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TextBook

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http://ki.se/en/neuro/johansson-laboratory%20and%20http://vetapedia.se/olle-johansson-associate-professor-ki/

… your notes …

Health Effects Of Artificial Electromagnetic Fields: A Wake-Up Call From A Neuroscientist… But Is Anyone In Power Picking Up? Hello…?

In the following, I will shortly summarize some personal reflections as well as scientific achievements, together with studies, old or new, from the international literature. Due to the overwhelming number of such, all bending like trees in a harsh breeze, pointing in the same direction away from the notion that modern artificial electromagnetic fields are safe, it is very important that the members of the general public ***immediately*** start to educate themselves and take precautionary actions of their own. It is too obvious nowadays that we - as citizens - cannot trust our elected bodies or commissioned authorities, and to make things clear and easy: do not blindly and wide-eyedly trust me either. As a reader, do educate yourself, discuss, think, think again, read more, and then make up your mind based on all the information you have collected and contemplated. Then take a lifestyle decision for yourselves and for your children based on your own convictions.

It is high time that we all, scientists, politicians, civil servants and citizens, finally realize how potentially dangerous man-made, artificial electromagnetic fields released from, and used by, our various electronic gadgets – such as powerlines, transformers and wiring inside household items, cell phones, tablets, laptops, baby alarms and monitors, and gas, water and electricity wireless smart meters, may be for our health. If the opposite should be claimed, then all of the published reports all must be wrong at the same time, and the probability for that is – to say the least – tremendously small!

The simplicity of this general issue - which has resulted, and is still resulting, in hundreds of fruitless meetings and many expensive and also downright harmful articles in world-famous journals being sponsored by the vested interests of industry and finance - is that modern, artificial electromagnetic fields must be regarded as a highly toxic environmental exposure, something I have pointed out a countless number of times. I wish I could say that there soon will be an end to this human, animal, plant, and bacteria 24/7, full-scale experiment, the largest ever on this planet, where every organism is not informed or has given any consent - completely in contraposition to the Nuremberg Code of Ethics - but not even with the alarming results of the recent American National Toxicology Program (NTP) cancer study [cf. "Report of Partial Findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposures)"; http://biorxiv.org/content/biorxiv/early/2016/05/26/055699.full.pdf] I can.

Instead of intensifying the research efforts, my own university, the Karolinska Institute, has now chosen to go in the opposite direction. (My personal reflection on this is: With the above NTP results at hand, I feel the need to move forward is much, much greater than ever!). Hopefully, their decision to back off will be – in the future – regarded as a wise and correct move, but the risk is

that the current very costly Macchiarini scandal [a visiting Professor at Karolinska Institute who was doing trachea surgery which resulted in six out of the eight patients dying, ending in a misconduct scandal] will be followed by yet another one, affecting very many more persons (just the above-mentioned American National Toxicology Program cancer study outcome could result, in the decades to come, in an additional 150,000,000 (150 million!) extra human cancer cases world-wide, something not easily swept under the carpet).

From a public health point of view, to turn a blind or - at best - an unwilling eye onto questions regarding possible risks is, in itself, a very risky behaviour, and may at end result in a terrible collision with a biomedical, harsh future reality. To blindfold oneself is great fun at a children's "pin-the-tail-on-the-donkey" party, but can - in the (presumed) adult world - easily result in a strong kick in the ass by the ass.

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A mantra often put forward is that there is no mechanism to explain any of the observed biomedical effects, but this is not true - for years there has been a number of such presented, including from myself and from professor Martin Pall. What is lacking is the willingness of society to actively test these hypotheses and continue to build knowledge towards a safe future, built on what I have coined as "green, human-friendly technology"! Only by actively pursuing that road can we grow in safe confidence, and any country or commercial company entering this area will prosper greatly, mark my words, and the world already now see measures being made to secure liability and responsibility issues (see below). At stake is not only we, the humans, but all living creatures on the planet including bacteria, plants, birds, bees, ants, and mammals. But at stake are not the manufacturers, operators, insurance companies, radiation protection authorities and not even the World Health Organization since they all (cf. below) have abandoned ship years ago.

Electromagnetic radiation is no longer covered by insurance as a result of health problems

Another mantra often vocalized – in the very richest countries such as Sweden - is that there is a "lack of money to support independent, critical projects." I do not need to comment on this, you should just come here and watch "the lack of money" openly displayed in the streets in the form of luxury cars, oversized houses and flats, and super-expensive fashion! So if you find this "lack of money", please, tell me. It has completely escaped my observational capacity for years.

Nowadays there is almost no space like the Internet. At home, at school, in cafes, even in public transport and in our workplaces, Wi-Fi (wireless internet) is available all around the clock. Internet access may seem nice at first glance, but needs to be evaluated in the event from a different angle: health. As recently pointed out by Ms Lorie Collins in the US, in less than a generation, widespread access to the Internet has revolutionized virtually every aspect of life, connecting people with unimaginable information and opportunities. But in the rush to embrace the convenience and affordability of Internet-based information we have failed to critically evaluate the health effects of exposing children (and ourselves!) to wireless-based technologies that we are now using to connect

our devices to the Internet, finally aiming at the most recent golden calf, the "Internet-of-Things" (IoT). However, the use of a wireless connection is not necessary for access to the Internet. Hardwired Internet access predated the use of wireless connection. While there is no argument that wireless access is convenient and a tremendous boon to business and communications, there now appears to be a tremendous price to be paid by exposing our children and ourselves to its radiation.

It is therefore no surprise that electromagnetic radiation no longer is covered by insurance as a result of health problems. The British insurance giant Lloyd's – together with other insurance companies - has launched a very vigilant move. Damage to health due to direct or indirect exposure to the electromagnetic radiation of our modern gadget-driven world is no longer covered by their insurance policies. So do not call the insurance companies in the future if you have become ill or sick due to mobile phone radiation, or if your child has come down with childhood leukemia due to powerfrequent magnetic field exposure, or an aggressive brain tumour or malignant heart cancer due to cell phone radiation, since your health insurance does not cover it. You better look for the telephone number to your government and parliament since they allowed the blanket-public roll-out of these exposures, as well as to your nearest university following the Karolinska Institute and instead removing the critical whistle-blowing scientists casting long and large shadows of doubt on these so-called "safe" gadgets. So you will have to - in the future - sue your government and parliament, meaning you will sue yourself since these levels of society use *YOUR* money to cover their backs.

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In this short paper, I will bring up reports and results from so-called peer review-based scientific publications, acknowledged by other scientists in the field. I will try to translate the data of these papers to your own reality. What does it mean for you, wherever you live, when scientists in their laboratories demonstrate serious effects in molecules, cells, tissues, organs and individuals as well as groups?

I will discuss ***something*** which many Steiner school and Steiner daycare centers have decided not to welcome in their premises. Instead they have determined to make the school a "wireless-free zone", because:

- They do not want to have the access to mobile phones interfering with the educational work. They want students to be 100% present – not just their bodies but also their full attention – at their activities in class, since presence is essential for their educational practices and ideas.
- They also want their students to be "off" mobile phone use in school, and with it, access to various social media, since these media often are used for slander and bullying.
- They also respect the need to adapt the school environment for staff and pupils that are electrohypersensitive. In such a way everyone is saved from any long-term health effects, such as impact on the fertility or cancer progress. There is considerable uncertainty about whether the constant presence of active wireless gadgets, such as cell phones and tablets, are safe for children. With this precautionary principle, like in many other schools, they want to rather be safe than sorry. Therefore, they have also, for the same reason, chosen not to have wireless

networks in classrooms.

To achieve their goals, the students deposit their phones to the teachers during class and get them back by the end of school. This is a practical solution for students who do not want to leave their phone at home. They also encourage parents to strongly support their aim for a radiation-free school day and a good learning environment.

I will discuss ***something*** which the insurance companies around the world, including "Lloyds" in the UK and "Reassurance" in Switzerland, refuse to take responsibility for. Among such items you find not only health effects of electromagnetic fields, but also health effects of GMO and nanotechnology. Is this not strange, they are all sold to us as 100% risk-free and completely safe. Then they should be safe to insure…!?

I will discuss ***something*** which the telecom manufacturers and operators completely and totally refuse liability for. Their products are safe, so they claim, but the do not – legally – touch them even with a barge pole or a pair of pliers. So, in a sense, these companies have their own precautionary principle (cf. below).

I will discuss ***something*** which the telecom operators – for health safety reasons - tell you to keep at least one inch from your body, and for which they have applied for technical patents based on cancer risks.

I will discuss ***something*** which the radiation protection authorities around the world say is completely and totally safe, but – for safety reasons – still suggest that we shall use as little as possible, and to use a hands-free accessory. Again, odd. Either a gadget is safe … or it is not.

I will discuss ***something*** which the radiation protection authorities around the world say gives off "very weak radiation," in spite of the fact that a single mobile phone to your head has magnetic fields equal to lifting several electric train engines to the very same head.

I will discuss ***something*** which the radiation protection authorities around the world say gives off "very weak radiation", in spite of the fact that the current allowed public microwave exposure levels – compared to the natural background – are one quintillion (1,000,000,000,000,000,000) times stronger.

I will discuss ***something*** which the educational authorities claim will revolutionize teaching and learning in spite of the fact that they have been used for years in Sweden parallel to an enormous drop in pedagogic quality and learning capacity, a fact brought up several times during the recent political party leader's debate in the Swedish public service TV.

I will discuss ***something*** which easily penetrates walls, floors, ceilings … and you! And while penetrating you it feeds colossal levels of energy into your body, making molecules break, changing the behaviour and molecular machinery of your cells, damaging cells all the way to cell death, and feeding cell growth.

I will discuss ***something*** which lacks any form of biologically-based exposure standards or hygienic safety levels. Instead the safety of these gadgets are determined using so-called technical recommendations based on acute heating of fluid-filled plastic dolls. Does that make you feel safe?

I will discuss toys, not life necessities such as clean water, clean air, food that can be eaten without risk, care, concern, love and respect. Children who do not get these necessities of life will perish. Children who do not have tablets and mobile phones still will mature to responsible and loving citizens - that you do not need to worry about.

In this paper, I will discuss toys, not life necessities...

Today, various wireless devices flood our homes, schools, and other workplaces. The questions about all their radiation are many and the fact that you read this paper today speaks a clear language. Adults are not at all sure that all this radiation is harmless, they are not at all sure that wireless technology is without risk.

To this, one can add numerous studies and reports, expert statements and overviews which in summary says that "there is a strong suspicion of harm." These texts also point out the need to use the Precautionary Principle, and this even stronger after the WHO has classified powerfrequent magnetic fields (by 2001) as well as radiofrequency electromagnetic fields (by 2011) as possibly carcinogenic (2B), and the very recent ruling of the Italian Supreme Court that mobiles can cause a brain tumour, and the very recent announcement of the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) that radiofrequent exposures should be reduced, and after that the Belgian government has announced measures to restrict the use of mobile phones by young children, sales of mobile phones to children under 7 years will be banned in shops and also on the internet, and adverts for mobile phones during children's programmes on TV radio and the internet will also be banned, and after that Dr Marie-Therese Gibson resigns from Tangara School for Girls over Wi-Fi health worries, and after that South Korean experts have noticed a surge in teenagers with poor memory. This new 'dementia' causes deterioration in cognitive abilities more commonly seen in people who have suffered a head injury or psychiatric illness. Experts blame game consoles and mobile phones for this worrying trend.

In addition, a bill to ban phones in schools was introduced in France in 2009. Bans came into effect in places like Nigeria in 2012, around the time that teachers in the Solomon Islands called for phones to be banned in their schools. Uganda banned phones in schools in 2013, one year after Malaysia reaffirmed its own similar ban. And it's not only been in schools where young people have been prohibited from using their phones over the years. In one prefecture in Japan in 2014 children were not allowed to use phones after 9 pm, not long after Belgium banned the sales and advertising of phones to children under seven. Earlier last year (2015), bans on student use of phones inside and outside of schools were considered in Indonesia.

Thus, we can immediately cross out the idea that these techniques would be safe, not even the WHO believes it - and they still have a category into which such proven safe exposures would fall ("Class 4 - proven human non-carcinogen"). The question now is instead how big the risk is and

what we accept the risk to cost in terms of health care, disability and premature death. Instead of avoiding the issue, it's high time to call a spade a spade.

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3.5-3.8 billion years ago the first unicellular organisms were formed and life was initiated on our planet. During the coming thousands of million years cells divided to form multicellular plants and animals, and they grew more and more complicated and sophisticated. Soon our planet was inhabitated by insects, reptiles, fish, birds and finally mammals. During some 5,000,000 years mankind has made its ascent, and our present subspecies, the *Homo sapiens*, has been around for about 200,000 years.

The recent massive rollout of various wireless technologies should be critically viewed against this background. The last 100 years we have very suddenly been exposed to radio, TV, computers, cellular telephones, wireless internet, light ray tubes, compact fluorescent lamps, and house-hold appliances of various kind. And, as pointed out many times during the last four decades by myself, this is the actual central question: "*Can we really count on Darwinian evolution to ensure that our cells have developed an automatic protective shield against power-frequent electric and magnetic fields, radio and TV signals, microwaves, and so on, i.e. environmental exposures that have never been around on our planet, or – if they have – been less than one quintillionth in strength?"* And the answer is so simple: Of course, we cannot count on any such protective shielding since it is just not present. We are more naked than any newborn baby when it comes to such presumed protection.

Once upon a time we all believed that radioactivity from radium, uranium and plutonium, the X-rays in medicine, as well as the ultraviolet sunrays, all were safe, as were very dangerous habits like smoking. We did not realize that they can harm us, indeed even kill us. In the 1940s kids' shoe shops were equipped with shoe-fitting machines that used strong X-rays, and wristwatches in the 1950s glowed in the dark because they were painted with radioactive paint. At the same time, responsible scientists and doctors started to realize that the warm and beautiful sunshine could actually can harm our cells and their DNA, leading to the development of skin cancer. The same sort of experts that today tell you that cell phone and Wi-Fi radiation is harmless, once told you that strong radioactivity, strong X-rays and UV light were harmless. And smoking, they said, was even was good for you! All of these hazards were quickly removed and are now gone, but a new one has appeared: The wireless society with all its gadgets.

Very early on I coined the expression that we are all subjected to "*The largest full-scale experiment ever: What happens when we, 24-hours around the clock, wherever we are, allow ourselves and our children to be used as guinea-pigs, whole-body-irradiated by new, man-made electromagnetic fields for the rest of our lives?"* This question is more valid and important than ever and it is up to our society, with its governments, parliaments and authorities to answer it – but they most often don't. So it is fair to ask: can we rely solely on our government and health authorities or do we have to take extra personal responsibility? Personally, and based on all the science that is flooding my desk, I say that this sudden exposure to new, man-made electromagnetic fields seems to cause a disturbance of the immune system to result

in molecular and cellular damage and tissue repair reduction which would lead to disease and impairment. To suddenly feed a stable biological ecosystem, like Planet Earth, with astronomical amounts of energy will propel cell growth, like cancer, damage the genome, and jeopardize the immune defence – the mechanisms behind this are not difficult to imagine. This is not a matter of "rocket science", the obvious evolutionary consequences are easy to grasp, and *it is time to wake up and take strong action!*

Scientists began, just like myself, to ask simple questions. The answers to these questions, however, shone by their absence, and instead the scientists found themselves involved in trouble, slander, opposition, bullying and ridiculing. That any radiation was harmless, was a recurring response from authorities, but it was very sharply apparent that it was very dangerous to try to study this modern man-made radiation. Very early on, I suggested that it should be required by manufacturers, operators and radiation protection authorities that they would take on a personal responsibility - legally watertight - when they said that radiation is harmless. So far, no one has volunteered to sign such a personal responsibility legal contract.

In 2003 the Australian philosopher Glenn Albrecht coined the term solastalgia to mean a "form of psychic or existential distress caused by environmental change." Albrecht was studying the effects of long-term drought and large-scale mining activity on communities in New South Wales, when he realised that no word existed to describe the unhappiness of people whose landscapes were being transformed about them by forces beyond their control. "A worldwide increase in ecosystem distress syndromes," wrote Albrecht, is "matched by a corresponding increase in human distress syndromes." Solastalgia speaks of a modern uncanny situation, in which a familiar place is rendered unrecognisable by climate change or corporate action: the home become suddenly unhomely around its inhabitants.

Solastalgia: a form of existential distress caused by environmental change

Albrecht's coinage is part of an emerging lexis for what we are increasingly calling the "Anthropocene": the new epoch of geological time in which human activity is considered such a powerful influence on the environment, climate and ecology of the planet that it will leave a long-term signature in the strata record. And what a signature it will be. We have bored 50 million kilometres of holes in our search for oil. We remove mountain tops to get at the coal they contain. The oceans dance with billions of tiny plastic beads. Weaponry tests have dispersed artificial radionuclides globally. The burning of rainforests for monoculture production sends out killing smog-palls that settle into the sediment across entire countries. We have become titanic geological agents, our legacy legible for millennia to come.

Among the anthropocenic stress factors are, of course, all artificial electromagnetic fields and signals. Cell phones were first introduced in the 1980s, became widely available in the U.S. during the 1990s, and today we're living in a society where cellphone-only households are no longer the exception; they're the norm.

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Even though they represent highly attractive technological developments claimed to improve our life, ease our everyday work, and amuse us with game centers and information tools, wireless gadgets such as cellular telephones, cordless indoor gadgets for telephony and internet browsing, wireless smart meters for water, gas and electricity, the overall "Internet of Things", Bluetooth accessories, and many other similar ones, do expose us to a potent toxic environmental pollution. The power-frequent electromagnetic fields and the microwave radiation may affect prenatal development in both humans and animals, as well as the health for children, teenagers, and adults. Various studies have reported that an electromagnetic field (EMF) may have serious, or very serious, side-effects in various tissues and cells, and especially so in the young and very young.

In a very interesting study, Cervellati *et al* (2009) were able to demonstrate a significant effect of high-frequency electromagnetic fields on connexins expression and localization in placental extravillous trophoblast cell line HTR-8/SVneo (trophoblasts are cells forming the outer layer of a blastocyst, which provide nutrients to the embryo and develop into a large part of the placenta). Connexins are membrane proteins able to influence trophoblast functions. Samples were exposed to pulse-modulated 1817 MHz sinusoidal waves (GSM-217 Hz; 1 h: SAR of 2 W/kg [=the maximal allowed public exposure level]). Connexin mRNA expression was assessed through semi-quantitative RT-PCR, protein expression by Western blotting, protein localization by indirect immunoflorescence, cell ultrastructure using electron microscopy. The exposure significantly and selectively increased Cx40 and Cx43, without altering protein expression. Nevertheless, Cx40 and Cx43 lost their punctuate fluorescence within the cell membrane, becoming diffuse after HF-EMF exposure. Electron microscopy evidenced a sharp decrease in intercellular gap junction-like structures.

This study is the first to indicate that exposure of extravillous trophoblast to GSM signals can modify connexin gene expression, connexin protein localization and cellular ultrastructure, and they may also explain why infertility was encountered in the Greek study by Magras & Xenos (1997), where a progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility, after in vivo exposures at several places around an antenna park outside of the city of Thessaloniki. At these locations, the radiofrequency power density was between 1,680 $\mu W/m^2$ and 10,530 $\mu W/m^2$, the latter being a typical exposure value 100 meters from a base station/antenna. The prenatal development of the newborns, however, evaluated by the crown-rump length, the body weight, and the number of the lumbar, sacral, and coccygeal vertebrae, was improved, something which may sound appetizing. But, remember, any abnormal pattern must always be regarded as just that: abnormal. To feed these fetuses with energy may have developed them – just as feeding a body-builder with anabolic steroids, but the latter then will get a dramatic reduction is genital development and fertility scores, just as the mice outside of Thessaloniki did. (Ask any professional body-builder if you do not believe me. Or ask a professional gardener what happens I you feed blooming plants with way too much fertilizers (=energy); they will get huge

green masses but very few and tiny flowers, if any. It is as simple as that, it is my working hypothesis, and you should quote it and demand research into this area of mechanistic approach.)

In contrast, Erkut *et al* (2016) investigated the effects of exposure to an 1,800 MHz electromagnetic field on bone development during the prenatal period in rats, and found that increasing the duration of exposure during the prenatal period resulted in a significant reduction of resting cartilage levels and a significant increase in the number of apoptotic chondrocytes and myocytes. There was also a reduction in calcineurin activities in both bone and muscle tissues. They observed that the development of the femur, tibia, and ulna were negatively affected, especially with a daily EMF exposure of 24 hours. So, in essence, bone and muscle tissue development was negatively affected due to prenatal exposure to an 1,800 MHz radiofrequency electromagnetic field.

A Belgian-Swedish study by Cammaerts & Johansson (2013) on ants, that were made unable to leave their artificial laboratory home, revealed that when exposed to cell phone radiation, they chose to move themselves and their eggs away from the radiation source. When a cell phone was placed beneath the part of the ant home where the ant eggs were stored, the eggs were immediately moved diagonally as far away as possible — and the ants established their *toilet area* over where the cell phone was placed. The adult ants displayed obvious behavioral disorders, with more disruption in their daily activities and an increasingly scanning of their local environment. It was clear that something concerned them.

French researchers, under the direction of Alain Vian at the Equipe de Recherche Transduction et Autosurveillance Cellulaire, Universite Blaise Pascal in Aubière, have shown that tomato plants react to the damage from the relatively weak 900 MHz radiation from cell towers (Roux *et al* 2008). The scientists believe they found an environmental factor that instantly impacts the genetic material in the tomato cells, which in turn resulted in the tomato plant cells reacting with a chemical damage sequence, involving the molecule calmodulin. The effect was described as "exactly as if we had crushed them with a hammer," by the scientists.

It was enough to expose a few leaves of the plant for the entire plant to react. The damage was lessened however, on the parts of the plant that were shielded from the radiation.

The interesting thing about tomatoes is that they cannot cheat or be swayed by emotions or expectations

- They have no conscience.
- They cannot move.
- They do not cheat the insurance company for money.
- They are not imagining things.
- The don't blame their workplace problems on alleged "electrical over-sensitivity."
- They don't read newspapers (they can't fall victim for any media psychosis).
- They are instead very sensitive to their surrounding environment and are fussy when it comes to conditions for their survival.

Had the French tomato plants been able to escape, they obviously would have done so.

Agarwal *et al* (2008) have shown that the use of cell phones decrease the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones and independent of the initial semen quality, and Rezk *et al* (2008) provided evidence that exposure of pregnant women to mobile phone significantly increase fetal and neonatal heart rate, and significantly decreased the cardiac output, and Lai *et al* (1994) demonstrated that after 45 min of exposure to pulsed 2,450 MHz micro-waves (2 microseconds pulses, 500 pps, 1 mW/cm2, average whole body SAR 0.6 W/kg), rats showed retarded learning while performing in the radial-arm maze to obtain food rewards, indicating a deficit in spatial "working memory" function. Their data indicate that both cholinergic and endogenous opioid neurotransmitter systems in the brain are involved in the microwave-induced spatial memory deficit. Highly similar conclusions were reached by Papageorgiou *et al* (2011) through their findings in young men suggesting that Wi-Fi exposure may exert gender-related alterations on neural activity associated with the amount of attentional resources engaged during a linguistic test adjusted to induce working memory.

Cell phones decrease semen quality by decreasing sperm count, motility, viability and normal morphology

In a recent review by Terzi *et al* (2016), they point to that studies on neurodegenerative disease, such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, and Huntington's disease, and some hypotheses-generating reflections, have shown evidence of a potential correlation between EMFs and the mechanism of neurodegeneration. In line with these conclusions is our own recent hypothesis which, overall, provide evidence from in vivo and in vitro and epidemiological studies suggests an association between RF-EMF exposure and either myelin deterioration or a direct impact on neuronal conduction, which may account for many electrohypersensitivity symptoms. The most vulnerable are likely to be those in utero through to at least mid-teen years, as well as ill and elderly individuals (Redmayne & Johansson 2014).

Naturally, one should not forget other life-style factors which may affect us, and maybe in concert

with EMFs. For instance Radwan *et al* (2016) found evidence for a relationship between sperm DNA damage parameters and everyday life factors. High and medium level of occupational stress and age increase DNA fragmentation index (p=0.03, p=0.004 and p=0.03, respectively). Other lifestyle factors that were positively associated with percentage of immature sperms (high DNA stainability index) included: obesity *and cell phone use for more than 10 years* (p=0.02 and p=0.04, respectively). Thus, data from the present study showed a significant effect of age, obesity, mobile phone use and occupational stress on sperm DNA damage. As DNA fragmentation represents an extremely important parameter indicative of infertility and potential outcome of assisted reproduction treatment, and most of the lifestyle factors are easily modifiable, the information about factors that may affect DNA damage are important, and should be reflected in precautionary societal advice to the general public.

In addition, accumulating evidence suggests significant biological effects caused by extremely low frequency electromagnetic fields (ELF-EMF)[9]. Although exo-endocytosis plays crucial physical and biological roles in neuronal communication, studies on how ELF-EMF regulates this process are scarce. By directly measuring calcium currents and membrane capacitance at a large mammalian central nervous synapse, the calyx of Held, Sun and coworkers (2016) report for the first time that ELF-EMF critically affects synaptic transmission and plasticity. Exposure to ELF-EMF for 8 to 10 days dramatically increases the calcium influx upon stimulation and facilitates all forms of vesicle endocytosis, including slow and rapid endocytosis, endocytosis overshoot and bulk endocytosis, but does not affect the readily releasable pool (RRP) size and exocytosis. Exposure to ELF-EMF also potentiates the post-tetanic potentiation (PTP), a calcium-dependent form of short-term plasticity, increasing its peak amplitude without impacting its time course. They further investigated the underlying mechanisms and found that calcium channel expression, including the P/Q, N, and R subtypes, at the presynaptic nerve terminal was enhanced, accounting for the increased calcium influx upon stimulation. Thus, rightfully they concluded that exposure to ELF-EMF facilitates vesicle endocytosis and synaptic plasticity in a calcium-dependent manner by increasing calcium channel expression at the nerve terminal. What this may mean at a macroscopical-behavioural level is up to further investigations (also see Pall 2013).

Wireless technology uses transmitters that emit electromagnetic waves creating radiation and electromagnetic fields. The research attached and cited shows that, at the power levels required for Wi-Fi to operate reliably over the project's large areas, the radiofrequency radiation as well as the low-frequency fields has significant biological effects, many of which - from a human perspective - must be considered as very serious. Thus, a rapidly accumulating body of scientific evidence of harm to health and well-being constitute early warnings that adverse health effects can occur with prolonged exposures to very "low-intensity" (remember again that the exposure levels that are regarded as "low-intensity" actually are astronomically high compared to natural background levels) electromagnetic fields at biologically active frequencies or frequency combinations. The

[9] ELF is the acronym for extremely low frequency, and refers to our household wiring - *Ed*

consequences of such exposures can be especially grave for electrohypersensitive individuals and children. The Wi-Fi industry uses inapplicable health safety standards, which I have explained above and again will dwell upon below, and flawed reasoning to promote Wi-Fi safety.

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The possibility of any health consequences of chronic exposure to pulsed microwave exposure from Wi-Fi is often denied, especially by vested interests. However, in the current field of science, the present state-of-the-art knowledge regarding this issue is clear, there are harmful biological effects from electromagnetic fields emitted by wireless transmitters such as those used by Wi-Fi.

Wireless communication is now being implemented in our daily life in a very fast way. At the same time, it is becoming more and more obvious that the exposure to electromagnetic fields not only can induce acute thermal effects to living organisms, but also non-thermal effects, the latter often after longer exposures. This has been demonstrated in a very large number of studies which includes cellular DNA-damage, disruptions and alterations of cellular functions like increases in intracellular stimulatory pathways and calcium handling, disruption of tissue structures like the blood-brain barrier, impact on vessel and immune functions, and loss of fertility. Scientists can observe and reproduce these effects in controlled laboratory experiments, and in epidemiological and ecological data derived from long-term exposures. Reflected in well-designed, case-control studies are the links all the way from molecular and cellular effects to the living organism up to the induction and proliferation of diseases observed in humans. It should be noted that we are not the only species at jeopardy, practically all animals and plants may be at stake.

Because the effects are reproducibly observed, and links to pathology cannot be excluded, the Precautionary Principle – or a complete ban! - should be in force regarding the implementation of this new technology within society. This will be the only wise method to support the sustainability of these innovative wireless communication technologies.

However, with the new American National Toxicology Program data in front of us, the question now is rather if not policy makers should immediately and strictly control exposure by defining biologically-based maximal exposure guidelines. These guidelines should take into account long-term, non-thermal effects, including especially vulnerable groups, such as the elderly, the ill, the genetically and/or immunologically challenged, children, fetuses, and persons with the functional impairment electrohypersensitivity, none of which are currently being accounted for by our current FCC/ICNIRP recommended guidelines.

In November, 2009, a Scientific Panel comprised of international experts on the biological effects of electromagnetic fields met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields from telecommunications and electric power technologies. This meeting was a direct consequence of on-going discussions since the mid-nineties, when cellular communications infrastructure began to rapidly proliferate. From this decade many resolutions, like the Benevento

(Belpoggi *et al* 2006), Venice (Avino *et al* 2008) and London (Johansson 2009a) Resolutions were created to protect health. Important conclusions were drawn from the 600-page Bioinitiative Report [http://www.bioinitiative.org] published August 31, 2007, which was a review of over 2,000 studies showing biological effects from electromagnetic radiation at non-thermal levels of exposure, and which later was partly published in the medical journal Pathophysiology (Volume 16, 2009). The Bioinitiative Report has since been updated (2012).

I have worked for many years trying to clarify the dangers of this 24/7, whole-body, artificial EMF irradiation. Along this struggle I have been proud to coauthor some of the most important compilations of the up-to-date knowledge, including (among many) the ones above.

The Seletun Scientific Statement (Fragopoulou *et al* 2010) recommends that lower limits (<0.017 μW/cm2) be established for electromagnetic fields and wireless exposures, based on scientific studies reporting health impacts at much lower exposure levels. Many researchers now believe the existing safety limits are inadequate to protect public health because they do not consider prolonged exposure to lower emission levels that are now widespread and do not take into account non-thermal effects. It should be noted that only one hygienic safety value ever has been proposed: 0.0000000001-0.000000000000001 μW/cm2 – this is the natural background during normal cosmic activities; proposed by myself, already in 1997, as a genuine hygienic safety value, and since then many times repeatedly presented. (Given the highly artificial nature of the current wireless communication signals, e.g. of their pulsations and modulations, it may actually boil down to 0 (zero) μW/cm2 as the true safe level.)

The body of evidence on electromagnetic fields requires a new approach to protection of public health; it needs to consider the growth and development of the fetus, and children; and should argue for strong preventive actions. These conclusions are built upon prior scientific and public health reports documenting the following:

- Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.
- ICNIRP/WHO and IEEE/FCC public safety limits are inadequate and obsolete with respect to prolonged, low-intensity exposures.
- New, biologically-based public exposure standards are urgently needed to protect public health world-wide.
- It is not in the public interest to wait.
- Electromagnetic radiation exposures should be reduced now rather than waiting for more proof of harm before acting. This is in keeping with traditional public health principles, and is justified now given abundant evidence that biological effects and adverse health effects are occurring at exposure levels hundreds to thousands of times, or more, below existing public safety standards around the world.
- There is a need for mandatory pre-market assessments of emissions and risks before deployment of new wireless technologies. There should be convincing evidence that products do not cause health harm before marketing. Such decisions have to be quickly

revised given new evidence.

- The use of telephone lines (landlines) or fiber optic cables for energy conservation infrastructure is recommended. Utilities should choose options that do not create new, community-wide exposures from wireless components. Future health risks from prolonged or repetitive wireless exposures may be avoided by using fiber-optic cable with wired/corded connections to the Internet. Energy conservation is endorsed but not at the risk of exposing millions of families in their homes to a new, involuntary source of wireless radiofrequency radiation, the effect of which on their health is known to be harmful.

Furthermore, based on the available scientific data, the Seletun Scientific Panel states that:

- Sensitive populations (for example, the elderly, the ill, the genetically and/or immunologically challenged) and children and fetuses may be additionally vulnerable to health risks; their exposures are largely involuntary and they are less protected by existing public safety standards.
- It is well established that children are more vulnerable to health risks from environmental toxins in general.
- The Panel strongly recommends against the exposure from wireless systems of children of any age.
- The Panel strongly recommends against the exposure from wireless systems of pregnant women.

This is all in accordance with the intentions of the Precautionary Principle, as summarized by Mats Dämvik and myself in our paper from 2010.

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I therefore – once again! - strongly encourage governments to immediately adopt a framework of guidelines for public and occupational EMF exposure that reflect the Precautionary Principle, or even altogether completely stop exposure. The Precautionary Principle states when there are indications of possible adverse effects, even if they seem uncertain, the risks from doing nothing may be far greater than the risks of taking action to control these exposures. The Precautionary Principle shifts the burden of proof from those suspecting a risk to those who discount it — as some nations have already done. Precautionary strategies should be based on design and performance standards and may not necessarily define numerical thresholds because such thresholds may erroneously be interpreted as levels below which no adverse effect ever can occur.

You often hear about "safe levels" of exposure when "experts" have falsely claimed to be experts... when the only expert comment should have been "I don't know"

You often hear about "safe levels" of exposure and too many times, "experts" have falsely claimed to be experts in the field when in actuality the only expert comment should have been: "I/we just do not know." Such fields were for instance: DDT, X-ray, thalidomide, radioactivity, smoking, asbestos,

BSE, heavy metal exposure, depleted uranium, and so on and so on, where the "no risk" flag was raised before true knowledge came around. Later on, the same flag had to be quickly lowered, many times after enormous economic costs and suffering of many human beings. "The protection from exposure to electromagnetic fields" issue is along those lines. It is now important to clearly identify the background and employment of every "expert" in different scientific committees, and likewise especially if they subsequently sit on the industry's chairs. It is, of course, very important (maybe even more important?) to also let "whistleblowers" speak at conferences, to support them with equal amounts of funding (or even more?). Of great concern is those scientists and other "experts" who, already from the very beginning, have declared that a certain source or type of irradiation, or a specified wireless product, is 100% safe – sometimes even before having properly examined them!

In the case of "protection from exposure to electromagnetic fields", it is thus of paramount importance to act from a prudence avoidance/precautionary principle point of view. Anything else would be highly hazardous! Total transparency of information is key here. I believe consumers are very tired of always getting the complete truth years after a catastrophe already has taken place. For instance, it shall be noted, that today's recommended values for wireless systems, the SAR-value, are just recommendations, and not safety levels. Since scientists observe biological effects at as low as 20 microWatts/kg, is it then really safe to irradiate humans with 2,000,000 microW/kg (with 100,000 times stronger radiation!), which is the current government recommendation level for us? [A recommendation that, as a matter of fact, even is scientifically outdated (cf. Panagopoulos *et al* 2013).] And, furthermore, it is very strange to see, over and over again, that highly relevant scientific information is suppressed or even left out in various official documents, high up in the governmental apparatus of society. This is not something that the consumers will gain anything good from, and, still, the official declaration or explanation (from experts and politicians) very often is: *"If we (=the experts) would let everything out in the open, people would be very scared and they would panic."* Personally, I have never seen this happen, but instead I have frequently seen great disappointment from citizens who afterwards have realized they have been fooled by their own employed experts and their own elected politicians.

Another misunderstanding is the use of scientific publications (as the tobacco industry did for many years) as 'weights' to balance each other. But you can NEVER balance a report showing a negative health effect with one showing nothing! This is a misunderstanding which, unfortunately, is very often used both by the industrial representatives as well as official authorities. The general audience, naturally, easily is fooled by such an argumentation, but if a deadly poisonous snake bites you, what good does it do you that there are 100 million harmless snakes around?

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Many cell phone and Wi-Fi base stations are close to beds, kitchens, playrooms, and similar locations. These wireless systems are never off, and the exposure is not voluntary. The Wi-Fi is being forced on citizens everywhere. Based on this, the inauguration of yet more and more Wi-Fi with grudging and involuntary exposure of millions to billions of human beings to pulsed

microwave radiation should immediately be prohibited.

Just as we are learning that cell phones are associated with brain and heart tumours, why are we installing more and more of the same technology next to, or in, everyone's homes, often with no legal right or practical possibility to opt out? Thousands of people have complained of tinnitus, headaches, nausea, sleeplessness, heart arrhythmia, and other symptoms after Wi-Fi was installed. Wireless technology is nowadays considered a public health hazard, and already lawsuits have been won. Such systems can violate already high FCC/ICNIRP recommended limits on human exposure to microwave radiation, and are being installed even as people are developing electrohypersensitivity which in Sweden is a recognized functional impairment (cf. Johansson 2015). There are also reports of Wi-Fi and similar systems interference with pacemakers and other implants. Should we not better value our health, and the health of our family and friends?

There is also emerging evidence that wireless, non-ionizing radiation (from cell phones, Wi-Fi, and smart meters) harms wildlife and damages trees. There have been direct reports of such radiation affecting vital bee populations, disturbing bird habitats, and interfering with avian navigational systems.

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The conversion to Wi-Fi, and similar wireless communication systems, is one of the largest technology rollouts in history, and yet virtually no public consultation with citizens or local governments was carried out in advance. Parallel to this, the World Health Organization (WHO; May 31, 2011) has classified the radiofrequency radiation used as a possible carcinogen, and the world's insurance companies have abandoned ship by not insuring or reassuring for health effects of electromagnetic fields. Around the world Wi-Fi companies continue to install their antennas, often without public awareness or consent. This is a genuine threat to our democracy and informed decision-making.

Once again, I want to come back to the very recent American National Toxicology Program (NTP) report ["Report of Partial Findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposures)"; http://biorxiv.org/content/biorxiv/early/2016/05/26/055699.full.pdf] which has shown that rats exposed to mobile telephony for two years have an increased incidence of aggressive brain tumours (gliomas) and malignant heart tumours (schwannomas). No tumours at all were observed in the unexposed control group.

This is, of course, a very interesting study, especially since it is based on observations of animals (rats which have a very short life-span so most tumour types never can develop - and still they did find a significant incidence increase in the exposed male rats {but not in the female; as pointed out by the lead author, Dr. Ronald L. Melnick, such differences are common in animal studies especially at sites that have higher background rates in male rats than females. This gender difference might also be a consequence of low statistical power.}). The lack of animal results has, as you know, been

held against epidemiologic findings in human populations. It is also very interesting to see the results arising from non-thermal exposure, rather than a thermal one.

The project has been underway for more than a decade, and with a $25 million price tag, is the most expensive ever undertaken by the NTP. The study involved more than 2,500 rodents, exposed to the same type of radiation found in cell phones, at the same frequencies, for nine hours every day, for two years.

A very mind-boggling finding is that the exposed rats lived longer, but it could make sense given the concomitant initial activation also of immune-defense/tissue repair systems (cf. Johansson 2009b).

One obvious fallacy is to confound "unexposed" rats with the tiny fragments of the general human population who have "no cell phones." The animal control group was kept in shielded metal chambers which completely isolated them from environmental radiofrequency fields. In this way, the control group is ***not*** analagous to the general human population without phones since the chamber shielded the control subjects from ***all*** radiofrequency fields.

Even though the incidences were regarded as low, transferred to the human population scale such a result still would mean - down the road - a tremendous future cost for the world's health care systems. And, with humans living for a much longer time, we may be witnessing future incidence increases at a dramatic scale (cf. calculations above).

Finally, in addition to the cancer incidence data of the American National Toxicology Program, just very recently they have come forward and revealed that the same radiofrequency/microwave radiation that led male rats to develop brain tumours also caused DNA breaks in their brains. Female rats — which did not have significant elevated tumour counts — had fewer DNA breaks [cf. http://microwavenews.com/news-center/ntp-comet-assay].

All these findings are part of the same $25 million NTP project. The NTP results provide "*strong evidence for the genotoxicity of cell phone radiation*," professor Ron Melnick told *Microwave News*. Melnick led the team that designed the NTP study; he is now retired. This "*should put to rest the old argument that RF radiation cannot cause DNA damage*," he said [cf. http://microwavenews.com/news-center/ntp-comet-assay].

To turn your back on these new findings would be as stupid as turning your back to an Egyptian cobra

It is, strictly scientifically, naturally very difficult - not to say impossible - to draw any far-reaching conclusions, but since we are talking about unborn foetuses, newly-born babies, children, teenagers, adults and elderly - all at once - it is fair to call for immediate and strong precautionary measures as well as much better monitoring of health parameters changes in our modern societies (cf. Hallberg & Johansson 2009).

The question is, if yet other studies find similar results, will the WHO not have to revise its class

2B carcinogen classification into a class 1? Against it speaks the clear observation that - *luckily!* - so far no epidemic incidence increases are seen; actually in Sweden - a very high- and "for long time"-exposed country the incidence is slowly decreasing, however in other countries the opposite is found. Nevertheless, to turn your back on these new findings would be as stupid as turning your back to an Egyptian cobra. You easily may have to regret it with your life.

The scientists must have regarded their results of very high importance since they released them before the entire study was completed, a rather unusual decision. As a consequence, I think - from now on - it will be very difficult to claim wireless systems to be without risk. The findings definitely revive questions about the safety of the devices, and the results of the NTP study have the potential to move a debate that has been locked in stalemate for almost as long as cell phones have been around. To say that the American NTP study is a paradigm-shifting one is to understate its importance.

Finally, seeing the results of course also revives me; maybe I - and many other scientists - was not wrong when I called for safety measures already back in the 1980ies; maybe it was morally-ethically 100% right to sound the alarm? (I have always lived by the notion that it is better to be safe than sorry - especially when we are talking about toys. The question is, however, who in the future will dare to speak up when new dangers emerge, given the tremendous cost in the form of bullying, slander, harassment and threats?!)

From a public health point-of-view no more research is needed, the proof in the form of thousands and thousands of peer review-based scientific publications is overwhelming – now society must dare to protect and to serve. Children can never be allowed to be victims of flimsy pedagogic tools, and absent adult responsibility, or to be exposed to a WHO-classified possible carcinogen. Our actions must solely aim for their needs, not for commercial greed. I say, finally, *stop walking for the cure, march against the cause!*

Stop walking for the cure, march against the cause!

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