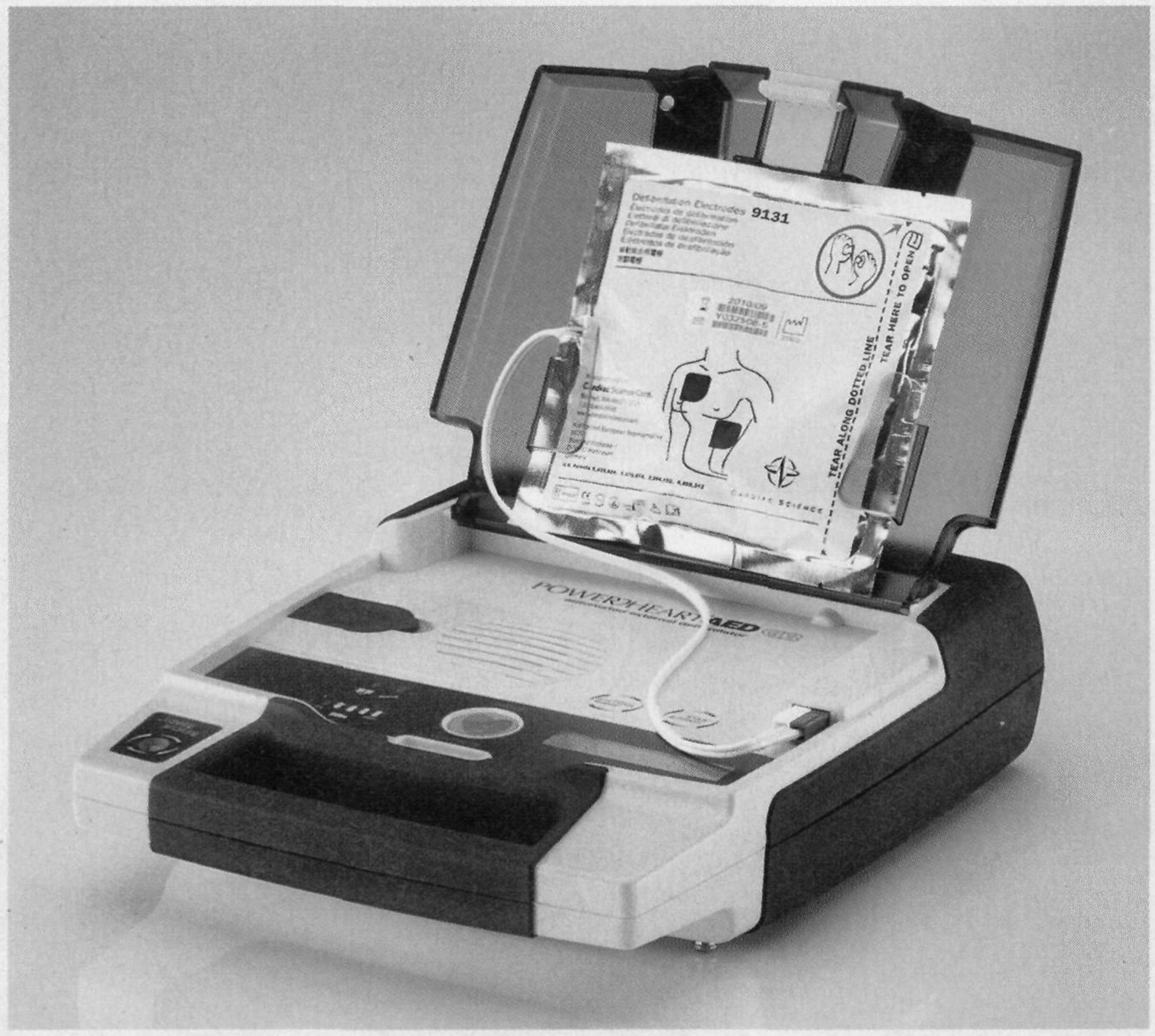

SIMPLY SAVED: The automated external defibrillator, which shocks hearts out of cardiac arrest, hides its sophisticated engineering behind a simple and cheery exterior. *PHOTO: CARDIAC SCIENCE*

of a lunch box [see "Simply Saved"], can now be found in hundreds of thousands of public places, including office buildings, transportation hubs, and gyms; they've also been installed in police cars, in schools, and even on the International Space Station. As the price continues to drop—units can sell for as little as US $1000—some experts are urging people at high risk for cardiac arrest to keep an AED in their homes, just in case.

The AED's widespread dissemination represents one of the greatest engineering success stories of the last few decades. In just 20 years, improvements in defibrillator design—in the efficacy of the waveform that delivers the electric shock, the way that the unit's energy is stored and delivered, and the AED's overall ease of use—have made it so that a layman can operate it with little more than a quick tutorial.

YOU'RE MEETING WITH a middle-aged coworker who suddenly slumps over. You have no idea what's wrong with him, but cardiac arrest seems likely. Fortunately, you've had basic training in how to respond to an emergency, so you snap out of your initial state of shock and call for emergency medical assistance.

On average, the wait for an ambulance in populated areas of the United States is about 11 minutes. From your first-aid training you know that a cardiac-arrest victim's chance of survival drops about 10 percent with every passing minute, which doesn't bode well for your coworker. You remember seeing an AED hanging on a wall nearby, and you dash off to retrieve it. Defibrillator in hand, you struggle to keep cool as you try to recall how this strange device works. You're under immense time pressure in an unfamiliar situation where every second counts.

Luckily for your colleague, the rest of your actions couldn't be more straightforward. From the moment you open the AED's brightly colored box, audio instructions prompt you with simple commands. First, they tell you to place two adhesive electrode pads on your coworker's bare chest, following the diagrams on the pad wrappers. The defibrillator's built-in electrocardiograph automatically detects and analyzes the state of the patient's heartbeat, and its software judges whether to administer a shock. Your colleague's heart is indeed in ventricular fibrillation, so the AED asks you to approve the delivery of a tailored burst of electric current. "Push the button," announces a firm voice emanating from the box. There's only one button, so you press it. Your coworker's body jumps a little, and that may be all that's needed to restore a normal rhythm to his heart. If not, the box prompts you to push the button again after some time. Thanks to your quick actions, your colleague is saved.

Meanwhile, what's happening inside the AED is a technical marvel. The device performs two main functions. First, it needs to recognize the lethal haywire rhythm of ventricular fibrillation. Second, it needs to deliver a 100-kilowatt shock to the heart. This jolt allows the heart to restart its normal rhythm, sort of like a Ctrl-Alt-Del for the organ. If the shock is delivered in the first minute of ventricular fibrillation, in more than 90 percent of cases the heart will regain a normal sequence of electric signals, and the steady contractions will return. It took decades of careful engineering to develop a device that could perform those two functions reliably, have a long shelf life, and be both safe and easy to use.

SAVED BY A SPOON: The first defibrillator used spoons as electrodes. *PHOTO: DITTRICK MEDICAL HISTORY CENTER/ CASE WESTERN RESERVE UNIVERSITY*

THE INHERENT VIOLENCE of an electric shock stands in stark contrast to its potential therapeutic effect. In fact, the origin of electrical defibrillation can be traced to both electrocution and efforts to electrify the United States in the early 1900s.

Engineers and medically inclined experimenters had long observed and tinkered with the potential of restoring life with electricity. Some of the