

# Does radio frequency electromagnetic radiation (EMR) cause cancer?

**There is still no hard evidence that low level EMR is dangerous to our health.**

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**D**oes non-ionizing radio radiation cause cancer? This issue has recently risen to the headlines in Israel following a series of three articles in a daily Israeli paper. These articles contained many imprecisions and misconceptions. I do not intend to argue with the contents of these articles, but to present the view of the scientific community on this question. The journalist interviewed civilians and veteran soldiers who unfortunately were ill with cancer. Some interviewees suggested that during their military service (over a course of several years), they were unwittingly exposed to a level of radio radiation higher than is permitted, and that several years after their discharge, or sometimes during their service, they were diagnosed with cancer. A physician who was interviewed for one of the articles about the alleged dangers of cellular phone radiation, said that his wife had died of a virulent blood cancer and that he felt her disease had been caused by her exposure to the radiation from a cellular base station located 20 meters from his house which had been active for six years. As to the question of why only his wife came down with cancer while he, his children, and his neighbors are still thankfully healthy, he

replied that his wife might have had a weaker immune system. This claim, which suggests that some of the population are more vulnerable than others, has not yet been proven. The common opinion in the scientific community is that radio radiation does not cause cancer or encourage the development of malignancies. The physician's claims of his late wife's increased vulnerability to the radiation of the cellular base station did not arise subsequent to profound scientific inquiry into the etiology of the illness, but from a natural, understandable human urge to implicate a "culprit"—the antennas of the base station, perceived to be an environmental hazard. This trend toward emotionally-based "blame" is clearly dangerous, as the implication of a certain cause, not thoroughly investigated, as being responsible for causing the illness could lead to failure to investigate other environmental hazards such as radon gas emission from the ground, the presence of carcinogenic pollutants in the air, food, water, ground, etc. Failure to identify the real environmental threat and to bring about its removal might eventually cause illness in other individuals exposed to the still undefined threat.

Those same articles quote Dr. Eliahu Richter, director of the unit for occupational and environmental health in Hebrew University, Jerusalem. Dr.

Richter stated that there was a direct causative link between EM radiation and malignant tumors discovered years after exposure. Dr. Richter also stated that the accepted general public safety standard—ICNIRP, established by the World Health Organization (WHO) overlooks athermal phenomena and, in fact, does not guarantee that after exposure to low intensity radiation, no biological processes could occur that might produce malignancies. Dr. Richter takes advantage of every opportunity to repeat the known cliché: *"Better safe than sorry."* Can anyone argue with this adage? It is obviously true, but is it applicable? We will return to this question at the end of this paper.

What, then, is the opinion of the scientific community on this subject? Is it possible to determine, based on the knowledge collected over the past 60 years, that there is a connection between exposure to non-ionizing radio frequency (RF) radiation and malignancy? Can it be determined with full certainty that there is no connection between malignancy and exposure to RF radiation? These and other questions were addressed in the Second International Conference on "Bioelectromagnetics."<sup>1</sup> This multi-participant conference was held in Bologna, Italy, in June 1997. Dr. Alex Wilenski, electronics engineer in Haifa's Rambam Medical Center directs medical equipment maintenance in the medical center. He reported on "Facts and opinions from the Bioelectromagnetics Conference" in Bologna. That same year (March 1997), a panel of experts convened in Ireland to address the examination of the scientific basis of papers related to malignancy and non-ionizing radiation exposure. After eight months of work, the Irish expert panel published its findings in a report.<sup>2</sup> This paper presents the essentials of that report. I will attempt to answer the question at the head of this paper based on the

variety of opinions from the forum lectures and other professional lectures as they were publicized in the Bologna conference and summarized by Dr. Wilenski—and based on the findings of the Irish team and two excellent retrospective reviews published by IEEE Spectrum<sup>3</sup> and Radiation Research<sup>4</sup> journals.

### THE BIOELECTROMAGNETICS CONFERENCE IN BOLOGNA, ITALY

Bologna is the hometown of Luigi Galvani and Guglielmo Marconi—familiar names connected to the subject of the conference. There was much symbolism in holding the conference in Bologna, hometown of the inventor of the radio. The conference was organized by well-known international agencies such as the IEEE—Institute of Electrical and Electronics Engineers, URSI—European Union of Radio Science, the International Association of Bioelectromagnetics, the Association for Physical Standardization in Biology and Medicine, and the European Bioelectromagnetics Organization. The conference lasted one week and included 13 forum lectures by prominent researchers in the fields of biology, biophysics, and biochemistry who specialized in the subject of the conference. In addition, 300 different lectures were given, and 300 research posters were presented.

### SUBJECTS DISCUSSED AT THE BOLOGNA 97 CONFERENCE

The subjects discussed at the conference comprised three major areas:

- Basic research into electricity and electromagnetics in biology
- Biological effects and hazards from radiation fields originating in systems used in daily life, such as communications, industry, and medicine
- The use of knowledge in bioelectromagnetics for medical and advanced biological objectives.

Dozens of lectures were given on the subject of radio radiation hazards to humans. The conference dealt with different fields related to the issue of radio radiation hazards. One of the issues frequently discussed was assessment of the intensity of the radiation field around cellular telephone antennas and the spatial heating in the human head while using a telephone. The experts' views are presented below:

- Examination of biological effects on a cellular level using knowledge from physics and chemistry.
- Laboratory experiments in cell cultures
- Laboratory experiments in animals
- Measurement of radio energy absorption in phantoms of the human head (with regard to cellular telephones)
- Development of technical measures for creating uniform, precisely measurable EM fields
- Development of mathematical models for calculating the intensity of the radiation field within the body, especially in the human head
- Findings of epidemiological studies (looking for a statistical relationship between morbidity and exposure to EM fields)
- International regulation and legislation. Harmonization of various standards for preventing conflicts between international regulation and local regulations which still differ from country to country.

### SO WHAT IS NEW?

No new scientific evidence has been introduced that might dispute the consensus accepted by all standards: specifically, deleterious effects are the result of tissue heating due to RF radiation energy absorption. All current standards limit exposure to a radiation level that prevents temperature elevation in living tissues. The standards establish safety margins base on a

whole body specific absorption rate (SAR) of electromagnetic energy that causes hyperthermic effects. In radiation levels exceeding the standards' limitations by several magnitudes, a significant thermal effect results that may elevate the temperature of the body core by over 1° C. It was noted that all standards add a safety coefficient of one order of magnitude or more. Therefore, the maximum possible temperature elevation under the limitations of the standards is so small that it cannot be measured using accepted scientific instruments. Most of the participants rejected the possibility of the following biological effects in radiation levels below the permissible exposure limits in the standards:

- DNA fragmentation
- Mutagenic effects (genetic mutations)
- Effects of transduction and amplification (this refers to sensitivity to various signals rendered across the cell and their amplified transduction, ultimately affecting some cellular process)
- Changes in calcium transport into the cell
- Changes in the quantity and composition of lymphocytes
- No evidence was found that radio radiation could combine with other factors in initiating or promoting tumors or disease (*i.e.*, no synergistic effects were found).

As for the issue of personal cellular phones which do not constitute a source of high environmental radiation but which can create a local radiation source around the head—the common view is that these do not pose a threat. The strong cerebral blood flow can cool small loci very effectively. Even if there were a fear of a minute spatial temperature elevation in tenths of a degree (if there were no cerebral blood flow), this heat is immediately removed by the brain's circulation. J. E. Moulder

*et al.* concluded<sup>4</sup> that "... A weight-of-evidence evaluation indicates that the evidence for a causal association between exposure to RF radiation and cancer is weak. However, relevant data in some areas are sparse. In particular, the epidemiological evidence is limited; and there is little immediate prospect for improvement, since highly exposed populations are relatively small and assessment of exposure remains a serious problem." The review states also that "... It is often stated that the risks from exposure to RF radiation, even if real, are too low to be of significance to public health. However, if the cancer risks suggested by some of the studies were real, then RF radiation could conceivably be a significant envi-

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### **It is never possible to say that any human activity is entirely safe.**

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ronmental cause of cancer. If an exposure affects many people, and the outcome is extremely adverse (as cancer can be), even a small increase in incidence can be a serious risk to public health. On the other hand, a small increase in risk for a rare disease has little consequence for the general population, which faces much larger risks in everyday life."

#### **ARE MOBILE PHONES SAFE?**

This is the subtitle of a paper published recently in IEEE Spectrum.<sup>3</sup> An excerpt reads:

*"The epidemiological results, so far, are certainly inconsistent with any large increase in risk (a doubling or more) of brain cancer from use of cell phones. Nor do the animal studies show clear-cut carcinogenic effects. However, the epidemiological studies lack the sensitivity to detect small increases in risk, and the*

*relevance of animal studies to human health is uncertain—both familiar problems with carcinogen risk assessment.*

*"In a document posted on the Web in February 2000, the US Food and Drug Administration noted that 'There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a [health] risk to millions of users.'"*

So far, the biological effects have been mentioned, but not the possible illnesses resulting from exposure to radio radiation. It is important to understand that the biological effect can be very significant in terms of its relation to illness, but demonstrating it does not prove a connection between exposure to radiation and the illness. Even if some biological effect were found to be a result of exposure to low-level radiation (under regulatory limits), and even if it were known that such an effect has some connection to illness—its discovery would not prove that there is a connection between exposure and the disease (although this would certainly be enough to warrant suspicion, and such a connection would have to be investigated thoroughly!).

Another "tool" for direct examination of the effect of exposure on health is medical statistics. At this point, it should be made clear that the majority of experts agree that the trials conducted thus far to isolate a connection between diseases and exposure to low intensity RF radiation were faulty and, that, consequently, no conclusions could be drawn from them. One example of flawed research methodology and the sensation caused by the press over the findings of a study is Dr. M. H. Repacholi's paper described below.

On May 1997, a "scoop" was published that shook the world. Surfing the Internet, members of the press discovered a paper by an

Australian researcher, well-known in this field, Dr. Repacholi. The title of the paper was: "Lymphomas in Eu-Pim Transgenic Mice Exposed to Pulsed 900-MHz Electromagnetic Fields."

The study deals with the effect of radio frequency fields (900 MHz) on the development of lymphomas in special mice which, because of genetic manipulation, tend to develop lymphoma spontaneously. Essentially, this predisposition means that this strain of mice were all destined to become sick and to die of lymphoma, even without exposure to radio radiation. The media report referred to normal mice and completely disregarded the paper's title that clearly indicates the use of special mice. Anyone who read the item in the print or electronic media would conclude that the findings are valid for "regular" mice, made sick by radio radiation. Far-reaching conclusions were drawn from this paper regarding the exposure of humans to radio radiation. Eventually, Dr. Repacholi himself discounted the study's findings and the statement that it might prove a connection between the exposure of transgenic laboratory mice to radiation and mortality caused by malignancy. Dr. Repacholi admitted that his research suffered from various shortcomings and technical errors and that its findings carried no scientific value. This story is one more example of many papers which reported sensational findings which later turned out to be devoid of scientific value. An essential for research with scientific merit is the ability to duplicate the results of a controlled experiment carried out under similar conditions. As stated above, many studies that have presented sensational findings could not be duplicated under similar conditions.

## CONCLUSIONS OF THE IRISH SCIENTIST TEAM<sup>2</sup>

In March 1997, a team of four Irish scientists convened to examine the

scientific merit of the most prominent research papers conducted up to 1997, dealing with the danger of malignant morbidity following exposure to EM radiation (including radiation from cellular base stations). The team included the following experts: Dr. Michael Maher, director of the department of radiotherapy in Mater Hospital, Dublin; Dr. Anthony Staines, director of the public health department, College University, Dublin; Professor Philip Walton, experimental physicist, College University, Dublin; Dr. Maurice Hurley, oncologist and expert on radiotherapy, Cork College Hospital University, Dublin.

The team published its conclusions in a detailed, clear, and succinct report, a selected part of which is presented below.

*"... Three (epidemiological) studies which are particularly relevant into the risk of incurring any of the types of cancer known to be connected to exposure to radiation (this refers to ionizing radiation): lymphoma, leukemia, and cerebral malignancies, have recently been published."*

The Australian study by Hocking *et al.* (1996), and two linked studies by Dolek *et al.* (1997) from the UK examined the health of populations living close to high power television and FM radio broadcasting towers. Dolek *et al.* were asked to investigate reports of a cluster of cases of leukemia and lymphomas around a transmitter mast at Sutton Coldfield in Birmingham. A detailed investigation of the risk of leukemia around this mast led to the conclusion that there was an excess risk of developing leukemia in adults. There was no indication of an excess risk of brain tumors, and there was some evidence for an excess risk for melanoma of the skin, and of bladder cancer. All of these risks grew smaller, as distance from the transmitter increased.

Dolek *et al.* then argued, that these risks, if they were really due

to the health effects of TV transmitter masts, would also be found around other such masts; whereas if they were due to something else, which by coincidence alone was occurring in areas close to the Sutton Coldfield mast, then there would be no such effect around other transmitters. They repeated their study (Dolek *et al.*, 1997), and found no evidence of any health effect for bladder cancer, brain cancer or melanoma of the skin. For leukemia, they found an increased risk in those living within 10 km of the tower, but none for those living within 2 km of the tower. In addition, the increased risk was very small, being approximately 3%—risk increased by a factor of 1.03. If this increase were a real effect of electromagnetic waves from the transmitter, one would expect that the risk would be highest among those living nearest to the transmitter and that risk would be reduced among those living furthest away.

At this time, no complete reports of the results of any study of mobile telephone users are available. Rothman and colleagues are involved in an extensive study in the USA, and this is likely to be the first to report. The results of this study are not expected to be published for several years. On the basis of most papers published to date, including extensive epidemiological studies conducted so far (*e.g.*, Robinette & Silverman, 1977), it can already be surmised that in the epidemiological study currently being conducted, the answer will be negative. Namely, a near zero probability for a connection between exposure to RF radiation from cellular telephones and malignancy.

On the subject of exposure to RF radiation from base stations, the Irish researchers concluded:

*"... It is never possible to say that any human activity is entirely safe. It can never be said that a mobile transmitter or a base station or anything else, is entirely safe, but*

*what can be said with confidence is that there is no evidence at present of any increased risk of cancer due to RF from operation of these base stations."*

## CONCLUSIONS

It seems that no expert among the attendees of the Bologna-97 conference can point with certainty to any case of damage to a person's health due to exposure to radiation at a level that does not cause tissue hyperthermia. The Irish expert panel determined in its conclusions that no proof had been found of an increased risk of incurring cancer subsequent to exposure to microwave radiation. Dr. A. Wilenski noted that these statements were made after over a hundred years of using radio technology and extensive exposure of humans to RF radiation over long periods of time.

When we examine the perception of the risk of radio radiation among the public in Israel and the world, we find fear and apprehension over the overt presence of any antenna. The public, concerned over health issues, feeds off sensationalized articles on the deleterious effects of radiation in the print and electronic media (e.g., the articles discussed above). Some people are convinced that any antenna is a cause of various illnesses and that the authorities are neglecting to regulate antenna construction by vested economic interests. Electrophobia<sup>5</sup> leads to a familiar ugly phenomenon; various "entrepreneurs exploit the public's fears and offer obviously unnecessary products and services, such as a cellular phone accessories that supposedly offer protection from radiation, services measuring radiation leakage from domestic microwave ovens, computer VDU, etc.

The media covers the controversy, and in the name of the public's "right to know" provides a stream of controversial information,

to say the least, despite and contrary to, the scientific consensus accepted worldwide. Following heavy public pressure on decision makers in industrialized countries, gargantuan budgets have been allocated to scientific studies with certain results—there is no proven connection between low intensity radiation and malignancies or illnesses in general. Assuming that these studies will continue over the next few years, their funding expenditures may well amount to billions of dollars. The assessment is that up to 1995, a sum of 23 billion US dollars was spent on scientific studies on these subjects and their offshoots. The common assessment today is that by 2010, more such large budgets will be spent, reaching a total of a trillion (1000 billion) US dollars. One can imagine the benefit to mankind if these budgets were channeled to medical research of unquestioned objective importance, such as finding a cure for AIDS, Alzheimer's, Parkinson's, hepatitis, various cardiac diseases, and other deadly diseases. There is no doubt that immense amounts allocated to research impact all consumers of wireless equipment. In short, the pressure groups raising an outcry over fear of radiation and its implications on our health are hurting themselves and other consumers of wireless technology services. Hefty price hikes result from the futile scientific studies. Dr. A. Wilenski adds: *"Instead of the heavy cost of measuring temperature elevations in the magnitude of a hundredth of a degree in the brain of a mouse exposed to cellular telephone radiation, resources could have been allocated to promising important studies that are of real value for mankind."* The question at the beginning of this paper leads to another important query: in the next millennium, and in light of the existing base of information, will we be able to view the subject of human expo-

sure to non-ionizing radio radiation with the proper perspective?

Is Dr. Richter's advice, *"Better safe than sorry,"* applicable to the issue of potential morbidity subsequent to exposure to low level radiation? This author believes that the scientific evidence collected to date (only a small part of which is presented here) leads to the opposite conclusion. It is more likely that we will regret (in the future) having been too cautious and having imposed unnecessary restrictions on the use of wireless technology that hindered the optimal use of this technology for the benefit of the individual and the community. We will surely lament having wasted huge budgets on scientific studies that result in only marginal benefit.

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