

The Influence of Electromagnetic (EM) Radiation on Biological Systems and Humans

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In 2019 and 2020, dissatisfaction with the announcement of the increasing installation of 5G mobile networks has been spreading on the Internet. Although 5G networks bring undoubted technological advances in multiple Internet acceleration and accompanying real-time automation and robotization (so-called Internet of Things), there are also strong resistances to the spread of 5G networks due to potential health problems and observed environmental effects on flora and fauna. Despite this, hundreds of Musk satellites have already been launched to cover 5G internet satellite communications on the entire planet, and it is planned to launch thousands of such satellites in the next few years.

At the beginning of the covid 19 pandemic, a 10-minute video has appeared on the Internet, quickly becoming viral, but it has been soon removed from social networks, not to spread rumors about the additional harmful effects of 5G networks on people in the era of the covid 19 pandemic. But, there can be a grain of truth in the whole story, because the human organism is extremely sensitive to non-thermal electromagnetic radiation of very low intensity. In 2016, my BSc graduate student wrote a diploma thesis *On biological influences of RF and MT of non-ionizing radiation*, with an excellent review of reference literature in that field [1], and last year we published two papers based on it [2,3].

Certainly of special concern are the potential health effects on the human population. For several decades, I have been researching the nature of psychosomatic diseases based on an imbalance in the activity of the acupuncture system, which is resonantly sensitive in the microwave range between 50 and 80 GHz. Restoring the disturbed acupuncture system to balance is the essence of the so-called microwave resonance therapies (MRT) discovered in the late 1980s and applied in accordance with the knowledge of Traditional Chinese Medicine. Soon afterwards, intensive multidisciplinary research has indicated that the acupuncture system behaves like a macroquantum system, which led to the emergence of Quantum Medicine, which has been then often called Information Medicine or Quantum Information Medicine due to its informational specifics [4].

Research in previous decades indicates an important *epigenetic role of stress* (including the so-called EM smog from a number of electrical devices in a wider EM range) in the development of a number of psychosomatic disorders. Therefore, a correct and comprehensive discussion is needed about the non-thermal effects of EM radiation in all bands (from ULF through RF / MW), which is opposed by powerful electrical and telecommunications lobbies. They are guided by radiation protection standards that are

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based solely on thermal influences. But there is a major impact on psychosomatic health of very low intensity of non-thermal radiation, so the efforts of mobile device manufacturers are in vain because the acupuncture system is extremely sensitive to very low radiation intensities through a system of non-threshold gap junction (GJ) electrical synapses that permeate the acupuncture system (as well as heart muscle, liver, smooth muscles, and neurons with electrical synapses) [4,5].

There are also *viral videos* that show how in the focus of the directional microwave field of three mobile phones (of even lower 3G or 4G generation) you can cook an egg or fry popcorn, and one can imagine what it happens to the brains of people who hold a mobile phone near their head during a conversation, or what will happen by using the phones of the future 5G and higher generations.

On biological influences and risks of RF / MW non-ionizing radiations

The biological effect is a change in the biological system that (i) can be measured and that (ii) occurs after a stimulus. The biological effect indicates the existence of sensitivity of the biological system to the appropriate stimulus. It is clear that a biological effect does not necessarily indicate the existence of a biological or health risk, for example if the change in the system is temporary, or if it has positive consequences. But if it is permanent, or if such changes often follow one another, then that effect should certainly be well studied.

It has long been thought that the only effect produced by RF / MW non-ionizing radiation is thermal. However, it turns out that there are effects that are not thermal, that require lower field intensities and that are far more significant than thermal because they are potentially very dangerous [4,5]. But major world organizations continue to deny the non-thermal effects and base their radiation protection recommendations on the thermal effect.

Thermal effects

A well-studied biological effect of RF / MW non-ionizing radiation is the heating, in which any dielectric material, including biological tissues, is heated by oscillations of polar molecules, which are induced by the EM field. When a person uses a phone, this thermal effect is most noticeable on the surface of the head, increasing the temperature by a small part of the degree. This increase in temperature is an order of magnitude smaller than the increase in direct sunlight. The human cerebral bloodstream is able to cope with excess heat by increasing blood flow. Exposure to higher RF / MW radiation can lead to tissue damage [6].

According to this principle, i.e. the biological effect, the recommended limits of human exposure have been formed, issued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which has published recommendations for exposure to non-ionizing radiation up to 300 GHz [7]. These recommendations are based on many years of evaluation of scientific reports. Only the thermal effect was taken into account for their formation, and the existence of non-thermal effects was denied. Restrictions are divided into two groups: (i) Basic Constraints and (ii) Reference Levels.

Basic restrictions depend on the frequency of EM radiation and between 100 kHz and 10 GHz are expressed via the quantity of SAR (Specific Absorption Rate, per unit mass in the prescribed time interval, with a temperature increase of more than 1°C), in order to protect the whole body, or local tissue or body parts.

Reference levels are used for practical assessment of exposure and maintaining it within the recommended limits. They are obtained from the basic limitations of mathematical modeling and on the basis of laboratory measurements, being expressed in measurable or reference values.

Non-thermal effects

Non-thermal effects are biological effects that occur at low intensities, i.e. field strengths, which cannot cause a thermal effect and which are sometimes significantly below the recommended exposure limits.

HSP proteins

Some scientists even claim that non-thermal effects are actually basically thermal. Thus, it was pointed out in [8] that there are several thermoreceptor molecules in cells and that they activate a cascade of other systems, mechanisms of genome expression; and production of heat shock proteins (hereinafter HSP) in order to protect cells from metabolic cellular stress produced by heating. They say that the increases in temperature are too small to be detected by the measuring instrumentation used in the research.

On the contrary, the authors in [9] showed that the effects related to HSP proteins are not a consequence of thermal effects, i.e. heating. They used a 900 MHz GSM mobile phone, whose radiation caused a temporary increase in Hsp27 protein activity. According to their conclusions, the activation of HSP proteins can lead to the development of cancer in the brain and to an increase in the permeability of the blood-brain barrier (BBB). Furthermore, if these events were repeated over a longer period, there could be an accumulation of brain tissue damage. They add that other factors that lead to brain tissue damage may be involved in the effects caused by cell phone radiation.

The authors in [10] developed a theoretical mechanism by which RF / MW radiation from mobile phones could cause cancer, through chronic activation of heat shock responses. Ascending regulation of HSP proteins is a normal defense response to cellular stress. However, chronic HSP protein expression is known to induce or promote oncogenesis, metastasis, or resistance to cancer drugs. They suggest that repeated exposure to mobile phone radiation (and certainly other sources of MW radiation) act as repetitive stress leading to continuous expression of HSP proteins in exposed cells and tissues, which affect their normal regulation and can lead to cancer. This hypothesis provides the possibility of a direct link between RF / MW radiation (and other ubiquitous digital radio technologies) and cancer.

Genetic effects

Many studies have shown that RF / MW radiation causes a change in gene and protein expression in certain cells at intensities that are less than the recommended limits. The study [11] reviewed 114 scientific papers dealing with the genetic effects of RF / MW non-ionizing radiation, published during 2007-2014. In the analysis of these works, it was shown that 74 (65%) of them showed biological effects, while the remaining did not. This study also analyzes 59 papers dealing with ELF radiation.

Several papers have implied the participation of free radicals in the genetic effects of RF radiation [12-14]. Increased free radical activity and changes in enzymes involved in cellular oxidative processes are the most consistent effects observed in human and animal cells after exposure to RF radiation. Many biological effects of EM fields can be explained by intracellular changes in oxidative status, including genetic effects [11].

The effects of RF and ELF radiation have been shown to be very similar. The explanation of similar genetic effects of these radiations, whose energies are many times different, is given in an interesting paper *DNA is a fractal antenna in electromagnetic fields* by M. Blank, R. Goodman, [15] and lies in the fact that DNA behaves like a fractal antenna. As the authors of that paper state in their conclusion, "a wide frequency range of interactions with EM radiation is a functional characteristic of fractal antennas, and DNA appears to possess two structural characteristics of fractal antennas, electrical conductivity and self-similarity." This property of DNA could explain the basic mechanism of its interaction with EM radiation, which is present at all radiation frequencies.

Two important findings in studies are that the effects of EM radiation depend on the waveform and cell type. In [14] it was shown that increased free radical activity and DNA fragmentation in rat brain glial astrocytes occur at 20 minutes of exposure to 50 Hz amplitude-modulated 900 MHz RF radiation, while this effect does not occur in unmodulated waves. The authors in [16] found that rat neurons are more sensitive than astrocytes, and showed that the gene expression of rat neurons changes under the influence of 1800 MHz RF radiation modulated with 217 Hz, which is common in mobile phones.

The authors in [17,18] showed that the non-thermal effects of MW radiation of mobile phones below the recommended limits depends on several physical and biological parameters. Frequency-dependent effects of GSM mobile phone on reparative 53BP1 / γ H2AX proteins and chromatin conformations in human lymphocytes were observed. They showed that the radiation of a UMTS mobile phone causes significant negative effects in human lymphocytes similar to the effects of a GSM phone and heat shock. Unlike GSM phones, UMTS emits MW radiation from a wider frequency window and can hypothetically cause greater biological effects due to the more "effective" frequencies.

UMTS MW radiation has been shown to affect chromatin and prevent the formation and localization of 53BP1 / γ H2AX proteins in the focus of double-stranded DNA breaks in human lymphocytes and have confirmed the dependence of the effects on frequency. What is particularly interesting is that the effects on 53BP1 / γ H2AX proteins lasted for 72 hrs after cell irradiation, even longer than the stress response to heat shock. This long-lasting effect on these important human cells of the immune system can represent a strong link between health hazards and mobile phones.

Reproductive disorders

The study [11] states that there are several studies that show that RF radiation has negative effects on reproduction, especially on the physiology of sperm and germ cell DNA. And a review of BioInitiative 2012 [19,20] summarized the evidence regarding infertility and problems with reproductive potential. Most evidence comes from human and animal tests on sperm and male fertility. Mobile phone radiation damages human sperm with very low power densities (in the range 0.00034 - 0.07 μ W/cm²). Exposure levels are similar to levels as a consequence of carrying a mobile phone in a trouser pocket, or from using a laptop in your lap. The authors state that sperm do not have the ability to repair DNA due to the structure of the protein [19,20].

Several studies have shown negative effects on sperm quality, motility and DNA damage in men who use mobile phones and especially in those who carry mobile phones, PDAs or pagers on their belt or in their pants pocket [12,13,21-23]. There are fewer animal studies that have looked at the effects of cell phone radiation on female fertility parameters. In [24], reduced ovarian development and size, premature cell death of ovarian follicles and ovarian-feeding cells in wine flies (*Drosophila melanogaster*) were obtained. In that paper, it is also shown that the reproductive capacity is much more weakened by modulated radiation compared to unmodulated.

The authors in [25] showed that exposure of mice to "standby" levels of RF radiation (mobile phone is turned on but does not transmit telephone conversation) caused a significant reduction in the number of egg follicles in pups, and also a significant reduction in the number of pups born in these conditions. And in [26], irreversible infertility of mice was shown after five generations exposed to RF / MW radiation. Mice were exposed to a baseline radiation level of less than one microwatt per square centimeter (< 1 μ W/cm²).

Neurological effects

There are many published papers dealing with the influence of RF / MW non-ionizing radiation on brain electrical activity (EEG), as well as on human sleep. Here are some of the ones that have noticed the

effects. There are also a large number of works in which no effect has been noticed. In [27], the influence of GSM mobile phone on the central nervous system (CNS) and evoked potentials (ERP) was noticed. The authors in [28] noticed changes in alpha waves in the EEG when subjects were exposed to mobile phone radiation. And in [29], similar effects of 2G and 3G mobile devices on EEG were observed.

There are several papers that have noted the effects of RF / MW radiation on sleep. In [30] it was observed that pulsed-modulated 900 MHz radiation increases the low-wave activity of the brain towards the end of sleep, negatively affecting the quality of sleep. And [31] confirms that mobile phone radiation affects EEG signals during non-REM sleep phases, and that this effect depends on the individual personality. In a study [32] using fluorodeoxyglucose and positron emission tomography, it was shown that exposure to MW radiation of the parts of the brain closest to the antenna when talking on the phone leads to an increase in glucose metabolism in them.

Electromagnetic hypersensitivity & sleep

In everyday life we are exposed to increased levels of combined static, ELF and RF / MW non-ionizing radiation. All these fields together form one colorful EM field, which is popularly called EM smog.

EM hypersensitivity (EHS) is the sensitivity of people to EM non-ionizing radiation. A large number of people report health problems attributing them to EM radiation. These people show various symptoms that, as they attribute them, occur during conversations on mobile phones, or even home cordless phones, or near mobile phone base stations, when using laptops or computers, near WiFi transmitters, in transportation, in a car, or when using household appliances [33,34]. The symptoms that occur are subjective and most often occur more than once at a time. Some of the main symptoms are: sleep disorders, headaches, nervousness, fatigue, problems with concentration and dizziness.

In a questionnaire conducted on general practitioners in Switzerland [35], 69% of them had EM radiation consultations, the average of about 3 consultations per year, and in 54% of cases the link between EM radiation and symptoms was considered probable. In another questionnaire conducted on physicians in Austria [36], only a third had never had such patients, and as many as 96% of physicians somewhat or completely believe that there is an impact of EM non-ionizing radiation on health. In Sweden, EHS is officially recognized as a functional disorder (not a disease), and surveys show that about 3% exhibit some of the symptoms when exposed to EM radiation, which implies that people with EHS should be provided with the opportunity to live and work in an environment with low EM radiation [37].

In [38] it was discovered that in EHS persons there is an increased concentration of mast cells in the skin, especially of the face. A higher number of mast cells may explain symptoms such as itching, pain, edema and erythema. In a study [39], clinical and biological 727 EHS and MCS self-reported cases were investigated. 521 were diagnosed with EHS, 52 with MCS and 154 with both EHS and MCS. Since inflammation is a key process that occurs in both EM radiation and chemical effects on tissue, and histamine is a major mediator in inflammation, they systematically measured histamine in patients' bloodstreams. Almost 40% had increased histaminemia. Oxidative stress is part of inflammation and plays a role in damage and response. Nitrotyrosine, the signal of peroxynitrite production (ONOO-) and BBB opening, was increased by 28%. Protein S100B which is also an indicator of BBB opening was increased by 15%.

Autoantibodies against O-myelin were detected in 23%, indicating that EHS and MCS could be associated with an autoimmune response. Hsp27 and / or Hsp70 were found in 33% of patients. Since most patients reported insomnia and fatigue as symptoms, they examined the ratio of 6-hydroxymelatonin sulfate and creatinine in urine within 24 hrs and found that it was reduced in all examined cases. Examination of blood flow in the brain revealed hypoperfusion around the thalamus (capsulothalamic), indicating that the inflammatory process involves the limbic system and the thalamus. Both disorders

have been shown to include hyperhystemiaemia, oxidative stress, autoimmune response, hypoperfusion in the capsulotalamic region, and BBB opening indicating chronic neurodegenerative disease. Analysis of the coincidence of EHS and MCS indicates a similar pathological mechanism.

Influences on cell biochemical processes

RF / MW non-ionizing EM radiation have been shown to affect biochemical processes in cells. It affects the GJ-channels by disrupting cell function. It has also been shown that RF / MW radiation affects and changes the concentration of ions in cells, especially calcium (Ca^{2+}). This section discusses the disturbing effects of RF / MW non-ionizing radiation on the organism at the cellular and molecular level, i.e. microscopic, which could lead to disorders and diseases of the organism, the so-called upward causation.

According to [40,41] the ELF component of the GSM signal affects the GJ-channels by inhibiting them and thereby disrupting the normal functioning of the cells. It was first shown [40] that ELF modulated RF / MW radiation affects the extraction of calcium from cells, at low power densities with a maximum at 0.6 - 1 mW / cm². Later on, GSM signals modulated with ELF with power densities of 0.06 - 0.436 mW / cm² were used [41]. Calcium excretion was increased due to radiation exposure and continued after radiation. Cell proliferation, DNA, RNA and protein synthesis are increased with ion concentrations in cells, especially calcium, and with cell membrane depolarization. It seems that the effects of the external EM field on ion concentrations are related to the interaction between the EM field and the ion channels of the membrane, which is manifested by improper operation, i.e. opening of these channels.

However, it is shown that EM RF / MW non-ionizing radiation in smaller doses and applied in a finer way can also have a positive impact on human health. The mechanisms and techniques based on this knowledge will be discussed in the next chapter, with the presented mechanism of RF / MW non-ionizing radiation on the global EM field of the human, which explains both positive and negative effects of this radiation on the human body through quantum holographic macroscopic downward causation (descending causality), with possible preventive bioresonant balancing effects on the organism exposed to the harmful effects of non-ionizing radiation.

On quantum-informational framework for psychosomatics

Contemporary medicine has put its emphasis on the *alopathic-dosed non-economic highly pharmaceutical-oriented* medicine technologies. On the contrary, in the past years more attention is payed to *bioadequate homeopathic-dosed economic bio-resonant quantum-informational medicine* technologies, related to usage of such values of the field energy, appearing in normal functioning of human organism. On these lines it has been appeared that stress-induced *psychosomatic diseases* imply the necessity of application of *holistic methods*, oriented to *healing the person as a whole* and not disease as a symptom of disorder of the whole, suggesting their *macroscopic quantum origin*. This has given rise to fast development of *integrative medicine* (cf. website of *The Academic Consortium for Integrative Medicine and Health*, founded by the end of 1990s, which includes over 70 highly esteemed US academic health centers and affiliate institutions [42]) and *transpersonal psychology* (cf. website of *The Association for Transpersonal Psychology*, founded by the beginning of 1970ies, and considered by A. Maslow as the fourth force in psychology, alongside with psychoanalysis, behaviorism, and humanistic psychology [43]).

Our previously developed generalized Hopfield-like neural macroscopic *quantum-holographic / quantum-gravitational* (QHQG) theoretical framework for psychosomatics provides fundamental holistic understanding of the nature of psychosomatic diseases as well as limitations of their prevention and healing methods. In the focus of these quantum-holistic methods are body's *acupuncture system and consciousness* – which (within the Feynman propagator version of quantum mechanics) have *quantum-informational structure of quantum-holographic Hopfield-like associative neural network* [44]. So, the *psychosomatic healthy state* appears to be the state of the *minimal entropy* (with single memory attractor),

while *psychosomatic disordered state* is the state of the *increased entropy* (with more memory attractors); then, application of some *psychosomatic therapy* naturally *decreases entropy* (degradation) i.e. *increases information* (organization) of the psychosomatic system [45]!

In the context of *acupuncture-based and consciousness-based approaches and techniques* [46] of *quantum-informational medicine*, their goal would be a bio-resonant excitation of the EM MW / ULF-modulated or RF / LF-modulated psychosomatically disordered state (acupuncture palpatory-painful or psychologically traumatic, as one of hundreds of possible disordered states) thus enabling that its initial memory attractor is bio-resonantly excited (similar to an annealing procedure in artificial neural networks [47]) becoming more shallower and wider on account of the deepening of the (energy-dominating) attractor of healthy (acupuncture palpatory painless or psychologically traumatic-free) state. Thus, all these acupuncture-based and consciousness-based holistic approaches and techniques might be considered as *quantum-informational therapies*, via *imposing new boundary conditions in the energy-state space of the acupuncture system / consciousness*.

However, when this process is hindered by *transpersonally entangled blockages* in the EM field-related energy-state space of the acupuncture system / consciousness – then memory attractors of a quantum-holographic network of field-related *collective consciousness* should be removed as well (via *prayer* or *circular (psycho / energy) therapies* from all relevant meta-positions included in the problem [48], thus providing *spiritual integration of personality* which *initiates the process of permanent healing* as suggested by experiences of clients in *post-hypnotic regressions* [49]). These transpersonal holistic procedures, alongside with working on all levels of *EM bio-resonant (MW / ULF-modulated or RF / LF-modulated) therapies* and *non-circular (psycho / energy) therapies* [45,46], might be the holistic clue for imposing healing boundary conditions in the energy-state space of the acupuncture system / consciousness of the patients.

The mentioned QHQG theoretical framework implies that quantum-holographic hierarchical parts carry information on wholeness, enabling subtle *quantum-holographic fractal coupling* between various hierarchical biophysical levels – including numerous acupuncture projection zones and corresponding organs and cells, with underlying *macroscopic quantum-informational control mechanisms of embryogenesis / ontogenesis and morphogenesis* and their backward epigenetic influence on the *expression of genes*, starting from the first fertilized cell division which initializes differentiation of the acupuncture system of non-threshold GJ-synapses [44].

The above problem is of fundamentally-theoretical physical significance, as it tackles the question of the *universality of quantum mechanics*, i.e. the question of general validity of the quantum-physical laws for *macroscopic phenomena* as well, mostly treated by the methods of classical physics. Although this question was raised in the early phase of the founding of quantum-mechanical theory (and temporarily put aside for very different reasons, being considered as a difficult scientific problem), in this respect the situation is not much better today, and it can be said freely that the problem of the universal validity of quantum mechanics is still open [50-52].

On this line, it should be pointed out that Sit'ko with co-authors have revealed *necessary and sufficient conditions* for existence of *macroscopic selfconsistent potentials* alongside acupuncture meridians, with EM MW *eigenfrequencies* of healthy and disordered states of the *acupuncture system* [53], pointing out that living systems are the fourth level of the quantum ladder of Nature (nuclear-atomic-molecular-biological), governed by specific macroscopic quantum laws of the *Physics of the Alive*. Further on, Sit'ko and co-authors have conducted EM MW measurements via specially designed radiometric system, which enabled obtaining of the following *important characteristics of the acupuncture channels and points* [54]: *channels* have diameter of 3÷5 mm in their surface exits in the acupuncture points; *refraction index* within channels is $n = 1$ as in the air, while being 5÷6 in the body outside channels.

Exotic aspect of acupuncture channels (of strange vacuum-like $n = 1$ refractive index) may be a relic of the external inflow of vital energy / prana / chi / uncreated light / Whole-Self Radiance (via miniature quantum-gravitational tunnels stabilized by exotic nature of vital energy as the quantum vacuum fluctuations in these tunnels [44,48,50]), indicating that this type of exotic transpersonal communications provides continuously-refreshing interaction between two mentally-addressed persons and thereby transpersonal stabilize quantum-entanglement of their acupuncture systems / consciousnesses, i.e. prevents decoherence of their macroscopic quantum-entangled states by interaction with their local bodily environments (in contrast to the situation in the microworld where there are no such stabilizing mental-transpersonal addressing exotic effects, and hence laboratory formed quantum-entangled particle-pairs must be well isolated from the environment in order to prevent their quantum-decoherence).

Discussion & conclusion

Digital communication technologies are increasingly evolving and becoming more widely used, especially new generations of mobile phones and local wireless networks. The effects of these new technologies, more precisely the EM MW radiation on the human body, have been studied a lot in recent times. Current science is not yet able to fully explain them and observe their ultimate dangers, but some worrying effects have been revealed in this paper that could directly endanger human life or affect offspring.

The potentially high-risk effects of EM MW non-ionizing radiation require additional experimental and theoretical research, and it is necessary to determine whether they are really that dangerous, when appropriate measures should be taken. Until everything related to EM MW is not deeply understood, it is necessary to be more careful in handling the devices that emit them and to avoid unnecessary exposure, with additional prevention methods suggested in this paper.

It is very intriguing that quantum-information balancing of disturbed psychosomatics can become very topical in the context of emerging new 5G mobile technologies, whose projected range (24-90 GHz) in full development will overlap with the frequency range of the acupuncture system (50-80 GHz), where bio-resonant deviations of only a few GHz on different acupuncture meridians are the cause of numerous psychosomatic diseases [53]. Along this line, applying *holistic anti-stress* recommendations for *regular balancing* of the acupuncture system / (individual and collective) consciousness can become significant for *improving psychosomatic status of the general population*.

So, we warmly recommend a simple 4-minute exercise from the group of *meridian EFT-like tapping practices of TaiChi-balancing* acupuncture meridians, which should be practiced daily instead of physical exercise [55]. Also, the author himself emphasizes daily *Jesus' prayer*, supplemented by *Bruno Grening's teachings & Hooponopono practice*, with harmonizing transpersonal effects on the collective consciousness as well [56]. Additionally, balancing of consciousness / bio-energy achievable through the *Whole-Self Radiance Relaxation Exercise* discovered and developed by Jon RG & Troya GN Turner is warmly recommended. [57]. All these preventive practices are very easy to adapt.

On the other hand, concerning ecological damage, if humans are not ready do so, we hope that evolution will make sure that species adapt to the new conditions of EM MW smog on the planet to which they are extremely sensitive through a system of non-threshold electrical GJ-synapses, as the oldest form of intercellular communication.

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