The Advent of the Wearable Computer

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SYNOPSIS

The new 'smartwatch', and soon 'smartglasses', will bring about a greater integration of the Internet in our daily lives. These developments are being paralleled by an increasing number of 'intelligent' computer devices embedded in the physical environment, creating a so-called 'Internet of Things'. At the same time, our atmosphere is now saturated with artificially propagated electromagnetic fields at densities far above what is found in nature. As we are swept towards the merger of real and virtual realities, the question arises as to how we can work towards a future in which truly human values can survive.

> The most wonderful aspect of life still seems to me that some coarse and crude intervention and even blatant violation can become the occasion for establishing a new order within us.
>
> Rainer Maria Rilke[1]

The Pebble Smartwatch

On 23 January of this year, the much-anticipated roll-out of the new Pebble smartwatch began. Worn on the wrist like a normal watch, it connects wirelessly (via Bluetooth) to the wearer's smartphone, allowing one to see who is calling, read text messages and emails, switch songs on one's iPhone, view weather alerts, and various other useful things. Although it is not the first smartwatch, an unprecedented buzz of excitement has gathered around it. In April last year, the small team who invented it launched a fund-raising campaign, in the hope of raising the not inconsiderable amount of $100,000 in the form of pre-orders. Against all expectation, they raised more than a hundred times that amount – $10.6 million – within just a few weeks. Once Pebble has fulfilled its pre-orders (for over 80,000 watches), the smartwatch will become available to the general public – probably around mid-March.

The Pebble smartwatch belongs to the next phase in the digital revolution: wearable technology. Following on the heels of the massively popular pocket-sized smartphone, the surge of interest in the Pebble is a further example not only of how digital technology has an irresistible appeal to a huge number of people, but also how this appeal seems to gain in strength daily, inveigling human beings into an ever closer connection with their digital devices.

As a result of miniaturisation, and the increase in both processing power and connectivity, the trajectory of the development of digital technologies is undoubtedly towards greater intimacy between them and us. Rahul Bhagat, head of operations for Pebble, said in a recent interview: 'I would like to think that Pebble is part of a larger movement towards consumer electronics that better integrate with users' daily lives while minimizing disruptions that occur while using them.'[2] One might think that the disruption caused by taking a smartphone out of a pocket or handbag in order to consult it is not so great, but the critical phrase is 'better integrate'. Smartphones are still *not quite accessible enough* to satisfy the desire for instantaneous connection: they need to be 'better integrated'.

People are hungry for this, and the hunger is felt by

many as an inner need. There is a strong desire today, even a yearning, to become more closely conjoined with computer technology. Given the trajectory towards greater miniaturisation and intimacy, it is significant that in a global survey conducted by *Time* magazine last summer (2012), nearly one in five respondents in the UK and USA, when asked if they think they need to have the latest technology, replied in the affirmative. In Brazil the figure was just over one in three, while in China and India it was more or less every other person.[3] What this means is that a very large number of people are completely caught up in the trend towards the deepening integration of computer technology in our daily lives.

Smart Glasses

About the same time as the Pebble team launched their funding appeal, another wearable computer project also attracted a huge amount of hype. This was the Google Glass project, a pair of 'smart' glasses that will use either transparent LCD or light-emitting diodes to display information in the wearer's field of vision. The glasses will have a built-in camera and GPS (Global Positioning System), so that they are 'location aware'; and when they finally come on stream they will have ^{3}G or ^{4}G data connections, so that information relevant to a person's surroundings can be delivered as a kind of overlay on what they are actually looking at.[4] This will, theoretically, make it possible for the virtual information input and the experience of the real environment to become meshed together in a new kind of experience, disingenuously referred to as 'augmented reality'. The 'augmented reality' glasses will, however, be more than just a computer screen in front of your visual field. According to well-informed insiders, the arm of the glasses will house hardware enabling direct communication with the World Wide Web, to be controlled by the voice input of the wearer. Gone, then, will be the need for keyboard and mouse. Through voice and ear (there will also be an in-built microphone), we will be able to summon up before our eyes computer-generated images and hear computer-generated sounds. So far, Google has kept to themselves the details of how their glasses will work, letting out just enough to whet the appetite of those avid for this next leap towards 'wearable'. At present, they seem to exist more as a work-in-progress than as a reality, but the Google Glass project is nevertheless widely expected to deliver a viable product by 2014.[5]

Although great efforts are being invested in designing glasses that will appeal to the most fashion-conscious consumer, and although there is clearly an advantage in being able to take the glasses on and off, the direction of travel of this technology is towards more permanently wearable contact lenses. Indeed, the first biologically safe wearable contact lenses with an imprinted electronic circuit just a few nanometres thick, combined with light-emitting diodes, were developed five years ago at the University of Washington.[6] Since then, the race to develop fully functional, high-performance compact eyewear has led to an intermediate hybrid of technologically enhanced contact lenses working in conjunction with light-weight HUD (Heads-Up Display) designer-style glasses.[7] According to one of the leading companies in the field, Innovega, based in San Diego, USA, this combination produces high-definition displays equivalent to a 240-inch television viewed at a distance of ten feet, while the wearer is at the same time able to see the surrounding real environment. In other words, the virtual content is directly and compellingly overlaid on to the real.

Smartglasses will be a significant step towards our being able to live in virtual and physical environments simultaneously. The kind of virtual environments accessed via online computer games, and websites such as Second Life (in which one assumes an online identity or 'avatar' in order to enter a computerised fantasy world) could in time become woven into the real environments of the physical world. For example, one's own avatar, as well as those of other people, could become virtual presences in the real world. Virtual reality, which today is already competing with real reality for people's attention and loyalty, will soon enough begin to accommodate itself within the world of our daily experience.

Innovega's hybrid glasses will, in all likelihood, far exceed the quality that the Google glasses will achieve, and the company has already signed a contract to deliver a fully functioning prototype to the Pentagon's research laboratory, DARPA (Defense Advanced Research Projects Agency), which, incidentally, provided the company with much of its funding for this project.[8] As Innovega's CEO, Steve Willey, put it, 'this could be the ultimate computer interface for the troops, something that's fully transparent and fully hands-free'. While we may expect to see this eyewear available to the general public towards the end of 2014 (as with the Google glasses), the longer-term aim, still some years away, is to develop a stand-alone contact lens, without the need to work in conjunction with glasses. In fact, according to Steve Willey, the ultimate goal is to develop a lens that could be implanted into the eye and 'hardwired' permanently.[9]

The Internet of Things

The inexorable progress towards wearable and, finally, biologically integral computing, with the opportunities that this will give for melding virtual and physical realities into a relatively seamless experience, is closely connected with, and to a large extent dependent upon, another parallel development. This is the migration of the Internet itself, from the self-enclosed global computer network into the physical environment, to become a physical world-web, or so-called 'Internet of Things'. In order for augmented-reality glasses to be able meaningfully to overlay and thus usefully 'augment' the physical reality perceived, it is necessary for what we perceive in the world to be computer compatible and, from a digital point of view, information rich.

Over the last few years, several large IT companies, including IBM, Microsoft and Advantech, have committed themselves to the massive expansion of the number of 'intelligent' computer devices embedded in the environment. Their ambition is quite breathtaking. It is to capture the whole planet in an information technology web, thereby creating an electromagnetic basis for a digitally enhanced 'intelligent planet', an all-encompassing electronic infrastructure. The physical objects that surround us are fast acquiring transmitters and receivers, micro-sensors and actuators that are binding things into computer networks (to give one small but familiar example, think of the popularity of the Global Positioning System, or 'sat nav'). One company involved in this project, HP Labs, describes its goal as being to implement 'a new information ecosystem, the Central Nervous System for the Earth (CeNSE), consisting of a trillion nanoscale sensors and actuators embedded in the environment and connected via an array of networks with computing systems, software and services.' The stated aim of HP Labs is to 'revolutionize human interaction with the earth as profoundly as the Internet has revolutionized personal and business interactions'.[10]

This is not something that is to be realised in some far-distant future. We are already witnessing the transformation of our environments from a condition of technological innocence to one in which they are electronically despoiled, as they are tied into the newly emerging 'information ecosystem'. There is now a rapidly increasing number of digital information devices embedded in the world of physical things, endowing them with virtual identities. One crucial component of the technology for accomplishing this is the RFID (Radio Frequency Identification) chip or tag, which has

'.....less and less will escape the new electronic information net .. being cast over the world.'

an integrated circuit for storing information, and can both send and receive an encoded radio signal that can be accessed at a distance, even if the tag itself is obscured by intervening objects. With more and more things and creatures equipped with these miniscule identifying devices, from cows in the field to leather boots in the shops, from buildings and automobile parts on the assembly line to the pet cat or dog injected with an RFID chip, less and less will escape the new electronic information net that is being cast over the world. Equipped with our wearable computing devices, and armed with the appropriate 'apps' (or dedicated software programmes), we will be able to lay claim to information about objects or creatures in our environment, otherwise inaccessible to those who are not so equipped. This is not because we will have developed a personal relationship to them, or a greater insight into, love or understanding of them, but because our wearable computer will have given us the power to access information held about them on a central electronic database.

Let us not think for a moment that the Internet of Things will be a docile servant of humanity. Not only will information be released to the human being, but also *from* the human being into the world, to be swept up by computerised surveillance systems, whether or not we ourselves are tagged, and with or without our conscious knowledge, let alone consent. This, of course, is already happening: the combination of CCTV, biometrics, tracking technologies and databases is a powerful one, and functions to a large extent autonomously. Already today a vast amount of data is captured and transferred to databases without human intervention – a process known

as 'autonomous data capture'. The new electromagnetic infrastructure is rapidly pervading the lived environment, and both inanimate physical objects and living creatures, including ourselves, are being systematically incorporated into it, each of us replete with our digital identities, and each of us fodder for the new electronic 'Central Nervous System for the Earth'.

The Electrification of the Air

The implications of the advent of the wearable computer cannot, however, be adequately appreciated unless we take into account a third factor, which is that both wireless computing and the complementary movement towards harnessing the external environment into a planet-wide electronic information network depend on the saturation of the atmosphere with electromagnetic radiation, at intensities far beyond anything that could possibly be described as natural, and with the intention that the whole globe be permanently bathed in high density electromagnetic fields.

While electromagnetic fields have their place in nature, they are extremely weak compared to the electromagnetic fields artificially propagated by the communications industry. According to Dr Ulrich Warnke, who has been researching the effects of man-made electrical fields on wildlife for more than 30 years, 'Technical wireless communication such as mobile radio, radio, TV and satellite communication is only possible because the power density of the utilised technical high frequency spectrum far exceeds that of natural radiation'.[11] 'Far exceeds' is something of an understatement. Artificially generated electromagnetic radiation levels in European cities in the radio and microwave frequency range are around *ten million* times denser than that of equivalent naturally occurring electromagnetic radiation within the same frequencies.[12] This fact alone should give us pause for thought, for our natural environment and all the creatures that are part of it, including of course ourselves, are now obliged to live within an atmosphere that has, beginning with the first radio wave broadcasts in the 1920s, become subtly but radically altered from how it used to be before radio and wireless communication began. It is now permeated with a diverse range of high frequency radio waves and microwaves from a wide variety of sources, and – compared with natural levels – at an exceedingly high power density and strength.

Radio waves are sometimes called, euphemistically, 'air waves', since they travel through the air. But they are not actually *air* waves: they are waves of radiant electricity, which – like the air – we cannot see, hear, smell, taste or touch. We know the air is there because we breathe it in and out, and our lives utterly depend on it from moment to moment. But we are inclined to forget that our clever wireless devices can only be so clever because every time they link us to the Internet or allow us to make a call, they are 'inhaling' and 'exhaling' an electrified 'atmosphere' that we have artificially engendered for them. Both wireless computing and the creation of the 'Central Nervous System for the Earth' require the maintenance and enhancement of this electrified atmosphere. The new 4G spectrum to be introduced in the UK this year is favoured because it is particularly good at penetrating forests and traversing hills, and will have six times the speed of 3G, enabling it to handle much more complex data streams.[13] The United Kingdom, like every other country in the world, is under constant pressure to 'improve' its wireless communication infrastructure, so that the atmosphere is ever-more densely saturated with electromagnetism.

Over the last 40 years, a large number of scientific studies have been conducted that suggest that radio and microwave frequency radiation can have a detrimental effect on living creatures: plant, insect, bird, amphibian, mammal and human.[14] While there is as yet no accepted scientific consensus, some of the studies make uncomfortable reading. It would seem that one of the principal impacts of this radiation could be through the disruption of the circadian rhythms of living organisms, thereby weakening their immune systems.[15] Those who take the trouble to seriously reflect on the direction of much current research may well find themselves concluding that electromagnetic radiation is intrinsically inimical to life.[16] This does not mean that living organisms cannot and do not utilise electricity. It is well known that electricity is present within living organisms at the cellular level, and is employed in communicating signals from one part of the body to another. But within the living organism, as in the natural environment, electrical activity is in minute homeopathic potencies, with electrical potentials measured in single or double-figure milli-volts, and electric currents measured in the tiniest possible strength of pico-amps. Thereby it is rendered subservient to the energies of life. When confronted, however, by vastly more powerful, raw electrical forces, often in complex interrelationships with each other, oscillating at different frequencies, and from multi-directional sources, especially in urban environments, it would not be surprising if the immune systems of living organisms, both

plant and animal, were affected, and the organisms then became more susceptible to disease. Evidence suggests that it is not only the immune system that could be vulnerable: loss of memory, poor concentration, reduced attention spans and cognitive function are all effects that have been attributed to radio frequency and microwave radiation exposure.[17] This, it would appear, may be the price exacted from human beings for the establishment of an electromagnetically based 'Central Nervous System for the Earth'.

The Singularity

It might seem that the driving forces behind the advent of the wearable computer, the 'Internet of Things' and the increasingly dense 'electrosmog' that some believe is making the atmosphere in which we live ever more hostile to health, are to be located, on the one hand, in the seemingly insatiable consumer demand for new technologies, and on the other hand, in the enormous profits to be made by the IT companies who cater to (and to a large extent generate) this demand. While these are certainly both powerful factors, if we are to understand the rapid changes that are taking place, we need to look not just at the driving forces behind current technological developments, but also at the ends and goals towards which these developments are taking us, and of which most people are but dimly aware. The vast majority of people have little idea of what is working at an ideological level, harnessing human ingenuity and stirring up human desires, so as to bend both to the realisation of aims that are thoroughly antithetical to our deeper spiritual interests.

A number of contemporary thinkers subscribing to the technophile ideology of 'transhumanism', most notably Ray Kurzweil in the USA, have given us an extremely clear picture of where such developments as the advent of the wearable computer and the Internet of Things actually belong in this wider teleological, or goal-oriented, perspective.[18] Kurzweil's nightmare predictions in his book, *The Singularity is Near*, are presented on a timescale that leads us, blow by blow, to an event in the middle of this century (to be precise, 2045), which he calls the 'Singularity'. Kurzweil defines the Singularity as:

> the culmination of the merger of our biological thinking and existence with our technology, resulting in a world that is still human but that transcends our biological roots. There will be no distinction, post-Singularity, between human and machine or between physical and virtual reality.[19]

According to Kurzweil, by mid-century, machine intelligence (i.e. computational power, measured in the number of operations per second) will be trillions of times greater than it is today, and the pressure on us to merge with this exponentially increasing machine intelligence through neural implants will be irresistible over the coming years.

The advent of the wearable computer, in this vision of things, is the next inevitable step towards the union of machines and human beings, bringing us closer both to the integration of computer technology within the physical organism, and to a coalescence of virtual and real worlds in our daily experience. While Google glasses may seem to many as the coolest innovation yet, they will soon enough be outmoded, and not just by smart contact lenses, or subsequently by retinal implants. By the 2030s, according to Kurzweil, nanotechnology will have advanced far enough to enable tiny nano-machines to be directly inserted into the brain, enabling people to switch from normal sensory perception of the environment to full-immersion virtual reality without the need for any other external intervention.[20]

Likewise, the concept of the Internet of Things, and the creation of a so-called 'intelligent planet', constitute but a stage towards the total saturation of the Earth with non-biological 'intelligence'. Through emerging nanotechnologies and enhanced microelectronics, 'intelligent' control of the natural environment, and many of the organisms within it, will be greatly strengthened. Just as transhumanist ideology envisages the human future as inseparable from the machine, so too is nature's destiny envisaged as becoming a kind of substratum of a vast artificial global brain. Kurzweil devotes a whole chapter to what will happen beyond this point, producing the dizzying vision of Artificial Intelligence radiating out from our electronically enhanced Earth and saturating the whole universe. Thus, the destiny of the universe is conceived as being ultimately to become an enormous supercomputer.[21] It is a dream of insane proportions, but precisely in this aspect of Kurzweil's thinking we are able to catch sight of the cosmic scale of the ideology of which Google glasses are but a tiny aspect.

Despite the nightmarish character of Kurzweil's vision of humanity's future evolution, his book *The Singularity is Near* has received support from a number of significant figures, including Bill Gates and various other prominent persons in the IT world.[22] Not only that, but in 2009, Kurzweil co-founded a new high-profile research and teaching institute in Silicon Valley, appropriately named 'Singularity University'. Backed by Google, NASA and

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various other big names, its mission is to train a new global elite to work with emerging technologies and, as its name indicates, to prepare for the mid-century merger of human and machine, and real and virtual realities. In Singularity University, big global problems are addressed, such as how to feed the world, how to clean up pollution, etc. on the premise that all major problems can find technological solutions by 'simple methods combined with heavy doses of computation'.[23] While we may recognise in this focus on current problems a thread of idealism at work within the transhumanist/singularitarian movement, the tenor of thought is both unremittingly technocentric and anthropocentric, the Earth being valued merely as the backdrop for human 'enhancement'. Due to the conception of the human being as no more than a biological computer, the notion of human enhancement is far indeed from genuine self-actualisation, for it is limited to enhanced *computational* power. The goal to be aimed at is that we become ever more clever, as if this were the equivalent of becoming spiritually fulfilled. This is why, to those who adhere to this outlook, the merger with artificial machine intelligence appears to be the only way forward for future human evolution, otherwise humans will simply be overtaken by machines.[24]

Kurzweil's writings and the Singularity University programme are just two pointers to the fact that current technological developments are not taking place in an ideological vacuum, but within a highly materialistic philosophical matrix, which is unable to conceive of a deeper level of thinking than that which solves problems by making calculations. This is in the tradition of Bacon, Hobbes, Descartes and Leibniz, whose mission it was to replace spiritual contemplation with calculative thinking as the paradigm for gaining knowledge. Anyone who has studied the history of modern computer technology will know that its origins lie in the mechanistic philosophy formulated in the seventeenth century by these thinkers.[25] Along with the thoroughly materialistic assumptions of this stream of philosophy, this type of thinking continues to underpin the research that is conducted today and the long- term goals that are set for future innovations. No matter if many of those who use these technologies have a developed inner spiritual life, and would be the last to condone the materialistic worldview, the technologies themselves are not philosophically neutral. Computer technology as such is an embodiment of reductionist thinking.[26]

The Challenges We Face

The advent of the wearable computer presents us all with the challenge as to how far and how warmly we are prepared to extend our embrace of digital technology, as we move towards the projected merger of human and machine. Let us suppose that in the next five years, Google glasses (along with various Apple, Samsung, etc. rival designs) become as popular as smartphones are today. Knowing that this is another incremental step towards an eventual human–machine merger, would we be prepared to take a stand and say, 'This is far enough. I refuse to buy a *wearable* computer'? Or would we be inclined to think that, as this still falls short of biological integration, it is acceptable? Here is a choice that we all are likely to have to make.

And as evidence emerges that radio frequency and microwave radiation affects the growth and health of trees, could be a cause of the collapse of bee colonies, and might well be connected to the decline in the sparrow population in our cities, as well as affecting the breeding success of other birds, not to mention making life intolerable for the roughly 2 per cent or more of the population who suffer from electro-hypersensitivity, are we not also obliged to question our use of smartphones and mobile phones too?[27]

There is yet another, more formidable challenge, however, which runs alongside this moral question: the challenge of addressing the hunger for genuine self-fulfilment, which many mistakenly seek to satisfy through greater connection with technology. For the strength of the enticement of the virtual world may best be understood as being due to its offering an alluring counterfeit to real human relatedness and authentic spiritual experience that alone can satisfy this hunger. If these latter are our values, and if we are also committed

to the difficult work of self-integration, and of growth towards greater inner autonomy, then we need to face down the pressures to integrate ever more intimately with machines, and we need to be vigilant lest we fall into an unwitting servitude to them. The fulfilment of *human* potential must be carefully distinguished from the fulfilment of the potential of machines to integrate with us, which is what the transhumanists advocate. As yet, we still have the freedom to make choices and embark upon resolves that may help to bring us into a healthy human relationship with our technologies, and this is something each of us can work towards, no matter what is happening at the collective level. Given its addictive nature, the technology actually presents an opportunity for us, by resisting it, to lift the veil on what it is concealing from us, and to glimpse that greater, more authentic experience from which it continually diverts us. Small steps to assert our human autonomy in relation to our digital devices can make a surprising difference, for example, by designating times and places that are technology-free: not to use it on Sundays, and to have one room in the house that is free of it. Such simple measures can often help us to re-attune to what is crying out for attention within our own souls.

In Plato's *Republic*, the philosopher describes a threshold experience of fundamental importance in human life. He called it the 'inner turn', or *metastrophe*, of the soul towards the realm of spirit.[28] It leads to our developing an interior faculty of knowing, through opening the 'eye' of the soul, so that it becomes capable of perceiving realities invisible to the physical eye. The 'inner turn' is an experience familiar to many spiritual traditions, and is often preceded by a powerful 'call' to an individual to awaken from the unreflective consciousness in which he or she is immersed. The challenge to make this 'inner turn' has never been easy to meet, the 'call' often hard to heed. And perhaps it has never been more difficult than it is today, with the countless pressures and distractions with which we daily have to contend. Perhaps, though, on a collective level, the very power of enthralment that our technologies wield over us needs to be recognised as masking that deeper call to the soul to make the inner turn. In which case, before 'augmented reality' glasses flood the market and we become yet more entranced by the false promise of virtuality, now seems like a good time to attend to the opening of the inner eye. S

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4 3G (Third Generation) refers to the wireless network used by smartphones, which enables wireless Internet access, mobile TV and video calls, as well as mobile telephony; while 4G (Fourth Generation) is a superfast mobile broadband, which enables easier and more reliable access to the Internet and a wider range of software applications. 4G is expected to become available in the UK towards the end of 2013.

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16 See note 14, above. There is a vast amount of research in this area, distributed across a multiplicity of specialist journals. Interested readers may find a useful starting point on the website of the BioElectromagnetic Research Initiative, at www.bemri.org. A good, readable overview of current research into the health effects of EMR on human beings is Sarah Benson, *Joining the Dots: An Overview of Adverse Public Health Trends from 1996–2009*, available online from www.emrstop.org One of the most authoritative studies on the health effects of EMR is The *BioInitiative Report* (2007; last updated 2012), written by a group of concerned scientists, researchers and public health professionals, and available online at: http://www.bioinitiave.org

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25 For an overview of this history, see Jeremy Naydler, 'The inhuman in our midst: reflections on the origins and development of the computer", *New View*, 56, 2010.

26 This is made evident in the writings of Alan Turing, to give just one example of a major twentieth-century pioneer of the computer. See, for instance, his seminal essay 'Intelligent machinery' (1948) in B. Jack Copeland (ed.), *The Essential Turing*, Clarendon Press, Oxford, 2004, pp. 395–432.

27 For trees see, for example, V. Balodis et al., 'Does the Skrunda Radio Location Station diminish the radial growth of pine trees?', *The Science of the Total Environment*, 180 (1), 1996, pp. 57–64; Katie Haggerty, 'Adverse influence of radio frequency background on trembling aspen seedlings: preliminary observations', *International Journal of Forestry Research*, 2010, 2010 – see http://www.hindawi.com/journals/ijfr/2010/836278/; and Andrew Goldsworthy, 'Why our urban trees are dying', Bio-Electromagnetic Research Initiative, 2011, at www.bemri.org. For bees, see W. Harst, J. Kuhn and H. Stever, 'Can electromagnetic exposure cause a change in behaviour? Studying possible non-thermal influence on honey bees – an approach within the framework of education informatics', *Acta Systemica*, 6, 2006, pp. 1–6; V.P. Sharma and N.R. Kumar, 'Changes in honeybee behaviour and biology under the influence of cellphone radiations', *Current Science*, 98 (10), 2010, pp. 1376–8; and U. Warnke, 'Bees, birds and mankind: destroying nature by "electrosmog"', BioElectromagnetic Research Initiative, 2009, at http://bemri. org. For sparrows, see J. Everaert and D. Bauwens, 'A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (*Passer domesticus*)', *Electromagnetic Biology and Medicine*, 26, 2007, pp. 63–72; Alfonso Balmori and Orjan Hallberg, 'The urban decline of the house sparrow (Passer domesticus): a possible link with electromagnetic radiation', *Electromagnetic Biology and Medicine*, 26, 2007, pp. 141–51; for the breeding success of storks, see Alfonso Balmori, 'Possible effects of electromagnetic fields from phone masts on a population of White Stork (*Ciconia ciconia*)', *Electromagnetic Biology and Medicine*, 24, 2005, pp. 109–19. For the percentage of the population suffering from electro-hypersensitivity, see the World Health Organisation report, *Electromagnetic Hypersensitivity*, World Health Organisation Press, Geneva, 2006, which puts it at between 1.5 and 3 per cent. Note, however, that the WHO does not accept that electromagnetic fields have been shown to cause the symptoms of electromagnetic hypersensitivity. Interested readers may find themselves convinced otherwise by consulting Section 24:F of *The BioInitiative Report* (updated 2012), which reviews recent electro-hypersensitivity studies, especially the groundbreaking study by D. E. McCarty et al., 'Electromagnetic hypersensitivity: evidence for a novel neurological syndrome', *International Journal of Neuroscience*, 121, 2011, pp. 670–6, and A. Marino et al., 'Response to letter to the editor concerning "Electromagnetic hypersensitivity: evidence for a novel neurological syndrome"', *International Journal of Neuroscience*, 122, 2012, pp. 402–3. See also Alasdair and Jean Philips, 'Electromagnetic Hypersensitivity (EHS)', at http://www.powerwatch.org.uk, which reviews current research.

28 Plato, *Republic*, Book VII.4, 518C-D.

Footnote: An earlier version of this article appeared in New View 65,2012,pp12-19