Microwaves Essay, Research Paper

Microwaves

You might remember the heroic role that newly-invented radar played in the Second World War. People hailed it then as "Our Miracle Ally". But even in its earliest years, as it was helping win the war, radar proved to be more than an expert enemy locator. Radar technicians, doodling away in their idle moments, found that they could focus a radar beam on a marshmallow and toast it. They also popped popcorn with it. Such was the beginning of microwave cooking. The very same energy that warned the British of the German Luftwaffe invasion and that policemen employ to pinch speeding motorists, is what many of us now have in our kitchens. It’s the same as what carries long distance phone calls and cablevision. Hitler’s army had its own version of radar, using radio waves. But the trouble with radio waves is that their long wavelength requires a large, cumbersome antenna to focus them into a narrow radar beam. The British showed that microwaves, with their short wavelength, could be focussed ina narrow beam with an antenna many times smaller. This enabled them to make more effective use of radar since an antenna could be carried on aircraft, ships and mobile ground stations. This characteristic of microwaves, the efficiency with which they are concentrated in a narrow beam, is one reason why they can be used in cooking. You can produce a high-powered microwave beam in a small oven, but you can’t do the same with radio waves, which are simply too long. Microwaves and their Use The idea of cooking with radiation may seem like a fairly new one, but in fact it reaches back thousands of years. Ever since mastering fire, man has cooked with infrared radiation, a close kin of the microwave. Infrared rays are what give you that warm glow when you put your hand near a room radiator or a hotplate or a campfire. Infrared rays, flowing from the sun and striking the atmosphere, make the Earth warm and habitable. In a conventional gas or electric oven, infrared waves pour off the hot elements or burners and are converted to heat when they strike air inside and the food. Microwaves and infrared rays are related in that both are forms of electromagnetic energy. Both consist of electric and magnetic fields that rise and fall like waves on an ocean. Silently, invisibly and at the speed of light, they travel through space and matter. There are many forms of electromagnetic energy (see diagram). Ordinary light from the sun is one, and the only one you can actually see. X-rays are another. Each kind, moving at a separate wavelength, has a unique effect on any matter it touches. When you lie out in the summer sun, for example, it’s the infrared rays that bring warmth, but ultraviolet radiation that tans your skin. If the Earth’s protective atmosphere weren’t there, intense cosmic radiation from space would kill you. So why do microwaves cook faster than infrared rays? Well, suppose you’re roasting a chicken in a radar range. What happens is that when you switch on the microwaves, they’re absorbed only by water molecules in the chicken. Water is what chemists call a polar molecule. It has a slightly positive charge at one end and a slightly negative charge at the opposite end. This peculiar orientation provides a sort of handle for the microwaves to grab onto. The microwaves agitate the water molecules billions of times a second, and this rapid movement generates heat and cooks the food. Since microwaves agitate only water molecules, they pass through all other molecules and penetrate deep into the chicken. They reach right inside the food. Ordinary ovens, by contrast, fail to have the same penetrating power because their infrared waves agitate all molecules. Most of the infarred radiation is spent heating the air inside the oven, and any remaining rays are absorbed by the outer layer of the chicken. Food cooks in an ordinary oven as the heat from the air and the outer layer of the food slowly seeps down to the inner layers. In short, oven microwaves cook the outside of the chicken at the same time as they cook the inside. Infrared energy cook from the outside in – a slower process. This explains why preheating is necessary in a conventional oven. The air inside must be lifted to a certain temperature by the infrared rays before it can heat the food properly.. It also explains why infrared ovens brown food and microwave ovens don’t. Bread turns crusty and chicken crispy in a infrared oven simply because their outside gets much hotter than their interior. Finally, as anyone who owns a microwave oven knows, you never put an empty container inside a radar range. Since nonpolar materials such as plastic and glass don’t warm up in the presence of microwaves, there will be nothing in the oven to absorb the radiation. Instead, it will bounce back and forth against the walls of the oven, creating an electrical arc that may burn a hole in the oven. This hushed energy, electromagnetic radiation, flows all around us. All forms of matter, even your own body, produce electromagnetism — microwaves, x-rays, untraviolet rays. It may interest you to know that whereas the human eye is sensitive to light radiation, the eye of the snake can sense infrared. Your body emits infrared radiation day and night, so snakes can see you even when you can’t see them. Though weak microwaves exist naturally, scientists didn’t invent devices that harnass them for useful purposes until the 1930s. In a radar range, the device from which microwaves emanate is a small vacuum tube, called a magnetron. A magnetron takes electrical energy from an ordinary household outlet and uses it to push electrons in its core so that they oscillate fast enough to give off microwaves. These are then relayed by a small antenna to a hollow tube, called a waveguide, which channels the microwaves to a fanlike stirrer that scatters them around the oven’s interior. They bounce off the oven walls and are absorbed by water molecules in the food. The U.S. Environmental Protection Agency estimates that our exposure to electromagnetic radiation increases by several percent a year. Look around you. The modern landscape fairly bristles with microwave dishes and antennae. Here again, in telecommuncations, it is the convenience with which microwaves can be focused in a narrow beam, that makes them so useful. Microwave dishes can be hundreds of times smaller than radio wave dishes. Industry employs microwaves heat in many ways — to dry paints, bond plywood, roast coffee beans, kill weeds and insects, and cure rubber. Microwaves trigger garage door openers and burglar alarms. The new cellular car phone is a microwave instrument. Microwaves and Your Body Not surprisingly, as high-powered microwaves have proliferated in the atmosphere and the workplace, a passionate debate has grown over the pontential danger they pose to human health. But that is a topic for another article. For the moment, scientists at the University of Guelph have recently reported using microwaves to raise chickens. Housed in a large oven-like enclosure, young chicks keep warm under a slow drizzle of radiation. So far, the chicks seem to like their home in the range. They’ve even learned to turn on the microwaves whenever they feel cold. A similar scheme for heating human beings has actually been proposed by a scientist from Harvard University. Equipping buildings with microwave radiators would cut energy costs, he says, since microwaves heat people and not the surrounding air. Just set the thermostat dial to rare, medium or well done! Some researchers are concerned that people who work with microwave equipment are absorbing low levels of radiation that may prove harmful over the long term. One line of experiments has shown that uncoiled DNA molecules in a test tube can absorb microwave energy. The unravelled DNA chains resonate to the microwaves in the same way that a violin string vibrates when plucked. The question this raises is this: does microwave radiation vibrate coiled DNA in the human body, and if so, is this vibration strong enough to knock off vital molecules from the chain?