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Microchipping people: the rise of the electrophorus

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Abstract

Automatic identification (auto-ID) is the process of identifying a living or nonliving thing without direct human intervention. Before auto-ID only manual identification techniques existed, such as tattoos and fingerprints, which did not allow for the automatic capture of data. Many researchers credit the vision of a cashless society to the capabilities of auto-ID. Since the 1960s automatic identification has proliferated especially for mass-market applications such as electronic banking and citizen ID. Together with increases in computer processing power, storage equipment and networking capabilities, miniaturization and mobility have heightened the significance of auto-ID to e-business, especially mobile commerce. Citizens are now carrying multiple devices with multiple IDs, including ATM cards, credit cards, private and public health insurance cards, retail loyalty cards, school student cards, library cards, gymnasium cards, licenses to drive automobiles, passports to travel by air and ship, voting cards, and other. More sophisticated auto-ID devices like smart card and radio-frequency identification (RFID) tags and transponders that house unique lifetime identifiers (ULI) or biometric templates are increasingly being considered for business-to-consumer (B2C) and government-to-citizen (G2C) transactions. For example, the United States is enforcing the use of biometrics on passports due to the increasing threats of terrorism, and Britain has openly announced that it is considering implanting illegal immigrants with RFID transponders. Internationally, countries are also taking measures to decrease the multi-million dollar costs of fraudulent claims made to social security by updating their citizen identification systems with more secure end-user devices.

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Rise of the *Electrophorus*

Katina Michael and M.G. Michael

Automatic identification (auto-ID) is the process of identifying a living or nonliving thing without direct human intervention. Before auto-ID only manual identification techniques existed, such as tattoos and fingerprints, which did not allow for the automatic capture of data. Many researchers credit the vision of a cashless society to the capabilities of auto-ID. Since the 1960s automatic identification has proliferated especially for mass-market applications such as electronic banking and citizen ID. Together with increases in computer processing power, storage equipment and networking capabilities, miniaturization and mobility have heightened the significance of auto-ID to e-business, especially mobile commerce. Citizens are now carrying multiple devices with multiple IDs, including ATM cards, credit cards, private and public health insurance cards, retail loyalty cards, school student cards, library cards, gymnasium cards, licenses to drive automobiles, passports to travel by air and ship, voting cards, and other. More sophisticated auto-ID devices like smart card and radio-frequency identification (RFID) tags and transponders that house unique lifetime identifiers (ULI) or biometric templates are increasingly being considered for business-to-consumer (B2C) and government-to-citizen (G2C) transactions. For example, the United States is enforcing the use of biometrics on passports due to the increasing threats of terrorism, and Britain has openly announced that it is considering implanting illegal immigrants with RFID transponders. Internationally, countries are also taking measures to decrease the multi-million dollar costs of fraudulent claims made to social security by updating their citizen identification systems with more secure end-user devices.

The relative ease of performing electronic transactions by using auto-ID has raised a number of social, cultural, religious and ethical issues. Among others, civil libertarians, religious advocates and conspiracy theorists have long cast doubts on the technology and the ultimate use of the information gathered by it. Claims that auto-ID technology impinges on human rights, the right to privacy, and that eventually it will lead to totalitarian control of the population have been put forward since the 1970s. This paper aims to explore these themes with a particular emphasis on emerging human transponder implant technology. At present, several US companies are selling e-business services that allow for the tracking and monitoring of individuals using RFID implants in the subcutaneous layer of the skin and Global Positioning System (GPS) wristwatches worn by subscribers. To date specialist literature has not consistently addressed philosophical issues related to chip implants for humans. Credible articles on implanting humans are mostly interviews conducted with proponents of the technology, such as Applied Digital Solutions (ADSX) representatives who are makers of the VeriChip system solution; Professor Kevin Warwick of the University of Reading who is well-known for his Cyborg 1.0 and 2.0 projects; and "implantees" like the Jacobs family in the US who bear RFID transponder implants.

More recently a handful of academic papers on human transponder implants have surfaced addressing specific themes such as legal and privacy concerns, ethical and cultural impacts, technological problems and health concerns, technological progress, and trajectories. While there is a considerable amount of other popular material available especially on the Internet, much of it is subjective and not properly sourced. One major criticism of these reports is that the reader is left questioning the authenticity of the information provided with meager evidence to support respective claims and conclusions. Authorship of this literature is another problem. Often these articles are contributed anonymously, and when they do cite an author's name, the level of technical understanding portrayed by the individual is severely

lacking to the detriment of what the writer is trying to convey, even if there is a case to be argued. This discussion first seeks to provide a sober presentation of cross-disciplinary perspectives on topical auto-ID issues with an emphasis on human transponder implants, and second to document some of the more thought-provoking dialogue which has already taken place on the topic.

In terms of methodology, original material is quoted extensively to ensure that the facts are presented "as is." There is nothing lost in simplified translations and the full weight of argument is retained, raw and uncut. In this context, therefore, the present authors cannot be accused of bias or misrepresentation. The narrative reporting style helps to guide readers through the paper, allowing individuals to form their own opinions and interpretations of what is being presented. Evidence for the issues discussed has been gathered from a wide variety of sources including offline and online documentation. A highly intricate thread runs through the paper telling the story of not just auto-ID but the impacts of the information technology and telecommunications (IT&T) revolution. Consequently, there is a predictive element to the presentation as well, which is meant to confront the reader with some present and future scenarios. The 'what if' questions are important as it is hoped they will generate public debate on the major social, cultural, religious and ethical implications of RFID implants in humans.

The purpose of the following few paragraphs is to providing a background in which to understand auto-ID innovation. It will also grant some perspective to the tremendous pace of change in IT&T, and note some of the more grounded predictions about the future of computing. From personal computers (PCs) to laptops to personal digital assistants (PDAs), and from landline phones to cellular phones to wireless wristwatches, miniaturization and mobility have acted to shift the way in which computing is perceived by humans. Lemonick captures this pace of change well in the following excerpt:

> [i]t took humanity more than 2 million years to invent wheels but only about 5,000 years more to drive those wheels with a steam engine. The first computers filled entire rooms, and it took 35 years to make the machines fit on a desk- but the leap from desktop to laptop took less than a decade… What will the next decade bring, as we move into a new millennium? That's getting harder and harder to predict.

Once a stationary medium, computers are now portable, they go wherever humans go. This can be described as technology becoming more human-centric, "where products are designed to work for us, and not us for them". Thus, the paradigm shift is from desktop computing to wearable computing. Quite remarkably in the pursuit of miniaturization, little has been lost in terms of processing power.

> The enormous progress in electronic miniaturization makes it possible to fit many components and complex interconnection structures into an extremely small area using high-density printed circuit and multichip substrates.

We now have so-named Matchbox PCs that are no larger than a box of matches with the ability to house fully functional operating systems. The development of wearable computer systems has been rapid. Salonen, and Mann are of the belief that "quite soon we will see a wide range of unobtrusive wearable and ubiquitous computing equipment integrated into our everyday wear". The next ten years will see wearable computing devices become a part of our daily lives, especially as the price for devices keeps falling. Whether noticeable or not by

users, the change has already begun. Technology is increasingly becoming an extension of the human body, whether it is by carrying smart cards or electronic tags or even PDAs and mobile phones. Furui predicts that "[p]eople will actually walk through their day-to-day lives wearing several computers at a time". Cochrane described this phenomenon as technology being an omnipresent part of our existence. Not only will devices become small and compact but they will be embedded in our bodies, invisible to anyone else. For the time being however, we are witnessing the transition period in which auto-ID devices especially, are being trialled upon those who either i) desperately require their use for medical purposes or ii) who cannot challenge their application, such as in the case of armed forces or prison inmates. Eventually, the new technology will be opened to the wider market in a voluntary nature but will most likely become a de facto compulsory standard (i.e. such as in the case of the mobile phone today), and inevitably mandatory as it is linked to some kind of requirement for survival. Upon reflection, this is the pattern that most successful high-tech innovations throughout history have followed.

Mark Weiser first conceived the term "ubiquitous computing" to espouse all those small information systems (IS) devices, including calculators, electronic calendars and communicators that users carry with them. It is important to make the distinction between ubiquitous and wearable computing. They "have been posed as polar opposites even though they are often applied in very similar applications". Kaku stated that ubiquitous computing is the time "when computers are all connected to each other and the ratio of computers to people flips the other way, with as many as one hundred computers for every person". This latter definition implies a ubiquitous environment that allows the user to seamlessly interface with computer systems around them. Environments of the future are predicted to be context-aware so that users are not disturbed in every context, save for when it is suitable. Kortuem recognizes that "[s]uch environments might be found at the home, at the office, at factory floors, or even vehicles". There is some debate however of where to place sensors in these environments. For example, should they be located around the room or should they be located on the individual. Locating sensors around the room enforces certain conditions on an individual, while locating sensors on an individual means that that person is actually in control of their context. The latter case also requires less localized infrastructure and a greater degree of freedom. Rhodes et al. argue that by "properly combining wearable computing and ubiquitous computing, a system can have the advantages of both".

Starner (2001) makes the distinction between privacy and security concerns. "Security involves the protection of information from unauthorized users; privacy is the individual's right to control the collection and use of personal information." Mills is of the opinion that some technology, like communications, is not non-neutral but totalitarian in nature and that it can make citizens passive.

> These glamorous technologies extend and integrate cradle-to-grave surveillance, annihilating all concept of a right to personal privacy, and help consolidate the power of the national security state… every technology, being a form of power, has implicit values and politics…

Over the years terms like *Big Brother* and *function creep* have proliferated to correspond to the all-seeing eyes of government and to the misuse and abuse of data. In most western countries data matching programs were constructed, linked to a unique citizen ID, to cross-check details provided by citizens, claims made, and benefits distributed. More recently however, the trend has tended towards information centralization between government agencies based around the auspices of a national ID to reduce fraud and to combat terrorism.

Currently computers allow for the storage and searching of data gathered like never before. The range of automated data collection devices continues to increase to include systems such as bar codes, magnetic-stripe card, smart card and a variety of biometric techniques, increasing the rapidity and ease at which information is gathered and processed. RFID transponders especially have added a greater granularity of precision in in-building and campus-wide solutions, given the wireless edge, allowing information to be gathered within a closed environment, unobtrusively, transparent to the individual carrying the RFID badge or tag. It is significant to note the increasing invasiveness of auto-ID on end-user participants, from labels used to identify nonliving things, to cards people carry, to the use of personal physical characteristics in biometrics. The human being can now also be considered an intrinsic component of the technological system.

Now, while auto-ID itself is supposed to ensure privacy, it is the ease with which data can be collected that has some advocates concerned about the ultimate use of personal information. While the devices are secure, breaches in privacy can happen at any level- especially at the database level where information is eventually stored after it is collected. How this information is used, how it is matched with other data, who has access to it, is what has caused many citizens to be cautious about auto-ID in general. Data mining also has altered how data is manipulated, filtered, and utilized all in the name of customer relationship management (CRM). It is not difficult to obtain telemarketing lists, census information aggregated to a granular level, and mapping tools to represent market segments visually. Rothfeder (1995) states:

> [m]edical files, financial and personnel records, Social Security numbers, and telephone call histories- as well as information about our lifestyle preferences, where we shop, and even what car we drive- are available quickly and cheaply.

Looking forward, the potential for privacy issues linked to chip implants is something that has been considered but mostly granted attention by the media. Privacy advocates warn that such a chip would impact civil liberties in a disastrous way. Even Professor Warwick, who has temporarily been implanted on several occasions, is aware that chip implants do not promote an air of assurance:

> Looking back, Warwick admits that the whole experiment [Cyborg 1.0] "smacked of Big Brother." He insists, however, that it's important to raise awareness of what's already technically possible so that we can remain in the driver's seat. "I have a sneaking suspicion," he says, "that as long as we're gaining things, we'll yell 'Let's have Big Brother now!' It's when we're locked in and the lights start going off- then Big Brother is a problem."

In this instance, Warwick has made an important observation. So long as individuals are "gaining" they generally will voluntarily part with a little more information. It is when they stop gaining and blatantly start being taken advantage of that the idea of Big Brother is raised. As Chris Hoofnagle, an attorney for the Electronic Privacy Information Centre in Washington, D.C., pointed out, "[y]ou always have to think about what the device will be used for tomorrow". According to McGinity, after his own examination of the subject, there is no end to the potential use of the chip in our day-to-day transactions:

> [e]xperts say it [the chip] could carry all your personal information, medical background, insurance, banking information, passport information, address, phone number, social security number, birth certificate, marriage license.

This kind of data collection is considered by civil libertarians to be "crypto-fascism or high-tech slavery". The potential for abuse cannot be overstated. Salkowski agrees pointing to the ADSX VeriChip system, stating that police, parents and ADSX employees could abuse their power. "It might even be possible for estranged spouses, employers and anyone else with a grudge to get their hands on tracking data through a civil subpoena". Hackers too, could try their hand at collecting data without the knowledge of the individual, given that wireless transmission is susceptible to interception. At the same time, the chip implant may become a prerequisite to health insurance and other services. "You could have a scenario where insurance companies refuse to insure you unless you agree to have a chip implant to monitor the level of physical activity you do" says Pearson of British Telecom. This should not be surprising given that insurance companies already ask individuals for a medical history of illnesses upon joining a new plan. Proponents say the chip would just contain this information more accurately. Furthermore,

> [c]ost-conscious insurance companies are sure to be impressed, because the portability of biomems [i.e., a type of medical chip implant] would allow even a seriously ill patient to be monitored after surgery or treatment on an outpatient basis.

In the US in 2001 several bills were passed in Congress to allow for the creation of three new Acts related to biometric identification of citizens and aliens, including the Patriot Act, Aviation and Transport Security Act, and the Enhanced Border Security and Visa Entry Reform Act. If terrorism attacks continue to increase in frequency, there is a growing prospect in the use of chip implants for identification purposes and GPS for outdoor tracking and monitoring. It is not an impossible scenario to consider that one day these devices may be incorporated into national identification schemes. During the SARS (severe acute respiratory syndrome) outbreak, Singapore and Taiwan considered going as far as tagging their whole population with RFID devices to monitor automatically the spread of the virus. Yet, independent of such random and sporadic events, governments worldwide are already moving toward the introduction of a single unique ID to cater for a diversity of citizen applications. Opinions on the possibility of widespread chip implants in humans range from "it would be a good idea," to "it would be a good idea, but only for commercial applications not government applications," to "this should never be allowed to happen". Leslie Jacobs, who was one of the first to receive a VeriChip implant told Scheeres,

> "[t]he world would be a safer place if authorities had a tamper-proof way of identifying people… I have nothing to hide, so I wouldn't mind having the chip for verification… I already have an ID card, so why not have a chip?"

It should be noted that some tracking and monitoring systems can be turned off and on by the wearer, making monitoring theoretically voluntary. Sullivan a spokesperson for ADSX, said: "[i]t will not intrude on personal privacy except in applications applied to the tracking of criminals". ADSX have claimed on a number of occasions that it has received more than two thousand emails from teenagers volunteering to be the next to be "chipped". There are others like McClimans that believe that everyone should get chipped. Cunha Lima, a Brazilian politician who also has a chip implant is not ignorant of the potential for invasion of privacy but believes the benefits outweigh the costs and that so long as the new technology is voluntary and not mandatory there is nothing to worry about. He has said, "[i]f one chooses to 'be chipped,' then one has considered the consequences of that action". Lima argues that

he feels more secure with an implant given the number of kidnappings in South America of high profile people each year- at least this way his location is always known.

Professor Brad Meyers of the Computer Science Department at Carnegie Mellon University believes that the chip implant technology has a place but should not be used by governments. Yet the overriding sentiment is that chip implants will be used by government before too long. Salkowski has said, "[i]f you doubt there are governments that would force at least some of their citizens to carry tracking implants, you need to start reading the news a little more often". Black echoes these sentiments:

> Strictly voluntary? So far so good. But now imagine that same chip being used by a totalitarian government to keep track of or round up political activists or others who are considered enemies of the state. In the wrong hands, the VeriChip could empower the wrong people.

In a report written by Ramesh for the Franklin Pierce Law Centre the prediction is made that:

> [a] national identification system via microchip implants could be achieved in two stages: Upon introduction as a voluntary system, the microchip implantation will appear to be palatable. After there is a familiarity with the procedure and a knowledge of its benefits, implantation would be mandatory.

Bob Gellman, a Washington privacy consultant, likens this to "a sort of modern version of tattooing people, something that for obvious reasons- the Nazis tattooed numbers of people- no one proposes". The real issue at hand as Gellman sees it is "who will be able to demand that a chip be implanted in another person." Mieszkowski supports Gray by observing how quickly a new technological "option" can become a requirement. Resistance after the voluntary adoption stage can be rather futile if momentum is leading the device towards a mandatory role.

McMurchie (1999) reveals the subtle progression toward embedded devices:

> [a]s we look at wearable computers, it's not a big jump to say, 'OK, you have a wearable, why not just embed the device?'… And no one can rule out the possibility that employees might one day be asked to sport embedded chips for ultimate access control and security…

Professor Chris Hables Gray uses the example of prospective military chip implant applications. How can a marine, for instance, resist implantation? The British Army is purportedly considering projects such as APRIL (Army Personnel Rationalization Individual Listings). Some cyberpunks have attempted to counteract the possibility of enforced implantation. One punk known by the name of "Z.L" is an avid reader of MIT specialist publications like open|DOOR MIT magazine on bioengineering and beyond. Z.L.'s research has indicated that:

> [i]t is only a matter of time… before technology is integrated within the body. Anticipating the revolution, he has already taught himself how to do surgical implants and other operations. "The state uses technology to strengthen its control over us," he says. "By opposing this control, I remain a punk. When the first electronic tags are implanted in the bodies of criminals, maybe in the next five years, I'll know how to remove them, deactivate them and spread viruses to roll over Big Brother".

Public concern about electromagnetic fields from cellular phones was a contentious issue in the late 1990s. Now it seems that the majority of people in More Developed Countries (MDCs) have become so dependent on mobile phones that they are disregarding the potential health risks associated with the technology. Though very little has been proven concretely, most terminal manufacturers do include a warning with their packaging, encouraging users not to touch the antenna of the phone during transmission. Covacio is among the few authors to discuss the potential technological problems associated with microchips for human ID from a health perspective. In his paper he provides evidence why implants may impact humans adversely, categorizing these into thermal (i.e. whole/partial rise in body heating), stimulation (i.e. excitation of nerves and muscles) and other effects most of which are currently unknown. He states that research into RFID and mobile telephone technology:

> ...has revealed a growing concern with the effects of radio frequency and non-ionizing radiation on organic matter. It has been revealed a number of low-level, and possible high-level risks are associated with the use of radio-frequency technology. Effects of X-rays and gamma rays have been well documented in medical and electronic journals…

In considering future wearable devices, Salonen puts forward the idea of directing antenna away from the head where "there may be either a thermal insult produced by power deposition in tissue (acute effects) or other (long-term) effects" to midway between the shoulder and elbow where radiation can be pushed outward from the body. Yet chip implants may also pose problems, particularly if they are active implants that contain batteries and are prone to leakage if transponders are accidentally broken. Geers et al. write the following regarding animal implants.

> Another important aspect is the potential toxic effect of the battery when using active transponders. Although it should be clear that pieces of glass or copper from passive tags are not allowed to enter the food chain. When using electronic monitoring with the current available technology, a battery is necessary to guarantee correct functioning of sensors when the transponder is outside the antenna field. If the transponder should break in the animal's body, battery fluid may escape, and the question of toxological effects has to be answered.

In fact, we need only consider the very real problems that women with unfit silicon breast implants have had to suffer. Will individuals with chip implants, twenty years down the track, be tied up in similar court battles and with severe medical problems? Surgical implantation, it must also be stated, causes some degree of stress in an animal and it takes between four to seven days for the animal to return to equilibrium. Most certainly some discomfort must be felt by humans as well. In the Cyborg 1.0 project, Warwick was advised to leave the implant under his skin for only ten days. According to Trull, Warwick was taking antibiotics to fight the possibility of infection. Warwick also reportedly told his son while playing squash during Cyborg 1.0: "Whatever you do, don't hit my arm. The implant could just shatter, and you'll have ruined your father's arm for life". It is revealing to note Warwick's appearance after the Cyborg 2.0 experiment. He looked pale and weary in press release photographs, like someone who had undergone a major operation. Covacio believes ultimately that widespread implantation of microchips in humans will lead to detrimental effects to them and the environment at large. Satellite technology (i.e. the use of GPS to locate individuals), microwave RF and related technological gadgetry will ultimately

"increase health problems and consequentially increase pressure on health services already under economic duress."

When the ENIAC was first made known to the public in February of 1946 reporters used "anthropomorphic" and "awesome characterizations" to describe the computer. The news was received with skepticism by citizens who feared the unknown. In an article titled "The Myth of the Awesome Thinking Machine", Martin stated that the ENIAC was referred to in headlines as "a child, a Frankenstein, a whiz kid, a predictor and controller of weather, and a wizard". Photographs of the ENIAC used in publications usually depicted the computer to completely fill a small room, from wall-to-wall and floor-to-ceiling. People are usually shown interacting with the machine, feeding it with instructions, waiting for results and monitoring its behavior. One could almost imagine that the persons in the photographs are 'inside the body' of the ENIAC. Sweeping changes have taken place since that time, particularly since the mid 1980s. Consumers now own personal computers in their homes- these are increasingly being networked- they carry laptop computers and mobile phones and chip cards, and closely interact with public automated kiosks. Relatively speaking, it has not taken long for people to adapt to the changes that this new technology has heralded. Today we speak of a Net Generation (N-Geners) who never knew a world without computers or the Internet; for them the digital world is as ubiquitous as the air that they breathe. What is important to N-Geners is not how they got to where they are today but what digital prospects the future holds.

> [O]ur increasing cultural acceptance of high-tech gadgetry has led to a new way of thinking: robotic implants could be so advantageous that people might actually want to become cybernetic organisms, by choice. The popularization of the cyberpunk genre has demonstrated that it can be hip to have a chip in your head.

The predictions of science fiction writers have often been promoted through the use of print, sound and visual mediums. Shortly will follow a small but representative list of sci-fi novels, films and television series that have undoubtedly influenced and are still influencing the trajectory of auto-ID. Chris Hables Gray tells his students

> …that a lot of the best cyborgology has been done in the mass media and in fiction by science fiction writers, and science fiction movie producers, because they're thinking through these things.

The popular 1970s series of *The Six Million Dollar Man*, for instance, began like this: "We can rebuild him. We have the technology. We have the capability to make the world's first Bionic man". Today bionic limbs are a reality and no longer science fiction. More recently AT&T's Wireless *mMode* magazine alluded to Start Trek (Goldberg 2004):

> They also talked about their expectations- one media executive summed it up best, saying, "Remember that little box that Mr. Spock had on Star Trek? The one that did everything? That's what I'd like my phone to be…"

Beyond auto-ID we find a continuing legacy in sci-fi genre toward the "electrification" of humans- from *Frankenstein* to *The Six Million Dollar Man*, from *The Terminal Man* to *Johnny Mnemonic* and beyond. While all this is indeed 'merely' sci-fi, it is providing shape, form, and narrative to an emerging "technique", allowing the imagination to be captured in powerful images, sounds and models. What is next? A vision of a mechanized misery as

portrayed in Fritz Lang's 1927 cult film classic *Metropolis*? Only this time instead of being under the subjugation of the Machine from the 'outside' atmosphere, we have gone one step further and invited the Machine to come 'inside' the body and marked this advancement as a 'technological breakthrough'. As several commentators have noted, "[w]e live in an era that… itself often seems like science fiction, and *Metropolis* has contributed powerfully to that seeming".

Some of the more prominent predictions and social critiques which have entered our social discourse are found inside the following novels: *Frankenstein* (Mary Shelley 1818), *Paris in the 20th Century* (Jules Verne 1863), *Looking Backward* (Edward Bellamy 1887), *The Time Machine* (H. G. Wells 1895), *R.U.R.* (Karel Kapek 1917), *Brave New World* (Aldous Huxley 1932), *1984* (George Orwell 1949), *I, Robot* (Isaac Asimov 1950), The *Foundation* Trilogy (Asimov- originally written in the 1950's for serial publication), *2001: A Space Odyssey* (Arthur C. Clarke 1968), *Do Androids Dream of Electric Sheep?/ Blade Runner* (Philip K. Dick 1968), *Stand on Zanzibar* (John Brunner 1968), *Man Plus* (Frederik Pohl 1970), *Neuromancer* (William Gibson 1984), *The Marked Man* (Charles Ingrid 1989), *The Silicon Man* (Charles Platt 1991), *Silicon Karma* (Thomas Easton 1997), *3001: The Final Odyssey* (Arthur C. Clarke 1997), *The Light of Other Days* (Clarke and Stephen Baxter 2000). The effects of cinema have made an even more substantial impression on the individual consciousness, many of these films are now ensconced in our popular culture and futuristic vocabulary: *Metropolis* (Fritz Lang 1927), *Forbidden Planet* (Fred Wilcox 1956), *Fail Safe* (Sidney Lumet 1964), *THX-1138* (George Lucas 1971), *2001: A Space Odyssey* (Stanley Kubrick 1968), *Solaris* (Andrei Tarkovsky 1972), *Westworld* (Michael Crichton 1973), *The Terminal Man* (George Lucas 1974), *Zardoz* (John Boorman 1974), *Star Wars* (George Lucas 1977), Moonraker (Lewis Gilbert II 1979), *Star Trek* (Robert Wise 1979), *For Your Eyes Only* (John Glen II 1981), *Blade Runner* (Ridley Scott 1982), *War Games* (John Badham 1983), *2010: The Year We Make Contact* (Peter Hyams 1984), *RoboCop* (Paul Verhoeven, 1987), *Total Recall* (Paul Verhoeven 1990), *Terminator 2: Judgment Day* (James Cameron 1991), *Sneakers* (Phil Alden Robinson 1992), *Patriot Games* (Phillip Noyce 1992), *The Lawnmower Man* (Brett Leonard 1992), *Demolition Man* (Marco Brambilla 1993), *Jurassic Park* (Steven Speilberg 1993), *Hackers* (Iain Softley 1995), *Johnny Mnemonic* (Robert Longo 1995), *The NET* (Irwin Winkler 1995), *Gattaca* (Andrew Niccol 1997), *Enemy of the State* (Tony Scott 1998), *Fortress 2* (Geoff Murphy 1999), *The Matrix* (L. Wachowski & A. Wachowski 1999), *Mission Impossible 2* (John Woo 2000), *The 6th Day* (Roger Spottiswoode 2000), *A.I. Artificial Intelligence* (Steven Spielberg 2001), *Minority Report* (Steven Spielberg 2002), *Terminator 3: Rise of the Machines* (Jonathan Mostow 2003). Other notable television and animation series include: *Dr Who*, *Lost in Space*, *Dick Tracy*, *The Jetsons*, *Batman, Star Trek*, *Space: 1999*, *The Six Million Dollar Man*, *The Bionic Woman*, *Andromeda*, *Babylon 5*, *Stargate SG-1*, *Gasaraki*, *Neon Genesis Evangelion,* and *FarScape.* What was once considered to be the natural realm of science fiction, or even… leftist propaganda, is now seriously discussed and investigated at the highest levels of applied science.

Auto-ID and more generally computer and network systems have influenced changes in language, art, music and film. An article by Branwyn summarizes these changes well.

> Language: "Computer network and hacker slang is filled with references to "being wired" or "jacking in" (to a computer network), "wetware" (the brain), and "meat" the body".

> Music: "Recent albums by digital artists Brian Eno, Clock DVA, and Frontline Assembly sport names like Nerve Net, Man Amplified and Tactical Neural Implant." See also the 1978 album by Kraftwerk titled "The Man Machine".
> Film: "Science fiction films, from *Robocop* to the recent Japanese cult film *Tetsuo: The Iron Man*, imprint our imaginations with images of the new."

Apart from the plethora of new terms that have been born from the widespread use of IT&T and more specifically from extropians (much of which have religious connotations or allusions), it is art, especially body art that is being heavily influenced by chip implant technology. Mieszkowski believes that "chipification" will be the next big wave in place of tattoos, piercing and scarification. In the U.S. it was estimated in 2001 that about two hundred Americans had permanently changed their bodies at around nine hundred dollars per implant, following a method developed by Steve Hayworth and Jon Cobb.

Canadian artist Nancy Nisbet has implanted microchips in her hands to better understand how implant technology may affect the human identity. The artist told Scheeres, "I am expecting the merger between human and machines to proceed whether we want it to or not…" As far back as 1997, Eduardo Kac "inserted a chip into his ankle during a live performance in Sao Paulo, then registered himself in an online pet database as both owner and animal". Perhaps the actual implant ceremony was not Kac's main contribution but the subsequent registration onto a pet database. Other artists like Natasha Vita More and Stelarc have ventured beyond localized chip implants. Their vision is of a complete prosthetic body that will comprise of nanotechnology, artificial intelligence, robotics, cloning, and even nanobots. More calls her future body design Primo 3M Plus. Stelarc's live performances however, have been heralded as the closest thing there is to imagining a world where the human body will become obsolete.

> A Stelarc performance… usually involves a disturbing mix of amplified sounds of human organs and techno beats, an internal camera projecting images of his innards, perhaps a set of robotic legs or an extra arm, or maybe tubes and wires connecting the performer's body to the internet with people in another country manipulating the sensors, jerking him into a spastic dance. It's a dark vision, but it definitely makes you think.

Warwick believes that the new technologies "will dramatically change [art], but not destroy it".

As Sacleman wrote in 1967 "[t]he impact of automation on the individual involve[d] a reconstruction of his values, his outlook and his way of life". Marshall McLuhan was one of the first explorers to probe how the psycho-social complex was influenced by electricity.

> Electricity continually transforms everything, especially the way people think, and confirms the power of uncertainty in the quest for absolute knowledge.

Numerous examples can be given to illustrate these major cultural changes- from the use of electricity for household warmth, to wide area networks (WAN) enabling voice and data communications across long distances, to magnetic-stripe cards used for credit transactions. But what of the direct merger of humans and technology- the fusion between flesh and electronic circuitry? Consider for a moment the impact that chip implants have had on the estimated 23,000 cochlear recipients in the US. A medical marvel perhaps but it too, not

without controversy. There are potentially 500,000 hearing impaired persons that could benefit from cochlear implants but not every deaf person wants one.

> Some deaf activists… are critical of parents who subject children to such surgery [cochlear implants] because, as one charged, the prosthesis imparts "the nonhealthy self-concept of having had something wrong with one's body" rather than the "healthy self-concept of [being] a proud Deaf".

Assistant Professor Scott Bally of Audiology at Gallaudet University has said:

> [m]any deaf people feel as though deafness is not a handicap. They are culturally deaf individuals who have successfully adapted themselves to being deaf and feel as though things like cochlear implants would take them out of their deaf culture, a culture which provides a significant degree of support.

Putting this delicate debate aside it is here that some delineation can be made between implants that are used to treat an ailment or disability (i.e. giving sight to the blind and hearing to the deaf), and implants that may be used for enhancing human function (i.e. memory). Some citizens are concerned about the direction of the human species as future predictions of fully functional neural implants are being made by credible scientists.

> [Q]uestions are raised as to how society as a whole will relate to people walking around with plugs and wires sprouting out of their heads. And who will decide which segments of the society become the wire-heads?

Those who can afford the procedures perhaps? And what of the possibility of brain viruses that could be fatal and technological obsolescence that may require people to undergo frequent operations? Maybury believes that humans are already beginning to suffer from a type of "mental atrophy" worse than that that occurred during the industrial revolution and that the only way to fight it is to hang on to those essential skills that are required for human survival. The question remains whether indeed it is society that shapes technology or technology that shapes society. Inevitably it is a dynamic process of *push* and *pull* that causes cultural transformations over time.

Ever since the bar code symbology UPC (Universal Product Code) became widespread some Christian groups have linked auto-ID to the infamous "mark" in the *Book of Revelation* (Rev 13:18): "the number of the beast… is 666". Coincidentally, the left (101), centre (01010) and right (101) border codes of the UPC bars are encoded 6, 6, 6. As it is now an established standard for every non-perishable item to be bar coded there was a close association with the prophecy: "so that no one could buy or sell unless he had the mark" (Rev 13:17). In full, verses 16-18 of chapter 13 of the Seer's Apocalypse read as follows:

> He also forced everyone, small and great, rich and poor, free and slave, to receive a mark on his right hand or on his forehead, so that no one could buy or sell unless he had the mark, which is the name of the beast or the number of his name. This calls for wisdom. If anyone has insight, let him calculate the number of the beast, for it is man's number. His number is 666.

According to some Christians, this reference would appear to be alluding to a mark on or in the human body, the prediction being made that the UPC would eventually end up on or

under human skin. As new bar code symbologies were introduced and the auto-ID selection environment grew, the interpretation of the prophecy further developed as to the actual guise of the mark. It was no longer interpreted to be 'just' the bar code.

Card technology such as magnetic-stripe and smart cards became the next focus as devices that would gradually pave the way for a permanent ID for all citizens globally: "He also forced everyone, small and great, rich and poor, free and slave, to receive a mark…" (Rev 13:16). Biometrics followed and immediately the association was made that the "mark" [Gk. *charagma*] would appear on the "right hand" (i.e. palmprint or fingerprint) or on the "forehead" (facial/ iris recognition) as was presumably prophesied. Short of calling this group of people "fundamentalists", as Woodward refers to one prominent leader, lawyer and well-known privacy advocate Simon Davies is more circumspect:

> "I think they're legitimate [claims]. People have always rejected certain information practices for a variety of reasons: personal, cultural, ethical, religious and legal. And I think it has to be said that if a person feels bad for whatever reason, about the use of a body part then that's entirely legitimate and has to be respected".

Finally RFID transponders made their way into pets and livestock for identification, and that is when some Christian groups announced that the 'authentic' mark was now possible, and that it was only a matter of time before it would find its way into citizen applications. Terry Cook, for instance, an outspoken religious commentator, "worries the identification chip could be the 'mark of the beast', an identifying mark that all people will be forced to wear just before the end times, according to the Bible". The description of an implant procedure for sows that Geers et al. give, especially the section about an incision being made on the skin, is what some religious advocates and civil libertarians fear may happen to humans as well in the future.

> When the thermistor was implanted the sows were restrained with a lasso. The implantation site was locally anaesthetized with a procaine (2%) injection, shaved and disinfected. After making a small incision in the skin, the thermistor was implanted subcutaneously, and the incision was closed by sewing. The position of the thermistor (accuracy 0.1C) was wire-connected to a data acquisition system linked to a personal computer.

"Religious advocates say it [i.e. transponder implants] represents 'the mark of the Beast', or the anti-Christ". Christians who take this mark, for whatever reason, are said to be denouncing the seal of baptism, and accepting the Antichrist in place of Christ. Horn explains:

> [m]any Christians believe that, before long, an antichrist system will appear. It will be a New World Order, under which national boundaries dissolve, and ethnic groups, ideologies, religions, and economics from around the world, orchestrate a single and dominant sovereignty… According to popular Biblical interpretation, a single personality will surface at the head of the utopian administration… With imperious decree the Antichrist will facilitate a one-world government, universal religion, and globally monitored socialism. Those who refuse his New World Order will inevitably be imprisoned or destroyed.

Barnet and Cavanagh describe this nebulous but universally recognized concept of a New World Order using a techno-economic paradigm in *Global Dreams*.

Companies that specialize in the manufacture of chip implant solutions, whether for animals or for humans, have been targeted by some religious advocates. The bad publicity has not been welcomed by these companies- some have even notably "toned down" the graphic visuals on their web sites so that they do not attract the wrong 'type' of web surfers. While they are trying to promote an image of safety and security, some advocates have associated company brands and products with apocalyptic labels. Some of the company and product names include: TagMaster, Biomark, BioWare, BRANDERS, MARC, Soul Catcher, Digital Angel, and Therion Corporation. Perhaps the interesting thing to note is that religious advocates and civil libertarians agree that ultimately the chip implant technology will be used by governments to control citizens. ADSX is one of the companies that have publicly stated that they do not want adverse publicity after pouring hundreds of thousands of dollars into research and development and the multi-million dollar purchase of the Destron Fearing company. So concerned were they that they even appeared on the Christian talk show *The 700 Club*, emphasizing that the device would create a lot of benefits and was not meant to fulfill prophecy. A spokesperson for ADSX said:

> [w]e don't want the adverse publicity. There are a number of privacy concerns and religious implications- fundamentalist Christian groups regard [i.e., implanting computer chips] as the Devil's work.

According to Gary Wohlscheid, the president of The Last Day Ministries, the VeriChip could well be the mark. Wohlscheid believes that out of all the auto-ID technologies with the potential to be the mark, the VeriChip is the closest. About the VeriChip he says however, "[i]t's definitely not the final product, but it's a step toward it. Within three to four years, people will be required to use it. Those that reject it will be put to death". These are, of course, the positions of those who have entered the debate from the so-called fundamentalist literalist perspective and represent the more vocal and visible spectrum of contemporary "apocalyptic" Christianity. In this context the idea of fundamentalism seems to be a common label today, for anyone within the Christian confession who questions the trajectory of technological advancement. Ultimately, for most members of a believing religious community, the general subject revolves around the most important question of individual freedom and the right to choose.

In an attempt to make our world a safer place we have inadvertently infringed on our privacy and our freedom through the use of surveillance cameras and all other ancillary. We equip our children with mobile phones, attach tracking devices to them or make them carry them in their bags and soon we might even be implanting them with microchips. This all comes at a price- yet it seems more and more people are willing to pay this price as heinous crimes become common events in a society that should know better. Take the example of 11-year old Danielle Duval who is about to have an active chip (i.e. containing a rechargeable battery) implanted in her. Her mother believes that it is no different to tracking a stolen car, simply that it is being used for another more important application. Mrs Duvall is considering implanting her younger daughter age 7 as well but will wait until the child is a bit older: "so that she fully understands what's happening". One could be excused for asking whether Danielle at the age of 11 can fully comprehend the implications of the procedure, both at the physiological and social dimensions, that she is evidently about to undergo.

Professor Warwick has said that an urgent debate is required on this matter (i.e. whether every child should be implanted by law), and whether or not signals from the chips should be emitted on a 24x7 basis or just triggered during emergencies. Warwick holds the position that "we cannot prejudge ethics". He believes that ethics can only be debated and conclusions reached only after people become aware of the technical possibilities when they have been demonstrated. He admits that ethics may differ between countries and cultures. The main ethical problem related to chip implants seems to be that they are under the skin and cannot just be removed by the user at their convenience. In fact there is nothing to stop anyone from getting multiple implants all over their body rendering some applications useless. Tien of the Electronic Frontier Foundation (EFF) is convinced that if a technology is there to be abused, whether it is chip implants or national ID cards, then it will because that is just human nature. Similarly, Kidscape, a charity that is aimed at reducing the incidence of sexual abuse in children believe that implants will not act to curb crime. Kidscape hold the position that rather than giving children a false sense of security because they are implanted with a tracking device that could be tampered with by an offender, they should be educated on the possible dangers. Implanted tracking devices may sound entirely full-proof but deployment of emergency personnel, whether police or ambulance, cannot just magically appear at the scene of a crime in time to stop an offender from committing violence against a hostage.

There are numerous arguments for why implanting a chip in a person is unconstitutional. But perhaps the "under-explored area", as Gellman puts it, are the legal and social issues of who would have power over the chip and all of the information that was gathered. Gellman is correct in his summation of the problem, but science has a proven way of entering into uncharted territory first, then asking the questions of implications later. ADSX, for instance, have already launched the VeriChip solution. Sullivan, a spokesperson for the company told Salkowski:

> "I'm certainly not a believer in the abuse of power," he offered, suggesting that [US] Congress could always ban export of his company's device. Of course, he admits he wouldn't exactly lobby for that law. "I'm a businessman," he said.

Black makes the observation that the US government might well indeed place constraints on international sales of the VeriChip if it felt it could be used against them by an enemy. Consider the governance issues surrounding GPS technology that has been in operation a lot longer than human RFID implants.

> Good, neutral, or perhaps undesirable outcomes are now possible… Tension arises between some of the civil/commercial applications and the desire to preclude an adversary's use of GPS. It is extremely difficult (technically, institutionally, politically, and economically) to combine the nonmilitary benefits of the system that require universality of access, ease of use, and low cost with military requirements for denial of the system to adversaries. Practical considerations require civil/commercial applications to have relatively easy access.

From a different angle, Rummler points out that the monitoring and tracking of individuals raises serious legal implications regarding the individual's capacity to maintain their right to freedom. He wrote:

> [o]nce implanted with bio-implant electronic devices, humans might become highly dependent on the creators of these devices for their repair, recharge, and maintenance. It could be possible to modify the person technologically… thus placing them under the absolute control of the designers of the technology.

Dr. David Feigal of The Food and Drug Administration (FDA) has been vocal about the need for those behind such devices as the VeriChip not to take medical applications lightly and that companies wishing to specialize in health-related implants need to be in close consultation with the FDA. There is also the possibility that such developments, i.e. regulating chip implants, may ultimately be used against an individual. The Freedom of Information Act for instance, already allows U.S. authorities to access automatic vehicle toll-passes to provide evidence in court; there is nothing to suggest this will not happen with RFID transponder implants as well, despite the myriad of promises made by ADSX. Professor Gray is adamant that there is no stopping technological evolution no matter how sinister some technologies may appear, and that we need to become accustomed to the fact that new technologies will continually infringe upon the constitution.

Luggables, like mobile phones, do create a sense of attachment between the user and the device but the devices are still physically separate; they can accidentally be left behind. Wearable computers on the other hand are a part of the user, they are worn, and they "create an intimate human-computer-symbiosis in which respective strengths combine". Mann calls this human-computer-symbiosis, "human interaction" (HI), as opposed to human-computer interaction (HCI).

> [W]e prefer not to think of the wearer and the computer with its associated I/O apparatus as separate entities. Instead, we regard the computer as a second brain and its sensory modalities as additional senses, which synthetic synesthesia merges with the wearer's senses.

Human-computer electrification is set to make this bond irrevocable once the intended trajectory has been realized. If at present all this talk gives the impression of a suburban myth, a far-fetched impossibility, a fundamentalist's or cyberpunk's or technological visionary's outrageous prediction, the history of science should teach us otherwise. This year alone, millions of babies will be born into a world where there are companies on the New York Stock Exchange specializing in chip implant devices for humans. They will grow up believing that these technologies are not only "normal" but that they are necessary, just like other high-tech technologies before them such as the Internet, PCs, smart cards etc. Consider the case of Cynthia Tam, aged two, who is an avid computer user:

> [i]t took a couple of days for her to understand the connection between the mouse in her hand and the cursor on the screen and then she was off… The biggest problem for Cynthia's parents is how to get her to stop… for Cynthia, the computer is already a part of her environment… Cynthia's generation will not think twice about buying things on the Internet, just like most people today don't think twice when paying credit card, or using cash points for withdrawals and deposits.

But you do not have to be a newborn of this generation to adapt to technological change. Even grandmothers and grandfathers surf the web these days and send emails as a cheaper alternative to post or telephone. And migrants struggling with a foreign language will memorize key combinations to withdraw money from ATM's even if they do not fully

perceive the technology at their command. Schiele believes that our personal habits are shaped by technological change and that over time new technologies that seem only appropriate for technophiles eventually find themselves being used by the average person. "[O]ver time our culture will adjust to incorporate the devices". Gotterbarn is in agreement.

> We enthusiastically adopt the latest gadget for one use, but then we start to realize that it gives us power for another use. Then there is the inevitable realization that we have overlooked the way it impacts other people, giving rise to professional and ethical issues.

Beyond chip implants for tracking there are the possibilities associated with neural prosthetics and the potential to directly link computers to humans. Warwick is also well aware that one of the major obstacles of cyber-humans are the associated moral issues- who gives anyone the right to be conducting complex procedures on a perfectly healthy person, and who will take responsibility for any complications that present themselves? Rummler asks whether it is ethical to be linking computers to humans in the first place and whether or not limitations should be placed on what procedures can be conducted even if they are possible. For instance, could this be considered a violation of human rights? And moreover what will it mean in the future to call oneself "human"? McGrath asks "how human"?

> As technology fills you up with synthetic parts, at what point do you cease to be fully human? One quarter? One third?... At bottom lies one critical issue for a technological age: are some kinds of knowledge so terrible they simply should not be pursued? If there can be such a thing as a philosophical crisis, this will be it. These questions, says Rushworth Kidder, president of the Institute for Global Ethics in Camden, Maine, are especially vexing because they lie at the convergence of three domains- technology, politics and ethics- that are so far hardly on speaking terms.

At the point of becoming an electrophorus (i.e. a *bearer* of electricity), "[y]ou are not just a human linked with technology; you are something different and your values and judgment will change". Some suspect that it will even become possible to alter behavior in people with brain implants, whether they will it or not. Maybury believes that "[t]he advent of machine intelligence raises social and ethical issues that may ultimately challenge human existence on earth." We know, for example, from the reports of the clinical psychologist Michael D. Yapko, that a procedure under "clinical investigation" called *Vagus Nerve Stimulation*, refers to a "pacemaker for the brain" which has been used to treat depression by sending electrical impulses to stimulate those parts of the brain which are considered "the underperforming areas". This, of course, raises the too obvious questions of the potential for 'mood' and 'mind' control.

A new line of "wearables" is now emerging that does not entirely fit the definition of the traditional wearable that assumes a presence outside the human body. Implantable devices such as RFID transponders cannot exactly be referred to as "wearables" because the component is not worn, rather they are ingrained, embedded, entrenched in the human body. The implant device is more than an extension; it becomes one with the body, a seamless fusion between the flesh and the foreign object. In the past, automated biometric recognition techniques were heralded as a coming together of humans and machines but today we have something beyond a mere meeting point, we have the potential for actual fusion on an evolutionary scale. The term "cyborg" has been hijacked by film and science fiction writers to mean "part machine, part human".

> Saffo, director of the Institute for the Future, does not doubt that people may become a race of cyborgs- "part man and part machine"… "We put all sorts of implants in [our bodies] today," says Saffo. "If we have metal hips, it only makes sense to have chips in, too".

The definition of cyborg, however, would be more relevant to bionics than to implantable devices. The human who has been implanted with a microchip is an *Electrophorus*, a bearer of "electric" technology. One who "bears" (i.e. a *phorus*) is in some way intrinsically or spiritually connected to that which they are 'carrying', in the same way an expecting mother is to the child in her womb. The root "electro" comes from the Greek *elektron* meaning "amber", and "phorus" means to "wear, to put on, to get into". To electronize something is "to furnish it with electronic equipment" and electrotechnology is "the science that deals with practical applications of electricity". The *Macquarie Dictionary* definition of *electrophorus* is "an instrument for generating static electricity by means of induction". The term "electrophoresis" has been borrowed to describe the electric activity to which the electrophorus is connected. McLuhan et al. believed that "…electricity is in effect an extension of the nervous system as a kind of global membrane". The description of electrophorus as has been adapted during the course of this discussion seems more suitable, if not more accurate than that of any other term, including that of the readily recognized but caricatured "cyborg". It is not surprising then, that these crucial matters of definition raise the metaphysical question of identity, which sci-fi writers are now beginning to creatively and in some instances to ontologically address.

Gotterbarn argues precisely that our view of computer technologies generally progresses through several stages:

> 1) naïve innocence and technological wonder, 2) power and control, and 3) finally, sometimes because of disasters during the second stage, an understanding of the essential relationship between technologies and values.

Bill Joy, the chief technologist of Sun Microsystems, feels a sense of unease about such predictions made by Ray Kurzweil in *The Age of Spiritual Machines*. Not only because Kurzweil has proven technically competent in the past, but because of his ultimate vision for humanity- "a near immortality by becoming one with robotic technology". Joy was severely criticized for being narrow-sighted, even a fundamentalist of sorts, after publishing his paper in *Wired*, but all he did was dare to ask the questions- 'do we know what we are doing? Has anyone really carefully thought about this?' Joy believes:

> [w]e are being propelled into this new century with no plan, no control, no brakes. Have we already gone too far down the path to alter course? I don't believe so, but we aren't trying yet, and the last chance to assert control- the fail-safe point- is rapidly approaching.

Surely there is a pressing need for ethical and cross-disciplinary dialogue on auto-ID innovation and more generally IT&T. If there has ever been a time when engineers have had to act socially responsibly, it is now as we are at defining crossroads.

> The new era of biomedical and genetic research merges the worlds of engineering, computer and information technology with traditional medical research. Some of the most significant and far-reaching discoveries are being made at the interface of these disciplines.

The principal objective of this paper was to encourage critical discussion on the exigent topic of RFID implants in humancentric applications by documenting some of the prominent social, cultural, religious and ethical issues. The evidence provided indicates that technology-push has been the driving force behind many of the new RFID transponder implant applications instead of market-pull. Most alarming is the rate of change in technological capabilities without a commensurate and involved response from an informed community on what these changes actually "mean" in real and applied terms, not only for the present but also for the future. It would appear that the accepted standard nowadays is to introduce a technology, stand back to observe its general effects on society, and then act to rectify problems as they might arise. The concluding point of this discussion is that the long-term side effects of a technology should be considered at the outset and not after the event. One need only bring to mind the Atomic Bomb and the Chernobyl disaster for what is possible, if not inevitable, once a technology is set on its ultimate trajectory.

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