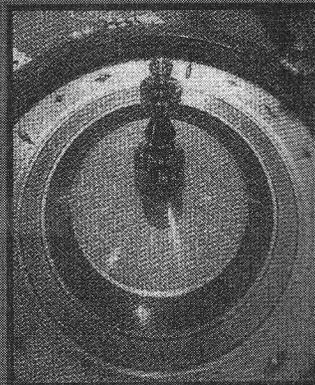
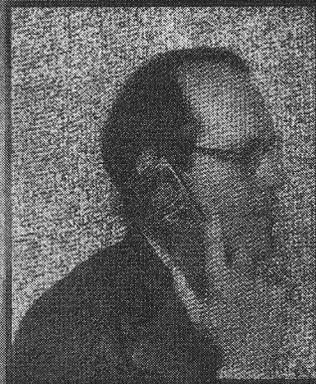


"You pick up the phone once, twice, ten times a day — or only a few times a month. But, each and every time, you're gambling that 'this time' won't be the occasion when the radiation causes irreparable damage to your brain. It only takes a seemingly small trauma at a very small location to result in tissue damage, DNA damage, or chromosome mutations."

# CELLULAR TELEPHONE RUSSIAN ROULETTE

A HISTORICAL AND SCIENTIFIC PERSPECTIVE

ROBERT C. KANE



Excerpts from the book:

"[A] repeated insult or irritation to a particular biological area, such as a small region of the brain, can lead to irreparable damage. [G]iven the existence of energy absorption "hot spots" . . . each damaging exposure to radiofrequency radiation provides a new opportunity that the damage will become permanent."

"[W]e can expect that no warning of brain tissue destruction would be provided to a cellular telephone user until the damage was so extensive that the scalp, which absorbs very little energy, sensed heating."

"Every action which occurs within that individual's life during that next week will be affected by the EEG modifications resulting from the portable cellular telephone call."

"[E]arlier, researchers have consistently reported that transmitting antennas could not be operated close to the human body—the human head—without violating the safe exposure limits."

"[T]he shape of the skull, thickness of sub-cutaneous fat, muscle layering, and how an individual holds a portable cellular telephone each contributes to make the energy absorption different from one individual to another. The important common factor, however, is that all individuals will absorb a large portion of the radiation."

"Today we know that even a single exposure to low level radiofrequency radiation causes damage to the DNA makeup of brain cells."

# **Cellular Telephone Russian Roulette**

*A Historical and Scientific  
Perspective*

Robert C. Kane

**VANTAGE PRESS  
New York**

FIRST EDITION

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## **About the Author**

Robert C. Kane has been actively employed in the telecommunications industry for more than thirty years . He holds a BSEE from the Midwest College of Engineering, an MSEE with an emphasis in electromagnetics from the Illinois Institute of Technology and also at the Illinois Institute of Technology, has completed the full course of study and research leading to the Ph.D. in electrical engineering with emphasis in the fields of electromagnetics and solid-state physics. As a research scientist and product design engineer, he has been directly involved with programs and projects for the design and development of portable cell phones, radio frequency mobile radios, microwave telecommunications systems, video display systems, and biological effects research.

## Introduction

The EMF and radiofrequency radiation issues are receiving a great deal of attention as of late. Whenever that, attention focuses on radiation from hand-held portable transmitters it invariably includes recent research findings that support the position that there may be an increased risk of disease caused by operating these devices.

Most notably, the currently available books, and articles on the RF radiation issue give only slight consideration, if any at all, to the large body of research studies that establish the scientific foundation on which the current findings are based.

Typically, the most recent research study will be reported as a revelation to be investigated further while industry continues to treat each such study as if it were isolated in the scientific universe. By keeping the findings uncollected and the data dissembled the financially interested parties can continue business as usual. Business and usual amounts to utilizing their substantial resources to employ the various media to broadcast the industry "belief system." The "belief system" renounces or buries unfavorable scientific findings.

This monograph takes a bold step backward by providing a broad view of the scientific landscape that clearly advises us that there is danger here. The bold step back ward is a historical accounting of the research that is available, has been available for forty years or more, and

has been neglected or buried by an industry that will place its absolute need to sell products above the health and well-being of its own customers. The practice of producing such products can only be viewed as predatory.

Never in human history has there been such a practice as we now encounter with the marketing and distributing of products hostile to the human biological system by an industry with foreknowledge of those effects. Unlike the tobacco industry, which could claim ignorance for many decades after its product came into common use, the telecommunications industry has had access to this same scientific research base to which you will now be introduced.

In this work you will not find details of the most recent research findings of cancer causation or DNA damage. Those studies, each in its turn, have been well publicized and quickly forgotten as the industry "spin doctors" discounted the importance of each finding. Instead what you will find here is a commentary that presents a litany of past research studies, hundreds of research studies from the 1950s through the mid-1990s. But don't be misled. These older studies are equally alarming in their findings of radiation exposure, DNA damage, chromosome damage, tissue damage, radiation absorption, cataract formation, tumor formation, memory loss, motor skills degradation, and more. There are many more studies, hundreds that might have been added, but the point is well made by those that are cited without the need to bludgeon the reader with more than what has been presented.

# **Cellular Telephone Russian Roulette**

# 1

## The Foundations of Radiation Research

### 1

The earth and all living creatures on the land have evolved in an environment that has a low background level of radiofrequency radiation that occurs naturally.

The power density that radiates, close to the head of a user, from a portable 'cellular telephone is 2 billion times higher than that background level. More explicitly, a portable cellular telephone, held in the operating position, will provide a power density of radiofrequency radiation about 2 billion times greater than occurs naturally in the environment.

Since the portables are designed to be operated by being placed against the side of the user's head, a large part of the transmitter energy is radiated directly into that person's brain.

For communication purposes that absorbed energy is useless. But even more significant is that the absorbed energy acts within the brain to provide dangerous and damaging biological effects. One way to look at the portable cellular telephone is to visualize placing a miniature microwave oven directly against your head. The radiofrequency energy is absorbed into the head and brain and

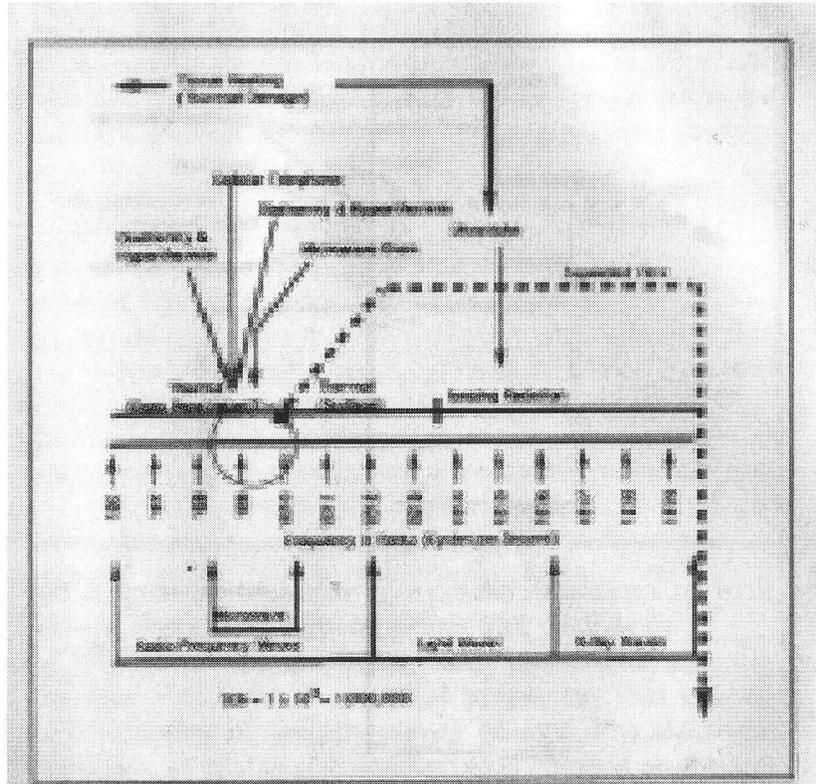
converted to heat. The small portable cellular telephones effectively deposit large amounts of energy into small areas of the user's head and brain. That energy will also reorient and displace the molecules of the brain and disrupt, the normal flow of ions through the membranes of brain cells.

In reality, microwave ovens are designed to be much less dangerous than portable cellular telephones. Microwave ovens are designed, and regulated by the EPA, to guard against any appreciable radiation outside of the unit.

Portable cellular telephones expose operators to levels of radiation that are much higher than the levels allowed for microwave ovens, and that radiation is focused directly into the brain of each and every user.

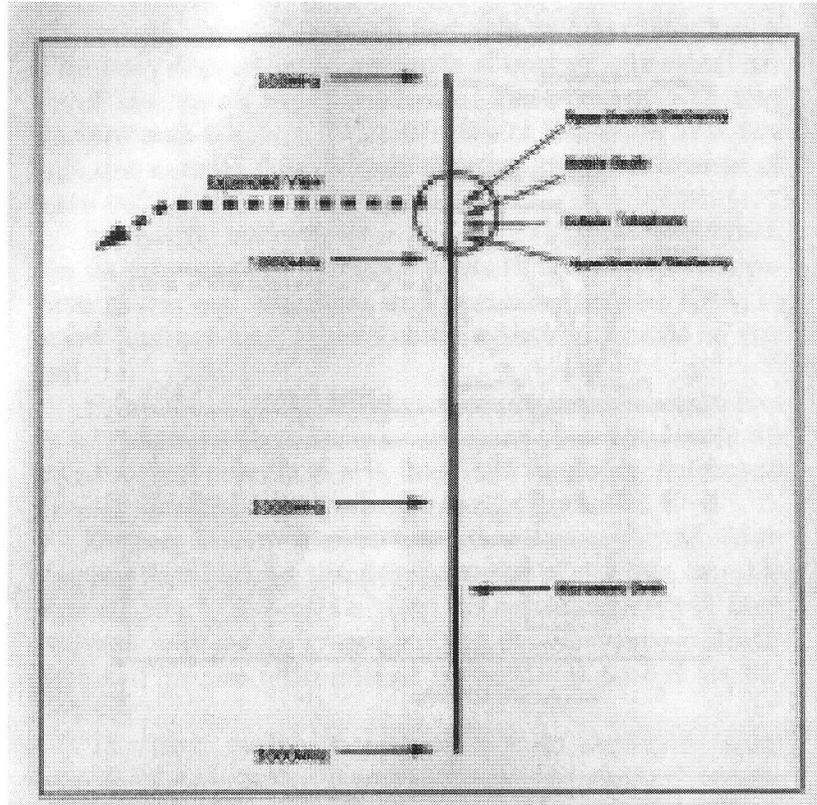
During World War II intensive research and engineering work led to the development of devices capable of producing high levels of electromagnetic energy at high frequency. The energy-generating devices were initially intended for use with critical radar development for the military.

The term radar is nothing but an acronym taken from Radio Detecting and Ranging. The radar frequencies are radio-frequencies. Some radar equipment operates in the same frequency range as does the cellular telephone, 800-900 MHz. Other radar systems operate at higher frequencies, around 2,000 MHz. In the early years of microwave ovens, they were commonly referred to as "radar ranges." There's nothing unique about radar; it's just another term for radiofrequency radiation. Along with the military applications of high-frequency energy generation for radar, research was initiated to investigate the prospects of utilizing the new energy source for medical applications.



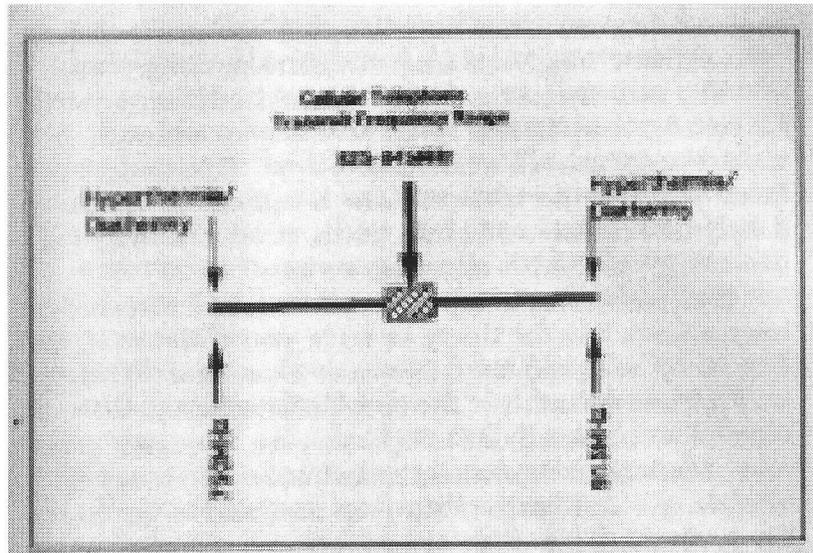
That work, although considered crude by today's standards and level of understanding, established a beginning point for research of the biological effects of radiofrequency (RF) and microwave radiation. The most significant facts learned in those early programs were that RF and microwave energy can be readily absorbed within the human body and that excessive energy absorption leads to tissue damage and death.

Considerable research has identified the radiofrequency (RF) energy that produces the most effective therapeutic results and, also, undesirable effects in people.



The frequencies from about 700 MHz to 1,000 MHz interact most efficiently with human tissue to yield the greatest energy absorption.

Notice that the frequency range of our interest, 750-950 MHz, occupies an infinitesimally small-portion of the electromagnetic spectrum. An even smaller portion of the spectrum is occupied by the portable cellular telephone transmit band, 825-45 MHz. It's a tiny sliver of the frequency spectrum in the very middle of the band



that is used for radiation absorption in connection with medical therapies—hyperthermia and diathermy.

Biological tissue — bone, fat, muscle, brain tissue - has well-defined electrical properties that control the absorption of radiofrequency energy. The electrical properties, or material characteristics, depend on the frequency of the electromagnetic energy. The properties at very low frequencies are much different from those at extremely high frequencies.

However, these material characteristics are virtually identical across the frequency range from 750 MHz to 950 MHz. That is, over the frequency range of 750 - 950 MHz the electrical properties of biological tissue do not change very much.

These energy absorption characteristics that make the 750 and 915 MHz frequencies so desirable for hyperthermia and diathermy treatments are also the very

same absorption characteristics that make the 825-45 MHz cellular telephone transmit band so dangerous. The radiofrequency radiation emitted from a portable cellular telephone is better able to heat and cook than is the energy used in a microwave oven. The energy radiating from the portable cellular telephone is deposited deeply into muscle and brain tissue more efficiently than the energy used with microwave ovens.

Manufacturers of microwave ovens, and researchers have known this for thirty or forty years. However, the frequency assigned to microwave oven manufacturers was the less desirable of the two. Unfortunately, for operators of portable cellular telephones, the frequency range most efficient at depositing radiofrequency energy deep into muscle and brain tissue was assigned to the portable products.

## 2

It has also been found that the electrical properties of various tissue layers may actually serve to increase the amount of radiofrequency energy absorbed within biological tissues such as muscle and brain.

### **Enormous variations in actually absorbed energy ... depend on the thickness of the subcutaneous fat layer. <sup>1</sup>**

The subcutaneous fat layer in humans lies beneath the skin and varies in thickness from one person to the

---

<sup>1</sup> H. P. Schwan and G. M. Piersol, "The Absorption [of Electromagnetic Energy in Body Tissues]," *International Review of Physical Medicine and Rehabilitation*, December 1954, pp. 371-404.

next. Certain thicknesses actually cause much more of the radiation to be absorbed deep within the body. The thickness of these layers, together with certain antenna distances, can establish what is known in the scientific community as a "matching" effect. Fat layers and bone may serve as matching layers to help with this enhanced absorption of energy. If fat and bone layers are about 1 cm in thickness it is possible to maximize the absorption so that nearly all of the radiation is absorbed into the brain or muscle.

Significantly, that early research pointed to the structure of the human head, brain tissue enclosed within bone and subcutaneous fat, as being most ideally suited to efficiently absorb radiofrequency energy.

The researchers confirmed experimentally the absorption depth, or penetration depth (depth at which energy level has dropped to 37 percent of the surface value), for muscle and brain tissue. As energy penetrates into biological tissue some of it is absorbed and the remainder moves deeper, something like a cup of hot coffee spilled onto a stack of napkins. As you look more deeply into the stack, less of the coffee has penetrated, until finally you come to a point where all of the coffee has been absorbed into the napkins above. So, too, with absorption of radiofrequency energy; from the point of energy deposition the intensity will decrease as one observes farther into the body. However, under some conditions energy will be focused directly into deep regions of the human brain. At 825-45 MHz, the radiating frequency range for the portable, the penetration depth into brain tissue is from 2 cm to 3.8 cm.<sup>2</sup>

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<sup>2</sup>C. Polk and E. Postow, eds., *CRC Handbook of Biological Effects of electromagnetic Fields*, CRC Press, (Boca Raton, FL: 1986).

Early experiments clearly show that the radiofrequency energy penetrates sufficiently deep within the biological tissue, such as a human brain, to provide a mechanism to effectively heat and in some cases overheat that tissue. According to the data of H. P. Schwan and G. M. Piersol, the radiofrequency radiation mostly passes through the surface layers of skin, fat, and bone and is absorbed within the underlying deeper tissue (brain tissue or muscle).

More recent work by N. Kuster<sup>3</sup>, O. Gandhi<sup>4,5</sup>, G. Lovisolo<sup>6</sup>, V. Hombach<sup>7</sup>, and others proves that a substantial amount of the radiofrequency radiation is deposited into the user's brain and converted to heat. These researchers have reported that from 50 percent to more than 90 percent of the radiofrequency energy is absorbed by the user instead of being transmitted into the atmosphere.

### 3

A unit of measure, called the Specific Absorption Rate (SAR)<sup>8</sup>, given in terms of Watts per Kilogram (W/Kg) or

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<sup>3</sup> N. Kuster, "Multiple Multipole Method for Simulating EM Problems Involving Biological Bodies," IEEE Transactions on Biomedical Engineering 40, no. 7 (July 1993), pp. 611-20.

<sup>4</sup> O. P. Gandhi, J. Y. Chen, and D. Wu, "Electromagnetic Absorption in the Human Head for Cellular Telephones," 16th Annual Bioelectromagnetics Society Conference, June 17, 1994, unpublished.

<sup>5</sup> O. P. Gandhi, "Electromagnetic Absorption in the Human Head and Neck for Cellular Telephones at 835MHz, revised," submitted to the U.S. Federal Communications Commission, August 1994.

<sup>6</sup> G. A. Lovisolo, "Hand-held Cellular Telephones: SAR Deposition in Phantoms," 16th Annual Bioelectromagnetics Society Conference, June 17, 1994.

<sup>7</sup> V. Hombach and H. Thielen, 16th Annual Bioelectromagnetics Society Conference, June 17, 1994.

<sup>8</sup> H. S. Ho and A. W. Guy, "Development of Dosimetry for RF and Microwave Radiation-II: Calculations of Absorbed Dose Distributions

milli—watts per gram (mW/g), provides more meaning and insight into experimental results. This measurement unit is particularly advantageous since absorption in biological bodies and specific organs is nonuniform and frequency-dependent. The SAR unit identifies the amount of power, in watts, that is absorbed in a gram of tissue.

A gram of tissue has a size of approximately a cube of one centimeter on a side or 0.4 inches on a side. Of course, a gram of tissue is not limited in shape, but for descriptive purposes it is instructive to visualize a cube.

Smaller volumes of tissue may also be considered when utilizing the SAR method, since it is a rate of depositing energy.

For example, if the energy absorbed in ten grams of tissue is measured the SAR is the average for each of the ten grams and if the energy deposited in 0.1 gram of tissue is used for the measurement the SAR is stated in terms of what the absorption would be if the rate were the same for ten of those 0.1 gram samples. The concept of SAR is a significant step forward, as it moves the discussion of safety or hazard to the place where the energy is absorbed - deep within the biological tissue. In the instance of portable cellular phones - within the brain.

Using the SAR (mW/g) lets the interested person, whether scientist, portable telephone user, or safety-conscious consumer, develop a clear visual picture of where the energy is deposited and how much is deposited. Use of the SAR, as a measure of absorbed energy, resulted in serious debate among researchers, since that meant the safety standards would need to be restated in terms of internal energy absorption in addition to power

density at the surface. That revision took place with the 1982 modifications to the IEEE/ANSI radiation exposure standard. But the portable cellular telephones were made exempt from any safety requirements—even for the SAR modification.

Experimental data show that energy absorption (SAR) within simulated brain material, at what would be the temporal lobe of the brain, is about 2.3 mW/g for a portable cellular telephone radiating 0.6 watts.<sup>9</sup> If it were not for the exemption that the industry promoted, the portables would be in violation of all accepted safety standards now in existence.

In another report of radiation penetration,<sup>10</sup> testing performed at 900 MHz and 0.6 watts output power provided averaged SAR levels of as much as 1.9 mW/g. This averaging, performed over ten grams of tissue, indicates that the peak energy absorption at local "hot spots" within that ten-gram volume was much higher than 1.9 mW/g. The researchers estimate that 72 percent of the radiated energy was absorbed by and "burnt off in the brain." Their choice of the phrase "burnt off in the brain" is very appropriate, as that is exactly what occurs. The radiofrequency energy is converted to heat, and the resulting heat, when sufficient, cooks the brain cells. But what is the significance of 2 mW/g, 3 mW/g, or 5 mW/g of absorption? Research results clearly show that such levels, measured in laboratory animals and models of humans, yield significant temperature rises

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<sup>9</sup> R. F. Cleveland and T. W. Athey, "Specific Absorption Rate (SAR) in Models of the Human Head Exposed to Hand-Held UHF Portable Radios," *Bioelectromagnetics*, 10, no. 2 (1989): pp. 173-86.

<sup>10</sup> G. A. Loxrisolo, et al., *Hand-Held Cellular Telephones: SAR Deposition in Phantoms*, 16th Annual Bioelectromagnetics Society Meeting, June 12-17, 1994, abstract book, p. 65.