

The Dawn of the Information Age: Computing in the 1940s

Preface

The decade of the 1940s witnessed a transformation that would reshape human civilization as profoundly as the Industrial Revolution. In laboratories and research facilities across the Allied nations, scientists and engineers were creating the first electronic digital computers. This account, drawn from interviews with surviving pioneers and declassified wartime documents, reveals how the urgency of global conflict accelerated technological progress that might otherwise have taken decades to achieve.

Chapter 1: The Catalyst of War

In the spring of 1943, as Allied forces prepared for the invasion of Italy, a different kind of battle was being waged in the basement of the Moore School of Electrical Engineering at the University of Pennsylvania. John Mauchly and J. Presper Eckert, along with a team of engineers, were racing against time to complete a machine that would revolutionize warfare – and ultimately, the world. The Electronic Numerical Integrator and Computer, known as ENIAC, was born from desperate necessity. The United States Army's Ballistic Research Laboratory faced an overwhelming challenge. Each new artillery piece required firing tables containing thousands of trajectory calculations. A skilled mathematician with a mechanical calculator could compute a single trajectory in twenty hours. The Army needed thousands of trajectories for each weapon. The mathematics of death had become a bottleneck in the machinery of war. "We knew that every day of delay meant American soldiers were firing artillery with imprecise calculations," recalled Herman Goldstine, the Army liaison to the ENIAC project, in a 1972 interview. "The pressure was immense. We worked eighteen-hour days, seven days a week. There was no concept of weekends or holidays. The war didn't take breaks."

Chapter 2: The Architecture of Innovation

ENIAC's design represented a radical departure from all previous calculating machines. Where mechanical calculators processed one operation at a time, ENIAC could perform 5,000 additions per second. Its 17,468 vacuum tubes, 70,000 resistors, and 10,000 capacitors filled a room 30 by 50 feet. The machine consumed 150 kilowatts of power – enough to dim the lights in the surrounding neighborhood when it was switched on. Yet ENIAC's true innovation lay not in its size or speed, but in its programmability. Unlike earlier fixed-purpose calculators, ENIAC could be reconfigured to solve different problems. This flexibility came at a cost: programming ENIAC meant physically rewiring the machine, a process that could take days. The women who programmed ENIAC – Kay McNulty, Betty Jennings, Betty Snyder, Marlyn Meltzer, Fran Bilas, and Ruth Lichterman – were mathematicians recruited from the Army's corps of human "computers." Their work, largely unrecognized for decades, established many fundamental principles of programming. "We had no programming languages, no operating systems, nothing," Kay McNulty Mauchly Antonelli later recalled. "We had to think like the machine. Every program was an act of invention."

Chapter 3: Parallel Developments

While ENIAC captured public imagination when its existence was revealed in 1946, it was not the only electronic computer under development during the war years. In Britain, the Government Code and Cypher School at Bletchley Park had constructed Colossus, a special-purpose electronic computer designed to break German encryption. The secrecy surrounding Colossus was absolute. While ENIAC's creators would receive recognition and acclaim, Colossus's designers – notably Tommy Flowers and Max Newman – would remain anonymous for nearly three decades. The British government ordered the destruction of most Colossus machines after the war, and participants were bound by the Official Secrets Act. Meanwhile, in neutral Switzerland, Konrad Zuse continued developing his Z-series computers in relative isolation. His Z3, completed in 1941, was arguably the world's first programmable, fully automatic digital computer. Built with telephone relays instead of vacuum tubes, it was slower than its electronic contemporaries but demonstrated that the fundamental principles of digital computation transcended specific technologies.

Chapter 4: The Stored Program Revolution

Even as ENIAC performed its first calculations, its creators recognized its limitations. The lengthy rewiring process required for each new program was impractical for a general-purpose computer. The solution came from an unlikely collaboration between mathematician John von Neumann and the ENIAC team. Von Neumann's "First Draft of a Report on the EDVAC" (Electronic Discrete Variable Automatic Computer), circulated in June 1945, proposed storing programs in the computer's memory alongside data. This concept – the stored program architecture – would become the foundation of all modern computers. The report sparked controversy over attribution that persists to this day. Eckert and Mauchly claimed they had independently developed the concept. Von Neumann's name on the widely-circulated report, however, led to the architecture being dubbed the "von Neumann architecture." "The tragedy was that what should have been a collaborative triumph became a bitter dispute over credit," observed historian Nancy Stern. "The stored program concept was probably an inevitable convergence of ideas, but the conflict fractured the original ENIAC team and scattered their talents to different institutions."

Chapter 5: From Laboratory to Industry

The transition from wartime research to commercial computing began even before the war's end. Eckert and Mauchly, frustrated by disputes over patent rights at the University of Pennsylvania, formed the Electronic Controls Company in 1946, later renamed the Eckert-Mauchly Computer Corporation. Their goal was ambitious: to build computers for business and scientific applications. The challenges were formidable. Vacuum tubes, the computer's essential components, were unreliable. ENIAC's tubes failed at an average rate of one every two days. For commercial viability, computers needed to run for weeks or months without failure. The solution required not just better tubes, but fundamental advances in error detection and correction. Financial challenges proved equally daunting. Building computers required enormous capital investment with uncertain returns. The Eckert-Mauchly Computer Corporation struggled until Remington Rand acquired it in 1950. This pattern – innovative startups absorbed by established corporations – would become a recurring theme in the computer industry.

Epilogue: The Future They Imagined

In 1949, *Popular Mechanics* made a bold prediction: "Computers in the future may weigh no more than 1.5 tons." This forecast, ridiculed today for its lack of imagination, actually represented remarkable

optimism. ENIAC weighed 30 tons. To imagine a computer weighing merely 1.5 tons was to envision a twentyfold improvement in just a few years. The pioneers of the 1940s could hardly imagine computers that would fit in a pocket, yet they glimpsed the transformation their work would bring. In a 1948 letter, Alan Turing wrote: "The machine is not a mere tool like a hammer or a printing press. It is an amplifier of intelligence itself. Its impact will be felt in every sphere of human endeavor." As we stand in the digital age these visionaries created, their legacy reminds us that revolutionary change often begins in modest circumstances: a basement laboratory, a wartime project, a small group of dedicated individuals pursuing an idea whose time has come. The information age was born not in a single moment of inspiration, but through years of persistent effort, collaboration, and the courage to imagine a different future.