UK Policing and Less Lethal Technologies – an Operational, Legal and Medical Perspective

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The President: Good evening, ladies and gentlemen. Tonight we are, as it were, twice blessed – with not just one speaker but with two. Not exactly a double act since they will make presentations sequentially on their subject, which is **UK Policing and Less Lethal Technologies**.

First, we will hear Colin Burrows, who retired from the Police Service of Northern Ireland on 30 April 2002, having completed over 31 years of police service. At the time of his retirement he was the Acting Assistant Chief Constable – Operational Support. He was awarded the Queen’s Police Medal in 1991.

In 1992, he gained a Master of Philosophy degree, the title of his thesis being “The Use of Lethal Force by Police”. His career included a four year secondment to the Police Scientific Development Branch of the Home Office (1992–96), advising on operational issues and the use of technology. Throughout much of his service, he worked closely with the UK’s Association of Chief Police Officers (ACPO) in the development of concepts and procedures related to the policing of “critical incidents”.

Upon retirement from the police service he was appointed by ACPO as a “Specialist Advisor” to the United Kingdom’s co-ordinated programme on the development of less lethal weapons and the management of conflict. This has involved advising on the assessment, development and of use of less lethal technologies. This programme has been described by a Government Minister as being more detailed and wide-ranging than any other.

Colin is the author of numerous papers and articles and is regularly called upon to provide expert review and evidence. He is also chair of the International Law Enforcement Forum on Minimal Force Options.

Until December 2005, Dr Graham Cooper was a Senior Fellow at the Biomedical Sciences Department of the Defence Science and Technology Laboratory (Dstl), Porton Down. He was also the Government’s representative on the Defence Scientific Advisory Council’s sub-committee on the medical implications of less-lethal systems (DOMILL). DOMILL offers independent advice to Ministers on the medical implications of the use of less-lethal systems for conflict management by the Police and the Army.

Dr Cooper was responsible for the Dstl/MOD basic science research into the medical management of casualties from conventional weapons, computer and physical models to assess human vulnerability to weapons (including less-lethal systems), and the interaction of non-ionising radiation with the body.

Dr Cooper has also undertaken research on novel concepts for personal armours (including bomb-disposal suits), the biomechanical principles of penetrating injuries and non-penetrating impact injuries, and the interaction of blast waves with the body. He has published widely in these fields, and is co-editor of a number of books on trauma. He is a Doctor of Philosophy and a member of the Order of the British Empire.
Since December 2005, he has worked for Dstl on a part-time basis, advising on biomedical aspects of less-lethal systems, and on combat casualty care.

I am delighted to invite Colin Burrows to make his presentation.

Mr Burrows: Mr President, distinguished members of the Society, I would like to thank you on behalf of Dr Graham Cooper and myself, and the wider UK Steering Group on Less Lethal Technologies, for your invitation to speak this evening. It is on behalf of that wider UK Steering Group that we are going to address the society.

Our presentation will address the definition of “less lethal options”; the type of technologies that have been introduced by police services across the UK under the “less lethal” umbrella and the impact these are having on operational policing. The presentation will focus on the legal, operational and medical issues which are relevant to the introduction, use and post-use application of such technologies.

I will also trace the key developments and strategic approach which has been taken by the UK Police Service, in conjunction with government to the development of acceptable and effective less lethal technologies.

There is considerable international debate concerning terminology and definition in respect of less lethal technologies. Terms such as non lethal, low lethality, less than lethal and less lethal are often used to refer to similar technologies. The police services in the United Kingdom have been deliberate in referring to less lethal options and have defined these as:

“Weapons, devices or tactics designed and intended to induce compliance without substantial risk of serious or permanent injury or death.”

Background

Less lethal technologies are not new; the traditional police truncheon, which until the mid-1990s was the only weapon carried routinely by British police officers, was intended as a less lethal weapon. Also, specialist firearms officers had CS canisters and other distraction devices for use at incidents involving hostages and barricade suspects. Similarly baton rounds were available for use, but until recently, they were never used in the United Kingdom outside Northern Ireland, where their use is confined to incidents involving serious public disorder.

However, the concept of unarmed officers routinely equipped with less lethal weapons, and of authorised firearms officers having routinely available less lethal weapons is a relatively new approach. Whilst the development has been evolutionary and incremental it has nonetheless been a strategic approach developed by the Association of Chief Police Officers (ACPO) in conjunction with the relevant government departments. The current policing interest in this subject can be traced back to the early 1990s.

One of the catalysts for a strategic approach to equip police to deal with violent attacks was the tragic murder of PC Patrick Dunne, an unarmed member of the Metropolitan Police shot and killed in October 1993, as he responded to what was considered a domestic incident. PC Dunne was on cycle patrol, wearing a fluorescent jacket, dealing with a routine enquiry, when he heard gunshots. He went to investigate and was fatally shot. The tragic incident led to a review of the whole issue of “officer safety” and the relationship between routine patrol and effective armed support.

It coincided with a time when the legal situation in respect of police health and safety and protective equipment regulations was beginning to change.

The Health and Safety at Work Act had been in force since 1974, but did not apply to police officers. Chief Constables were taking cognisance of it but were not obliged to follow it to the letter. The Personal Protective Equipment at Work Regulations 1992 were enacted, but there were exemptions for the police and there was a raft of other legislation being enacted. It was not until 1997 that the Police Health and Safety Act firmly placed the police service within the full ambit
of health and safety legislation. Other regulations such as the Control of Substances Hazardous to Health Regulations (COSHH) 1998 came later; these were particularly relevant to less lethal weapons such as chemical incapacitant.

Part of the Police Services’ strategic response to the shooting of PC Dunne was a review of the nature and type of armed response and in parallel, a programme to improve the protection of unarmed officers, with a focus on body armour, batons and less lethal weapons including incapacitating chemical sprays. Work on body armour, which until this time was restricted to body armour worn by police firearms officers and officers in Northern Ireland, was extended to cover officers on routine patrol. However the more frequent threats faced by officers came not from firearms but from “bladed weapons”. It is one of the technical anomalies that materials which will stop a bullet can often be penetrated by a knife. Providing combined knife and ballistic protection therefore became a personal protective equipment issue for the UK police service and it now not uncommon to see officers on foot patrol and indeed even Community Safety Officers wearing overt body armour as a routine protection.

In respect of the style of batons used by the police there was also significant change with a move away from the traditional police truncheon. At the time this was considered so significant that ACPO engaged the Home Secretary in the debate about police batons. Scientific and technical work was commissioned, which concluded that a proper strike with an instrument designed for the purpose to an appropriately selected part of the body was more effective and potentially less injurious that being struck with a traditional police truncheon.

A new approach to officer safety was emerging: body armour and a variety of new batons including side-handle and friction lock batons were being adopted by the service and there was increasing interest in the adoption of an incapacitant spray which could be routinely carried by officers. Many of these were concepts and technologies which had been already been introduced by police forces in North America. However, the philosophy surrounding US law enforcement is very different from that in the UK. The style of patrolling, with equipment routinely carried including firearms, is also very different. It was therefore important that ACPO made sure that the policy and guidance for operational use of such equipment was placed in a distinctive UK context.

The concept of equipping every operational patrol officer with a chemical based incapacitant spray was a radical step. It was decided that the services’ approach should be for a clearly defined operational requirement against which there should be assessment of scientific and technical products followed by a medical assessment. This was followed by ministerial endorsement for any significant change to police equipment before operational trials and post-use review began. This process laid the foundation for future work and was eventually ratified in the Home Office Code of Practice on the Police Use of Firearms and Less Lethal Weapons issued in December 2003.

It was essential that the possession and use of the emerging range of equipment was placed within a “use of force framework” appropriate for the legal situation in the UK. Interestingly, s 3 of the Criminal Law Act 1967, which was and remains the primary legal reference for use of force, does not refer to police officers or distinguish a police officers’ use of force in the course of their duties from that of ordinary citizens. Nor does s 3 of the Criminal Law Act refer to or distinguish use of firearms from other kinds of force, such as placing someone in an arm lock or striking them with a baton; it simply says a person may use such force as is reasonable in the circumstance.

Behind this is the idea of the police officer being a “citizen in uniform”, who unlike his US counterparts was not deemed to hold a “privileged” position in his or her use of force, but would be accountable in the same way as the ordinary citizen and had to operate under the same legal framework.
However, the range of new equipment would produce a differently empowered citizen who could carry a range of weaponry and equipment that would be a criminal offence for ordinary citizens. This has implications for the test of reasonableness of action – and the test is that of what a reasonable constable, trained and equipped to manage conflict and intervene in potentially violent situations, should do. This raises issues about objective and subjective decision making and the extent to which operational decisions to intervene using such equipment are considered reasonable in the circumstances. The policy of an individual Police Force in respect of use of force, equipment, training and certification of competence becomes a central issue.

There were other provisions, in particular the common law provisions in respect of self-defence, interestingly with a more subjective test of officer perception of threat where a test of honestly held belief is applied. In police interventions in which self defence is raised as the explanation for use of force, issues of immediacy of perceived threat become key.

Operational decisions are not made with the quiet reflection that takes place in the courtroom, but rather in the presence of the “uplifted knife”, to take a quote from US law which has entered into the British jurisprudence on the issue. I particularly like this quotation from Lord Diplock in relation to a soldier in Northern Ireland who used force on what turned out to be an unarmed person whom he believed to be a terrorist. Whilst the reference was made in the 1970s, it is still most relevant, in defining the critical nature of decision making in life threatening situations and placing it within an operational context:

“the postulated balancing of risk against risk, harm against harm isn’t undertaken in the calm, analytical atmosphere of the courtroom but in the brief second or two in which the accused had to decide whether to shoot or not under all the stresses to which he was exposed.” (Lord Diplock, AG Ref (NI) (No. 1 of 1975) (1977))

Whilst the situation, in that case, was whether the soldier should or should not shoot a conventional firearm, the principle equally applies to whether to spray or not a chemical incapacitant or to strike or not with a baton or other less lethal technology.

The decision to trial the introduction of CS spray was supported by Government in August 1996 when the Home Secretary, Michael Howard, gave his full support to the programme. Prior to its introduction study tours had taken place in North America, France, and Belgium. Operational, scientific and medical authorities in these countries were sought out in respect of toxicology, respiratory and operational implications of using such equipment. NGOs and civil liberties groups were consulted.

There were a number of different types of chemical incapacitant sprays being used internationally by different police organisations. The decision in the UK was to go for CS irritant dispensed from a hand held aerosol canister in a liquid stream which contains a 5% solution of CS in the solvent Methyl Isobutyl Ketone (MIBK). CS is often incorrectly referred to as “CS gas”; it is important to state that CS is not a gas, it is a white crystalline substance carried normally in water or liquid, smoke or powder.

The intention was to minimise a person’s capacity for resistance without causing unnecessarily long discomfort. CS is a peripheral sensory irritant. In most cases spraying will result in the subject’s eyes being forced shut, and a burning sensation on the skin around the eyes and face. When inhaled, breathing may be affected. This will normally be sufficient to render a subject incapable of continuing an attack. However, the effects may be instantaneous or can be delayed for up to 20 seconds and officers are trained to be aware that no incapacitant is universally effective and there may be individuals on whom an incapacitant may not be effective at all or only partially so. It is therefore important that officers have other options and contingencies for dealing with the situation and do not become reliant on any one device.
It was very evident from the study tours conducted that incapacitant sprays were providing officers, for the first time, with a defensive weapon which could be used effectively irrespective of the physical strength or martial arts skill of the officer.

I referred earlier to the use of incapacitant sprays by police in North America. The most commonly used incapacitant spray there was Pepper Spray, or more correctly Oleoresin Capsicum (OC), an extract of pepper plants. In the 1990s the use of OC was sweeping the United States, changing policing entirely, to the extent that there was a trend in some jurisdictions of officers not even carrying batons, because they believed, wrongly, that they had this new magic bullet. It won’t surprise you that the magic bullet does not exist and many of those officers who went into situations only carrying sprays found out, to their cost, about the 15% of the population who are immune or on whom there is only a limited effect. Who are the 15% of the population on whom these devices have the least effect? They tend to be those who are high on particular types of drugs, particularly cocaine and PCP, those who are high on alcohol and those who have severe emotional and mental problems – the very client group that the police service is so often called to engage with.

Interestingly, if you were to look at use of conventional firearms, you will find that same grouping appearing and you will find the same difficulty in terms of effect, where the emotional arousal and physiological changes very often override the pain inhibitors and all things in the body.

Recently a number of UK police forces have been adopting a new incapacitant spray containing a substance known as PAVA (pelargonic acid vanillylamide). The spray contains a 0.3% solution of PAVA in a solvent of aqueous ethanol. A 0.3% solution has been selected because this is the minimum concentration which will fulfil the purpose of the equipment; namely to minimise a person’s capacity for resistance without unnecessarily prolonging their discomfort. The liquid stream is a spray pattern and has a maximum effective range of 2.5 to 4.5 metres. Maximum accuracy, however, will be achieved over a distance of 1.25–2 metres.

**Human Rights Issues**

The use of force raises a range of human rights issues. The Human Rights Act 1998 gives further effect to rights and freedoms guaranteed under the European Convention on Human Rights and it could not be more relevant to the issues surrounding the possession and appropriate use of less lethal technologies. Article 3 deals with torture and inhumane or degrading treatment. There is a question whether spraying somebody with a product of this kind amounts to such treatment.

In the United States, in one particular well referenced incident in which occurred in 1997 in California, police confronted “sit down” protesters who refused to move. The police sprayed pepper spray onto cotton swabs, and rubbed it across the eyelids of a number of protestors, causing significant pain as a means of gaining compliance. Unsurprisingly, this resulted in a number of lawsuits, some of which were sent to the jury in the United States District Court for Northern California, asserting that a county policy that allows the authorities to smear pepper spray ointment on the eyes of protesters constitutes an unnecessary and excessive use of force, tantamount to torture.

The incident highlights the interconnection between policy, operational practice, medical assessment and operational guidance. Was the use of the spray in that way proportional, reasonable or appropriate, or was it a misuse of technology? Certainly, I think any use of that type within a UK context would breach Article 3 of the European Convention on Human Rights in respect of torture, cruel or inhumane treatment.

Under Article 2 of the European Convention the “right to life” is protected by law and no more force than absolutely necessary should be used. This has two implications for less lethal weapons. Firstly, if there is not a less lethal option available, armed police will have to resort to a
conventional firearm with potentially lethal consequences. Secondly, there are implications in respect of secondary and longer term effects of less lethal technologies and after use procedures.

**Causation**

Within the United States, there were a number of cases where people had died after being sprayed with OC. Currently this is reported to be in excess of one hundred. There continues to be debate as to the issue of causation – that is, whether exposure to the spray was the direct cause of death. There is a similar debate (which Dr Cooper will touch on) in respect of taser use.

Determining causation became a central issue in relation to incapacitant sprays. Was it the pepper-based spray that was the cause of death, or was it to do with post arrest procedures, and were there particular high risk groups? Analysis showed that those who died tended to be obese individuals who had been restrained and laid in certain positions after arrest and restraint, leading to what we now call “positional asphyxia”. There was also a new category of high risk groups emerging in the literature, referred to as those suffering from “excited delirium”. The research revealed that these individuals exhibited a form of behavioural disturbance that went beyond the distressed state that police normally face. The features of this extreme state, referred to as “excited delirium,” include agitation, excitability, paranoia, aggression, great strength, and numbness to pain. When confronted or frightened, these delirious individuals can become oppositional, defiant, angry, paranoid, and aggressive.

There is a great deal of controversy, particularly in the US, regarding the use of this syndrome to explain sudden death while restrained.

Incapacitant spray is now widely used in the United Kingdom and all police forces issue either CS or PAVA based incapacitant sprays to operational officers.

The availability and use of less lethal options is, as we have noted, not only an officer safety issue but gives rise to a number of human rights issues.

Within Article 2 of the ECHR there is a positive duty to protect life and uphold life. The McCann case (following the killing of three IRA terrorists in Gibraltar by British Special Forces), which went to the European court for judgment, ruled that when considering the appropriateness of use of force, consideration must be given not only to the actions of those who actually administered the force but also all the surrounding circumstances including such matters as the planning and control of the incident (*McCann v United Kingdom* (1995) 21 EHRR 97). It was also held that:

> “The State must provide appropriate training, instructions and briefing to those who are placed in situations where lethal force may be used and that where a particular operation/incident was planned and controlled by the authorities, it must be done so as to minimise, to the greatest extent possible, recourse to lethal force.”

Implicitly, there is a shift in focus to encompass, beyond the individuals who squeeze the trigger or those who strike the blow, those involved in the briefing and the planning of operations – did they brief and plan the operation so as to minimise to the greatest extent possible recourse to lethal force? Not simply whether given the circumstances the firing of the shot was right in the face of the believed bomb or the believed strike, but could the response to the perceived or anticipated threat have been planned in such a way as to make resort to lethal force unnecessary or a last resort?

Minimising resort to lethal force brings the availability and assessment of less lethal options into sharp focus and raises issues in respect of the obligation to have less lethal options, and their predictability and effect. Now predictability is a particularly difficult issue. Predicting effect, even with those weapons designed to cause major injury and to cause life threatening injury and death, is particularly difficult. Many in this audience will have encountered persons in A&E departments who should, given their injuries, not be alive, let alone conscious, and yet they
remain capable of cognition and movement and often survive. You will also have encountered individuals who have suffered what appears to be a minor fall or superficial injury but their injuries are life threatening.

You can therefore envisage the difficulties faced in attempting to design a weapon system where you are trying to maximise the immediacy of effect and at the same time minimise or ideally eliminate the potential for life threatening injuries.

If we extend this to trying to mitigate against secondary or unintended potential for causing death or life threatening injury and other serious effects it brings us back to the whole issue of causation and death in custody. This was particularly relevant to the introduction of incapacitant sprays. It was not sufficient just to look at the immediate effect but to explore issues of toxicology, mutagenicity, carcinogenicity. It was therefore necessary to seek the advice of experts within the Department of Health. Key questions began to emerge: is the incapacitant a respiratory sensitizer? What are the aftercare issues and how do we manage to prevent deaths happening in custody?

The Early Northern Ireland Experience

There was a considerable body of knowledge about the effects of CS, often referred to as tear gas, which had been used across the world in dealing with serious public disorder. Its use in Northern Ireland in the late 1960s and early 1970s had given rise to the Himsworth Report which is acknowledged as one most authoritative studies on the effects of CS. The Himsworth Report included a statement that “Chemical agents should be studied more akin to the effects of a new drug than a new weapon”. As general principle, that is something that the UK government has applied to a broad range of less lethal technologies, and while it is not always been possible to test systems such as impact weapons in terms of a drug, medical evaluation and assessment of consequence of use have been required prior to approval for introduction.

Along with the use of pyrotechnic CS as a means of crowd control there was the early military use of baton rounds or rubber bullets or plastic bullets, as they are sometimes referred to. The use of baton rounds in public disorder became a very contentious issue. The International Commission on Policing in Northern Ireland chaired by Chris Patten was later to report that:

“The most controversial aspect of public order policing in Northern Ireland has been the weaponry used by the police, in particular plastic baton rounds.”

The commission also observed that:

“while baton rounds were available for use in other United Kingdom police services … although there have been some close calls, they have never actually [at that stage] been used.”

In excess of 125,000 baton rounds have been fired in Northern Ireland since record keeping commenced in the early 1970s. Between 1970 and 1989 there were 16 confirmed fatalities and one additional alleged fatality associated with the use of baton rounds. The loss of any life during public disorder is tragic, and all police action is designed to minimise the risk, in so far as this is humanly possible. Where loss of life does occur, the impact on families, local communities, and the officers involved is immeasurable. There, use was however not simply in situations of serious public disorder but within a context of political civil unrest, terrorism and armed policing with extensive military support.

The Patten Commission recommended that “an immediate, substantial investment be made in a research programme to find an acceptable, effective and less potentially lethal alternative to baton rounds”. The Commission also recommended that “the police should be equipped with a broader range of equipment which might reduce reliance on, or defer resort to, the baton round”.

The Work of the UK Steering Group

In order to progress these two recommendations, the British Government formed a UK-wide Steering Group comprising policy makers, subject-matter experts, ACPO portfolio holders, MoD and Home Office personnel with scientific, technical and medical expertise. Implicit within the approach was to review, and where appropriate develop, less lethal technologies on an all UK basis and against international best practice. It was also determined that the review should be framed within an overall context of alternative approaches to the management of conflict irrespective of whether police were dealing with threats from individual aggressors acting on their own or as part of a group.

It was essential that a structured approach was taken to the work including how to address issues of acceptability using the human rights framework. A strategic framework was developed to assist with auditing the technologies which would be underpinned by issues of legality. The four headings forming the basis of the strategic audit framework were strategic, ethical, operational and societal issues.

It was also important that the UN Basic Principles on the Use of Force and Firearms were reflected in the work of the Steering Group. The UN basic principles required that:

“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 (Article 2).”

In addition Article 3 of the UN Basic Principles required these:

“should include the development of non-lethal incapacitating weapons for use in appropriate situations … with a view to increasingly restraining the application of means capable of causing death or injury to persons.”

It will be noted that the UN provision mandates both governments and law enforcement officials to develop such technologies. The UK approach has been to articulate operational requirements and to assess commercial technologies against the requirements. I think that every commercial technology available to the Police Service has been discussed and written up and is publicly available. Where technologies existed which met the operational requirement, such as taser and water cannon, they have been subject to independent testing and medical evaluation. Where technologies have not existed to meet the exacting standards in the ACPO Operational Requirement the approach has been develop specific technologies against a tightly drawn technology-specific operational requirement.

In 2001, not long after the work on Patten’s recommendations commenced, two incidents occurred, one in Gothenburg and the other in Genoa, where during public disorder at world trade events, police officers drew their guns, discharging rounds and, in the disturbance in Genoa, this resulted in the death of a protestor. This reinforced – if reinforcement was needed – what Patten and the International Commission had said in relation to the non-availability of appropriate less lethal weapons:

“All of us began our work wanting to recommend that [baton rounds] should be dispensed with straight away. But we do not want to see a situation in which the police would have no choice but to resort to live rounds sooner than would be the case today.”

Over the last five years the Steering Group has conducted operational needs analysis, developed operational requirement, carried out literature review of commercial off-the-shelf-technologies, reviewed international approaches to conflict management, identified technologies to be developed and systemically assessed and where necessary developed alternative technologies.

This has included work leading to the introduction of alternative designs of impact rounds, water cannon and electrical conducted energy devices (tasers). An integral part of the work has
been independent evaluation of the medical effects of the less lethal technologies (about which Dr Cooper will speak).

The work has also been subject to international peer review through the auspices of the International Law Enforcement Forum on Minimal Force Options. The programme has been described by a government minister as “more detailed and wide-ranging than any other”.

Early in the programme a new design of baton round, designated the L21A1, was approved and issued to police forces in England, Wales, and Northern Ireland, and to the Army. The weapon launch platform was also equipped with a new optic sight. These design changes were very important; they changed not only the velocity of the projectile, the nature of the impact, but consistency and accuracy of the munition.

All the deaths associated with baton round usage in Northern Ireland were, with one exception, associated with head hits. The exception was a direct blow to the cardiac region.

The new design work aimed to make the projectiles more accurate, thus reducing unintended strikes to the most vulnerable parts of the body. This required not only design and development of the weapon systems but also guidelines and training for commanders and users of the system.

Use of Baton Rounds as a Less Lethal Option by Police Firearms Officers

The baton round which was eventually developed was a significantly different shape from its predecessor. It had a very flat trajectory and was a consistent accurate round, as accurate as a modern handgun at 20 metres. To achieve all of this and to optimise the consistency of the new round a complete systems approach was taken. Included within the system and consequently its evaluation was each of the following components:

• the optical sight;
• the weapon;
• the projectile;
• the operational guidance for use including post incident procures.

The accuracy and consistency of the L21A1 with the new sight enabled Ministerial approval to be given to ACPO for use of the system in situations where police firearms officers were being deployed, thus providing them with a less lethal option.

One of the first operational uses of the system was on 12 July 2001 during serious public disorder in Northern Ireland. However on the same evening Police in Liverpool were dealing with a very different situation involving a 21 year old man by the name of Andrew Kernan, who suffered from schizophrenia and was armed with a samurai sword. Police attempted to use CS spray, which did not appear to have any effect on this occasion. They were not equipped with a baton gun and the incident concluded when the police shot and killed Mr Kernan. In response to the incident, there were intensified calls for the police to be equipped with less lethal options. Mr Kernan’s mother was among those who called for the police to have other ways of dealing with violent incidents.

Four days later on 16 July 2001, there was another fatal shooting when police officers shot dead Derek Bennett at Marston House, Brixton, London. Mr Bennett had been in possession of a cigarette lighter shaped like a gun, and had caused the officers to believe was that he was in possession of a real gun. While I do not believe the availability of a less lethal weapon would have made any difference to the outcome in that case, with the incident coming four days after the Liverpool shooting there were further calls from public representatives for the police to be equipped with a broader range of equipment, including statements from the Home Secretary.

By the end of 2001 a number of Great Britain police firearms units had been equipped with the L21. The first operational firing of the rounds in England and Wales was in February 2002, by North Wales Police. A second incident occurred in Surrey, on 7 April 2002, when a man
brandishing a sword and hand gun was struck by the L21 and arrested, sustaining only bruising to his lower stomach.

The Replacement of Rigid Baton Rounds by an Attenuating Energy Projectile

The L21 baton was subsequently replaced by a new impact round known as the Attenuating Energy Projectile (AEP) in the summer of 2005. A total of 61 L21 rounds were discharged in England and Wales by police firearms officers in 46 situations where, had it not been for the availability of this weapon system, they might have had no alternative but to have discharged live rounds.

Five years after the establishment of the UK wide Steering Group, a range of less lethal weapons are available to the police:

- incapacitant sprays;
- taser;
- attenuating energy projectiles;
- water cannon.

Four publicly available reports have been published (www.nio.gov.uk/phase_4_report_on_baton_rounds.pdf) and publication of the 5th report is imminent.

Lives are being saved and the police have a broader range of equipment, and in appropriate situations, an alternative to the discharge of conventional firearms.

Arrangements are in now in hand for the chair of the UK Steering Group to migrate from the Northern Ireland Office to the Home Office.

Each of the technologies has limitations with operational implications. Incapacitant spray for example only has an effective range of between 3 to 6 feet; it has a very limited effect on certain people, and it probably takes between 5 and 15 seconds to work – a long time if somebody is threatening you with a knife or a broken bottle.

Taser has a maximum range of 21 feet and there are environments where use of electrical weapons is very hazardous.

Impact rounds, depending on the area of strike and the tolerance of different individuals, have very variable effects.

Water cannons are designed primarily for use against crowds and groups of people and have limited range and effect, dependent on how they are used.

However that is not the end of the story. Work is continuing on a very different projectile: the Discriminating Irritant Projectile (DIP). This is based not on kinetic energy effects but on an irritant that would be delivered to a violent individual’s upper body. There are several commercial products that already operate on this basis and one is used by some police services in North America and Western Europe, but we have been unable to identify any that meet our accuracy and safety criteria. The development of the DIP, as a new system, is inevitably a longer term project but work has already commenced with some positive indications so far.

The new Attenuating Energy Projectile is an impact round; unlike the previous generations of solid baton rounds it has a soft, collapsible front end. But how do you make something softer that would be as hard hitting? How do you make it less life threatening but as effective?

Similarly with taser: how can you expose a person to 50,000 volts without putting life at risk? These are typical of the difficult questions with which the Steering Group, which has access to knowledgeable people, regularly wrestles. Indeed, Dr Graham Cooper has advanced this work and he will tell you about the medical implications of less lethal technologies and in particular the work on the Attenuating Energy Projectile and Taser.

Dr Graham Cooper: Mr Chairman, ladies and gentleman. I am the Government’s representative on the independent medical panel, DOMILL. Government Ministers require an
independent opinion on the medical implications of use of the less lethal systems that Colin has been describing. It was part of the Strategic Audit Framework that Colin described.

The independent medical evaluation is undertaken by a committee called DOMILL – the DSAC Sub-Committee on the Medical Implications of Less Lethal Systems. DSAC is the Defence Scientific Advisory Council, which is a non-governmental public body advising the Ministry of Defence. The terms of reference of DOMILL are:

- advise on the biomechanical and clinical aspects of generic less-lethal systems;
- issue independent statements, based on Guidance to Users;
- advise on the risk of injury from specific less-lethal systems to enable users to make tactical decisions and develop guidance to minimise injury.

Perhaps their most important task is to issue independent statements based on the ACPO Guidance to Users, and ACPO Policy. These statements are for Ministers and they are put into the public domain, indeed into the library of the House of Commons. Independent medical advisers also advise on risks; risks that can be exemplified and discussed within the Guidance to Users. For example, if a water cannon is to be used against an individual, it is a high risk to do so if that individual is near a wall, because the water jet will throw them against the wall.

The independent committee comprises clinicians and there is also an American member. They are independent of the MoD, Home Office and the Northern Ireland Office and it is their primary responsibility to advise government Ministers.

What I would like to do now is take you through two of the systems that Colin has described to you, the AEP system, which is a successor to the Baton Round, and the taser system. Both of these systems are now in use in Great Britain.

When the independent medical assessors are considering less lethal systems, there are basically two categories. There are systems that are designed by government, and the Attenuating Energy Projectile, the successor to the L21 (which is a kinetic energy projectile) was developed by Government. There are also commercial systems, such as the taser, and part of the responsibility of DOMILL is to review the safety claims of manufacturers; in other words, you do not necessarily believe what it says on the box with regard to commercial systems. But one of the advantages of commercial systems is that there is usually some operational experience of use, particularly in North America, so there is some important information to guide the medical assessors.

AEP was developed because the independent medical statement on the L21 Baton Round recommended that Government should invest in research to develop a system that would reduce even further the risk of head injury. You have heard from Colin that when firing kinetic energy projectiles at individuals, the greatest risk is hitting the head. One way to reduce this risk is to make the system very accurate and consistent. However, an impact to the head could still occur, and what you should strive to do is to reduce the force to the head and thus the severity of that impact. The principal medical requirement for this new system was to reduce the clinical consequences of an impact to the head. I will be describing some of the tests that were done.

The AEP must also demonstrate further improvements in safety, compared to the L21, and that potential for injury behind the target at maximum range is minimised. One of the greatest risks from kinetic energy systems is missing the target and the projectile ricocheting. Once a projectile ricochets it can fly in any direction. So, while you try to minimise the risk of missing people by making the system very accurate and consistent, in operational circumstances there is always the risk of a miss and a ricochet. Additionally, the dispersion must not be worse than the L21. One can make a system very accurate by undertaking activities such as zeroing the weapons appropriately, and by training people. If you have a system that is reasonably accurate; i.e. the average point of impact is where it should be according to the Guidance; if the consistency round to round is not very great you run the risk of projectiles striking the head because of the large
dispersion. So from a statistical perspective it may be accurate, i.e. the average point of impact is at the belt-buckle, but if there is a large dispersion around this average, you can get individual projectiles coming towards the head. Plainly this needs to be minimised by high accuracy and a low dispersion (good consistency).

A great deal of work was undertaken on the AEP system. I am not going to go through all the data on these slides but would like to give you an idea of the scope of work that was undertaken. The first thing that DOMILL do when they are asked to assess a system is to look at the policy and the guidance and how the system should be used. DOMILL does not look just at the technology, they look at the whole system, the training, the accountability, and these sorts of issues. But two of the critical factors are accuracy and dispersion, and on this system there was a considerable quantity of work undertaken comparing the accuracy and the speed down range with that of the L21, and how consistent the projectile was. The basic objective of all this work was to compare the likely incidence of impact to the head from the L21 and the AEP.

Skull fracture and brain injury are obviously very critical issues. The primary design aim of the new AEP system was to reduce the clinical severity of impact to the head. Many tests were undertaken on a variety of model systems, and this highlights one of the problems that DOMILL had: using appropriate models to predict human injury from these sorts of less-lethal systems. Various model systems are used, both computer based and physical. One example is the bovine scapula; there is now good experimental evidence to show that it is a very good analogue for certain parts of the human skull, at least for the purpose of analysing skull fracture. Many tests were undertaken using this model and comparing the AEP and the L21, and the severity and incidence of fractures observed. Extensive mathematical modelling was undertaken in parallel to the physical tests. We cannot predict quantitatively the risk of skull fracture from the models should one of these projectiles hit the skull, but what we can do is to compare the model responses to the L21 and the AEP. Does the AEP have a reduced risk of fracture compared to the L21? Yes, it does. But, as we all know, fracture is just one issue, because we also need to determine how energy is transferred into the brain. Mathematical modelling was undertaken (I will not go into the details) to predict how the projectile breaks the skull, the characteristics of the pressures generated in the skull (that reflect within the skull and do damage to the brain), and to compare these outputs from the L21 and the AEP.

The pressures predicted to occur in the brain when the L21 strikes the skull are shown on this slide. You can see waves bouncing around in the brain within the skull cavity; they are intense pressure waves within the brain capable of doing damage, and when you compare these to those from the AEP incorporating energy attenuating features, it is evident that the pressures in the brain with the AEP impact are much less.

These sorts of computer models and physical models are used to try and compare the risk of brain injury from the two systems.

How about skin penetration? These are non-penetrating projectiles and they should not penetrate the skin, and certainly not perforate the body wall. There are a number of models used to assess perforation risk: physical models, which are based on gelatine and chamois hide, and computer models. The computer model shown on this slide shows the L21 and AEP projectiles striking the skin, and predicts the stresses to the skin; from these data we can compare the potential for the two projectiles to lacerate the skin.

Chest injuries are very important. There is certainly a history of people struck with the old baton rounds having pulmonary contusions, illustrated on this slide, and the government has invested a great deal of money in developing model systems to assess this risk. On this slide is a physical model of the human chest; projectiles can be fired at this artificial body wall and by measuring and comparing the velocity at the body wall from the two systems, predictions can be made of the risk of internal injury to the chest.
All these assessment systems require considerable investment, which the government has provided.

As I mentioned at the outset, ricochet is a very important issue, because if targeted subjects are missed and the projectile strikes the ground, there is an increased risk of striking heads. Tests to compare the risks from the two systems were undertaken by firing them at piles of rubble, and at walls and doors. The projectiles were tracked in three dimensions to determine where the two types of projectiles were heading, and the risk of striking the heads of personnel within a crowd.

DOMILL concluded with regard to the head that with the new AEP projectile there was a low risk of striking the head and that, on the basis of the modelling I have just shown you, the AEP produces lower pressures in the brain, lower risk of skull fracture, lower risk of penetration into the brain by the projectile and there was a much higher incidence in the models of no fracture at all from the AEP.

So, on the basis of this sort of modelling, they concluded that the AEP is likely to result in less damage to the brain and skull than the L21.

However, they warned, “the clinical impact of the reduction in brain damage cannot be quantified because of limitations in current models”. There are very few models of human injury that can deal with these sorts of fast impacts. In fact, it is not possible to actually quantify the risk from these sorts of systems. The available approach is to observe what has happened operationally with the old system and then in the laboratory to compare the response of various physical and computer models to impacts from the old and new systems to determine whether you are actually deriving safety benefits.

I want to focus a little more on the M26 and X26 tasers. In simple terms, tasers work by firing out two barbs which attach to the body. An electrical current will pass from one barb into the body, and back through the other barb into the unit. This produces tetanisation of the muscles and the person will collapse. Overall, it is a very effective system. There are two sorts of taser, the M26 and the more recent X26.

Current ACPO Policy with regard to the use of taser allows it to be used by firearms officers in situations where an authority for firearms will be granted in accordance with the ACPO Manual. It is a potential alternative to the use of lethal force.

The UK government undertook a very wide-ranging review of taser technology. This was the first time that an independent review of this technology had been undertaken. Most of the information available up to that time came from the manufacturers. The Home Office Scientific Development Branch did an extensive study of tasers, looking at how officers could potentially use them, the nature of the electrical output, the accuracy and other performance attributes. They compared them to the ACPO generic Operational Requirements for less-lethal systems:

- accurate and discriminating;
- instantaneous effect, and sufficiently long lasting to achieve control;
- operational range of 1–50 m;
- ease of deployment and operation;
- suitable for use with other less lethal options;
- suitable for a range of environmental conditions;
- an audit trail of usage.

The taser does not meet all these ACPO Operational Requirements; it has failed the range requirement, for example; but nevertheless ACPO considered that it filled a very critical gap and DOMILL was tasked to undertake an independent medical assessment of tasers used according to the ACPO Policy and Guidance.

It is worth highlighting the statement at the bottom of the slide: “Any application of force carries a risk of injury”. DOMILL categorised the principal risks. There may be a disturbance of normal heart rhythm; in the worst case it could be ventricular fibrillation. Drug use, strenuous
exercise, heart disease may predispose to ventricular fibrillation, and there is possibly also a risk to pacemakers. There may also be physical injury associated with taser use; i.e. if both barbs land on the subject and the subject drops, there may be a risk of head injury; there may also be skin damage from the barbs. And of course there may be coincidental injuries that are not related to use, such as self-inflicted wounds. These are the general categories of trauma that could potentially occur in an incident in which taser was deployed and fired.

The questions that DOMILL posed (which were actually addressed on their behalf by the Defence Science and Technology Laboratory and funded by the Home Office) were, first of all: can taser pulses actually affect heart rhythm? 50,000 volts are applied to the chest. Do the M26 and X26 differ in terms of electrical output? Do they differ in respect of affecting cardiac rhythm? Secondly, do drugs affect heart excitability, irrespective of taser use? It has been found with the ACPO use of tasers that around about 60% of people involved in these incidents are intoxicated by either drugs or alcohol. If a subject has taken drugs, say PCP or cocaine, does this make his heart more excitable; i.e. are these drugs pro-arrhythmic? Thirdly, what is the evidence for death caused by or related to operational use of taser in the US? Have there been deaths in the US caused by tasers?

DOMILL have produced three medical statements on tasers. The first was in December 2002 and, following that medical statement, the Home Secretary agreed to a trial in five forces, and that commenced in April 2003. With the successful completion of that trial and further work undertaken by DOMILL, a second statement was issued in July 2004, and in September 2004 the Home Secretary agreed for the provision and use of taser in all forces in England and Wales. During this time, Taser International introduced the X26, and so a separate statement was also required with regard to the risks from the X26.

The first statement addressed the M26 and was the outcome of a very thorough review of the medical literature and operational literature; over 800 references were reviewed. DOMILL considered that it was unlikely that operational deaths had been caused directly by tasers. They concluded that the risk of life threatening or serious injuries from the M26 appeared to be very low. They recommended that more research should be undertaken. They asked Dstl to predict the magnitude of currents flowing in the heart. If you put current into the body via the surface, some of that current will access the thoracic cage and will flow through the heart. What is the magnitude and shape of the current waveform? They also asked Dstl to determine the effect of drugs on the excitability of the heart. They also required that medical briefing notes be prepared. Three sets of briefing notes were drafted: any subject that is exposed to taser has a briefing note explaining to them what has happened to them, and the after-effects they can expect. There are also briefing notes for the subject’s General Practitioner and also for an Emergency Medical Department.

The second statement reviewed the independent trial report in the five forces by Price Waterhouse Coopers; they wrote a favourable independent report on the use of tasers from an operational perspective. Dstl undertook a further review of the risks to pacemakers and other implanted electronic devices. We don’t have time today to go into the details, but there is a low risk to pacemakers and other electronic implantable devices.

For the work Dstl undertook addressing the pro-arrhythmic effects of drugs, a simple but well-characterised in vitro system was used. The pro-arrhythmic potentials of Ecstasy, PCP, cocaine, cocaethylene, methamphetamine, morphine and tetrahydrocannabinol were investigated in the sheep Purkinje fibre model. Prolongation of the action potential was the metric employed. So did drugs make hearts more prone to disturbances of rhythm? PCP and Ecstasy prolonged the action potential, and there was evidence from the literature that others such as cocaine may have adverse cardiac effects. The conclusion that DOMILL came to on the basis of this work was that the risk of an adverse response in the context of tasers, or indeed any other form of use of force, for example, during the arrest and detention of individuals, may be higher after use of some of these
drugs. Their second statement concluded that on the basis of the additional work undertaken, the risk of life threatening or serious injury from the M26 was very low.

When undertaking medical assessments it is essential to make an appropriate medical audit of use, and they requested that they be advised of forensic medical examiners’ reports and operational reports for all uses in Great Britain; this has occurred. DOMILL reviews the ACPO information and forensic medical information of all operational uses of tasers.

The third statement compared the existing M26, which the Home Secretary had authorised for use, and the new X26 developed by Taser International. There are differences between these two systems. For example, this slide presents the characteristics of the pulses of energy that are applied to the body by M26 tasers. These are very short pulses of 50 millionths of a second and they repeat at 38 times a second. The X26 is a different sort of pulse. It’s of longer duration, it has a more negative component and it repeats at a different rate. They are different systems from an electrical perspective. They may have different effects on the heart, and so additional work was undertaken on the X26 to compare it with the risks from the M26.

This was achieved by developing a computer model that predicted the flow of currents in the body. The currents flowing in the heart were predicted for both the M26 and X26 tasers. This slide shows a lateral view, of an electromagnetic version of a human being. The taser probes and the heart are shown. The computer predicts the shape and magnitude of currents in the heart, and so for various barb separations, the peak current in milliamps/mm² flowing in the heart is shown. You can then take the predicted current and apply it to an isolated beating heart in the laboratory, and determine whether the predicted currents can change its rhythm. Can you affect the rhythm with the taser currents predicted to flow in the normal heart?

The worst case scenario is that the currents will provoke ventricular fibrillation. The conclusion of the work was that if you take the currents that are predicted to flow in the heart and apply them to beating hearts, they will not induce ventricular fibrillation. To invoke VF, one has to increase the currents; with the X26, greater than 240 fold increase is required before you may induce ventricular fibrillation. This slide demonstrates the pressure in the heart ventricles during a taser application – there is no disturbance in rhythm and it is not going into fibrillation. But if you take rectangular pulses, you can make the heart fibrillate – this is used as a positive control. So the preparation can fibrillate to square pulses, but the taser predicted currents (magnitude and shape) will not induce fibrillation, even when increased to between 70 and 240 fold for the two taser technologies.

Ventricular fibrillation is a serious manifestation of disturbances in cardiac rhythm. Are taser predicted currents capable of producing effects such as Ventricular Ectopic Beats? How far below the threshold for VEBs are the taser currents? The in vitro model showed that the predicted taser currents are a factor of at least 64 below the VEB threshold. There is quite a wide margin of safety from the taser currents flowing in the heart.

DOMILL concluded that it is unlikely that the M26 and X26 will affect heart rhythmicity, but they did consider that drugs, heart disease, exercise may modify the threshold. The early work had shown that certain drugs, such as PCP and Ecstasy, may be pro-arrhythmic; they will reduce the threshold for adverse effects on the heart. In operational circumstances officers need to be aware that subjects whom they believe have consumed drugs may be at additional risk. Although these risks are probably very low officers need to be aware of them and to be observant.

On the basis of the modelling and in vitro tests, DOMILL concluded that the cardiac risk of the X26 was less than the already low risk from the M26.

We then come on very briefly to some of the other issues that have arisen: the report of deaths in people who have been subjected to taser. Amnesty International published a document in which they report that between January 2001 and November 2004, 74 people died in custody in incidents where taser had been used (with other force options). They have undertaken a further analysis of 16 autopsies, and they believe that in seven of these deaths, the taser contributed to
that death. We have a very difficult issue here. Is there evidence that tasers have actually caused the deaths? What is the evidence that the tasers have contributed to the deaths, or has taser just been associated with other force options and not contributed to the death? The evidence is that there has never been a death directly attributed to a taser, but there have been some deaths in which Amnesty International and medical examiners believe that the taser contributed to the death along with other force options.

As far as use in Great Britain is concerned, there have been over 200 uses of tasers. DOMILL have audited these uses and there has been no evidence of unexpected or serious injuries in the use of tasers in Great Britain.

The UK government was at the forefront of independent research into taser risks and the US Department of Defence, police organisations in Canada and other nations have also done research audited by independent panels, and the general conclusion is that the risks from tasers are very low.

DOMILL concludes that if tasers are used according to ACPO Policy and Guidance there is a very low risk of direct cardiac events. There is no unequivocal evidence for directly caused deaths in the US and Canada, even in higher risk groups. There have certainly been some associated delayed deaths, but the general view of the independent medical panels that reviewed these is that it is unlikely that taser contributed, though there is some dispute. Certainly in five cases, medical examiners believe that taser, along with other force options and other factors (such as drug use), probably contributed to the death. The medical audit of use in Great Britain is absolutely essential and DOMILL are offered reports on every instance of taser use in Great Britain. Overall, the taser is a low risk option.

I would like to finish now on some of the key points gathered from our experience regarding medical evaluation of less lethal systems. It is very important to acquire independent medical opinion and to publish it. All the medical statements I have described, the statements on the AEP, water cannon, taser, are publicly available; they are published on the Northern Ireland Office website and in the library of the House of Commons.

We have to be very cautious of commercial claims. It is absolutely critical that Government undertakes independent assessment of these claims, which requires considerable investment. We need to understand the difference between hazard and risk. Any use of force is hazardous. What the authorities try to do, with Guidance, Policy and identifying risks to users, is reduce the actual risk of an adverse effect.

We need to use appropriate injury models. I did not have time to go into this today and it gets rather technical, but trying to predict effects from very short duration currents or from very fast projectiles is very difficult; the models are simply not available. We end up in this difficult position where we can’t actually predict in absolute terms what the risk of a serious adverse effect is. All we can do is review the operational data we have, and do tests on a variety of mathematical and physical models to try and compare the hazards from the existing and new systems, and thereby make qualitative assessment of the risks from operational use.

Colin described the importance of assessing “systems”, not just the technology. This is very important. DOMILL do not assess technologies, they assess systems. They consider the Guidance and Policy as well as the technology.

It is also very important, particularly with novel systems such as tasers, that we brief medical practitioners. Many medical practitioners will not know what a taser is and will not understand the potential risks from tasers.

My final point is that we can apply rigour in the laboratory to predict outputs such as the pressures in the brain, the risk of skull fracture, stresses in the skull and the currents in heart, but these are outputs of models – representations of real systems. They give us some guidance, but they don’t predict risks absolutely, and so it is extremely important we also audit the results from
operational use. We need to understand how appropriate and reliable our models are and we must recognize that laboratory studies are not equivalent to results from operational use.

Thank you very much. (Applause.)

Discussion

The President: Thank you very much, both of you. It is reassuring to hear how much thought and how much work is going into producing weapons and systems which will disable wrongdoers without harming them in the way that we hear so much about every day of the week. However, I heard only recently that the only way to disable a suicide bomber was to shoot him in the head. We have time for a few questions.

Dr Edward Josse: I am basically a forensic medical examiner and I have seen the use of tasers and been very impressed with them. However, I really wanted to ask a question on CS spray. I am also a chest physician, so I see quite a number of individuals who have been exposed to CS spray and then asked to blow into an evidential breath machine, and it is difficult. Now the forms, the NGGDA Form, which is the form used by police, say that there should be a 30-minute lapse between exposure to CS spray and use of the evidential breath machine and, talking to my colleagues, it was expected that it was to allow respiratory problems to resolve and that after time they would do so, but on enquiry from Forensic Science Services that was not the position at all. It was because the diluter for the controlling agent could contain alcohol and the alcohol would have been sprayed on the clothing of the individual, possibly into his mouth, and cause an abnormal reading on the evidential breath machine. You will know from the literature on the use of CS spray on respiratory effort that it may cause problems for hours and days later, so I just wanted to hear your views on this particular point, namely of using CS spray and then asking individuals under the Road Traffic Act to provide a specimen. Do police officers recognise the fact that there may continue to be problems with these individuals long after the event?

Dr Cooper: I am not aware that CS causes bronchial constriction. Certainly with pepper spray there are some potential medical problems associated with its use. I am not an expert on irritants, so I can’t really answer your question.

Mr Burrows: Could I just make a comment about CS. CS is used in three different scenarios and in three different products. The first is in the spray formulation that I spoke about in the presentation, another is in a tear gas form – I don’t like the term, because it is not a gas. It can also be fired from a shotgun into a room, particularly where there are hostages, to cause confusion and give the entering forces an advantage, and it can be sprayed directly on to people. What is different in the three cases is the carrier used to convey the CS particles and the size of the particles. Primarily the CS which is used in the spray is designed to get into the eyes, and the reason it works on the street is not because the person starts coughing and wheezing. The eyes close, light becomes painful and if you force your eye open you will see. When you can’t see you start reaching out to secure your position, people often reach for the ground and officers usually at this stage go forward to assist. The eye closing provides the primary effect that gives officers a operational advantage when the spray is used. In the other applications it is the coughing, the wheezing, tearing, etc, and that is controlled by the size of the particles. Normal recovery time is about 10 to 15 minutes, normal recovery time. The only point I would make is that if officers have to resort to this spray when dealing with a violent motorist, their primary concern is their own safety and it is only after they have secured the offender that they can they consider the implications in respect of drink drive legislation.

Ms Selina Lynch: You mentioned the range for the taser and I wanted to know what the range is and whether there is a difference between the types of taser that you spoke about.

Dr Cooper: 21 feet. That is the theoretical maximum operational range. In practice, in tests undertaken by the Home Office Scientific Development Branch it is more like 15 feet. I mean, the
ideal would be to have a taser without wires. It has been worked on in certain laboratories, but it is a long way off.

**Mr Burrows:** The reason is that with the present design of tasers the wires actually connect the subject to the power supply, which is inside the taser, and the wires remain connected to the gun. The wires are only 21 feet long, but you must get both barbs to strike and to impact into the clothing or the body to have an effect.

**Dr Cooper:** If you miss with one of the barbs it won’t work. There have been cases where the second barb has landed on wet ground and you will then get a contact through the wet ground to the person.

**Mr Burrows:** It happened in London within about two months of the taser being introduced.

**The President:** May I on behalf of all of us here thank you both very much indeed for a very informative and interesting presentation. It was very useful. There are a number of coroners in the audience who will find this extremely useful. On behalf of the Society may I offer you, Colin, that, and Graham, this, small token of our appreciation.

**Dr Cooper:** Thank you very much.

**Mr Burrows:** Thank you. (Applause.)