

1-1-2008

# Laser Weapons: An Emerging Threat

Robert J. Bunker  
*Claremont Graduate University*

Dan Lindsay

---

## Recommended Citation

Bunker, Robert J., and Dan Lindsay. "Laser Weapons: An Emerging Threat." Spec. issue of FBI Law Enforcement Bulletin. Apr. 2008: 2-7. Print.

This Article is brought to you for free and open access by the CGU Faculty Scholarship at Scholarship @ Claremont. It has been accepted for inclusion in CGU Faculty Publications and Research by an authorized administrator of Scholarship @ Claremont. For more information, please contact [scholarship@cuc.claremont.edu](mailto:scholarship@cuc.claremont.edu).

# Laser Weapons An Emerging Threat

By ROBERT J. BUNKER, Ph.D., and DAN LINDSAY



Laser and beam weapons have been the stuff of science fiction lore for many years. Good science fiction, however, is based on some kind of science fact and, if done properly, will become less implausible over time. This now is occurring with lasers—both when used in an improvised weaponry role and when produced as dedicated laser weapons.<sup>1</sup>

Military entities have debated the implications of a shift to laser and other forms of directed energy weaponry for quite some time. In today's world of terrorist plots and increasingly violent criminals, the law enforcement community must become aware of this development as well. While most information on the topic has been military in nature, a growing body of literature has begun to focus on the terrorism potential and criminal use of laser systems against civil aviation and airborne and ground law enforcement assets.<sup>2</sup> This law enforcement threat has emerged in tandem with a marked increase in lasings and illuminations over the past decade and the national tracking of these incidents by the Federal Aviation Administration (FAA).

Other issues of interest touch upon law enforcement's future utilization of lasers and directed energy weapons and citizens' future right to bear laserarms (handheld laser weapons). A

brief look at the early emergence and development of firearms can help explain what now is taking place with lasers.

### Legacy of Firearms

Firearms have existed for well over 500 years. Prior to their emergence, however, less sophisticated forms of weaponry included the sword, spear, lance, and bow. During the transition to the modern world, the longbow and crossbow, the two reigning missile weapons of the medieval era, were successfully challenged and eventually replaced by the more advanced firearm first introduced to the battlefield in the 14th century.<sup>3</sup>

Early handheld firearms looked like miniature cannons. Wooden sticks were strapped to iron pipes with one end blocked and a touch hole bored so as to ignite the crude gunpowder mixture. Glowing sticks and wires brought to the touch hole served to fire the weapon, which shooters pointed in the general direction of the target because aiming was impossible. From these humble beginnings, firearms evolved over the course of centuries into true handheld weapons with many recognizably modern components. Gains in standoff range, accuracy, lethality, and reliability became dramatically evident as sophistication increased.

Firearms—then characterized as crude and unreliable—beat out competing weapons of



*Dr. Bunker is the CEO of a security consulting corporation in Claremont, California.*



*Chief Safety Officer Lindsay serves with the Ontario International Airport, as well as the Los Angeles, California, Department of Airports and its Airport Law Enforcement and Protection Services.*

late medieval and early modern times because they offered potentials the other, then dominant, systems did not. Whereas both longbows and crossbows had exhausted their human and quasi-mechanical power sources, firearms began to exploit the deadly force capability provided by chemical reactions and internal combustion. This new and advanced weapon ultimately would take down the old medieval order by shooting the knight from his horse and breaching the high walls of the lord's castle.

This end state came about by means of a gradual process. The development of the musket into the rifle and the addition of the bayonet culminated in the ascendancy of the modern firearm as the dominant system in warfare. In tandem with long-gun evolution, pistols became

available for military and eventual policing functions, and siege, later field, artillery began to emerge on the battlefield.

### Transition to Laser Weapons

As in the transition from medieval to modern weaponry, legacy systems, such as conventional firearms, will not be supplanted overnight. Still, this process of weaponry evolution will not occur over centuries but in mere decades as a result of the ever-increasing pace of technological innovation.

It is projected that an incremental process will unfold over the course of many decades as lasers, and other forms of directed energy weapons, emerge haphazardly as components that will augment firearms (e.g., laser sights) and also be fielded as stand-alone systems both

---

complementing and challenging firearms.<sup>4</sup> As energy source output, transmission efficiency (lessened energy loss), storage, and reliability increase, so, too, will handheld laser weapon capability. For this reason, this developmental pattern, except for its historically compressed nature, will likely mimic that of the firearm.

Beyond offering advanced power source exploitation potentials over firearms, lasers possess several enhanced tactical and operational functions.<sup>5</sup> Moreover, for policing purposes, the most significant of these capabilities include those identified as exploiting fifth-dimensional operational space.<sup>6</sup>

- **Speed of light:** Because a laser beam travels at 186,000 miles per second, no time of flight exists for it to hit a target. As soon as the trigger of the laser weapon is pulled, the target has been engaged.
- **Energy concentrated on the target:** Unlike many omnidirectional munitions, all of the energy of a laser is focused in a coherent beam upon the target. The smaller and tighter the beam, the more energy is concentrated at the point of impact.
- **Straight line of flight:** No fire control is required to calculate a ballistic trajectory and lead.

Whatever is aimed at is hit, based on a straight line of sight and flight.

- **Extreme standoff potential:** Stronger lasers have stand-off ranges in excess of most modern firearms; however, beam coherence issues arise at extreme ranges of laser employment.

**“  
A laser, like  
any other device  
or weapon, may be  
employed by criminals,  
terrorists, or military  
combatants.  
”**

- **Silent:** No detonation or back blast is required as a by-product of operating a laser because no internal combustion or chemical reaction takes place to power the laser beam.
- **Potentially invisible:** Infrared lasers are invisible to the human eye, thus typically undetectable without infrared detection equipment. In the case of visible lasers, they can be pulsed, thereby limiting the opposing force's ability to detect their use.
- **Deep clip:** As long as a power source exists, a laser can continue to operate,

which eliminates the need for large quantities of ammunition. The only real potentially inhibiting factor is overheating because of long durations of use.

- **Rheostat:** The energy levels produced can be increased and lowered, allowing for the more tailored application of force. Low levels could cause less lethal effects, while more energy emitted could result in lethal-force applications.
- **Frequency shifting:** Tunable lasers, those with shifting wavelengths, are highly resistant to countermeasures based on filters that block known threat wavelengths.
- **Unique wounding:** Corneal and retinal damages to the eyes may take place with low-energy lasers. Besides thermal effects, the potential for photochemical changes in the eye also may result from some laser injuries. Combinations of charring and lacerations may occur with high-energy laser injuries, which require a far more complex medical response than ones produced by standard firearms.
- **Psychological impact:** Once personnel, both military and law enforcement, realize that utilizing magnifying optics or viewing the operational space with the

naked eye can pose the risk of being injured or blinded, their mission performance could become degraded. This is compounded by infrared laser use because damage to the eye can be taking place without the target initially even knowing that it is happening.

### Target Sets

Laser devices and weapons have disruptive (visual) and destructive (primarily thermal) effects upon their targets. Under normal viewing conditions, weaker low-energy lasers have only disruptive effects, whereas stronger ones also have eye damage and destructive capabilities that allow them to start fires and either melt or burn through objects that have little density. The weaker lasers, such as laser pointers, typically are effective at night for vision disruption purposes, while the stronger systems can be used both in daytime and nighttime conditions. A laser, like any other device or weapon, may be employed by criminals, terrorists, or military combatants.

The target sets that can be disrupted, and potentially destroyed, by using lasers are pretty much the same for both law enforcement and civil aviation applications. However, civil aviation tends to have many more soft targets, such as fuel trucks, even though police

helicopters are much softer targets than passenger airliners.

Tactics, techniques, and procedures for individual user and opposing force laser applications can be generated for law enforcement red-teaming purposes.<sup>7</sup> Needless to say, as with any targeting endeavor, weapons effects can be matched to target-set weaknesses and vulnerabilities, and a reasonably competent operations plan can be constructed. In this instance, the eyes (vision) of law enforcement and commercial aviation personnel are the greatest vulnerabilities.

### Conclusion

Several years ago, one of the authors characterized the emergence of lasers and directed energy weapons as a

“new gunpowder revolution”<sup>8</sup> and still adheres to that observation. Laser weapons and devices will have an immense impact on future policing activities, especially in the coming decades when they mature as systems and eventually move along the continuum from exotic to what will be considered more conventional weapons. This impact is projected to come about primarily because of two broad waves of change in this type of weapon’s usage.

The first, derived from negligence and ignorance, represents the vast majority of incidents, criminal intent, and eventual terrorist and global insurgent use of these systems.<sup>9</sup> Millions of handheld laser pointers and other low-energy laser devices have been

### Target Sets

#### Law Enforcement

- Personnel (line officers, specialized units, supervisors)
- Matériel (police cars, helicopters, fixed-wing aircraft, equipment)
- Infrastructure (buildings, communication systems)

#### Civil Aviation

- Personnel (pilots, flight crews, passengers, maintenance staff, rescue workers)
- Matériel (aircraft, fuel trucks, equipment)
- Infrastructure (terminals, control towers, radar, communication systems)

## *Airborne Law Enforcement Laser Illumination*

By Alfredo Parra, Jr.

At about 10 p.m. on March 21, 1998, I was the flight officer aboard the Ontario, California, Police Department's helicopter orbiting a burglary in progress. As I was directing ground officers to the suspect, the pilot, Pete Ambriz, told me that we were being illuminated by a laser. Fortunately, he could maintain control of the helicopter. After officers took the suspect into custody, Pete turned in the direction of the laser and flew about 500 feet above the ground. Our aircraft, modified with two strobes for low-level operations in the area of our international airport, also had a 50-million candlepower searchlight, so we could be seen for miles.

At that point, I was looking at the horizon and saw the laser beam. It was angled from the ground below and to the left of the aircraft and was not bright enough to cause concern. Suddenly, however, it moved up and right and, within an instant, a bright intense red light covered the front windscreen and interior of the cockpit. The beam was too bright to see through, and there was no visibility to the front of the aircraft. I could see the beam moving, and, occasionally, I could see forward as the beam tracked our aircraft. I saw Pete flying while looking out the left side of the aircraft as he kept his heading. After about 10 seconds, I saw the beam move downward, fade, then turn off. As the beam was moving away from the aircraft, I could clearly see its source. The beam was so intense, straight, and bright that it pointed like an arrow to its source. As it was turned off, I saw it glow down and move north at the rear of a house and then inside what turned out to be the rear sliding door. Later, I determined the distance to be just over 1 mile, or about 14 city blocks. I learned from the manufacturer of the device that, at that distance, the beam would have been approximately 7 feet in diameter.

I directed Pete to the home and had a ground unit respond. The officer contacted the suspect and retrieved the device. The suspect subsequently admitted aiming the device at the helicopter and eventually pleaded guilty to a misdemeanor violation of California Penal Code Section 247.5, Discharging a Laser at an Aircraft. He was sentenced to 3 months in the county jail and 3 years on probation.

---

*Detective Parra serves with the Ontario, California, Police Department.*

---

manufactured over the past few decades, and now dozens, if not hundreds, of them are directed at civil, commercial, military, and law enforcement aircraft; police and emergency services personnel; professional and

amateur athletes; bus drivers; and everyday citizens on a yearly basis. Fortunately, the majority of these devices, under normal viewing conditions, do not pose eye hazards. Still, these lasers may offer significant

visual disruption potentials. Regardless of user intent, this wave of change already has begun and is based on lasers as threat systems to law enforcement officers. An eventual component of this wave

of change will be the creation of law enforcement policies, tactics, and countermeasures with respect to laser threats.<sup>10</sup>

The second wave of change is expected to be based on the utilization of lasers and other directed energy devices by law enforcement agencies themselves. This can be seen today with laser sights added to firearms and the use of laser dazzlers as less lethal forms of force. While this wave of change remains immature, over time, more and more directed-energy capabilities will be implemented for law enforcement use.

With such scenarios in mind, the law enforcement profession must recognize that lasers are emerging as the weapons of the future. Just as the firearm ushered in the modern era, the laser will profoundly influence what transpires for succeeding generations. ♦

#### Endnotes

<sup>1</sup> The authors' past writings on laser threats include Dan Lindsay and Robert J. Bunker, "The Laser Threat to California Airborne Law Enforcement," *The Journal of California Law Enforcement* 34, no. 2 (March-April 2000): 12-20 (an earlier version, "The Laser Threat to Airborne Law Enforcement," appeared in two parts in *Air Beat* (November/December 1998, 26-29 and January/February 1999, 14-16); and Robert J. Bunker, "Terrorist Laser Employment Against Civil Aviation: Issues, Concerns, and Potential Incidents," *Transit Policing* 8, no. 1 (Spring 1998): 7-8 and 21-28.

<sup>2</sup> U.S. Department of Justice, Federal Bureau of Investigation, FBI Academy Library, *Subject Bibliography: Laser Devices and Weapons* (Quantico, VA, June 2007).

<sup>3</sup> T. Lindsay Moore, "The Structure of War: Early Fourth Epoch War Research," in *Non-State Threats and Future Wars*, ed. Robert J. Bunker (London, UK: Frank Cass, 2003), 157-170.

<sup>4</sup> This projection has provided underlying guidance to less lethal weapons research and field activities initiated by the National Law Enforcement Corrections Technology Center; the National Institute of Justice Technical Working Group on Less Lethal Weapons; and the Technology Exploration Program of the Los Angeles County, California, Sheriff's Department.

<sup>5</sup> Many of these capabilities were recognized initially quite sometime ago by Brigadier Bengt Anderberg, "The Low-Energy Laser Aimed at the Eye as a Potential Antipersonnel Weapon," *The RUSI Journal* 133, no. 1 (Spring 1988): 35-40.

<sup>6</sup> Sid Heal, "Fighting in the Fifth Dimension," *OnPoint: A Counterterrorism Journal for Military and Law Enforcement Professionals* (April 2005); retrieved from <http://www.uscav.com>.

<sup>7</sup> Robert J. Bunker, "Criminals and Laserarms: Counter-Optical Tactics," *The Tactical Edge* 14, no. 8 (Fall 2000): 45-48.

<sup>8</sup> Robert J. Bunker, "New Gunpowder Revolution," *The Police Chief*, June 1998, 49. This observation was drawn from even earlier military-related research Dr. Bunker conducted on the topic.

<sup>9</sup> With a fixation on man-portable air defense systems, rocket-propelled grenades, bombs and improvised explosive devices of various types, and small arms, a time lag before terrorist laser weapons use takes place is expected. Still, the Japanese terrorist group Aum Shrinkyo attempted to use a laser device as a weapon back in the 1990s, so wild-card scenarios are not out of the question.

<sup>10</sup> Additional forms of directed energy defense against radio frequency and other devices also may, at some point, become warranted.

## Wanted: Photographs



The *Bulletin* staff is always looking for dynamic, law enforcement-related photos for possible publication in the magazine. We are interested in photos that visually depict the many aspects of the law enforcement profession and illustrate the various tasks law enforcement personnel perform.

We can use color prints, digital photographs, and slides. It is our policy to credit photographers when their work appears in the magazine. Contributors should send duplicate, not original, prints as we do not accept responsibility for damaged or lost prints. Send photographs to:

Art Director  
*FBI Law Enforcement Bulletin*, FBI Academy, Law Enforcement Communication Unit, Hall of Honor, Quantico, VA 22135.