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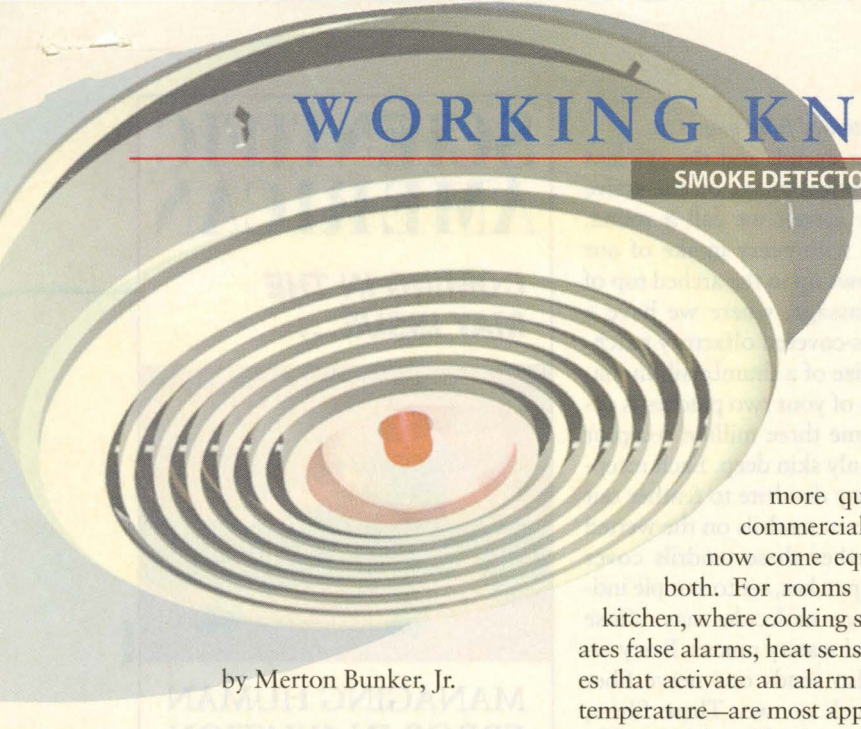
Working Knowledge Article

Scientific American

SMOKE DETECTORS



by Merton Bunker, Jr.

In the late 1930s the Swiss physicist Walter Jaeger tried to invent a sensor for poison gas. He expected that gas entering the sensor would bind to ionized air molecules and thereby alter an electric current in a circuit in the instrument. His device failed: small concentrations of gas had no effect on the sensor's conductivity. Frustrated, Jaeger lit a cigarette—and was soon surprised to notice that a meter on the instrument had registered a drop in current. Smoke particles had apparently done what poison gas could not.

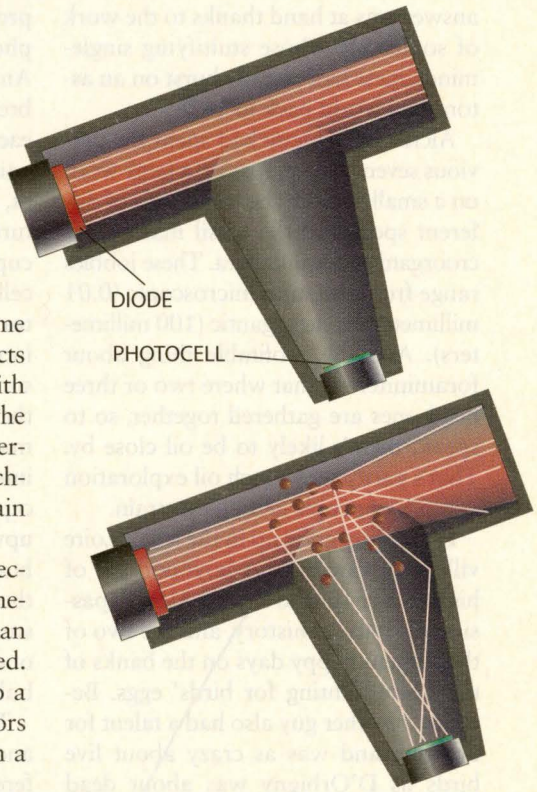
Jaeger's experiment was one of the advances that paved the way for the modern smoke detector. It was 30 years, however, before progress in nuclear chemistry and solid-state electronics made a cheap sensor possible. The first commercial smoke detectors came to market in 1969. Today they are installed in 93 percent of U.S. homes.

Smoke detectors fall into two major classes. Ionization detectors, the most common units, trigger an alarm after smoke particles attach themselves to ionized air molecules. In contrast, a photoelectric unit can detect light that is scattered by smoke particles onto a photocell, thereby initiating an alarm. In another type of photoelectric device, smoke can block a light beam. In this case, the reduction in light reaching a photocell sets off the alarm.

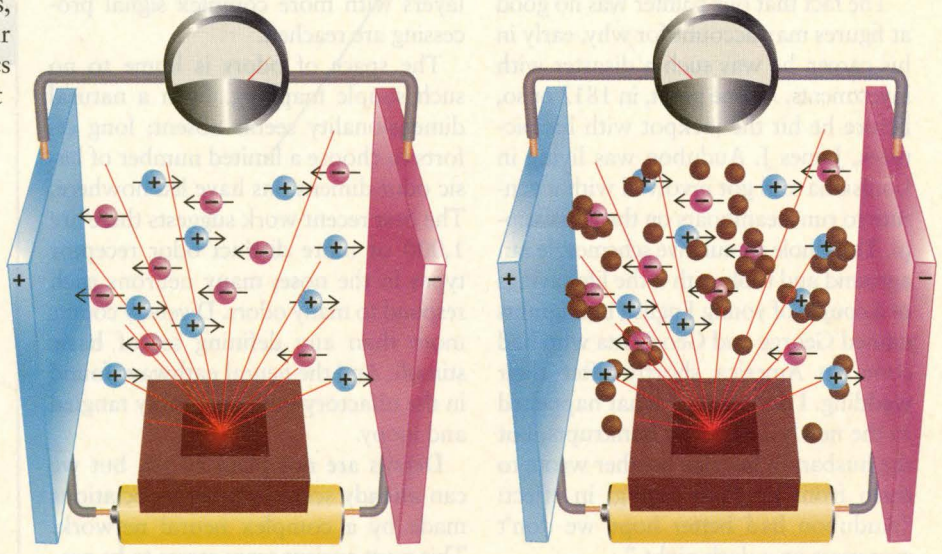
Ionization detectors respond faster to flaming fires than do photoelectric detectors, which sense smoldering fires more quickly. Some commercial products now come equipped with both. For rooms such as the kitchen, where cooking smoke generates false alarms, heat sensors—switches that activate an alarm at a certain temperature—are most appropriate.

The simple technology of fire detection has continued to undergo refinement. Alarms with strobe lights can even awaken the hearing impaired. These measures have contributed to a heartening statistic: smoke detectors have reduced the chance of dying in a fire at home by roughly half.

MERTON BUNKER, JR., is the senior electrical engineer for signaling systems at the National Fire Protection Association. The association produces the National Fire Codes, which includes a standard for fire alarms.



PHOTOELECTRIC DETECTOR functions by employing a light-emitting diode that sends a beam of light unimpeded across a chamber (*top*). When smoke enters, light scatters in all directions. A photocell at an angle to the diode senses the light and sets off an alarm (*bottom*).



IONIZATION DETECTOR operates by ionizing air molecules (*pink and blue spheres*) with alpha particles from a radioactive material, americium 241 (*red lines*). The ions then carry a small current between two electrodes (*left*). Smoke particles (*brown spheres*) attach to the ions (*right*), thus reducing current flow and initiating an alarm.

ILLUSTRATIONS BY MICHAEL GOODMAN