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big TV transmitter, microwaves are clearly dangerous; they cause animal (including human) tissues to overheat and, in some cases, to develop tumors. But what about low-level exposure, such as the microwave bathing someone gets when he walks under overhead power lines, or cooks with a microwave oven? After 6,000 studies over 40 years, such exposure has not been *proved* to be risk-free. But while a few studies have found links to changes in the brain, blood, heart, and immune system, as well as to chromosome damage and cancer, most researchers have found no danger, observe Foster and Guy, biophysicists at the Universities of Pennsylvania and Washington.

Although physicians have used microwaves for heat therapy (i.e. diathermy) to loosen up stiff backs and to ease the pain of arthritis since the 1950s, they largely ignored the possible side effects. Then the U.S. military (particularly the Navy) began testing the biological effects of radar, invented during World War II. In 1953, a University of Pennsylvania researcher proposed a limit on human microwave exposure—a level one-tenth as intense as that of bright sunlight, or 100 watts per square meter of flesh; it was not until 1966 that Washington recognized this standard, on the recommendation of the American National Standards Institute (ANSI), a private advisory organization.

By 1982, better methods of measuring energy absorbed by the body prompted ANSI to set more precise limits for exposure to high-intensity sources such as large antennae and military radars. Determined by calculations involving such factors as the position of people relative to the microwave source, the new limits are intended to ensure an energy dose that heats the body more slowly than does moderate exercise.

Still, doubts about such "safe" limits persist. Some recent U.S. experiments have produced disturbing results. One study has suggested that the "microwave auditory effect" (the "clicks" that people sometimes hear when exposed to microwave pulses) is due to vibrations within the brain. Another investigation has raised the possibility that microwaves cause tumors in rats.

So far, however, neither recent federally funded research (\$10 million per annum) nor a review of the basic studies has convinced the authors that low-level microwave radiation will hurt anyone.

Zoning Out Ozone

"The Ozone Deadline" by Rochelle L. Stanfield, in *National Journal* (Sept. 13, 1986), 1730 M St. N.W., Washington, D.C. 20036.

It is just a colorless, odorless gas, and a natural one too. And in its proper place, the upper stratosphere, it is beneficial: Ozone shields the Earth's inhabitants from the sun's ultraviolet rays.

Environmentalists have long worried that the ozone layer aloft is being thinned out by certain gases used in aerosols drifting up from the ground. Now, observes Stanfield, a *National Journal* reporter, specialists at the U.S. Environmental Protection Agency (EPA) are concerned about *too much* ozone at the Earth's surface.

Ozone forms in the surface air when hydrocarbons (e.g., gasoline vapors and paint fumes) combine with nitrogen oxide spewed out of smoke-

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stacks and auto tail pipes; weather and other factors play roles that are not yet fully understood. What has become clear is that high concentrations of ozone can cause chest pains, eye problems, and headaches; prolonged exposure may permanently damage lung tissue. And plants, observes Stanfield, are at even greater risk than people. In studies on California's southern coast and in the San Bernardino Mountains, researchers have found that high ozone levels have reduced yields of tomatoes by 33 percent, beans by 26 percent, and tree growth by as much as 67 percent.

Surface ozone, in short, is more harmful than was thought when Congress passed the Clean Air Act of 1977, which mandates reducing the gas to a maximum level (0.12 parts per million parts of air) by December 31, 1987. But even that goal is distant: At least 73 U.S. regions, encompassing 80 million people, will probably miss the deadline. Los Angeles has levels triple the federal limit; in the New York City-Connecticut vicinity and in Houston, the levels are roughly double the maximum.

Although ozone's components have many sources, motor vehicles and industry generate more than 70 percent of the hydrocarbons, which makes them prime targets for regulation. But any fix will be expensive; thus the oil companies want Detroit to outfit its cars with vapor-capturing canisters (cost: \$30-\$150 each), and the automakers argue that all gas pumps should have fume-recovering hoses and nozzles, costing filling station operators \$12,000 to install and \$2,000 a year to maintain.

The Clean Air Act empowers the EPA to penalize areas that fail to meet the ozone limits with a cutoff of federal highway aid and a ban on construction projects. But Stanfield doubts that the EPA will take those tough steps, since some progress is evident. Nationally, ozone levels declined seven percent between 1979 and 1984.

ARTS & LETTERS

Explaining Hitchcock

"Personality, Pathology, and the Act of Creation: The Case of Alfred Hitchcock" by Stanton Peele, in *Biography* (No. 3, 1986), Dept. of English, Univ. of Hawaii, Honolulu, Hawaii 96822.

Gulls attack humans (*The Birds*, 1963); a mad motel-keeper stabs a woman in the shower (*Psycho*, 1960); a husband hurls his wife from a church belfry (*Vertigo*, 1958).

Such unsettling images, arising out of one man's bizarre imagination, made Alfred Hitchcock (1899-1980) the master of the macabre. The London-born director's gruesome style has also led some film critics to view his work as *pathological*. In *The Dark Side of Genius: The Life of Alfred Hitchcock* (1983), Donald Spoto went so far as to call this producer of 53 feature-length films a man gripped by misogyny, sadism, and fetishes concerning the bathroom and other matters involving the body and sex. "Hitch," born to poor Catholic Cockney parents, was seriously maladjusted, to the detriment of his art.