

**PARLIAMENTARY OFFICE FOR EVALUATION OF  
SCIENTIFIC AND TECHNOLOGICAL ALTERNATIVES**

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Senators Jean-Louis LORRAIN and Daniel RAOUL*

**ARGUMENTS IN FAVOR OF APPLYING THE  
PRECAUTIONARY PRINCIPLE TO COUNTER THE EFFECTS OF  
MOBILE PHONE BASE STATIONS**

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**I – INTRODUCTION.**

To allow for the correct functioning of the millions of mobile cellular telephones, thousands of mobile telephone base stations have been sited in Europe and throughout the entire world. In the preponderant digital technology currently on the market, high frequencies (or microwaves - MW) pulsed with extremely low frequencies (ELFs) are utilized. These high frequencies operate in the 900 MegaHertz (MHz) range for the GSM system (Global System for Mobile Communication) and in the 1800 MHz range for the DCS system (Digital Cellular System)<sup>(1)</sup>. Let us note here that these 2 frequency ranges are very close to that of the domestic microwave oven which functions at 2450 MHz.

**Of particular note:**

- The text that follows does not pretend to be exhaustive concerning the numerous scientific studies that report the existence of biological effects relating to exposure to microwaves.
- Neither does it tackle the problem of the biological effects of the extremely low frequencies that are present in mobile telephone signals.

While for the users of mobile cellular telephones the MW exposure is in the “near field”, for the populations living in the vicinity of base stations this exposure is in the “far field”.<sup>(2)</sup>

During the “far field” exposure, different factors are liable to modify the level of exposure for the neighboring populations and in particular:

- The distance from the emitting source: at several meters from a base station, one can measure high frequency power densities of several tens of microwatts per

- centimeter squared ( $\mu\text{W}/\text{cm}^2$ ) through  $10\mu\text{W}/\text{cm}^2$  (6.1 volts per meter – V/m) at 50 meters<sup>(3)</sup>.
- The fact of whether or not one falls within the principal high frequency lobe situated in front of emitting antennas: this principal lobe carries electromagnetic energy stronger than that of the secondary lobes found on the sides of and behind the antennas.
  - The presence of “passive reflectors” in the form of metallic structures (window shutters, garage doors, flights of stairs, etc.) capable of amplifying high frequencies.<sup>(4)</sup>
  - Fluctuations in the strength of the signals emitted by base stations as a function of the number of telephone calls being handled by them.
  - The presence of other electromagnetic sources in the environment (power lines, electrical transformers, household electrical equipment, etc.) that can interfere with high frequencies from base stations.<sup>(5)</sup>

Measurement of electromagnetic fields in the environment of base stations at any given moment appears insufficient to accurately describe the level of chronic exposure to high frequency radiation for neighboring inhabitants. One key factor is that the number of antennas present and operating at a given site varies over the course of time according to the needs of different operators.

## **II. WHY SHOULD THE PRECAUTIONARY PRINCIPLE BE APPLIED TO COUNTER THE EFFECTS OF BASE STATIONS?**

Several arguments can be advanced and are developed hereafter:

- Microwave effects have been known and referenced for more than 40 years.
- Exposure to a mobile cellular telephone generates biological effects.
- Biological effects are reported among people living in the vicinity of base stations and TV and radio transmitters.
- Certain countries have already adopted for their populations exposure limits lower than the currently accepted limits (in France).
- Sensitivity to high frequencies is not the same for all.

### **1. Microwave effects are known and have been referenced for more than 40 years.**

Chronic exposure to microwaves is responsible for, among other things, the appearance of “microwave syndrome” and augments the risk of cancer.

**1-1) “Microwave syndrome”**, also called radiofrequency sickness, has been described since the 1960’s by researchers in Eastern countries<sup>(6)</sup>. One recent publication<sup>(7)</sup> clarifies that this pathology is tied to chronic exposure to pulsed high frequencies, similar to those generated by mobile cellular phone technology.

It is characterized by:

- A debility syndrome (fatigue, irritability, nausea, headaches, anorexia, depression).
- A cardiovascular dysfunction syndrome (bradycardia, tachycardia, hypertension or low blood pressure).
- A brain dysfunction syndrome (drowsiness, insomnia, concentration difficulties). Chronic exposure is also associated with dermatological problems (skin allergies, eczema, psoriasis), changes in blood chemistry, disruption of electroencephalograms and reproduction, effects on sense organs, and tumors.

### **1-2) Carcinogenic risk:**

- From 1953 to 1976 the personnel of the American Embassy in Moscow were subjected to a chronic irradiation from microwaves at a mean power density of 1 to 2.4 uW/cm<sup>2</sup> (1.9 to 3V/m), with maxima of short durations of 5 to 18 uW/cm<sup>2</sup> (4.3 to 8.2 V/m) and with frequencies varying from 600 MHz to 9.5 GHz. One study of these personnel evidences an increased risk of leukemia and of uterine cancer<sup>(8)</sup>.
- A study of 9,590 Canadian telecommunications workers underscores a significant increase in the number of melanomas when compared to the general population<sup>(9)</sup>.
- A survey conducted by the American army on 880,000 persons exposed to microwaves reports a significant increase in the risk of brain tumors<sup>(10)</sup>.
- The effects of chronic exposure of Polish servicemen to ultra-short waves associated with microwaves (frequencies from 150 to 3,500 MHz) have been studied for 20 years on approximately 120,000 persons. The results obtained show significant increases in the risk of cancers of the blood, esophagus, stomach, colon, skin (melanoma) and brain, for a microwave exposure not exceeding 200 uW/cm<sup>2</sup> (27.4 V/m)<sup>(11)</sup>.

## **2. Exposure to a mobile cellular telephone generates biological effects.**

**2-1)** A Swedish-Norwegian epidemiological study of 11,000 mobile cellular telephone users gives evidence to a relationship between the exposure (number and duration of phone calls) and the increase in complaints such as headaches, fatigue, feeling of warmth on the ear<sup>(12)</sup>, etc.

**2-2)** A French study of mobile phone users reports a significant rise in the frequency of complaints during the phone call such as tingling in the ear, feeling of discomfort, and warmth of the ear. These symptoms relate to duration of the call (> 2 min) and the number of calls per day (>2). This study also gives evidence to a greater sensitivity for women to sleep disturbances when compared to men. For the authors the feeling of warmth of the ear represents an alert that should bring about the termination of the phone call<sup>(13,14,15)</sup>.

**2-3)** Other significant effects were observed during experiments conducted on human volunteers, in particular:

- Disruption of cerebral electrical activity<sup>(16)</sup>.
- Changes in sleep<sup>(17)</sup>.
- Effects on arterial pressure<sup>(18)</sup>.

- Increase in headaches<sup>(19)</sup>, etc.

#### **2-4) Cancer risks.**

- **In animals:**

A significant rise in the risk of lymphoma following exposure to a GSM-type signal was observed in mice<sup>(20)</sup>.

- **In man:**

- Several publications find no association between mobile phone usage and the risk of cerebral tumors<sup>(21-22-23)</sup>. To the contrary, one study evidences a significant rise in the risk of cerebral tumor linked to mobile phone usage (Relative risk = 2.6. Confidence interval = 1.02 – 6.71)<sup>(24)</sup>.
- Concerning the eye, one study shows a significant rise (Relative risk = 4.2, Confidence interval = 1.2 – 14.5) in the risk of uveal melanoma in relation to “probable/certain” use of a cellular mobile phone<sup>(25)</sup>.

#### **2-5) COMOBIO Report** (Communications Mobiles et Biologie: - Program financed by the Ministries of Research and of Industry).

In rats exposed to GSM-type electromagnetic waves generated by a mobile phone, the COMOBIO Report (Internet site: <http://www.sig.enst.fr/comobio>) underscores:

- Disturbances to the Blood-Brain Barrier ( permeability of the intracranial blood vessels) which could be, according to the authors, at the origin of localized inflammatory processes responsible for the development of migraine headaches in susceptible people.
- A rise in the number of astrocytes (brain cells) translating to a inflammation that could be the sign, according to the authors, of neuron injury.
- Modifications in the quantity and/or the affinity for their receptors of essential brain neurotransmitters (GABA, Dopamine, Glutamate).

#### **Of particular note:**

- The COMOBIO study results confirm the known microwave effects on the Blood-Brain barrier, neurotransmitters, and cerebral receptors in various animal species<sup>(1)</sup>.
- GABA is the brain’s principal inhibitor neurotransmitter. Its decrease is the origin of diseases such as epilepsy. It is equally implicated in neurological diseases such as Parkinson’s Disease and Huntington’s Disease.
- Variations in the concentration of Dopamine in the brain are responsible for pathologies such as Parkinson’s Disease and schizophrenia.
- Glutamate is the brain’s principal exciter neurotransmitter. Its increase can lead to mood changes (irritability, aggression, etc.). It is equally involved in neurological diseases like Parkinson’s Disease.

### **3. Biological effects are reported by persons living in the vicinity of mobile phone base stations and radio/television transmitters.**

#### **3-1) Persons in the vicinity of base stations.**

According to an Australian government report<sup>(26)</sup>, persons exposed in their homes at 200 meters from a base station complain of symptoms that recall those described in radiofrequency sickness: chronic fatigue, multiple allergies, sleep disturbances, and premature menopause.

The only study that currently exists is French and concerns 530 persons living in the vicinity of base stations<sup>(27,28)</sup>. In comparison with the reference group (persons situated at > 300 m or not exposed to base stations), it gives evidence of a significant rise in the frequency of certain complaints at a distance of:

- 100 m for irritability, depressive tendencies, memory loss, concentration difficulties, vertigo.
- 200 m for headaches, sleep disturbances, feelings of discomfort, skin problems
- 300 m for fatigue

### **3-2) Persons living in the vicinity of radio/television transmitters**

Radio/television transmitters generate electromagnetic waves that are essentially ultra short (VHF) and/or high frequencies. Studies concerning these types of transmitters demonstrate biological effects at weak and very weak power densities:

- In mice, after 5 successive generations, exposure to an ultra short-wave transmitter (80 MHz) and a high frequency transmitter (900 MHz) and at a power density of 168 to 1.053 nanoWatts per centimeter squared (nW/cm<sup>2</sup> – 0.8 to 1.98 V/m) brings about a lowering of fertility and a general impairment of the physiological state<sup>(29)</sup>.
- In adults exposed within a radius of 2 km to radio (30 MHz)- and television (1 GHz) transmitters at power densities of 1.3 uW/cm<sup>2</sup> (2.2V/m) for television and 5.7 uW/cm<sup>2</sup> (4.6 V/m) for radio, a significant rise in the risk of leukemia and bladder cancer is observed.<sup>(30)</sup>
- In children exposed within a radius of 12 km to television relay transmitters at ultra short waves (63 to 215 MHz) at power densities from 0.02 to 8 uW/cm<sup>2</sup> (0.07 to 5.4 V/m), a significant rise in cases of leukemia and deaths from leukemia is reported<sup>(31)</sup>.
- In children exposed to ultra short (154 to 162 MHz) waves pulsed at 24.4 Hz from a radio transmitter at power densities of 0.3 to 1.64 uW/cm<sup>2</sup> (1.06 to 7.8 V/m) when compared to children who were not exposed or were living behind the transmitter, these effects were demonstrated:
  - Reduction in memory and attention
  - Reduction in motor function
  - Slowing of reflexes<sup>(32)</sup>.
- A study conducted around a radio transmitter in Rome gives evidence of a significant rise in mortality from leukemia for persons living within a 3.5 km radius (Relative risk = 2.5, Confidence interval = 1.07 to 4.83) and a significant lowering of risk with distance away from the transmitter<sup>(33)</sup>.

### **4. Some countries have already adopted lower exposure limits for their populations than those currently allowed (in France).**

In a 1998 order (decree) Italy adopted an exposure limit of 10 uW/cm<sup>2</sup> (6.1 V/m) in place of 450 and 900 uW/cm<sup>2</sup> (41 and 58 V/m) currently allowed in European regulations for the frequencies of 900 and 1800 MHz respectively<sup>(34)</sup>. In December 2000, The Grand Duchy of Luxembourg adopted an exposure limit of 3 V/m<sup>(35)</sup>. In Austria, the Salzburg Resolution recommends 0.6 V/m<sup>(36)</sup>.

**Of particular note:**

- Mayors of French towns have taken actions to prohibit the siting of mobile phone base stations at distances less than 300 m from residences.
- In Belgium in a decision of March 6, 2000, the National Assembly prohibited the siting of a base station antenna by applying the precautionary principle in making mention of the reasonable question of risk for the health the people living nearby.

**5. Sensitivity to high frequencies is not the same for all.**

In 1995 the French Air Force conducted an epidemiological study in which 30 % of the personnel presented with a non-specific neurovegetative syndrome and 10% presented with authenticated clinical signs. Following this study, the National Institute of Research and Safety (INRS) concluded that: *“These exists indisputably an individual sensitivity the the effects of radiofrequencies. Undergoing the same exposure, certain individuals can present with clinical disturbances and others not.”*<sup>(37)</sup>

According to the International Radiation Protection Association (IRPA), this individual sensitivity to radiofrequencies would have a genetic basis<sup>(4)</sup>.

Recent results underscore a greater sensitivity in women to electromagnetic waves generated by mobile phones<sup>(14,15)</sup> or by a mobile phone base station<sup>(28)</sup> when compared to men. It is equally apparent that children are more vulnerable than adults due to their developing nervous systems and a more intense absorption of electromagnetic energy by their tissues<sup>(2)</sup>.

**III – CONCLUSION.**

With regard to the preceding, it is advisable from now on to apply the precautionary principle to counter the effects of mobile phone base stations. Some measures should be put into effect rapidly so as to protect the populations living in the vicinity of base stations. In accordance with the precautionary principle, base stations will not be sited at less than 300 meters from populated places. Antennas will be carefully orientated so that the principal high frequency radiation lobe is not directed toward places (daycare centers, schools, hospitals, and senior citizen centers, etc.) where people are found who are susceptible to being more sensitive to electromagnetic nuisances. This prudent avoidance measure must be applied equally to residential areas reached by microwave beams since certain of their occupants can be “electrosensitive.”

Regular measurement of high frequency power densities must be made at different times of day and various times of the year. In base station environments, those living in the vicinity should not be exposed to an average annual power density above 0.1 uW/cm<sup>2</sup> (0.61 V/m). Zones where residents' exposure to high frequencies is above this

amount should be clearly marked (signs at ground level, signs with a signaling system, etc.)<sup>(1)</sup>

A medical follow-up for base station maintenance workers (blood analyses, baseline EEG's and ECG's) is imperative. No base station work site should be entered until the transmitting equipment has been deactivated. For other categories of workers who work in proximity to base stations (elevator maintenance, ventilation maintenance, etc.) it is advisable to post visible warnings about the biological risks and safe distances to respect in relation to base stations.

New microwave frequencies are being developed for mobile telephones. Those very close to microwave oven frequencies (UMTS system in the 2 to 3 GHz range) will contribute, with the buildout of new telecommunications networks (local radio loops, Hertzian bridges, etc.), to the growth of non-ionizing radiation exposure to populations.

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