

# Lecture 21

## Microwave radiation

### Science

- What is the difference between ionizing and non-ionizing radiation?
- How can non-ionizing radiation effect the body?
- Is ionizing radiation hazardous

### Microwave radiation after WWII

- important military technology
  - developed new generations of radar transmitters
  - were responsible for deployment
  - looked out after any possible health effects
- concern about health effects
  - reports of baldness and sterility in men
  - knew that it could heat and burn
  - also knew that had been used for therapy

### 1953, Navy conference

- difference between thermal and athermal?
- assume only effects can be thermal
- do estimates of thermal overload
- safety standard =  $10\text{mw}/\text{cm}^2$
- 1966, ANSI standard

### Philosophy of standards

- look for adverse effects
- link adverse effects of a specific cause, including levels of exposure
- build in a safety factor (usually 10) and set standard
- burden of proof is on the exposed, not those who are imposing the risk

### Military follow-up in the 1960s:

- continued studies
- some anomalies began to appear
  - reports that some people could hear radar
  - USSR set standard 1000x lower, at  $100\text{ microwatts}/\text{cm}^2$
  - Russians were bombarding the Embassy in Moscow with modulated microwave beams
- leads to public/private split
  - publicly, ANSI standard is “safe”
  - privately, athermal, low-level effects

### Secret experiments

- studies of radar crew on ships

- colony of monkeys and irradiated with Moscow Signal (Project Pandora)
- blood tests on Embassy employees

### **Emergence of public concern**

- Johnson, radiation protections, 1968
- 1968, Radiation Control act passed
- 1970, Occupational Safety and Health Act

### **Government failure to act:**

- BRH took immediate action
  - microwave oven standard, 1mw/cm at 5 cm.
- 1970 OSHA adopted ANSI standard
- 1975, OSHA's standard successfully challenged in court
- 1975-78, EPA failed to set a standard

### **Public problems**

- early 1970s, stories adverse effects of microwaves
  - NY Ophthalmologist, Milton Zaret, cataracts
  - stories about project Pandora began to appear
- February 1976 Moscow Signal story broke
- late 1976, Paul Brodeur's articles began to appear in New Yorker;
- 1977, published *The Zapping of America: Their Deadly Risk and the Cover-up*

### **Why did the microwaves become controversial?**

- Scientific ambiguity - there is no sure evidence to suggest safety or widespread hazards
- Vested interests
- Have failed to come up with a mechanism for dealing with science-values problems such as this

### **Since early 1980s, problem disappeared and reappeared**

- mid 1980s, microwaves replaced by more specific problems
- examples
  - electric power lines
  - cellular phones
  - VDTs
  - heating blankets

### **Microwave communication**

- uplink facilities vs. point to point communications
  - cellular phones
  - solar power satellites (SPS)
  - ELF, Extremely Long Frequency,

### **VDTs (video display terminals)**

- early 1980s, reports of health effects
  - spontaneous abortions, birth defects, teratogenic effects
- *Microwave News* and *VDT* news
- clusters:
  - 7/8, Ottawa Canada
  - 10/18 Toronto Canada
  - 7/13 Air Canada offices
  - 8/12, Dallas, TX
  - 10/15, Atlanta

### science

- 1 in 5 pregnancies ends on spontaneous abortion
- 1 in 100 births, serious birth defect
- 1,000,000s of women work with VDTs

### Follow-up studies

- measure radiation --> very low, below safety levels
- in vitro studies
  - 1982, Delgado reported teratogenic effects in chick embryos
  - 1986, Office of Naval Research, Project Henhouse
- in vivo experiments
  - retrospective studies

### Electric Power Lines

- early 1980s, emerge as a concern
  - rash of grass-roots organizations
  - power companies responded by doing scientific tests
- science:
  - microwaves, VDTs, etc. short waves, shorter than radio
  - electric 60 cycles/second
  - ELF, few cycles per second

### NAS/NRC report (1996)

- “No clear, convincing evidence exists to show that residential exposures to electric and magnetic fields (EMFs) are a threat to human health....”
- available: <http://www2.nas.edu/whatsnew/>
- reviewed more than 500 studies

### Current state of the debate:

- cell phones
- current and pending lawsuits

