Lee de Forest, inventor of the vacuum-tube amplifier, and Bell Labs President Mervin Kelly. (Courtesy AT&T Archives)

room-filling computers as the ENIAC and UNIVAC burned out with all-too-frustrating frequency. Only large corporations, the armed services and government agencies could afford these massive, power-hungry monstrosities and the vigilant staff to keep them operating. "It seems to me," Shockley conjectured in December 1949, "that in these robot brains the transistor is the ideal nerve cell."

But the transistor has proved to be much more than merely a replacement for electron tubes and electromechanical switches. Shrunk to less than a ten-thousandth of its original size and swarming by the millions across the surfaces of microchips, it has opened up entirely unexpected realms of electronic possibility, which even the most farsighted could not have anticipated during those booming postwar years. The transistor was, as historians Ernest Braun and Stuart MacDonald observed, "the harbinger of an entirely new sort of electronics with the capacity not just to influence an industry or a scientific discipline, but to change a culture."

Characteristically, particle physicists were among the first to glimpse the potential ramifications of this revolutionary new solid-state amplifier. "I would be very anxious to do some experimenting to learn about the techniques of your new Germanium triods," wrote Fermi to Shockley in early January 1949 (misspelling the final word). After receiving a few samples and testing them at his University of Chicago laboratory, Fermi replied, "They really are very fine gadgets, and I hope very much that they might be useful in our work."

THOMSON'S DISCOVERY triggered a spectacular century of innovation in both science and technology. Paced by increasingly detailed knowledge of the electron's properties and behavior, scientists and engineers developed many other advanced devices—lasers, light-emitting diodes, microwave tubes, solar cells and high-speed microprocessors, to name several—that are essential to modern computing and global communications. Today we know the mass and charge of the electron to better than seven significant figures. Aided by quantum mechanics, we can accurately calculate its energy levels in all kinds of atoms, molecules and solid-state substances. Largely taken for granted, such information is crucial for the precision control of electrons at the submicron scales that characterize many leading-edge technologies.

Of critical importance in attaining this deep understanding was the ease with which electrons can be detached from other forms of matter and manipulated using electromagnetic fields. Such features were readily apparent in Thomson's landmark experiments, for example, and Millikan exploited them in his research. In certain key instances the energy required corresponds to that of photons in visible light. This unique partnership between the electron and photon (whose centennial we will also celebrate in the not-too-distant future) is central to much of