmaceutical drugs have argued though, licensing in and of itself does not guarantee adequate safeguards (Abraham, 1995). The regulation mechanisms must be backed with organisational control systems that make public the evidential basis of decisions as well as the criteria for making those decisions. Areas of medical uncertainty need to be defined and reduced. As with the monitoring of adverse reactions to drugs, creating open and rigorous systems for the 'post-marketing' surveillance effects of weapons is also necessary. In many cases, such as that of England and Wales, this will require institutional reforms in the way the use of force, injuries and compensation claims are monitored and made available to police officers and the public.

Without an explicit and transparent rigorous procedures for the regulation of such non-lethal weapons, there is the potential for quite a bit of negotiation over the meaning of safety claims. As has been illustrated in this paper, in such situations the danger exists of unduly optimistic assessments of the potential effects of technology being made where scientific doubt is interpreted in favour of a liberal and poorly monitored deployment. Those social scientists and others concerned with the health implications of such technology would well be advised to maintaintake a certain degree of scepticism about the claims made. To counter the problems that arise from the poor state of existing regulations, there is a need for strict licensing of the production and approval of non-lethal weapons, one that is open to the highest levels of scrutiny.

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