

## 6 The degradation technologies II

### Waves and bytes

This chapter will look at two very controversial areas of possible neuroweapons development: nonlethal directed energy weapons or ‘electromagnetic mind control’ and cyber or ‘informational’ weapons that ‘hack’ the human mind, either through a BCI or through perception, e.g. subliminals. A general problem with respect to reviewing these technologies, which has been acknowledged by many NLW experts, is the fact that much of this kind of NLW research is highly classified. Neil Davison’s excellent book on NLW mentions ‘secrecy’ more than twenty times and he devotes three long paragraphs to it (Davison, 2009). The NRC report on ‘Emerging Technologies’ only has some small sections dealing with neuroweapons (NRC, 2008: 133). At least it acknowledges that the ‘neurotechnology degradation market segment is completely underground with only speculative information available. This cognitive weapons market does exist’ (NRC, 2008: 129). The Royal Society report only discussed neuropharmaceuticals and bioregulators as potential neuroweapons, mostly disregarding other approaches (Royal Society, 2012: 43–59).

A researcher of neuroweapons not only has to deal with the issue that official information is unavailable, but furthermore with the problem of outright disinformation. Steven Aftergood has pointed out that Cold War secrecy systems such as Special Access Programs (SAPs) ‘authorizes defense contractors to employ “cover stories” to disguise their activities. The only condition is that “cover stories must be believable”’ (Aftergood, 1994: 44). Some researchers such as Robert O. Becker have suggested that governments have purposefully disseminated disinformation to the public to muddy the waters (Binhi, 2009: XI). This claim begins to make sense if one scans through some of the popular electromagnetic mind control literature often found on the Internet, which alleges the existence of technology far beyond published science, but does so with such detail and consistency that a coordinated disinformation effort seems plausible. Aftergood has suggested with some irony: ‘[i]f non-lethal technology is so fragile that simply acknowledging it would negate its effectiveness, then it probably isn’t worth much’ (Aftergood, 1994: 45).

Taking into account the obstacle of official secrecy and the vast amount of misinformation and disinformation regarding ‘mind control’ weapons, the

chapter will focus on the known principles and technologies, as well as known NLW systems and research. It is argued that acoustic and electromagnetic weapons can have behavioural effects, although extreme effects or actual ‘mind control’ seem less likely. The second section of the chapter will investigate approaches like subliminals, ‘narrative networks’ and ‘mind viruses’ that attack neuro-cyber systems, which could potentially produce anything from mild to extreme effects. The chapter concludes that NLW are already reaching some maturity, where they can be useful on the battlefield and that behavioural effects, within limitations, are certainly possible.

## **6.1 Waves**

Since Project Pandora, which investigated possible health damage and behavioural effects of low-energy EMF in the 1960s, there has been a lot of speculation about ‘psychotronic’ or electromagnetic mind control weapons (Davison, 2009: 163). While very little tangible proof for the existence of such weapons has materialized after more than half a century, there is still mounting scientific evidence that electromagnetic mind control using directed-energy weapons (DEW) could be possible at some point in the future. This section will discuss DEW as potential neuroweapons in the light of weapons, technologies and scientific research that is in the public domain.

The Pentagon defines DEW as: ‘A weapon or system that uses directed energy to incapacitate, damage, or destroy enemy equipment, facilities, and/or personnel’ (US DoD, 2007: I-8). This includes all weapons that use energy for producing a weapons effect, such as lasers, masers, high energy radio frequency (HERF) weapons, high-powered microwaves (HPM) and acoustic weapons. The US military is already investing heavily into DEW with the DEW research budget growing from \$7.72 billion in 2010 to \$12.15 billion in 2014 since they are believed to be a ‘game changer’ (Ellis, 2015: 10). Some of these weapons are anti-personnel weapons that can be used for crowd control and for incapacitating potential attackers. Relevant with respect to neuroweapons are: (1) stun weapons that jam the CNS or brain, (2) high power RF, microwave and millimetre wave weapons that cause pain or debilitate, (3) acoustic weapons that cause pain, debilitate, or otherwise incapacitate, (4) ‘voice-of-God’-weapons that may be used in PSYOPS attacks and (5) low power EMF that may be able to interfere with biochemical processes and functions in the brain and other organs.

### **6.1.1 Stun weapons**

Stun weapons are NLW that have an immediate incapacitating effect on the target by causing the loss of control of a victim’s body or by rendering the victim unconscious. To achieve this, stun weapons attack the CNS and the brain. Currently, stun weapons tend to use electricity and rely on direct contact to incapacitate an individual and are called Tasers. The Taser was

first invented by Thomas A. Swift in 1970. It fires either a wired projectile for establishing direct contact, or may use a self-contained ‘Taser round’ (Davison, 2009: 22). A more advanced stun weapon is the myotron that through touch scrambles brain signals in the motor cortex by emitting rapid pulses of electromagnetic radiation, resulting in the victim losing control over all voluntary muscle movements for up to 30 minutes (Pasternak, 1997). Although the myotron is not a DEW, it demonstrates the potential for a stun weapon out of *Star Trek* that paralyzes a victim for an extended period of time.

According to military analyst James Dunnigan, RF signals can be used for hacking the CNS and causing a stun effect. He writes in his book: ‘Radio frequency (RF) systems. These are radio transmitters that jam and short-circuit the human nervous system. This temporarily disables the people the radio beams are aimed at. Think “Phasers on stun” and you’ll get the idea. A tricky bit of business, this, for it can also cause long-term effects. It works on animals; no one is admitting to human experiments’ (Dunnigan, 1996: 223). Although no RF anti-personnel weapons have surfaced yet, there are stun weapons openly under development that rely on light and sound to hack a person’s brain.

Since 2001, the Pentagon’s Joint Non-Lethal Weapons Program (JNLWP) has been working on a distance weapon called *Personnel Halting and Stimulation Response Rifle* (PHASR) – previously known as *Portable Efficient Laser Testbed* (PELT), which was originally described as a nonlethal laser dazzler for temporarily blinding and disorienting enemies. According to Davison, the PHASR is being designed to employ a two-wavelength laser system, one to heat the skin of the target person and the other as a ‘dazzling’ weapon against the eyes’ (Davison, 2009: 76). A JNLWP fact sheet summarises:

PHASR achieves the desired degree of protection through the synergistic application of two non-lethal laser wavelengths during the course of protection activities that will deter, prevent, or mitigate an adversary’s effectiveness. The laser light from PHASR temporarily impairs aggressors by ‘dazzling’ them with one wavelength. The second wavelength causes a repel effect that discourages advancing aggressors.

(quoted from Hambling, 2008)

The military stopped funding for PHASR in 2008 after constructing a prototype, but research on a long-distance stun weapon continues. The company Genesis Illumination patented in 2011 the StunRay light dazzler, which is ten times more powerful than an aircraft landing light and which works by overloading the neural circuits connected to the retina. The company claims that the weapon is effective up to 150 feet and can incapacitate a person for up to 20 minutes (V. Ross, 2011).

A future dazzling laser could take advantage of the so-called ‘Bucha effect’ in order to stun or disorient an adversary. The ‘Bucha effect’ was

discovered in the 1950s after several helicopters crashed for unknown reasons. The rotor blades caused a flicker effect that disoriented the pilots thereby causing the crashes (Ronson, 2002: 147). An Air Force research paper on NLW describes the Bucha effect as: 'High intensity strobe lights which flash at near human brain wave frequency causing vertigo, disorientation, and vomiting' (Bunker, 1997: 16). Persons with epilepsy may suffer seizures as a result of exposure to incoherent light sources (Bulletin of Atomic Scientists, 1994).

The Soviets were apparently first to weaponize the Bucha effect. During the Vietnam War the American military recovered a so-called LIDA machine that had been used by Soviet interrogators on American PoWs (Begich, 2006: 98). The machine can produce pulsed electromagnetic 40 MHz signals, stroboscopic light, heat and auditory signals for brain entrainment. The device is rumoured to have such a strong tranquilizing effect to the point of putting people to sleep almost instantly. The captured LIDA machine was tested in the US by physicist Ross Adey, who found that it could indeed prolong sleep states or shift sleep patterns to deeper levels (Tyler, 1986: 254).

The previously cited DIA report from 1972 discusses Soviet light and sound weapons in the context of behavioural control in some detail. It states that there is 'general agreement that flicker has the potentiality of causing considerable interruption of the normal functions of the human nervous system', suggesting that flicker rates in the alpha rhythm of the EEG interfere with consciousness and that 'visual illusions appear to be produced by frequencies above 10 – 12 Hz' (US DIA, 1972: 79)

After 40 years of investigating the concept, the US military is reportedly still interested in a pulsed light- and sound-based stun weapon. The *Distributed Sound and Light Array Debilitator* (DSLAD) will, according to Sharon Weinberger, 'use essentially off the shelf technology to see if combining aversive noises with light produce some special debilitating effects. Anecdotal effects include dizziness and loss of balance, and of course, nausea' (Weinberger, 2007d). The DSLAD was tested by the JNLWP engineers in 2009, who claimed that 'preliminary results indicate that non-lethal sound and light at moderate intensities are effective at producing measured effects in targeted individuals' (Bowen, 2009).

Former head of the Los Alamos NLW program, John Alexander, suggested in his book the use of Pulsed Periodic Stimuli (PPS) in the form of acoustic waves for achieving a stun effect: 'The technique [PPS] can be applied to situations where it is desirable to cause perceptual disorientation in targeted individuals. This is important, as it is the first acoustic weapon that does not rely on high intensity to cause the desired effects. Rather low-intensity, pulsed, acoustic energy can induce fairly strong effects in humans' (Alexander, 1999: 102). The technique referred to by Alexander does not appear anywhere else in the NLW literature, but may exist within classified programs.

### 6.1.2 *High-power microwave and millimetre wave weapons*

The Soviets had been working on potentially lethal high-power microwave weapons since the 1960s (Gallagher, 1987: 23). In the US, interest in HPM weapons grew in the 1980s due to discoveries related to generating microwaves with higher powers and at higher frequencies (Davison, 2009: 164). These weapons are generally shrouded in secrecy. However, there were unconfirmed reports that Britain was working on a secret radiofrequency/ microwave weapon and that such a weapon may have been used on peace activists at Greenham Commons in 1984–85 (Kattenberg, 1987: 9). According to an article by international lawyer Louise Doswald-Beck and electronics expert Gerald Cauderay,

[r]esearch work in this field [electromagnetics] has been carried out in almost all industrialized countries, with a view of using these phenomena for anti-material or anti-personnel weapons. Tests have demonstrated that powerful microwave pulses could be used as a weapon to put an adversary hors de combat or even kill him. It is possible today to generate a very powerful pulse (e.g. between 150 and 3,000 MHz), with an energy level of several hundreds of megawatts. Using specially adapted antenna systems, these generators could in principle transmit over hundreds of meters sufficient energy to cook a meal.

(Doswald-Beck and Cauderay, 1990)

So far, only two anti-personnel microwave weapons systems have been publicly acknowledged: the Active Denial System (ADS) and the MEDUSA system.

The development of the ADS began probably in the 1990s and the program was declassified in December 2000 (Davison, 2009: 166–167). The technologies used in the ADS are similar to high-powered microwaves (HPM) and are being developed as anti-material NLW that target electronics (Davison, 2009: 167). The ADS device can be mounted on a HUMVEE or a similar vehicle and it uses 95 GHz millimetre waves. The microwaves only penetrate 0.4 mm of the skin and cause a strong burning sensation by heating the skin to 44 to 55 degrees centigrade (Davison, 2009: 167). After intensive testing on 700 human volunteers, the Pentagon determined that the ADS is safe for use as a nonlethal weapons system and decided to deploy it in Afghanistan in 2010. The system was recalled after a month without ever having been used because of the controversial nature of the weapon (Shachtman, 2010). Another factor may have been the complexity of the system that makes it difficult to deploy, including the need to cool down the pulse generators for 16 hours before it can be fired (Weinberger, 2012).

The other microwave-based weapon that has been openly announced in 2003 is the *Mob Excess Deterrent Using Silent Audio* (MEDUSA) system that was under development by the Sierra Nevada Corporation. The main idea

behind MEDUSA was to use the Frey or microwave auditory effect to beam noise into the heads of adversaries to cause discomfort and disorientation.

Potential applications of the MEDUSA system are as a perimeter protection sensor in deterrence systems for industrial and national sites, for use in systems to assist communication with hearing impaired persons, use by law enforcement and military personnel for crowd control and asset protection. The system will: be portable, require low power, have a controllable radius of coverage, be able to switch from crowd to individual coverage, cause a temporarily incapacitating effect, have a low probability of fatality or permanent injury, cause no damage to property, and have a low probability of affecting friendly personnel.

(US Navy, 2004)

Although the initial Navy evaluation of MEDUSA was positive, Sierra Nevada Corporation has discontinued the project, possibly because it may have shown to permanently damage human brain tissue (Hambling, 2008).

Many NLW researchers believe that there is more to microwave weapons systems like ADS and MEDUSA than meets the eye. An article in *Nature*, written by an anonymous scientist, argues:

Many records related to the Active Denial System remain classified and inaccessible to the public and the scientific community. The US Air Force's unwillingness to reveal the full scope of its research into the biological effects of high-power microwaves in the 1990s, which included work on their auditory and lethal effects, flies in the face of the defence department's claims that it is interested in classifying only weapons technology, and not science. If, as the Air Force says, the biological research never led to weapons, then there is no reason not to release it.

(*Nature*, 2012: 178)

It seems probable enough that high power electromagnetic waves and fields could have an influence on the brain and affect mental capacity and behaviour. Physicist Vladimir Binhi stated: 'The brain and nervous system are considered particularly vulnerable to EMF [electromagnetic fields] because their functioning is based on transfer of nerve impulses, which involve electrical processes within and in between nerve cell membranes' (Binhi, 2009: 61). It is therefore theoretically possible that high-powered microwave (HPM) weapons could disrupt or interfere with brain functions.

Even based on the acknowledged thermal bioeffects of microwaves it would be possible to build an effective crowd control weapon that can severely disorient people. A DoD study on 'Bioeffects of Certain Non-Lethal Weapons' suggests that heating the brain with microwaves could affect mood and behaviour. The report states:

Body heating to mimic a fever is the nature of the RF incapacitation. The objective is to provide heating in a very controlled way so that the body receives nearly uniform heating and no organs are damaged. Core temperatures approximately 41°C are considered to be adequate. At such temperature a considerably changed demeanor will take place with the individual. Most people, under fever conditions, become much less aggressive; some people may become more irritable. The subjective sensations produced by this buildup of heat are far more unpleasant than those accompanying fever. In hyperthermia all the effector processes are strained to the utmost, whereas in fever they are not. It is also possible that microwave hyperthermia (even with only a 1°C increase in brain temperature may disrupt working memory, thus resulting in disorientation.

(US DoD, 1998)

According to a US Army intelligence report summarizing Chinese research into the bioeffects of HPM (that produce an EMP), even lethal effects are possible. The report states: 'The high mortality rates of animals (especially for primates) exposed to EMP radiation in the recent Chinese experiments are in graphic contrast to the lack of reported bio-effects associated with EMP exposures during the period of atmospheric testing (during the 1950s and 1960s) by the United States and other nations' (US Army, 2005: 134). The report suggests that this may be explained by the very high energy levels used by the Chinese researchers. The Soviets were reportedly able to kill goats from 1 km distance with an EMP device and cause an incapacitating/ disorienting effect over 2 km distance (De Caro, 1987: B03).

A report by the European Parliament claims that '[s]ome microwave systems have been proposed, which can raise body temperature to between 105 to 107 degrees F, to provide a disabling effect in a manner based on the microwave cooker principle. However, the greatest concern is with systems which can directly interact with the human nervous system'. The report indicates that secret research in the US and Russia in this field 'can be divided into two related areas: (i) individual mind control and (ii) crowd control' (European Parliament, 1999: LIII).

While behavioural effects are clearly possible using high powered RF and microwaves, there are also some fairly obvious limitations that have likely hampered the development of anti-personnel microwave weapons: (1) the effective range of these weapons is fairly limited because of 'atmospheric breakdown' that absorbs more of the energy over longer distance (Brunderman, 1999: 19); (2) there is a high risk of fratricide, as anything within the beam of the weapon and close to the antenna will be radiated and affected (Brunderman, 1999: 20); (3) adverse weather conditions such as strong humidity or rain can greatly impact on the effectiveness of a RF/ microwave weapon (Weinberger, 2012); and (4) high powered RF and microwave weapons could easily produce permanent injury such as brain damage. Taken together, this might suggest that HPM is a technological dead-end (Weinberger, 2012).

Table 6.1 The electromagnetic spectrum

| <i>Wave type</i> | <i>Frequency range</i>         | <i>Frequencies</i> | <i>Wavelengths</i>     |
|------------------|--------------------------------|--------------------|------------------------|
| Radio Waves      | Extremely Low Frequency (ELF)  | 3 Hz – 30 Hz       | 10 Mm – 100 Mm         |
|                  | Super Low Frequency (SLF)      | 30 Hz – 300 Hz     | 1 Mm – 10 Mm           |
|                  | Ultra Low Frequency (ULF)      | 0.3 kHz – 3 kHz    | 100 km – 1000 km       |
|                  | Very Low Frequency (VLF)       | 3 kHz – 30 kHz     | 10 km – 100 km         |
| Radio Waves      | Low Frequency (LF)             | 30 kHz – 300 kHz   | 10 km                  |
|                  | Medium Frequency (MF)          | 300 kHz – 1,5 MHz  | 650 m                  |
|                  | High Frequency (HF)            | 1.7 MHz            | 180 m                  |
|                  | Very High Frequency (VHF)      | 30 MHz – 300 MHz   | 10 m                   |
| Microwaves       | Ultra High Frequency (UHF)     | 300 MHz – 3 GHz    | 10 cm – 1 m            |
|                  | Super High Frequency (SHF)     | 3 GHz – 30 GHz     | 1 cm – 10 cm           |
|                  | Extremely High Frequency (EHF) | 30 GHz – 0.3 THz   | 1 mm – 1 cm            |
| Infrared         | Far Infrared                   | 0.3 THz – 6 THz    | 50 $\mu$ m – 1 mm      |
|                  | Medium Infrared                | 6 THz – 100 THz    | 3 $\mu$ m – 50 $\mu$ m |
|                  | Near Infrared                  | 100 THz – 385 THz  | 780 nm – 3 $\mu$ m     |

Source: Author's own data.

### 6.1.3 Acoustic weapons

Acoustic weapons can use audible sound or they could use infrasound (20 Hz or below) or ultrasound (20 kHz or above). In here only infrasound and ultrasound weapons are relevant, since they have been claimed to be able to affect the human brain and CNS. Similar to microwave weapons decades of research into infrasound and ultrasound weapons have not resulted in the official deployment of any weapon of that kind. Experts such as physicist Jürgen Altmann have cast doubt about the general feasibility and practicality of acoustic weapons (Altmann, 1999). It is still worthwhile to consider acoustic weapons with respect to their ability to affect the human mind in more subtle ways than severe incapacitation.

The myth of the powerful infrasound weapon originated from the French acoustician Vladimir Gavreau, who made in 1968 the extraordinary claim that infrasound of 7 Hz would have strong physiological effects on the human mind and body and that it could be weaponized (Altmann, 1999: 15). A sound gun that he built based on the discovered principle, had supposedly near lethal effects, but further experiments undertaken elsewhere were not able to independently reproduce Gavreau's results (Volcler, 2013: 26–27).

Nevertheless, many references to infrasound weapons can be found in the NLW literature. For example, a US Air Force reference work on NLW suggests: 'Very low-frequency sound which can travel long distances and easily penetrate most buildings and vehicles. Transmission of long wavelength



sound creates biophysical effects; nausea, loss of bowels, disorientation, vomiting, potential internal organ damage or death may occur' (Bunker, 1997: 2–3; similar: Lyell, 1997: 3; US DoD, 1972: 92–93; Koplow, 2006: 19).

The aforementioned declassified DoD summary on the bioeffects of certain NLW from 1998 also claims that human tests have indicated that infrasound can have disorientating effects on humans: 'Human subjects listened to very high levels of low-frequency noise and infrasound in the protected or unprotected modes. Two-minute duration as high as 140 to 155 dB produced a range of effects from mild discomfort to severe pressures sensations, nausea, gagging, and giddiness. Effects also included blurred vision and visual field distortions in some exposure conditions' (US DoD, 1998).

These statements can be contrasted with Altmann's conclusion that '[c]ontrary to several articles in the defense press, high-power infrasound has no profound effect on humans. The pain threshold is higher than in the audio range, and there is no hard evidence for the alleged effects on inner organs, on the vestibular system, for vomiting, or uncontrolled defecation up to levels of 170 dB or more' (Altmann, 1999:61).

This being said, there is some recent research that suggests that infrasound might be able to affect the moods and emotions of people in more subtle ways. Researchers from the University of Hertfordshire claim that exposure to infrasound was described by test subjects as "shivering on my wrist", "an odd feeling in my stomach", "increased heart rate", "feeling very anxious", and "a sudden memory of emotional loss" (Amos, 2003). The researchers speculated that infrasound produced by organs may be responsible for strong religious experiences that some people have in church. Movie makers have already included inaudible infrasounds in horror movies to increase the emotional impact of the pictures (Stewart, 2013). Although Altmann has pointed out that infrasound is very unsuitable as a DEW, as it propagates in all directions and as the effective range would be too short (Altmann, 1999: 46–47), infrasound may be still useful for interrogations or in situations where targeted persons are in confined spaces, e.g. underground structures or inside buildings.

#### **6.1.4 'Voice-of-God' weapons**

The Air Force *Vistas* document projects for 2050 '[t]he ability to communicate directly to designated individuals, perhaps through bone conduction or through direct stimulation of the basilar membrane or the auditory cortex without the limitations of conventional communications equipment' (US Air Force, 1994: 109). It has been alleged that the capability of putting voices into people's heads could be misused for mind control (Binhi, 2009: 40). A 'voice-of-God' weapon would be a means of communication that can send speech directly into the heads of enemies for the purpose of impersonating a supernatural entity (God or a ghost) with the aim of confusing or commanding them. Interestingly, there are actually several potential methods of how one can project sound or speech in a manner that targets one person,

but is inaudible to a bystander, which includes (1) bone conduction, (2) the microwave auditory effect and (3) ultrasound projection.

The oldest technology is called ‘bone conduction’ and it was discovered by the inventor Patrick Flanagan in 1958, which was popularized in a 1962 *Life* magazine article that celebrated the thirteen year old ‘whiz kid’ (Moesser, 1962: 69–72). The patent filed by Flanagan in 1968 describes the device he calls ‘neurophone’ in the following way: ‘This invention relates to electromagnetic excitation of the nervous system of a mammal and pertains more particularly to a method and apparatus for exciting the nervous system of a person with electromagnetic waves that are capable of causing that person to become conscious of information conveyed by the electromagnetic waves’ (US Patent 3393279 A). The neurophone transmits sound through skin contact and can even be heard by deaf persons (Moesser, 1962: 69). According to Flanagan’s website *neurophone.ca*, the DIA temporarily classified the invention after the *Life* magazine article. It is a proven technology and the neurophone is commercially available from the inventor for \$500.

The second method is called microwave auditory effect (MAE), which was discovered by radar operators during the 1940s, who often heard an inexplicable knocking or ticking noise. In 1962 the physicist Allan Frey was able to reproduce the effect using pulsed microwaves at ‘extremely low average power densities’, enabling ‘the perception of sound’ by ‘normal and deaf humans’ (Frey, 1962: 689). An article by Don Justesen from 1975 refers to an experiment by Joseph Sharp and Mark Grove at the Walter Reed Army Institute, which apparently showed that speech could be transmitted using the MAE. Sharp and Grove were able to understand nine out of ten words that they had recorded and then transmitted as ‘voice modulated microwaves’ (Justesen, 1975). This was also suggested in 1976 DIA report (US DoD, 1976: VIII), as well as in the aforementioned NLW report (US DoD, 1998). The US Army also referred to a MAE-based ‘voice-to-skull’ device on a webpage, claiming that the technology was already in use as an electronic scarecrow (Weinberger, 2008b). Sceptics have pointed out that the power levels required for transmitting sound by microwaves would be so high that brain damage due to microwave thermal effects would result (Heger, 2008) and that there would be no conclusive evidence for MAE at lower energy densities (Binhi, 2009: 39).

The third known technology is based on directed sound using ultrasound and was developed in the late 1990s. The company *Holosonics* founded by Joseph Pompei introduced the *Audio Spotlight* in 2004, which converts audible sound into ultrasound that can be projected in a narrow beam. Pompei’s invention is based on research undertaken by a Japanese research group in the 1980s (Lee, J., 2001). People standing within the ultrasound beam can clearly hear the sound, but people standing outside of it cannot. The technology was used in a New York advertising campaign for a TV series on paranormal phenomena. The *Audio Spotlight* loudspeakers were placed on a warehouse and aimed at passerby, whispering ‘It’s not your imagination’ (Volcler, 2013: 121). DARPA announced in 2007 a program for developing a ‘sonic projector’,

which would be based on the same technology and could be used as a ‘voice-of-God’ weapon (Volcler, 2013: 122).

### **6.1.5 Low energy EMF**

While thermal bioeffects of microwaves are scientifically acknowledged, the issue of possible non-thermal effects remains a hotly debated one. Constant exposure to low energy electromagnetic fields (EMF) is suspected to affect the general health and well-being of people. There is even speculation that low energy electromagnetic waves could manipulate brain processes and could affect moods, perception and behaviour in some way. This section will discuss some of the evidence for non-thermal effects of microwaves and other sources of EMF.

A particular concern are *extremely low frequency* (ELF) waves and microwaves that are modulated in the ELF range, as they could interfere with biological cycles – brain waves are in the ELF range with their average between 0 and 30 cycles (Becker, 1990: 212). Apart from the highly controversial mind control aspect, a further complication arises from the fact that the \$2.2 trillion a year global telecommunications industry has a major stake in the use of low power microwaves (6.8 billion cell phones and over one billion wi-fi connections as of 2013). Any health hazard from low energy non-ionizing radiation (electromagnetic fields or EMF) has to be categorically denied in order to discourage lawsuits, which still occur since ‘[s]ome experts and scientists in this field believe that these EMFs can cause such adverse health effects’ (Anibogu, 1998: 11).

Regardless, there is a growing body of scientific evidence that EMF or electropollution through long-term EMF exposure is indeed harmful and is affecting many people, who suffer from electromagnetic hypersensitivity (some countries such as Sweden recognize it as a proven health condition or functional impairment). Recently, 195 scientists from 39 countries sent a letter to the World Health Organization that stated: ‘[b]ased on peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices... The various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF’ (Harkinson, 2015).

Many studies on microwaves from the 1960s and 1970s have already indicated many of the potential issues: long-term exposure to microwaves can cause genetic mutation, brain tumours and other cancers, behavioural abnormalities (suicide), alterations in biological cycles, weakening of the immune system and alterations in learning ability (Becker, 1990: 214–215; also Brodeur, 1977). A 1970 RAND metastudy on neurological effects of microwaves suggested: ‘it seems likely that neural function, and therefore behavior, are indeed disturbed by low intensity microwaves...the studies consistently and repeatedly report that human beings do exhibit behavioral disturbances when exposed to low intensity microwaves’ (MacGregor, 1970: 8).

These conclusions are not too different from some more recent studies that also indicate brain and behavior changes resulting from long-term EMF exposure. For example, a study from 2000 claims: 'Natural and man-made electromagnetic fields influence the mood and behavior of healthy and sick people. Considerable evidence suggests that electromagnetic fields affect sleep' (Sher, 2000). Another study from 2006 has linked ambient electromagnetic fields to human moods and behaviour, finding a significantly increased suicide rate during periods of geomagnetic storm (Berk et al., 2006). Continuous electromagnetic field exposure has been linked in scientific studies to 'cancer, heart disease, sleep disturbance, depression, suicide, anger, rage, violence, homicide, neurological disease and mortality' (Cherry, 2002). A leaked study on the British police radio system TETRA prepared for the Police Federation of England and Wales contends that microwaves pulsed in certain frequencies can induce paranoia, depression, suicide, manic behaviour and blindness (Trower, 2001: 30).

Russian scientists have claimed long ago that there are nonthermal bioeffects of EMFs possible at lower energy densities. A Russian military article by Major General Belous claims:

Studies into the impact of electromagnetic radiation on the human organism show that even exposure to low intensity EM radiation results in an array of functional changes and disturbances. In particular, EM radiation can disrupt the heart rhythm and even, according to some scientists, can cause cardiac arrest. There are two types of impact: thermal and non-thermal. The thermal impact causes an overheating of tissue and organs, and with sufficiently long radiation can cause irreparable pathological changes. The non-thermal impact mainly leads to functional disorders in various organs of the human organism, especially in the cardio-vascular and nervous systems.

(Belous, 2009: 72)

Similarly, national security expert Chuck De Caro wrote that 'a highly tuned RF device could act as a sort of negative pacemaker, inducing heart attacks by overriding the heart's normal "P" wave' (De Caro, 1985: B3). EMF, and in particular ELF and modulated microwaves, could be therefore weaponized. Of course, such weapons would often fail to produce any instant effects. However, constant and long-term exposure could be used for influencing moods and general mental capacity.

An article by Paul Tyler on 'The Electromagnetic Spectrum in Low-Intensity Conflict' discusses the potential uses of electromagnetic radiation, especially ELF radiation, in terms of their bioeffects in the context of 'dealing with terrorist groups, crowd control, controlling breeches of security at military installations, and anti-personnel techniques in tactical warfare' (Tyler, 1986: 251). After giving an overview of Soviet research, Tyler argues that scientists in the West have erroneously assumed that a 'microwave is a

microwave', not taking into account that even the slightest variation in frequency can make a huge difference in bioeffects (Tyler, 1986: 256).

The general idea is that specific frequencies could have fairly specific physiological and possibly behavioural effects. For example, according to the medical doctor Robert C. Beck, 'ELF fields of 6.67 Hz and lower can produce symptoms of confusion, anxiety, depression, tension, fear, mild nausea and headaches, cholinergia, arthritis-like aches, insomnia, extended reaction times, hemispheric EEC desynchronization, and many other vegetative disturbances' (Beck, 1986: 47).

Chinese military analysts have suggested that electromagnetic waves could be used for producing specific genetic effects. They stated: 'high-intensity ultraviolet waves and electromagnetic waves can induce genetic locus cell mutation. If we determine the relationship between the specific frequency, wavelength, or power of the ray or wave and the specific gene or locus, we can cause injury by remote, radiation-induced, genetic function changes' (Guo and Yang, 2005: 77). It may also be possible to manipulate emotion with specific electromagnetic waves. Binhi suggests that weaponized EMF could 'cause pain, fear, or similar reactions in personnel, to influence the perceptions and attitudes of individuals and groups, which finally could disrupt military operations' (Binhi, 2009: 6–7).

A particularly frightening possibility in this respect has been discussed by neuroscientist Michael Persinger, who has extensively published on EMF influence on the brain. Persinger suggests that the brain uses frequencies for 'informational transactions' between brain structures: 'Consciousness would be associated with an electromagnetic pattern generated by a neural aggregate with invariant statistical features which are independent of the cells contributing to each feature' (Persinger, 1995: 793). According to this theory, 'specific neuropatterns can be evoked by extremely weak magnetic fields whose intensities are within the range of normal geomagnetic variations', as electrical processes in the brain are so weak (Persinger, 1995: 795). Persinger claims that he can produce altered states of consciousness, 'sense of presence' and spiritual experiences by generating weak EMF near the heads of test subjects (Persinger, 2003). Persinger argues:

Within the last two decades...a potential has emerged which was improbable but which is now marginally feasible. This potential is the technical capability to influence directly the major portion of the approximately six billion brains of the human species without mediation through classical sensory modalities by generating neural information within a physical medium within which all members of the species are immersed.

(Persinger, 1995: 797)

What he is suggesting is that through the precise electromagnetic manipulation of the earth's atmosphere it could be possible to affect the minds and well-being of all humans in the world. It is clear that Persinger's theories are very

controversial in the scientific community. A group of Swedish researchers was unable to reproduce any of the effects claimed by Persinger (Granqvist et al., 2004). Many potential weapons applications of weak EMF therefore remain highly speculative apart from the realization that constant exposure to EMF is unlikely to be healthy.

### **6.1.6 Electromagnetic mind control?**

Currently, there is no strong evidence that electromagnetic mind control is feasible in the way it has been suggested by conspiracy writers. At the same time, it is clearly within the bounds of existing technology to use high-powered microwaves (and also lasers), exploiting well-understood thermal effects, to cause discomfort, disorientation, depression and even death. Such weapons would violate international law since they would most likely cause ‘unnecessary suffering and superfluous injury’ (Rosenberg, 1994: 45), but terrorists and some state actors might develop and employ such weapons. At lower energy densities, constant exposure can result in genetic damage, cancer, sleeplessness and mental disorders in a time frame of years, if not decades.

It has been suggested that governments might focus their efforts with respect to electromagnetic mind control in the ELF and the GHz frequency ranges (Binhi, 2009: X-XI). Clearly, more research is needed before one can completely dismiss the theoretical feasibility of electromagnetic mind control. Binhi, who has conducted the most exhaustive scientific review on this subject, concludes

there are no physical reasons to assert that EM mind control is not possible. Under the influence of a remote source of EMF, the brain is exposed to the EMF as a whole. Therefore one could expect that the EM impact would be similar to that of chemicals, but can induce particular states of mind... there are no fundamental constraints to realization of remote EM [electromagnetic] control over the human brain with the goal to bring the mind in obedience with the will or another vulnerable state.

(Binhi, 2009: 93)

This possibility may be still far off, but lesser effects such as influencing moods, emotions, sleep, cognition and mental capacity could already be feasible with today’s technology.

## **6.2 Bytes**

Not all neuroweapons that influence human thoughts, emotions and behaviour have to be material in nature – some of them might be simply information or software that can ‘hack’ the human brain and/or target the cognitive system. Much of this relates to the ancient practices of psychological warfare and to modern military deception and propaganda, which can all be made much more

effective with the insights provided by neuroscience research. Some newer technologies and approaches discussed below include subliminals (including silent sounds), narrative networks and the manipulation of perception, using holograms and invisibility cloaks.

### **6.2.1 Subliminals**

Since Freud, it is known that much of our psyche remains subconscious. The subconscious fears and desires, nevertheless, have great influence on the human mind and human behaviour in ways that are beyond the understanding of the conscious mind. So the idea is if one could manipulate the subconscious, one could influence conscious behaviour without the person being aware of any external influence. Hence the concept of the ‘subliminal’ stimulus was born, which is not consciously perceptible, but is still registered by the mind. The marketing industry has been interested in subliminal advertising for a very long time. The practice of subliminal advertising has been first revealed by Vance Packard in 1957 in his book *The Hidden Persuaders*.

It has been reported in the news media that subliminals have been used successfully by department stores to reduce shoplifting (Time, 1979). Often advertising subliminals contain hidden references to ‘the taboos of society – sex, death, incest, homosexuality, and at times, pagan icons’ (Chen, 1990: 2). The communications scientist Wilson Bryan Key claimed that the advertising industry would spend upwards of \$50,000 for checking every single detail in an advert. Key testified before Congress ‘that there are some 500 published articles on the effects of subliminal suggestion in the psychology literature. While inconclusive, the research seems to indicate that subliminal messages “affect some people under some circumstances, some of the time”’ (Chen, 1990: 2).

According to subliminal communication expert Eldon Taylor, a subliminal stimuli can be subdivided into four groups: (1) ‘Below the level of registration’, (2) ‘Above the level of registration but below the level of detection’, (3) ‘Above the level of detection and discrimination, but below the level of identification’ and (4) ‘Below the level of identification only because of a defensive action’ (E. Taylor, 2007: 30). These categories can be used for the analysis of subliminals and the development of research designs.

In the 1980s, there was a growing concern across Western societies about satanic subliminal messages that may be embedded in heavy metal music, which would encourage suicidal, homicidal, or other antisocial behaviour. These concerns were sparked by the case of two young adults, who shot themselves after listening to a *Judas Priest* record that had a suicide theme and a subliminal message that said ‘do it’. This resulted in a lawsuit and a trial in 1990. The case was eventually dismissed on grounds that subliminals could not have led to the suicides. Some have taken the verdict to mean that subliminals just do not work and are therefore no threat to the freedom of will (Streatfield, 2008: 171–209; E. Taylor, 2007: 30–31).

Taylor claims '[c]ontrary to popular opinion, the literature and evidence supporting subliminal information theory is robust' (E. Taylor, 2007: 29). Although it is true that subliminals are very unlikely to override the most basic instincts of nature and principles of morality, some lesser effects are clearly possible. The ten billion dollar self-help industry and the much bigger advertising industry rely on the effectiveness of subliminals, which would suggest that subliminals can and do influence people under certain conditions in terms of their 'conscious perception, dreams, drives, emotions, memory, defense mechanisms of perception, value system, and verbal behavior' (E. Taylor, 1990: 11). This has been validated by several recent neuroscience studies that used EEGs or fMRIs to detect brain responses to subliminal stimuli or that observed behaviour of test subjects after they were given imperceptible stimuli.

The earliest research in this field was undertaken by neuroscientist Benjamin Libet in the 1960s. Using an EEG, Libet discovered that a brain can respond to a subliminal stimulus without conscious awareness of the stimulus: '1. Cerebral cortical activities, in response to a somatosensory stimulus, must proceed for about 500 ms in order to elicit the conscious sensation. 2. Activations of shorter durations at the same intensities can produce unconscious detection of that input' (Libet, 2002: 291). In other words, if neural activities in response to a stimulus remain below the 500 ms threshold, then the stimulus will not become conscious, although it was clearly registered by the brain.

A study carried out at University College London (UCL) also found that the brain responds to subliminal stimuli, if it is not too busy or distracted, which may suggest that 'subliminal advertising might affect our decisions about buying things' (Jha, 2007). A follow-up study at UCL discovered that subliminals work better with negative messages than with positive ones. Words displayed on a computer screen for just 0.2 seconds had a greater impact on test subjects if they were emotional and negative than positive terms, which might suggest that evolution has made brains responding to subconscious warning signs rather than subconscious signs that everything is OK (Bahrami et al., 2007: 509–513).

A Duke University study suggests that company logos displayed only a fraction of a second affect behaviour in terms of the traits associated with the brands. For example, the Apple brand encouraged people subconsciously to come up with unusual solutions to a problem, while the Disney logo made people behave more honestly (Science Daily, 2008). In another study at Kent University from 2014 it was shown that an athlete's performance could be affected by showing positive or negative subliminal visual cues before an exercise (Blanchfield et al., 2014). Obviously, subliminal stimuli could be used to enhance the effectiveness of PSYOPS messages.

### **6.2.2 *Silent sounds***

It is quite extraordinary that one can find no discussion of the exploitation of subliminals in PSYOPS manuals or literature, which either means that



nobody in the PSYOPS field ever thought about the use of subliminals, or that such information remains highly classified. According to a story by the British channel *ITV*, subliminals hidden in ‘silent sounds’ may have been operationally used during the 1991 Gulf War. The *ITV* article stated: ‘The clandestine station programming consisted of patriotic and religious music and intentionally vague, confusing and contradictory military orders and information to Iraqi soldiers in the Kuwaiti Theater of Command (KTO). The size and power of enemy forces was always intentionally exaggerated. Surrender was encouraged’ (*ITV*, 1991). Most interesting is *ITV*’s claim that the radio messages had embedded subliminals and inaudible sounds:

According to statements made by captured and deserting Iraqi soldiers, however, the most devastating and demoralizing programming was the first known military use of the new, high-tech, type of subliminal messages referred to as ultra-high-frequency ‘silent sounds’ or ‘silent subliminals’. Although completely silent to the human ear, the negative voice messages placed on the tapes alongside the audible programming by PSY-OPS psychologists were clearly perceived by the subconscious minds of the Iraqi soldiers and the silent messages completely demoralized them and instilled a perpetual feeling of fear and hopelessness in their minds.

(*ITV*, 1991)

Many more details regarding the use of ‘silent sounds’ during the Gulf War can be found in an article by bioelectromagnetics expert Judy Wall in the *Nexus* magazine, which explains Oliver Lowery’s invention ‘Silent Sound Spread Spectrum’ (S-Quad), which was allegedly used ‘with great success in the Gulf War’ (Wall, 1998). While the Patent does exist (#5,159,703) and Lowery confirmed the story to journalist Jon Ronson, there is no further independent confirmation that can be found anywhere (Ronson, 2004: 189–193)

Regardless whether this happened or not, it is notable that US PSYOPS were tremendously effective during the Gulf War: within 24 hours of the ground war already 10,000 Iraqi soldiers surrendered to coalition forces. The Iraqis were so desperate to surrender that they even surrendered to Western journalists and drones. Overall, 87,000 Iraqi soldiers surrendered during the conflict and 17,000 deserted, which has to be considered an enormous and often overlooked PSYOPS success (Wojtysiak, 2001).

### ***6.2.3 The 25th frame technique***

From Russia originated the theory or myth of the ‘25th frame effect’ and it has remained quite persistent over the years. According to this theory, humans perceive 24 images per second. By adding a 25th frame shown on a screen a subliminal message can be included to subconsciously manipulate the viewers, who will not consciously register the existence of the added frame.

Timothy Thomas mentions in his *Parameters* article that the Russians claimed to have developed a computer virus that manipulates the computer display to hack a user's mind:

According to Solntsev, one computer virus capable of affecting a person's psyche is Russian Virus 666. It manifests itself in every 25th frame of a visual display, where it produces a combination of colors that allegedly put computer operators into a trance. The subconscious perception of the new pattern eventually results in arrhythmia of the heart. Other Russian computer specialists, not just Solntsev, talk openly about this '25th frame effect' and its ability to subtly manage a computer user's perceptions. The purpose of this technique is to inject a thought into the viewer's subconscious.

(T. Thomas, 1998)

It was reported by the *LA Times* that the Russian TV channel ATV based in Yekaterinburg has used this technique to manipulate its viewers into watching it more. The use of subliminals on Russian TV had become so pervasive and aggressive that the Russian Ministry for Press, Broadcasting and Communications decided to take action by developing a scanning software that can detect methods like the 25th frame and by banning violators from the airwaves (Dixon, 2002).

The BBC recently reported that the Russians have deployed the 25th frame technique in the Ukraine to influence Ukrainian audiences. The Ukrainian intelligence service SBU has found subliminal messages embedded in TV programming from the news channel *Rossiya 24*. They allegedly found hidden messages in the TV signal such as 'torched by the Right Sector', 'people killed by Banderites [followers of Ukrainian wartime nationalist leader Stepan Banderaj]' and 'National Guard murderers' (BBC, 2014). Unfortunately, there is seemingly no scientific study in the West that has specifically looked into the 25th frame effect, which means that it remains speculative.

#### **6.2.4 DARPA's Narrative Networks**

In 2011, DARPA announced its Narrative Networks (N2) program, which is apparently aimed at 'master[ing] the science of propaganda' (Lim, 2011). According to DARPA program manager William Casebeer, the goal of narrative networks is to 'understand how narratives influence human thoughts and behaviour, then apply those findings to a security context in order to address security challenges such as radicalization, violent social mobilization, insurgency and terrorism, and conflict prevention and resolution' (Weinberger, 2014b). The original program announcement stated:

DARPA is soliciting innovative research proposals in the areas of (1) quantitative analysis of narratives, (2) understanding the effects narratives have

on human psychology and its affiliated neurobiology, and (3) modeling, simulating, and sensing – especially in stand-off modalities – these narrative influences. Proposers to this effort will be expected to revolutionize the study of narratives and narrative influence by advancing narrative analysis and neuroscience so as to create new narrative influence sensors, doubling status quo capacity to forecast narrative influence.

(DARPA, 2011)

The solicitation listed three sub-goals: (1) ‘Develop new, and extend existing narrative theories’, (2) ‘[i]dentify and understand the role of narrative in security’, and (3) ‘[s]urvey and extend the state of the art in narrative analysis and decomposition’ (DARPA 2011). The DARPA project website summarises the aims of the project in the following way: ‘to understand how narratives influence human cognition and behavior, and apply those findings in international security contexts. The program aims to address the factors that contribute to radicalization, violent social mobilization, insurgency, and terrorism among foreign populations, and to support conflict prevention and resolution, effective communication and innovative PTSD treatments’ (DARPA website).

The proposed research methods include neuroscience approaches such as ‘[a]nalyz[ing] the neurobiological impact of narratives on hormones and neurotransmitters, reward processing, and emotion-cognition interaction’ (DARPA website). For example, a N2 grant worth \$200,000 was awarded to researchers from Arizona State University in 2012, who have already produced a preliminary project report. The published report indicated the development of a ‘persuasion protocol’ and the use of EEGs for human tests (Corman, 2011). Other N2 researchers at Georgia Institute of Technology monitor the brain processes of test subjects with MRIs while they watch dramatic scenes from popular movies to determine their emotional responses to them. One of the findings is that in situations of great suspense the test subjects decreased their awareness of the world around them (Cha, 2015).

It is widely understood that ‘narratives in the form of stories, rumors, biographies and pictures drive our behaviors and shape our convictions’ (Petit, 2012: 26–27). The apparent idea behind N2 is to better understand how narratives motivate enemies and to eventually come up with more persuasive narratives that counter those other narratives and thereby reduce the enemy’s motivation to engage in conflict in the first place.

The two legal scholars Cass Sunstein and Adrian Vermeule from Harvard University have argued even before N2 that there is a need to scientifically fight harmful narratives such as ‘conspiracy theories’ taking advantage of neuroscience. They warned that ‘inevitably action will ensue’ as a result of the spread of conspiracy theories on the Internet: even without directly causing violence ‘such theories can still have pernicious effects from the government’s point of view, either by inducing unjustifiably widespread public skepticism about the government’s assertions, or by dampening public mobilization and participation in government-led efforts, or both’ (Sunstein and Vermeule, 2009: 220).

In order to counter this threat the authors suggest to ‘cognitively infiltrate’ these groups by ‘government agents’ covertly participating in the debates and debunking them or ‘to induce some cognitive diversity’ for confusing, deceiving and discrediting people (Sunstein and Vermeule, 2009: 224–226).

That this idea has gone far beyond philosophical theorizing can be shown by the fact that the British intelligence service GCHQ commissioned in 2011 a study by behavioral scientist, Mandeep Dhami from then Cambridge University, to improve the art of Internet trolling (Dhami, 2011). In the study the following methods are suggested ‘to discredit, promote distrust, dissuade, deter, delay or disrupt’: upload Youtube videos containing ‘persuasive communications’, ‘[s]etting up Facebook groups, forums, blogs and Twitter accounts’, ‘[e]stablishing online aliases/ personalities’, ‘[p]roviding spoof online resources’, ‘[s]ending spoof e-mails and text messages from a fake person or mimicking a real person’, etc. (Dhami, 2011: 9). A whole arsenal of dirty tricks is revealed for influencing and manipulating people in the online world, which are undoubtedly already employed by many intelligence and security services around the globe.

The DARPA scientists envision N2 also as an early-warning device that can detect ‘who has fallen prey to dangerous ideas’ (Lim, 2011). For example, the use of certain language can function as an indicator for violence (Weinberger, 2014b). In this aspect, narrative networks sounds a bit like the DHS FAST program or other pre-crime programs, which all suffer from the same problem: human behaviour is complex and machines will end up generating lots of false positives, thereby putting innocent people at risk. It seems also likely that there is a serious risk of ‘blowback’ from introducing new narratives: people may interpret invented narratives in unforeseen ways, leading to surprising behaviour (Sunstein and Vermeule, 2009: 225). Furthermore, there is an ethics issue with respect to deliberately deceiving people, even if it is a ‘noble lie’ that helps reduce the motivation for violence, as ‘deceit can hamper the exercise of rational choice at every step’ and thereby hurt people (Bok, 1989: 26). Sunstein and Vermeule have, however, been widely criticized for advocating the wilful deception of the public as a means of neutralizing dissenters.

### ***6.2.5 Holograms and invisibility cloaks***

A slightly different approach of influencing an enemy’s behaviour is to manipulate the enemy’s sensory perception using advanced technology that creates holographic 3D images that are realistic and to alternatively render real objects invisible to an enemy. Some of these ideas will probably not be achievable or particularly useful in operational situations, but there are no reasons why they could not work in principle.

A hologram is a three-dimensional image of an object created by a laser, which under optimal light conditions may be mistaken for a real object. Holography or the science of creating holograms has been invented by Dennis Gabor in 1947. Potential applications for holograms range from entertainment

to medical training and human machine interface technology. There are also obvious military applications with regard to military deception and PSYOPS. The USAF had temporarily a webpage that featured an 'airborne holographic projector'. The picture on the webpage showed an aircraft projecting its own image ahead of itself and the description stated: 'The holographic projector displays a 3-dimensional visual image in a desired location, removed from the display generator. The projector can be used for psychological operations and strategic perception management. It is also useful for optical deception and cloaking, providing a momentary distraction when engaging an unsophisticated adversary'. Claimed or desired capabilities of the holographic projector included '[p]recision projection of 3-D visual images into a selected area; [s]upports PSYOP and strategic deception management; [p]rovides deception and cloaking against optical sensors' (US Air Force, 2003). In 2010 Pentagon scientists proposed a 'face of Allah'-weapon that would project a realistic holographic image of a deity into the sky 'to incite fear in soldiers on a battlefield' (Axe, 2010). Holography is one of those military technologies where it is very challenging to find good information on the current state of the art. So it remains very hard to judge what is or might be possible in this respect.

Neuroscience could provide greater insights into the workings of human vision, resulting in new and revolutionary camouflage technology up to the point of making objects or soldiers completely invisible to the human eye, as well as optical and other kinds of sensors. Camouflage patterns could be tailored perfectly to the operating environment using software that 'crunch[es] meteorological data on typical lighting and visibility conditions, combined with information about the colours and predominance of shapes visible in cities, fields and wilderness areas' (Economist, 2008). Battledress uniforms have now light-absorbing features and patterns that are so efficient at concealing soldiers that observers need to be 40 per cent closer to them in order to see them than was the case back in 2000 (Economist, 2008).

Another approach to relative invisibility is called 'adaptive camouflage' and is based on adjusting the colour and texture of an object to the background, making it very hard to perceive, especially from distance. For example, an aircraft could have colour changing or electrochromatic panels on its fuselage and wings that adjust to the exact colour and brightness of the sky in the background, making the aircraft virtually invisible from below. Aviation enthusiasts have speculated about secret US 'daylight stealth' aircraft since the late 1990s. A more technologically advanced approach is to bend light waves around an object so that a viewer cannot see it from a particular position. However, once the viewer moves to the side, the object may become partially visible because of different light refraction.

The Canadian company *Hyperstealth* claims to have developed a nanotechnology-based material it calls 'Quantum Stealth', which supposedly makes an object invisible across the spectrum of visible light and infrared (Anthony, 2012). It seems that scientists all around the world are discovering new ways of making things invisible. For example, researchers from

the University of Toronto have built an electromagnetic invisibility cloak. According to scientist George Eleftheriades, 'It's very simple: instead of surrounding what you're trying to cloak with a thick metamaterial shell, we surround it with one layer of tiny antennas, and this layer radiates back a field that cancels the reflections from the object' (Parnell, 2013). Such invisibility technology could be used defensively, depriving the enemy of targets, or offensively, sneaking up on the enemy in order to make an attack more likely to succeed.

### **6.2.6 'Mind viruses'**

The term 'mind virus' appears in the previously cited Timothy Thomas article, which refers to the 25th frame effect (T. Thomas, 1998). However, a different concept of a mind virus was proposed by neuroscientist Rajesh Rao: 'Malicious entities could send a "virus" as part of a communication from a machine, resulting in cognitive impairment or cognitive manipulation' through a BCI (Rao, 2013: 274). In other words, a BCI could be hacked and be used against the wearer of the BCI, for example by stimulating specific brain regions in a malicious fashion. Writing in *Wired Magazine* analysts for the Australian army, Chloe Diggins and Clint Arizmendi, claim that 'the marriage between neuroscience and military systems will fundamentally alter the future of conflict' since BCIs create new vulnerabilities that can be exploited:

We need to prevent BCIs from being disrupted or manipulated, and safeguard against the ability of the enemy to hack an individual's brain. The possibilities for damage, destruction, and chaos are very real. This could include manipulating a soldier's BCI during conflict so that s/he were forced to pull the gun trigger on friendlies, install malicious code in his own secure computer system, call in inaccurate coordinates for an air strike, or divulge state secrets to the enemy seemingly voluntarily.

(Diggins and Arizmendi, 2012)

Although it seems like a long way before soldiers are outfitted with brain monitoring and brain stimulation devices or even brain chips that could be remotely hacked, the day may not be as far off as one might think. The US Army expects this to happen in the 2020 to 2040 time bracket (Brady, 2015: 6–7).

## **6.3 Conclusion**

This chapter has reviewed possible electromagnetic/ acoustic and 'informational'/ cyber neuroweapons that could be developed. Stun weapons that hack the CNS through direct contact or by dazzling a person with an incoherent light source have been proven to work with several prototypes

in existence. It was shown that RF/ microwave type weapons can impact mental capacity and otherwise incapacitate due to thermal effects occurring at high energy densities. These weapons would be limited mostly by range and atmospheric conditions, but they are clearly possible to develop, as are so-called ‘voice-of-God’ weapons. There is far less proof that acoustic weapons and RF/ microwave weapons with low energy density exploiting assumed non-thermal effects are feasible or practical. Infrasound seems to have some influence on human emotions and well-being. There is also a growing amount of studies that show that long-term exposure to EMF can have negative health effects (cancer) and may impact on behaviour (suicide). It is hard to say, whether more precise effects on human behaviour could be possible with low energy RF/ microwaves – physicist Binhi has argued that there is at least no physical principle that would make this impossible in the future. Equally controversial are other forms of ‘mind hacking’ such as the use of subliminals. Several experts such as Wilson Bryan Key and Eldon Taylor have argued that subliminals are effective in influencing human behaviour under certain conditions. The use of subliminals by the advertising industry has been publicly known since 1957 and only recently neuroscience has been able to confirm that there is such a thing as a subconscious or subliminal stimulus and that it can influence human behaviour. It seems obvious enough that this can be exploited in PSYOPS campaigns. The only unclassified program in this field is DARPA’s N2, which includes the use of neuroscience for researching the influence of narratives on people. N2 is meant as a ‘defensive weapon’ that can neutralize enemy narratives and as an early-warning system that can detect radicalization. Finally, the chapter discussed the possibility of hacking the brain using BCIs that could enable others to take control over a person. This possibility is real, although it will take some time before such a threat can materialize – again there is no scientific reason why it would not be possible to ‘roboticise’ a human: it has been done to animals with great success (see chapter 1).