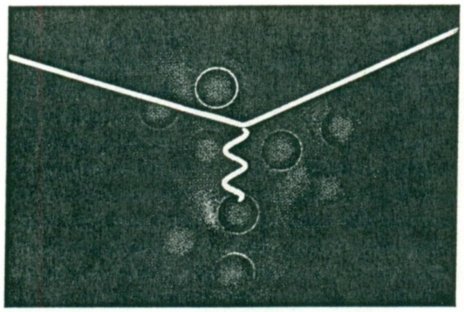
WORLD VIEW

BIRTHDAY FOR THE ELECTRON

It was found 100 years ago; can we rediscover those heady days in Cambridge?

BY OLIVER MORTON

A HUNDRED YEARS AGO J. J. Thomson discovered that cathode rays, one of the hot topics in the science of the day, were composed of particles with a fixed ration of electrical charge to mass. Those particles are what we now call electrons; and although the modern picture of the electron—a sort of part wave, part particle that hangs around the outskirts of atoms—was a long way off when Thomson read the first paper describing his experiments to the Royal Institution in London on April 30, 1897, those experiments are still taken as one of the founding discoveries of modern physics. The centenary year of the electron is an occasion for talks and plaques and self-congratulation wherever particle physicists come together. The tone is one of celebration—look how far we've come! But there are undercurrents of darker emotions, of nostalgia tinged with regret and envy.



Smash: *Electron meets proton*

A century of science has taken humanity's understanding of the electron from Thomson's laboratory bench to places barely conceivable. We have seen electrons swap their allegiances from atom to atom at speeds whose measurement beggars belief, completing chemical reactions in the time it would take light to travel a millionth of a meter. Yet the electron is also master of the long haul. In billions of billions of billions of years, when the stars and galaxies are so long dead that they cannot spark the faintest fires of memory, matter as we know it will fade away. The neutrons and protons that make up atomic nuclei will dissolve themselves into a dew of electrons. But those electrons, as far as we can tell, will persist forever, accompanied only by their wraithlike siblings the neutrinos, the last hints of matter in a cold, dark void.

A wonder of theory, the electron is also a workhorse of practice; anything electronic, rather than simply electrical, depends on a scientific understanding of the electron. The descendants of Thomson's early cathode-ray tubes sit behind our TV screens and desktop monitors, their electrons knocking photons from the screen. These particles of light then hit our retina, where they are converted into the sluggish but ineffably subtle signals of what we now know to be the brain's own electronic signaling systems.

Thomson himself, though, has not left much of an afterimage on the back of our mind's eye. The Cambridge historian Simon Schaffer notes that outside the realm of physics, Thomson is probably best known for John Gielgud's portrayal of him in the film "Chariots of Fire": the crusty and not entirely endearing master of Trinity College. There may be truth in the Gielgudy image. But Thomson, who ran the Cavendish Laboratory at Cambridge, deserves better. Cavendish became one of the greatest laboratories of the 20th century, and that should count for something.

In the 1880s physicists thought that they had the world more or less wrapped up. There were theories of work and energy, of electromagnetism, of gravity, of optics; and they all worked very well. But in the late 1890s, the field exploded. X-rays and radioactivity were discovered in 1896, the electron in 1897; the quantum theory of energy was proposed by Planck in 1900, that of light by Einstein in 1905, that of the atom by Niels Bohr in 1913. For the best part of 40 years from 1895 physics was in tumult as the world of the atom was opened up and found to be far stranger than anyone had dreamed possible. And in those 40 years the Cavendish was second to none. Thomson's predecessor as Cavendish professor, Lord Rayleigh, had been a great physicist, too, and won the Nobel Prize—as did Thomson, and the next three men to hold the position, a run unequaled at any other institution.

If there's a hint of regret and envy in the electron's centenary, it's for that time and place. For a time when everything was new and exciting, when huge shifts in ways of thinking about the world happened once or twice a decade, sometimes once or twice a year. And yet these advances were amenable to study by small teams, like those that gathered around Thomson and later Rutherford, or Bohr or Enrico Fermi.

Physics just isn't like that anymore—especially not the particle physics that can trace its ancestry back to those glory days of the Cavendish. At the forefront of particle physics, experimenters stand in massed regiments around vast siege engines. Meanwhile, theorists search in vain for any tenuous thread of evidence that might link one of their fascinating fancies to the world the experimenters prod and poke.

The same changes that have stretched our knowledge of the electron and its brethren have also stretched the ways in which physics is done. In some ways it now simply takes more manpower and more theoretical arcana to drag the ever more out-of-the-way phenomena of the universe into the seminar rooms of ever more universities. A huge intellectual effort has engendered a huge infrastructure, one that often seems as trifling as it is utterly necessary.

For all that, it's a fair bet that science will surprise us again, as it did in the 1890s. Already, there are hints that particle physics may be about to find unexpected novelties. But it would be wrong to expect the surprise this time to come from rays and little particles, as it did a century ago. It might come from anywhere—perhaps from the "Quantum computers" creeping to life in small labs and holding out the tantalizing possibility of bridges between parallel universes, perhaps from something currently yet more obscure or seemingly utterly uninteresting. Let's hope that if such a time does come again, some latter-day Thomson can carve out the right place in which to seize it. If such institutional rebirth could be accomplished in Victorian England, it should still be possible today. Shouldn't it?