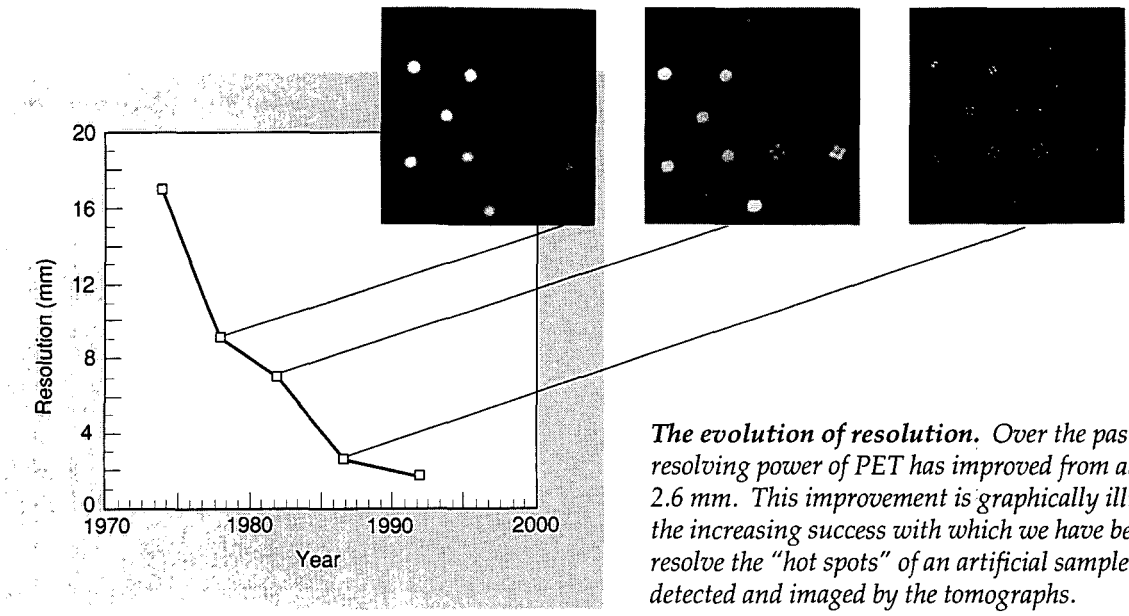
# A PET PRIMER

## *Positron Emission Tomography: Evolution of a Technology*

One of the unexpected fruits of basic physics research and the computer revolution is the noninvasive imaging power available to today's physician. Technologies that were strictly the province of research scientists only a decade or two ago now serve as the foundations for such standard diagnostic tools as x-ray computed tomography (CT), magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), ultrasound, single photon emission computed tomography (SPECT), and positron emission tomography (PET). Furthermore, prompted by the needs of both the practicing physician and the clinical researcher, efforts to improve these technologies continue. This booklet endeavors to describe the advantages of achieving high resolution in PET imaging.

The history of PET can be traced to the early 1950s, when workers in Boston first realized the medical imaging possibilities of a particular class of radioactive substances. It was recognized then that the high-energy photons produced following the decay of positron-emitting isotopes could be used to describe, in three dimensions, the physiological distribution of "tagged" chemical compounds (see facing page). After two decades of moderate technological developments by a few research centers, widespread interest and broadly based research activity began in earnest following the development of sophisticated reconstruction algorithms and improvements in detector technology. By the mid 1980s, PET had become a practical tool for medical diagnosis and for dynamic studies of human metabolism. Today, because of its millionfold sensitivity advantage over MRI and its chemical specificity, PET is used to study Alzheimer's disease, Parkinson's disease, psychiatric disorders, epilepsy, tumors, and coronary artery disease. Its use has added immeasurably to our current understanding of flow, oxygen utilization, and the metabolic changes that accompany disease.

For the past 15 years, a team of physicists and physicians at the Donner Laboratory of the Lawrence Berkeley Laboratory has been devoted to advancing the power of PET imaging to its physical limits. A product of their research is today's most advanced instrument, the Donner PET-600, which has a resolution of 2.6 mm. Nonetheless, further improvements are vital if the full imaging potential and biomedical scientific advantages of PET are to be realized.




***The evolution of resolution.*** *Over the past decade, the resolving power of PET has improved from about 9 mm to 2.6 mm. This improvement is graphically illustrated by the increasing success with which we have been able to resolve the "hot spots" of an artificial sample, which are detected and imaged by the tomographs.*