Computing Before Computers

Edited by William Aspray

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Table of Contents

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Introduction

Wherever we turn we hear about the "Computer Revolution" and our "Information Age." This is testimony to the public awareness of the invention and rapid development of the computer since the Second World War and the fundamental changes it has driven in the way we conduct business, perform scientific research, and spend our leisure time. With all of this attention to the computer we tend to forget that computing has a rich history that extends back beyond 1945. Since antiquity societies have had a need to process information and make computations, and they have met this need through technology.

We offer here a concise survey of computing technology prior to the development of the modern computer. We show the continuity of the history of computing by tracing several distinct older traditions that over the last forty years have converged in today's technology. Our study ends essentially in 1945, at the time when the plans for the first electronic, stored-program computer were being made. However, we do follow the exit of these earlier technologies, none of which survived long after the commercialization of computers in the 1950s.

All of the contributors to this volume are historians or computer scientists who have specialized in the study of computer history for at least a decade. We have tried here to wear our scholarship lightly. All efforts have been directed toward providing a balanced and accurate account of our subject, while writing at a level accessible to the general reader. We have attempted to relate technical innovations to their intellectual, social, and institutional contexts: to consider not only the machines and devices that were built and the innovations they incorporate but also the purposes for which they were to be used, the financial and organizational constraints and opportunities that shaped their developments, and the impact they had on individuals and institutions. We recognize, however, that computing has only recently come under historical scrutiny and that our remarks,

especially on the context of technological development, are of only a preliminary nature.

This book includes seven chapters, an introduction, and an epilog. The first chapter covers two millennia of effort to develop arithmetic and the means to facilitate its computation. The story takes a modern turn in the late–nineteenth century when the desk calculator, invented 200 years earlier, became economically viable for American and European businesses. The essay traces the steady improvement in desk calculators in the twentieth century, their incorporation into the business world, and their diminished role after the invention of the computer.

The second chapter, on difference and analytical engines, examines nineteenth-century attempts to build machines to compute mathematical tables. The prominent figure here is the British mathematician Charles Babbage, who in the plans for his analytical engine originated the fundamental idea of program-controlled computing. The need for machines to calculate mathematical tables continued in the twentieth century, and this line is traced through the work in the 1940s of Howard Aiken and George Stibitz.

Computers are able to process symbols and control logical operations as well as calculate numerical problems. The first serious efforts to mechanize logical processes, in nineteenth-century Britain, are the starting point of the next essay. It continues with the development of logic machines in the twentieth century and, more significantly, the increasing knowledge of the relationship between logic and computing that forms a basis for computer science theory today.

Punched-card sorting and tabulating equipment was first built to process information from the 1890 United States Census. By the 1930s punched-card machinery became commonplace in medium-sized and large businesses in Europe and the United States. At the same time astronomers and other scientists began to adapt it to their own uses. These business and scientific users provided the original customer base for the electronic stored–program computer, while their punched-card equipment was adopted as peripheral equipment for the first electronic computing systems.

By the 1930s a rich array of calculating technology existed in the form of desk calculators, punched-card equipment, and analog computers (in which numerical values are measured rather than counted). The next chapter examines a range of analog devices used especially during the 1930s and the Second World War for scientific

and engineering calculation. These include differential analyzers, wind tunnels, network analyzers, and gunnery computers. Analog and hybrid digital-analog computers were built until the 1960s, but they were eventually overtaken for almost every scientific and engineering application by the speed, precision, and programming flexibility of digital computers.

A major reason for the success of the modern computer is its processing speed. Until the 1930s most calculating equipment was slow by comparison, due to the slow rate of operation of mechanical switches. In the 1930s, in independent projects in the United States and Germany, computing devices were developed that used electromechanical relays for switching. These provided marked increase in speed over mechanical calculators. The next chapter examines the electromechanical calculators built at Harvard University and Bell Laboratories in the United States and by Konrad Zuse in Germany.

Even electromechanical relays were too slow to solve cryptanalytic and ballistic table-making problems confronting the Allied countries during the Second World War. These problems were met by the first serious attempts to develop electronic calculating equipment, notably the American calculator ENIAC and the British Colossus. The seventh chapter traces the move to computing with electricity, a critical step in the advance to the modern computer.

The convergence of these prewar calculating technologies in the modern computer is the topic of the epilog. It shows how calculator users and applications were already well established by the 1930s; how various pieces of the new technology (e.g., the program-control concept, electronic switching, and punched-card peripherals) were already in place; and how many of the precomputer projects grew into projects to build the first generation of computers.

Note

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