

To bee, or not to bee, that is the five “G” question – by Olle Johansson

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Olle Johansson KI – Photo: NASMS, A. McDowell

The collective evidence we can draw from the current scientific status regarding adverse health and biological effects of artificial electromagnetic field exposures, such as from cell phones, antennas/base stations, TV and radio towers, babyalarms, smart meters, powerlines, and WiFi routers, points to that we may be jeopardizing more than our own health and behaviour. Bacteria, plants, birds, frogs, and pollinating insects, may all be targeted, and it is obvious we must proceed with the highest caution before immersing the citizens and our wildlife in more and more artificial electromagnetic fields. We may, as a matter of fact,

already be gravely endangering our current as well as coming generations. To not act today, may prove a disaster tomorrow, and such lack of action may again result in the classical “late lessons from early warnings”, or – even worse – “too late lessons from early warnings”.

By Olle Johansson, former head of The Experimental Dermatology Unit, Department of Neuroscience, Karolinska Institute, Stockholm, Sweden, and former adjunct professor of The Royal Institute of Technology, also Stockholm, Sweden, now retired and leading The Institute of Common Sense for Common Sense, Utö/Stockholm, Sweden.

As a scientist and as a citizen, I do not know if the new version of wireless telecommunication, the so-called 5G, is safe or not. Neither does the The Federal Communications Commission (FCC) which is an independent agency of the United States government created by statute to regulate interstate communications by radio, television, wire, satellite, and cable, nor The American Food and Drug Administration (FDA) which is a federal agency of the United States Department of Health and Human Services, one of the United States federal executive departments.

When they – at the recent Feb. 7th, 2019, Senate Commerce, Science, and Transportation Committee hearing on the future of 5G wireless technology and their impact on the American people and economy – were asked by the U.S. Senator Richard Blumenthal why there is a lack of any scientific research and data on the 5G technology’s potential health risks, and where he also criticized the FCC & FDA for inadequate answers on outstanding public health questions, *he had to point firmly to that the wireless carriers concede they are not aware of any independent scientific studies on safety of 5G!*

On April 15, 2019, Rep. Peter A. DeFazio, the House Transportation and Infrastructure Committee Chairman, wrote a letter to the FCC Chairman Ajit Pai and acting FDA Commissioner Norman Sharpless inquiring about the status of the government’s research into the potential health effects of radiofrequency (RF) radiation and its relation to the FCC’s guidelines for safe human RF exposure levels, in light of the Commission push to roll out 5G technology and over 800,000 new antenna installations in the United States, aiming at providing a fast Internet service to 99% of the Americans within six years

Ref: [FCC chairman backs T-Mobile-Sprint deal in key endorsement](#)

Rep. DeFazio pointed out that although the Commission sought comment on whether its RF safety guidelines should be reassessed in 2013, no further action has been

taken and the guidelines have not been updated since their implementation in 1996. DeFazio's letter asks for details on the health-related studies conducted and what efforts have been taken by the agencies to educate and inform the public about its RF/5G technology research.

Again, it is obvious from the consumer's point of view that nothing is to be found in the filing cabinets of the FDA or the FCC.

But, all over the world, the consumers/citizens as well as our parliament politicians are still told, *e.g.* by the Swedish, Norwegian and Danish governmental radiation and health authorities that there is no reason for any concern. *Excuse me!* If no one – including the American FCC & FDA – is aware of any independent scientific studies on safety of 5G, then I must be very concerned taking into account the fact that from the current vast scientific literature, counting more than 26,000 relevant entries into various literature databases, on the other G:s, like 2G, 3G and 4G, as well as similar exposures from TV and radio towers, babyalarms, smart meters, and powerlines, it is obvious we must proceed with the highest caution before immersing the citizens and our wildlife in more and more artificial electromagnetic fields.

We may, as a matter of fact, already be gravely endangering our current as well as coming generations. To not act today, may prove a disaster tomorrow, and such lack of action may again result in the classical “late lessons from early warnings”, or – even worse – “too late lessons...”.

And for all the civil servants – employed by various governmental authorities – to actively lure their own government and parliament must be regarded as very serious. I believe it is called “high treason” to engage in such an act, or...? I, as a scientist, am not here to promote convenience or economic growth, but only “*to serve and protect*” human health, as well as to directly protect other animals, plants, and bacteria. These aims must be my only target, not to ensure consumers nor parliaments “there is no cause for alarm” which would be a blatant lie.

Based on earlier conclusions, the World Health Organization (WHO) in Geneva already in 2001/2002 classified powerfrequency magnetic fields as possibly carcinogenic for childhood leukemia (Class 2B), and, by May 31, 2011, radiofrequency electromagnetic fields were also classified as possibly carcinogenic for certain brain tumours (Class 2B). In the same year, the Council of Europe said “*Ban mobile phones and wireless networks in schools*”, since these technologies have “*potentially harmful*” effects on humans. The Council of Europe concluded

that *immediate (!) action was required to protect children*. In Sweden *nothing* happened along these lines, the children were – and are – obviously not worth protecting from the effects summarized below, as compared to protecting profit, money, and unlimited greed. All of this in spite of that the 2B classification means that we do put our children in an exposure equally bad as many very dangerous substances and exposures, such as lead, petrol exhausts, marine diesel fuel, HIV type 2, Human Papilloma Virus, dry cleaning chemicals, methylmercury, hexachlorobenzene, chloroform, carbazole (as in tobacco smoke), etc., all found in the same category 2B. Quite a paradox, is it not, and definitely no exposures parents would happily subject their loved children to, or what do you think...?

The paradox is even more obvious since all these gadgets – from an evolutionary point-of-view – are toys. Children who do not get tablets and smart phones still will mature to responsible and loving citizens – that you do not need to worry about! But without the real life necessities such as clean water, clean air, food that can be eaten without risk, care, concern, love and respect, they will perish, as if wildlife, such as pollinating insects, is/are damaged beyond repair.

Sometimes the toy aspect of 5G seems quite a bit over the top! A few days ago I read about how the commercial company, Ordnance Survey Limited in England, promise that

“Together, we’ve developed a demonstrator tool that lets network providers and local authorities visualise the best locations for placing radio antennae – to help deliver faster network speeds and better coverage that will cater for the increase of mobile and connected devices”. – [5G. We’ll keep you connected](#), Ordnancesurvey.co.uk

Among their images is one of St. Peter’s Church in Bournemouth with oblique imagery from Leica Geosystems.

But how stupid of me, I believed a church was for prayer, respect, sadness, happiness, contemplation and preaching, not to be colour-coded by Leica Geosystems...and definitely not providing a church spire platform assisting in relaying hard-core pornography, violent movies, amoral and unethical messages, etc. Is that really what our churches should be used for? But I suppose the driving force, as so often, is greed, not need.

So no wonder that the citizens of Bournemouth now are upset!

With the very recent American National Toxicology Program's study [2016-2018], which found a clear link between near-field radiofrequency radiation from mobile phones and malignant gliomas of the brain and schwannomas in the heart of rats, and the Italian Ramazzini rodent far-field exposure/cancer results [2018/2019] supporting the first, the above is of even stronger importance.

And in 2012, the Italian Supreme Court ruled for the first time that mobiles can cause a brain tumour! And do not forget that the very same WHO (cf. above) cancer-classified powerfrequency magnetic fields as possibly carcinogenic (Class 2B) already in 2001/2002!

Besides the brain and heart cancer risks, cell phone and WiFi signals may also affect the blood-brain barrier to open and let toxic molecules into the brain, hurt and kill neurons in the hippocampus (one of the brain centres for memory), down- or up-regulate essential proteins in the brain engaged in the it's metabolism, stress response and neuroprotection. Exposed sperms have been seen with more head defects, decreased sperm count, lowered motility, decreased viability, and other malfunctions as well as DNA damage, and severe effects on fertility have been found. Wireless signals can increase oxidative stress in cells and lead to increase of proinflammatory cytokines and lower capacity to repair genotoxic DNA single- and double-strand breaks. Cognitive impairments in learning and memory have also been shown. Results from the OECD's PISA performance surveys in reading and mathematics show decreasing results in countries that have invested most in introducing computers, tablets and cell phones in school. Multitasking, too many hours in front of a screen, less time for social contacts and physical activities with risk for neck and back aches, overweight, sleep problems, and information technology (IT) addiction are some of the known risks and side-effects of IT. They stand in marked contrast to the often claimed, but largely unproven possible benefits (the OECD actually says frequent use of computers in schools is more likely to be associated with lower results!).

And the implications of the most recent findings – by Taheri *et al* from 2017 – of bacteria exposed to mobile phone and WiFi radiation turning resistant to antibiotics are chilling, to say the least, and may easily explain the on-going huge and highly frightening development into more and more antibiotics-resistant microorganisms around the world. The latter has very recently summoned the G20 countries – in 2017 – to discuss the fact that each year more than 25,000 Europeans die prematurely due to antibiotic resistance. By the year 2050 it has been calculated to be about 10,000,000 humans world-wide, and neither of these two estimations have taken into account the Taheri *et al* findings, thus, the 10,000,000 can easily instead become 7,600,000,000...not then counting all livestock dying for the same reason.

Finally to be noted while you still can see this text, the blue light beaming from smartphones and tablets is changing cells in our eyes that could accelerate blindness, according to a recent study by Ratnayake *et al*, in Nature Scientific Reports, 2018. Researchers from The University of Toledo studied the impact of blue light – which comes from the sun as well as digital devices – on our eyes. The study found blue light triggers "toxic" reactions in retinal molecules that sense light and signal the brain. The retinal used by photoreceptors in our eyes is what allows people to see.

Results showed blue light helps generate poisonous chemical reactions killing photoreceptors, which cannot be restored once they die off. This leads to macular degeneration, an incurable eye disease that causes blindness starting in your 50s or 60s, researchers said.

Blue light can also affect your sleep, suppressing your body's ability to create the hormone melatonin, according to the American National Sleep Foundation. They suggest staying away from devices at least 30 minutes before going to bed.

Ref: USA Today: [Blue light from phones, tablets could accelerate blindness and hurt vision, study finds](#)

Maybe the latter can explain the dramatically increased insomnia problems encountered in our modern society?

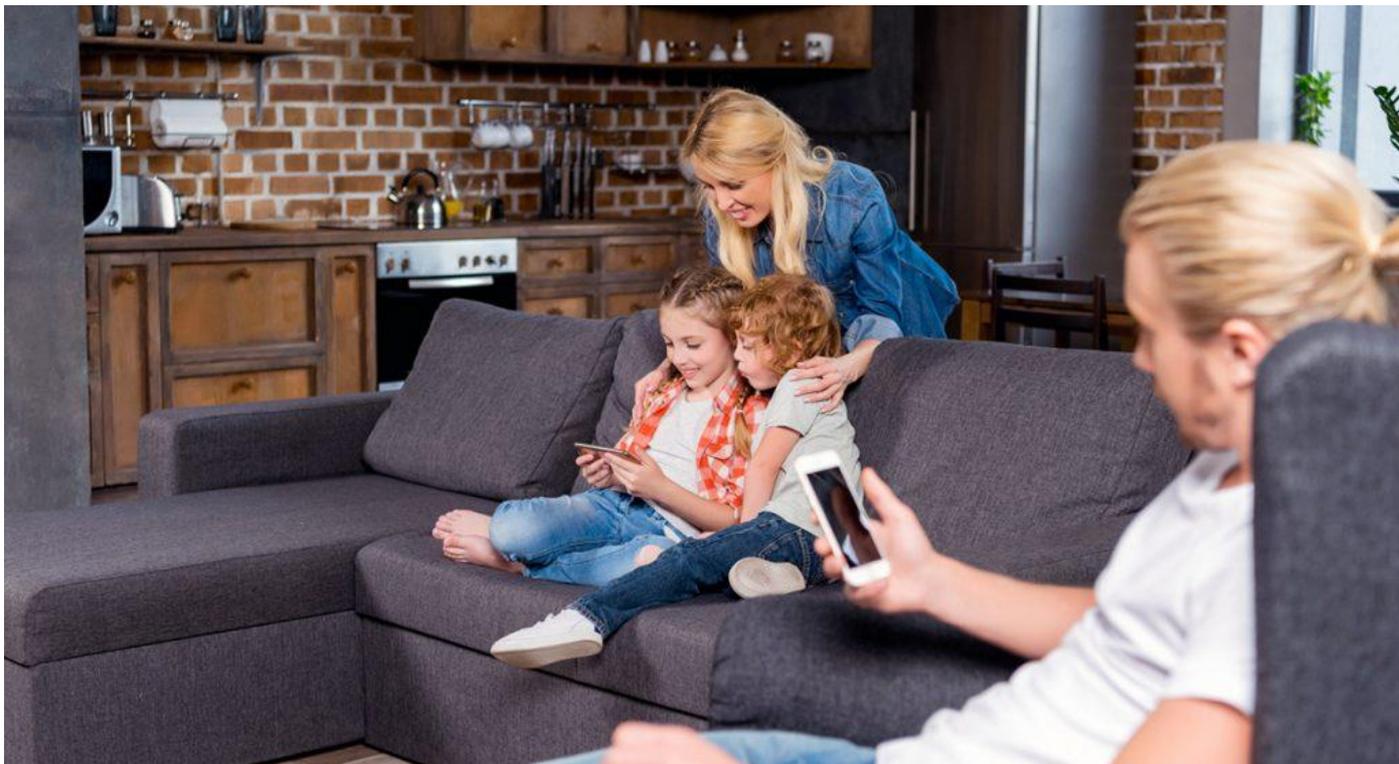
Often, in the general debate, you hear representatives of various authorities declare that if we are just staying below the current guideline recommendations (given as $\mu\text{W}/\text{m}^2$; 1800 MHz) of 9,000,000 $\mu\text{W}/\text{m}^2$ – ICNIRP's (1998) and WHO's recommendation for Sweden, Norway, Denmark, and many other countries, and 10,000,000 $\mu\text{W}/\text{m}^2$ for the USA, then everything is fine. But the natural background during normal cosmic activities is only 0.000001-0.00000000001 $\mu\text{W}/\text{m}^2$, thus the maximum allowed exposure load on the citizens is 1,000,000,000,000,000 times stronger. Would we trust anyone proposing that we can withstand a 1,000,000,000,000,000 times stronger outdoor air pressure, or a 1,000,000,000,000,000 times higher indoor temperature?

Against this background, I already in 1997 – at a Stockholm trade union (Statstjänstemannaförbundet; ST) discussion – proposed this natural background of only 0.000001-0.00000000001 $\mu\text{W}/\text{m}^2$ as a genuine hygienic safe limit! And I still stand with it, and hereby repeat it.

Official governmental human exposure guidelines, originally entirely based on technical arguments, fluid-filled plastic dolls (!) and model-based mathematical calculations, are decades out of date – and are only concerned with one single 6- or 10 minute acute thermal exposure, in an environment completely free of any other similar irradiation for the rest of your life. Real-life events occur up to 100,000 times below these “guidelines”, during constant 24/7 exposure load, and with endless other sources of electromagnetic background fields and signals! Bees, birds, and humans are not fluid-filled plastic dolls, and we are not technical machines.

New, biologically-based public exposure standards are thus urgently needed to protect public health and wildlife world-wide.

So we must live with the realization that science has demonstrated that acute or chronic exposure, well below current official guidelines, to wireless radiation could be harmful. In addition, we must understand that children are more vulnerable to environmental exposures than adults – and they depend on us to protect them – and the effects on them will be more devastating for society. *We can loose the old, but not the young!*



Family at home with their smartphones. Photo: Mostphotos.se

Recently, as a matter of fact, things have started to change in certain countries, like a bill to ban phones in schools that was introduced in France in 2009, and further tightened in January 29, 2015. 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 the government in Belgium 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. In 2015, bans on student use of phones inside and outside of schools were considered in Indonesia, and in 2013 in South Korea 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.

Furthermore, a press release by February 27, 2017, has been sent out about Maryland State's Children's Environmental Health and Protection Advisory Council being the first in USA to issue new recommendations to reduce Wi-Fi exposure of children, and a similar press release from March 6, 2017 tells us that "Cyprus Removes Wi-Fi from Kindergartens and Halts Wireless Deployment Into Public Elementary Schools". As a Swede I must, however, strongly wonder: in all these impressive statements and decisions ... where is my own country Sweden? Swedes cover our children in strongly coloured overalls, reflective vests, safety helmets, bicycle helmets, and more, but allow them to walk 'naked' in relation to the ambient artificial electromagnetic fields which have been cancer-classified by the WHO for nearly two decades!

Others have also added to these actions and launched responses to my original proposal of strongly reducing public exposure:

- The United Educators teacher's union of the San Francisco Unified School District, [passed a resolution](#) recently regarding radiofrequency radiation and cell phones, where they call for safer standards (2017)
- The Court of Florence has [ordered the immediate shutdown](#) of Wi-Fi in the Botticelli Comprehensive Institute, to protect the health of a minor, and to use hardwiring (2019)
- An Italian court has very recently [ordered the government](#) (Ministries of the Environment and Education) to launch a campaign to advise the public of the health risks from mobile and cordless phones (2019)

Very early I also coined the expression that *this is 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 (at colossal exposure levels!) for the rest of our lives?”

Few have tried to answer that particular question, but some organizations that definitely, and to 100%, trust the current scientific results and our common knowledge about potential health effects of man-made, artificial electromagnetic fields, and thus listen to me and others, are the manufacturers, the operators, the radiation protection authorities and even the World Health Organization since they all have abandoned ship years ago. It is also, of course, no surprise that electromagnetic radiation no longer is covered by insurance or reinsurance as a result of health problems. The British insurance giant Lloyd’s – together with other insurance and reinsurance 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 are no longer covered by their insurance policies.

So do not call the insurance companies in the future but your government and parliament since they allowed the public blanketing roll-out of these exposures. In addition, critical whistleblowing scientists, casting long and large shadows of doubt on these so-called “safe” gadgets, have effectively been removed, instead of supported.

Tom Butler, Professor of Information Systems, specialising in Semantic & Regulatory Technologies, Principal Investigator at GR3C at UCC, Cork, Ireland, and former Irish Research Council awardee, recently said

“Children are at growing risk of present and future ill-health from wireless technology due to weak governments, captured government departments and agencies, corrupt institutions, a compliant press and unethical or ignorant academics.” (April 24, 2019; Raidió Teilifís Éireann, [RTE.ie](https://www.rte.ie))

I certainly, definitely and sincerely hope *You* do not live in such a country, but in a real democracy, putting the citizens’ need at first, instead of greed!

Out in society, more and more rumble is heard from the legal machinery; lawyers, barristers, judges and attorneys are vividly explaining the various potential legal breaches having been made when allowing public blanketing coverage of artificial electromagnetic fields for 5G, and previously for 4G, 3G, and so forth. With all due

respect for these very capable experts, personally, I would rather live in a society built on common sense than on endless and hugely expensive legal battles in Courts of Law. Issues, such as if pollinating insects are harmed by potentially environmentally-toxic modern man-made exposures, are easily solved by scientifically sound and well-controlled observation and experimentation. And, and here is a vital clue for tomorrow, the knowledge thus learnt can be used to develop tomorrow's green, human- and environmentally-friendly technology, allowing huge positive profits to be made, rather than destroying the planet. But, of course, the knowledge learnt may teach us that we just can not subject ourselves or wildlife to colossal amounts of radiated energy – we and they are just not built for it!

Being myself a member of the mental fire brigade we call academic science, I very much more – like the ordinary fire brigade – like to search for trickles of smoke before they turn into big fires. Therefore I most often start by looking for real societal needs.

The last May weeks, 2019, we have seen in the media that up to one million plant and animal species face extinction, many within a few decades, because of human activities, documented by the recent and most comprehensive report yet on the state of global ecosystems, from a United Nations-backed panel called the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). *Without drastic action to conserve habitats, the rate of species extinction – already tens to hundreds of times higher than the average across the past ten million years – will only increase, says the analysis.*

According to the report, agricultural activities have had the largest impact on ecosystems that people depend on for food, clean water and a stable climate. The loss of species and habitats poses as much a danger to life on Earth as climate change does, says a summary of the work, released on 6 May, 2019. Biodiversity should be at the top of the global agenda alongside climate, concluded Anne Larigauderie, IPBES executive secretary, at a 6 May press conference in Paris, France. “*We can no longer say that we did not know*”, she also said.

Without “transformative changes” to the world's economic, social and political systems to address this crisis, the IPBES panel projects that major biodiversity losses will continue to 2050 and beyond. “*We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide*”, says IPBES chair Robert Watson, an atmospheric chemist at the University of East Anglia in Norwich, UK. Such damage to ecosystems would undermine global efforts to

reduce poverty and hunger and promote more sustainable development, the IPBES report finally concludes.

*From: [Humans are driving one million species to extinction](https://doi.org/10.1038/d41586-019-01448-4), Nature 2019; **569**: 171, doi: 10.1038/d41586-019-01448-4*

There is emerging evidence that wireless, non-ionizing radiation (from cell phones, Wi-Fi, and smart meters) harms wildlife and damages plants and trees. There have been direct reports of such radiation affecting vital bee populations, disturbing bird habitats, and interfering with avian navigational systems. Let us therefore look at just a few of many published scientific papers in a more detailed manner and with the exact references given:

Balmori [2009] early discussed the possibility that phone masts located in their living areas are irradiating continuously some species that could suffer long-term effects, like reduction of their natural defenses, deterioration of their health, problems in reproduction and reduction of their useful territory through habitat deterioration. Thus, electromagnetic radiation can exert an aversive behavioral response in rats, bats and birds, such as sparrows, he claimed.

[Balmori A, “Electromagnetic pollution from phone masts. Effects on wildlife”, Pathophysiology 2009; 16: 191-199]

He also performed an experiment by exposing eggs and tadpoles of the common frog (*Rana temporaria*) to electromagnetic radiation from several mobile (cell) phone antennae located at a distance of 140 meters [Balmori 2010]. The experiment lasted two months, from the egg phase until an advanced phase of tadpole prior to metamorphosis. Measurements of electric field intensity (radiofrequencies and microwaves) in V/m obtained with three different devices were 1.8 to 3.5 V/m. In the exposed group (n = 70), low coordination of movements, an asynchronous growth, resulting in both big and small tadpoles, and a high mortality (90%) was observed. Regarding the control group (n = 70) under the same conditions but inside a Faraday cage, the coordination of movements was normal, the development was synchronous, and a mortality of 4.2% was obtained. These results indicate that radiation emitted by phone masts in a real-life situation may affect the development and may cause an increase in mortality of exposed tadpoles. This research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts, WiFi routers, and more.

[Balmori A, “Mobile phone mast effects on common frog (*Rana temporaria*) tadpoles: the city turned into a laboratory”, Electromagn Biol Med 2010; 29: 31-35]



Frog. Photo: Capri23auto. Licence: [Pixabay.com](https://www.pixabay.com) (free use)

As pointed out by Arno Thielens and coworkers [2018], insects are continually exposed to radiofrequency (RF) electromagnetic fields at different frequencies. The range of frequencies used for wireless telecommunication systems will increase in the near future from below 6 GHz (2G, 3G, 4G, and WiFi) to frequencies up to 120 GHz (5G). Their recent paper is the first to report the absorbed RF electromagnetic power in four different types of insects as a function of frequency from 2 GHz to 120 GHz. A set of insect models was obtained using novel micro-CT (computer tomography) imaging. All insects showed a dependence of the absorbed power on the frequency, and they showed a general increase in absorbed RF power at and above 6 GHz, in comparison to the absorbed RF power below 6 GHz. Their simulations showed that a shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3–370%.

[Thielens A, Bell D, Mortimore DB, Greco MK, Martens L, Joseph W, “Exposure of insects to radiofrequency electromagnetic fields from 2 to 120 GHz”, *Nature Scientific Reports* 2018, 8:3924 | DOI:10.1038/s41598-018-22271-3]

A number of reports have shown evident hazardous effects of microwave radiation (MW) on embryo development in chicken. In the paper of Tsybulin *et al* [2012], they aimed at elucidating the effects of MW emitted by a commercial model of GSM 900 MHz cell phone on embryo development in quails (*Coturnix coturnix japonica*)

during both short and prolonged exposure. For that, fresh fertilized eggs were irradiated during the first 38 h or 14 days of incubation by a cell phone in "connecting" mode activated continuously through a computer system. Maximum intensity of incident radiation on the egg's surface was 0.2 $\mu\text{W}/\text{cm}^2$. The irradiation led to a significant ($p < 0.001$) increase in numbers of differentiated somites in 38-hour exposed embryos and to a significant ($p < 0.05$) increase in total survival of embryos from exposed eggs after 14 days exposure. They hypothesized that observed facilitating effect was due to enhancement of metabolism in exposed embryos provoked via peroxidation mechanisms. Indeed, the level of thiobarbituric acid (TBA) reactive substances was significantly ($p < 0.05-0.001$) higher in brains and livers of hatchlings from exposed embryos. Thus, observed effects of radiation from commercial GSM 900 MHz cell phone on developing quail embryos signify a possibility for non-thermal impact of MW on embryogenesis. They suggested that the facilitating effect of low doses of irradiation on embryo development can be explained by a hormesis effect induced by reactive oxygen species (ROS). Obviously, future studies need to be done to clarify this assumption, however, it must also be pointed out that any effect (negative or positive) deviating from the normal situation – although tempting *e.g.* from a commercial point of view – always has to be judged as abnormal, and therefore potentially harmful.

[Tsybulin O, Sidorik E, Kyrylenko S, Henshel D, Yakymenko I, "GSM 900 MHz microwave radiation affects embryo development of Japanese quails", *Electromagn Biol Med* 2012; 31: 75-86]

The exponential increase of mobile telephony naturally has led to a pronounced increase in electromagnetic fields in the environment that may affect pollinator communities and threaten pollination as a key ecosystem service. Previous studies conducted on model species under laboratory conditions have shown negative effects of electromagnetic radiation (EMR) on reproductive success, development, and navigation of insects. However, the potential effects that widespread mobile telecommunication antennas have on wild pollinator communities outside the laboratory microcosm are still largely unknown. Lázaro *et al* [2016] studied the effects of EMR from telecommunication antennas on key wild pollinator groups (wild bees, hoverflies, bee flies, remaining flies, beetles, butterflies, and wasps). They measured EMR at 4 distances (50, 100, 200 and 400 m) from 10 antennas (5 on Limnos Island and 5 on Lesbos Island, eastern Mediterranean, Greece), and correlated EMR values with insect abundance and richness (the latter only for wild bees and hoverflies). All pollinator groups except butterflies were affected by EMR. In both islands, beetle, wasp, and hoverfly abundance decreased with EMR, whereas the abundance of underground-nesting wild bees and bee flies unexpectedly increased with EMR. The effect of EMR on the abundance of remaining flies differed between islands. With respect to species richness, EMR only tended to have a negative effect

on hoverflies in Limnos. As EMR affected the abundance of several insect guilds negatively, and changed the composition of wild pollinators in natural habitats, it might also have additional ecological and economic impacts on the maintenance of wild plant diversity, crop production and human welfare.

[Lázaro A, Chroni A, Tscheulin T, Devalez J, Matsoukas C, Petanidou T, “Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators”, *J Insect Conserv* 2016; 20: 1-10]

Burlaka *et al* in 2013, aimed at understanding the potential mechanism(s) behind long-term exposure of humans to low intensity radiofrequency electromagnetic radiation (RF-EMR) possibly leading up to a statistically significant increase in tumor incidence. Mechanisms of such the effects are unclear, but features of oxidative stress in living cells under RF-EMR exposure have previously been reported. Their animal model study aimed to assess a production of initial free radical species, which leads to oxidative stress in the cell, by employing embryos of Japanese quails who were exposed *in ovo* to extremely low intensity RF-EMR of GSM 900 MHz (0.25 $\mu\text{W}/\text{cm}^2$) during 158-360 h discontinuously (48 sec – ON, 12 sec – OFF) before and in the initial stages of development. The levels of superoxide ($\text{O}_2\cdot^-$), nitrogen oxide ($\text{NO}\cdot$), thiobarbituric acid reactive substances (TBARS), 8-oxo-2'-deoxyguanosine (8-oxo-dG) and antioxidant enzymes' activities were assessed in cells/tissues of 38-h, 5- and 10-day RF-EMR exposed and unexposed embryos. The exposure resulted in a significant persistent overproduction of superoxide and nitrogen oxide in embryo cells during all period of analyses. As a result, significantly increased levels of TBARS and 8-oxo-dG followed by significantly decreased levels of superoxide dismutase and catalase activities were developed in the exposed embryo cells. Burlaka *et al* [2013] rightfully concluded that exposure of developing quail embryos to extremely low intensity RF-EMR of GSM 900 MHz during at least one hundred and fifty-eight hours leads to a significant overproduction of free radicals/reactive oxygen species and oxidative damage of DNA in embryo cells. These oxidative changes may lead to pathologies up to oncogenic transformation of cells, as suggested in the rodent studies cited above.

[Burlaka A, Tsybulin O, Sidorik E, Lukin S, Polishuk V, Tsehmistrenko S, Yakymenko I, “Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation”, *Exp Oncol* 2013; 35: 219–225]

In the Greek study by Magras & Xenos [1997], 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

$\mu\text{W}/\text{m}^2$ and $10,530 \mu\text{W}/\text{m}^2$, 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 initially may sound appetizing. But, remember again, 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 in 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 if 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.)

[Magras IN, Xenos TD, “RF radiation-induced changes in the prenatal development of mice”, *Bioelectromagnetics* 1997; 18: 455-461]

In the ground-breaking work of Dimitris Panagopoulos he *i.a.* investigated the effect of GSM radiation on ovarian development of virgin *Drosophila melanogaster* female insects [Panagopoulos 2012]. Newly emerged adult female flies were collected and divided into separate identical groups. After the lapse of certain number of hours – different for each group – the insects (exposed and sham-exposed) were dissected and their intact ovaries were collected and photographed under an optical microscope with the same magnification. The size of the ovaries was compared between exposed and sham-exposed virgin female insects, during the time needed for the completion of oogenesis and maturation of the first eggs in the ovarioles. Immediately after the intact ovaries were photographed, they were further dissected into individual ovarioles and treated for TUNEL and acridine-orange assays to determine the degree of DNA damage in the egg chamber cells. The study showed that the ovarian size of the exposed insects is significantly smaller than that of the corresponding sham-exposed insects, due to destruction of egg chambers by the GSM radiation, after DNA damage and consequent cell death induction in the egg chamber cells of the virgin females as shown in previous experiments on inseminated females. The difference in ovarian size between sham-exposed and exposed virgin female flies becomes most evident 39-45 h after eclosion when the first eggs within the ovaries are at the late vitellogenic and post-vitellogenic stages (mid-late oogenesis). More than 45 h after eclosion, the difference in ovarian size decreases, as the first mature eggs of the sham-exposed insects are leaving the ovaries and are laid.

[Panagopoulos DJ, “Effect of microwave exposure on the ovarian development of *Drosophila melanogaster*”, *Cell Biochem Biophys* 2012; 63: 121-132]

Margaritis *et al* [2013] utilized a similar approach by employing the model biological organisms *Drosophila melanogaster* and *Drosophila virilis* to assess effects on apoptotic cell death of follicles during oogenesis and reproductive capacity (fecundity) decline. A total of 280 different experiments were performed using newly emerged flies exposed for short time daily for 3-7 d to various EMF sources including: GSM 900/1800 MHz mobile phone, 1880-1900 MHz DECT wireless base, DECT wireless handset, mobile phone-DECT handset combination, 2.44 GHz wireless network (Wi-Fi), 2.44 GHz blue tooth, 92.8 MHz FM generator, 27.15 MHz baby monitor, 900 MHz CW RF generator and microwave oven's 2.44 GHz RF and magnetic field components. Distance from the emitting source, the exposure duration and the repeatability were examined. All EMF sources used created statistically significant effects regarding fecundity and cell death-apoptosis induction, even at very low intensity levels (0.3 V/m blue tooth radiation), well below ICNIRP's guidelines, suggesting that *Drosophila* oogenesis system is suitable to be used as a biomarker for exploring potential EMF bioactivity.

[Margaritis LH, Manta AK, Kokkaliaris CD, Schiza D, Alimisis K, Barkas G, Georgiou E, Giannakopoulou O, Kollia I, Kontogianni G, Kourouzidou A, Myari A, Roumelioti F, Skouroliakou A, Sykioti V, Varda G, Xenos K, Ziomas K, "Drosophila oogenesis as a bio-marker responding to EMF sources", *Electromagn Biol Med* 2013; Early Online: 1–25, DOI: 10.3109/15368378.2013.800102]

Exposure of different animal species to radiofrequency electromagnetic fields (RF-EMF) could cause various biological effects such as oxidative stress, genotoxic effects and dysfunction of the immune system, something addressed by Vilić *et al* in 2017, pointing to that there is a lack of results on oxidative stress response and genotoxicity in the honey bee (*Apis mellifera*) after exposure to RF-EMF. Their study was therefore performed to investigate the effects of exposure to RF-EMF on the activity of catalase, superoxide dismutase, glutathione S-transferase, lipid peroxidation level and DNA damage in honey bee larvae. Honey bee larvae were exposed to RF-EMF at 900 MHz and field levels of 10, 23, 41 and 120 V/m for 2 h. At a field level of 23 V/m the effect of 80% AM 1 kHz sinusoidal and 217 Hz modulation was investigated as well. Catalase activity and the lipid peroxidation level decreased significantly in the honey bee larvae exposed to the unmodulated field at 10 V/m compared to the control. Superoxide dismutase and glutathione S-transferase activity in the honey bee larvae exposed to unmodulated fields were not statistically different compared to the control. DNA damage increased significantly in honey bee larvae exposed to modulated (80% AM 1 kHz sinus) field at 23 V/m compared to the control and all other exposure groups. Modulated RF-EMF produced more negative effects than the corresponding unmodulated field. Although honey bees in nature would not be exposed to such high field levels as used in their experiments, the results show the need for further intensive research in all stages of honey bee development.

[Vilić M, Gajger IT, Tucak P, Štambuk A, Šrut M, Klobučar G, Malarić K, Žaja IŽ, Pavelić A, Manger M, Tkalec M, “Effects of short-term exposure to mobile phone radiofrequency (900 MHz) on the oxidative response and genotoxicity in honey bee larvae”, J Apicult Res 2017; 56: 430-438]

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, 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.

[Cammaerts MC, Johansson O, ”Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus”, Electromagn Biol Med 2014; 33: 282-288]

I immediately after our 2013 study wrote [a commentary](#) in 2014 where I urged pregnant women and children not to expose themselves to wireless radiation, and concluded that *we humans are mostly just standing around talking about this, whereas ants and bees are fleeing the field!* In it I also pointed to that [a survey](#) carried out by Daniel Favre in 2011 in Lausanne, Switzerland; also see: [Mobile phone-induced honeybee worker piping](#) and <https://www.jscimedcentral.com/Behavior/Articles/behavior-2-1010.pdf>, had shown that the signal from the cell phones may not only confuse bees, but also cause their death. When researchers exposed bee hives to cell phone radiation, the bees occupying the hive simply choose to move away and never return. I concluded that this is exactly the behaviour that beekeepers worldwide call CCD, Colony Collapse Disorder, a phenomenon that involves an abrupt disappearance of bees from their hives. Many other studies have in addition shown that bees are affected by and react to radiofrequency radiation. Scientists opine that exposure disrupts the hive, interferes with navigation, weakens the immune system [also cf. Johansson 2009] and contributes to colony collapse [for references and further discussion, see Cammaerts 2017], so my idea above did find good ground for further exploration.

[Johansson O, “Disturbance of the immune system by electromagnetic fields – A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment”, Pathophysiology 2009a; 16: 157-177]

[Cammaerts M-C, “Is electromagnetism one of the causes of the CCD? A work plan for testing this hypothesis”, J Behav 2017; 2: 1-6]

French researchers, under the direction of Alain Vian at the Equipe de Recherche Transduction et Autosurveillance Cellulaire, Université Blaise Pascal in Aubière, have shown that even 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 in public interviews 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.

[Roux D, Vian A, Girard S, Bonnet P, Paladian F, Davies E, G Ledoigt, “High frequency (900 MHz) low amplitude (5 V/m) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato”, *Planta* 2008; 227: 883-891]

In a replication study, following the preliminary findings of five Danish schoolgirls (Lea Nielson, Mathilde Nielsen, Signe Nielsen, Sisse Coltau and Rikke Holm, at Hjallerup Skole, under the supervision of their biology teacher Mr. Kim Horsevad), professor Cammaerts and myself studied the effect of mobile phone base station signals on common *Brassicaceae Lepidium sativum* (cress d’Alinois) seed germination [Cammaerts & Johansson 2015]. Under high levels of radiation (70-100 $\mu\text{W}/\text{m}^2 = 175 \text{ mV}/\text{m}$), the seeds never germinated. In fact, the first step of the seeds’ germination – the imbibitions of germinal cells – could not occur under radiation, while inside the humid compost such imbibitions occurred and roots slightly developed. When removed from the electromagnetic field, seeds germinated normally. The radiation was, thus, most likely the cause of the non-occurrence of the seeds’ imbibitions and germination.

[Cammaerts MC, Johansson O, “Effect of man-made electromagnetic fields on common *Brassicaceae Lepidium sativum* (cress d’Alinois) seed germination: a preliminary replication study”, *Phyton, International Journal of Experimental Botany* 2015; 84: 132-137]

In summary, if you are an ant, tomato plant, frog, chicken, mouse, or any of the above animals and plants, you better not buy and use a cell phone or a WiFi router. Rather leave them to the humans, eh...? And with the enormous reductions of bird and pollinating insect species reported world-wide the last two decades it is fair to ask “Is the constant and seriously severe bombardment from various artificial EMF sources a culprit in this?”

(As pointed out many times, and most recently by Dr. Vibeke Frøkjær Jensen in her elegant address to members of the Danish Parliament, at "The 5G Conference" on the 4th of May, 2019, in Christiansborg in Copenhagen, the current and previous roll-outs of blanketing telecom systems may stand in opposition to The Aarhus Convention, The Habitat and Bird Directives, The Biodiversity Convention, The Bonn Convention, The Bern Convention, and The Precautionary Principle. In addition, I wonder if consumers are aware that the mass culling of healthy trees all over the world is reported to be related to the fact that trees, their foliage and especially wet foliage, can absorb and therefore impede, the propagation of 5G, the new generation of wireless technology? This untested, new technology – together with previous versions – not only may threaten the life and health of our trees, plants, animals and wildlife, but also ourselves. I say these roll-outs may entirely stand in opposition to life on this planet. So by acting to protect our wonderful trees from harm, we may also safeguard ourselves, our children and the wellbeing of future generations. I very much hope that our elected representatives will be successful in educating the public on this issue. If not, then our civil servants and politicians either must step down, or come up with the proofs of safety that at least the American FCC and FDA do not yet have. But since many politicians are less familiar with genuine truth and complete honesty, there is still hope.

One very interesting political move is the one recently launched by the Croatian political party "Human Shield" ("Živi zid") which for the first time has transformed many of the elephants in the room into adult action.

At their conference, "Telecommunication infrastructure and its impact on environment and health", in Zagreb, Croatia, May 19, 2019, they presented a programme to be aimed at both their national political arena as well as to the European Parliament. In it they have actions aiming at educating the general public about adverse health effects of artificial electromagnetic fields, such as from cell phones, antennas and WiFi routers, and with special focus on children and adolescents, as well as working for much tighter zoning regulations and laws. With politicians such as Ms Maja Očko Šunjić and Mr. Ivan Vilibor Sinčić at the helm, they may become one of the most important condensation points for establishing genuine facts and consecutive solutions during the coming years. The European Parliament needs such politicians who have the strength, courage, and commitment to stand up against lobbying and corporate interests in order to protect public and wildlife health. The way may look long, and we did not choose to follow it because *it is easy but because it is hard*, but thanks to this political initiative it can be shortened.

I have, personally, always in my own adulthood pointed to that human development must sometimes mean taking steps backwards. I am glad that more and more people

now realize the same, and for instance the fashion giant “Gant” has recently released a documentary on YouTube called “Flipping the ladder” asking “*What if the next step in your career isn’t up?*”. One can also ask “*What if the next step in your career isn’t destroying the future of yet an animal or plant species?*”, but instead to try to solve one of the above-mentioned problems.

Scientists’ – including my own – wishes for practical solutions now begin to carry fruit, including this new Swedish mobile phone case/shell (patent pending) that reduces radiation by up to 99.9%, global.rpofsweden.com, without interfering with the functionality or battery time. The measurements of the case have been done completely independently by Danish (EKTOS A/S, Copenhagen) and Finnish (Verkotan OY, Oulu) authorized and accredited laboratories, with myself as an independent and unpaid observer.

Very likely, this is not the final and only answer to the question “How can one protect oneself?”, but it may definitely be worth trying the case/shell. To do nothing is – at least – definitely a way that will not yield any protection, especially not with the oncoming increase of radiation via 5G, IoT, 6G, and similar installations.

To further speed up the process of developing tomorrow’s green, human- and environmentally-friendly technology I hereby again suggest – as an innovative first policy proposal – one way to achieve safety would be a governmental tax on current electronic and electrical products so that independent research can be properly performed.

I have said and written, over and over again, that we can immediately cross out the idea that these techniques and gadgets would be safe, since 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”). *So Senator Blumenthal’s, Rep. DeFazio’s and my questions above are particularly relevant from this point of view.* The question now is instead how big the risk is and what we accept the risk to cost us as a society outside of the insurance and telecom companies’ realms. Instead of avoiding the issue, it’s high time to be completely outspoken, blunt, even to the point of rudeness.

I so much hope my own government, it’s departments and agencies, institutions, press and academics have the back-bone to stand up and to call things by their proper names without any ‘beating about the bush’. To guarantee our and the Planet’s health this is the only way forward. I say loudly: *call a spade a spade, and a risk a risk, and*

a future cost a cost, please! Allow the citizens, with full information at hand, to make an informed choice before it is too late for any lessons!

I summarize again: Do not believe that mobile phones, tablets and Wi-Fi are safe; they are not! (And, as you now know, the major 'players' in our society already know it.) These gadgets and their highly artificial electromagnetic fields interfere with normal brain function, learning and memory, fertility, cancer risks and have been shown to shatter the DNA in cells. They do not go well with bacteria, plants or other animals, quite far from it. All of this can be found in peer-reviewed scientific journals but, until now, has not been in the public domain.

The body of evidence on health and biological effects of artificial electromagnetic fields requires a new approach to protection of public and wildlife health; the growth and development of the fetus, and of children; and argues for strong preventative actions. These conclusions are built upon prior scientific and public health reports documenting the following:

- 1) Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.
- 2) ICNIRP and IEEE/FCC public exposure recommendations are inadequate and obsolete with respect to prolonged, low-intensity (non-thermal) exposures.
- 3) New, biologically-based public exposure standards are urgently needed to protect public health and wildlife world-wide.
- 4) It is not in the public, nor in the animals', plants' or bacterias', interest to wait.

There is an urgent need for completely independent research projects to be inaugurated immediately to ensure our public health, as well as the safety and future of other animals, plants and bacteria. These projects must be entirely independent of all types of commercial interests; public health and the future of wildlife can not have a price-tag! It is also of paramount importance that scientists involved in such projects must be free of any carrier considerations and that the funding needed is covered to 100%, not 99% or less. This is the clear responsibility of the democratically elected body of every country to do good, rather than to do well. As already said above, as an innovative first policy proposal, one way to achieve this would be a governmental tax on electronic and electrical products so that independent research can be done on their safety. — But what does your “democratically elected body” choose to do?

So we can conclude that various gadgets are sold to us under the notion they are “safe”, in spite of the fact no one knows they are. — We can also conclude it is safe not to ask too many questions otherwise we run the risk of finding out that actually all these gadgets come with risks that are not commonly known, but firmly acted upon by for instance the world’s insurance and reinsurance companies, the telecom manufacturers and the WHO. They have their own ‘precautionary principle’ meaning “rather economically safe than legally sorry!” — Finally, for many scientists it has not been safe to try to investigate the adverse health effects of these gadgets since it means quickly losing their funding, their positions and gravely endangering their personal reputation. Personally, I find it appalling and alarming that we allow our mental fire brigade soldiers to be slandered, ridiculed, defamed and publically smeared, and having their personal health and family situation ruined, for just doing their job, *i.e.* what the general public expects from them. *I say: shame on you who orchestrated such attacks, I find them disgusting and infantile. I say: we must have a completely new adult society, proudly wearing our stripped yellow-black vests to honour Mr. and Mrs. Bee. I say: Go vest, go vest!*



European honey bee – Photo: John Severns, Wikimedia Commons

*Senator Richard Blumenthal summarized “I believe the American people deserve to know what the health effects are...We are flying blind here on health and safety”.
...A few bees and other insects are still flying. But for how long...?*

Will it end with a thousand “G” for a few, but with no bee for the rest of us?

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