A History Of Computing Technology

by Michael R. Williams

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The book "*A History of Computing Technology*" describes historical aspects of calculation and concentrates on the physical devices used to aid people in their attempts at automating the process of arithmetic. It highlights the major advances in arithmetic from the beginning of counting, through the three most important developments in the subject: the invention of the zero, logarithms and the electronic computer, providing the reader an understanding of the way these ideas developed and some computing tools that had been built up till the 1960s. The bits and pieces of a computer (including the software) came together over many centuries, each of so many people adding a small contribution. In this respect, the book tells many of the interesting stories about both the machines and the scientists that produced them. It focuses on the extraordinary accomplishments of those computer pioneers whose work will stand as proof of their genius and hard work.

The first edition of the book appeared in 1985 and, in 1995, Michael Williams decided to revise his work in order to correct a few errors that were found in the original version. The second edition, issued in 1997, contains 9 Chapters. At the end of each chapter, the reader is encouraged to consult the reference materials cited for exact dates. At the end of this second edition, an Appendix presents the approximate data of major events cited in the book. An Index also presents in alphabetical order the main events and names of companies or names of specialists mentioned in the text of the book.

Chapter_1 concentrates on the beginnings of computing technology. It outlines the sense of numeration, the additive number system and the positional system and points out other methods of numerical notation (knotted cords for record keeping, tally sticks, numerical grids a/o.) Calculation was a need from the early days when it was necessary to account to others for individual or group actions, particularly in relation with keeping inventories or reconciling finances.

Early aids to calculation: finger reckoning, the abacus, the quadrant, two legged instruments, the proportional compass, Napier's bones, logarithms and the slide rule formed the object of **Chapter 2**. Early human being counted by means of matching one set of objects with another set. Early counting tables, called abaci, not only formalised this counting method but also introduced the concept of positional notation that we use today. The next logical step was to produce the first "personal calculator"-the abacus- that used the same concepts of one set of objects standing in for objects in another set, but also the concept of a single object standing for a collection of objects-positional notation. Only when the process of counting and arithmetic became a more abstract process and different sizes of groups were given a symbolic representation so that the results could be written on a storage medium, such as papyrus or clay, did the process of calculation become a process of symbol manipulation. In the opinion of the reviewer, the book would have gained more value if there had been pointed out that John Napier made in 1612 the first printed use of the decimal point, after it had been invented in the Netherlands.

The development of automatic computation really began with the invention and development of mechanical devices to automatically perform the four standard arithmetic functions._**Chapter 3** titled "Mechanical Calculating Machines" presents the history of these machines starting with the first inventor, Wilhelm Schickard, considered producer of the first really workable mechanical adding machine in 1623. Wilhelm Schickard described a machine that combined the concept of Napier's bones (in a cylindrical form) with a simple adder that allowed the user to more easily complete the multiplication of multi-digit numbers. In the reviewed book, the author, Michael Wiliams pointed out that no original copies of Schickard's machine had been found, but it is not explained the fact that this is the credit for the first adder with automatic carry, often given to Blaise Pascal. In the same third Chapter, the author mentioned that in 1673 Gottfried Wilhelm Leibniz, using a stepped cylindrical gear, had built a calculator capable of multiplication, in which a number was repeatedly and automatically added into an accumulator and that the less known Samuel Morland, in 1688, had invented three different kinds of calculating instruments and that René Grillet in 1678 had edited a short description of his calculating machine. Chapter 3 ends by a subchapter titled "Commercially Produced Machines" in which Thomas Arithmometer, Baldwin-Odhner

Machines and Key-Driven Machines are presented with some finger of production till year 1912. In the terms of the reviewer, the Mechanical Calculating Machines have performed a more important role. Thanks to the efficiency of the Odhner system, for example, Sweden has taken a prominent position in the world of the mechanical calculating machine industry. If we go back to the pre-last world war year, 1938, when reliable statistics were still published, we find Sweden taking second place in world exports, preceded only by the United States with their enormous office machine industry. Swedish exports slightly exceeded those of the highly industrialised Germany and were considerably ahead of Switzerland, the fourth-ranking country exporting mechanical calculating machines to the world. The mechanical calculating machines now belong to the past but they played an important role even after the second world war, when they became electromechanical office calculating machines. A fact that should be mentioned is that an electromechanical calculating office machine executed basically mathematical operations and a machine with these features must be the result of a complex and very difficult manufacturing process. Even the simplest model required the assembly of thousands of small parts, based on infinitesimal tolerances, and on specially trained personnel. In production of electromechanical calculating machines, nothing must be left to chance, nothing to negligence or inadequate control and skill.

Chapter 4 of the reviewed book is dedicated to the Babbage Machines. Charles Babbage designed a Difference Engine (in 1822), but in 1833 he realised that his first machine was a special purpose machine capable of only one single operation. Abandoning this line of work, he designed the Analytical Engine that had the basic components of a modern computer and led to Babbage being described as the "Father of the Computer". Ada Augusta King, countess of Lovelace, a friend of Charles Babbage, translated into English an article about Analytical Engine, published by an Italian military engineer, L.F. Mendreea, in a Swiss periodical, and added an extensive set of comments and notes which provided us with a wealth of details as to exactly how the Analytical Engine was to function. The reviewed book would have gained more value if there had been mentioned that, for her comments and notes, Ada Augusta King became the world's first programmer.

The book "A History of Computing Technology" does not mention George Boole who in 1854 described his system for symbolic and logical reasoning, to become later the basis for computer design. In the book, the name of Alan Turing is mentioned but there is nothing about Turing's idea of a "Universal Machine" capable of executing any describable algorithm and forming the basis of the concept of "computability". Perhaps more importantly Turing's ideas differed from those of others who were solving arithmetic problems by introducing the concept of "symbol processing".

Chapter 5 titled "The Analog Animals" is dedicated to the presentation of the known two basic methods of representing numerical quantities inside a calculating machine: the analogue and the digital. This Chapter emphasises that the analogue calculating instruments and machines actually go back in history much farther than the digital ones. The fifth Chapter presents the Astrolabe, the Antikythera Device, the Tide Predictors, the Differential Analyzers a.s.o.

The decade starting in the late 1930s saw a number of different groups construct working calculators with some type of automatic control system. Digital computing came to the fore again in the 1930's when a number of scientists recognised that the technology had reached the stage where the necessary components of a computer were available. **Chapter 6** of the reviewed book, titled "The Mechanical Monsters" tells us the history of these mechanical calculators, that can be divided into four basic lines:

- work done in Germany by Konrad Zuse, who developed his Z1 computer in his parents' living room, a relay computer using binary arithmetic. He continued with Z2 in 1938 with the help of Helmut Schreyer, and after that the Z3 computer that can be compared in speed to the Harvard Mark 1. Although the Mark 1 was finished some two and a half years later than Z3, it was no faster. The floating point representation of numbers in the Z3 made it more flexible than the Mark 1's fixed point scheme. In 1950, Konrad Zuse fled to Switzerland where he reconstructed his Z4 calculator at the University of Zurich and, what is not said in the reviewed book, he founded a computer company that was eventually absorbed into the Siemens Corporation;
- work done at the Bell Telephone Laboratories. One of the major computational problems at the Bell Laboratories was in the domain of complex numbers. Stibitz's first full-scale electromagnetic relay calculator solved this problem and was named the Complex Number Calculator (later Bell Labs Model 1). What is not said in the reviewed book is the fact that a year later Bell Labs Model 1 was the first to be used remotely over telephone lines, setting the stage for the linking of computers and communication

systems, time-sharing, and eventually networking. A tele type was installed in a hallway outside the meeting rooms for the annual American Mathematical Society conference at Darmouth College, and connected to the Complex Number Calculator in New York. Among the people who took the opportunity to try out the system were Norbert Wiener and John Mauchly;

- the projects undertaken by Howard Aiken who was considering the problems of computation at Harvard, whose work would come to fruition in 1944;
- the efforts of IBM in the design of both small and large scale mechanical and electromechanical computing equipment. The first large scale automatic general purpose electromechanical calculator was the Harvard Mark 1 (AKA IBM Automatic Sequence Control Calculator -ASCC). The ASCC was not a stored program machine but instead was driven by a paper containing the instructions. Since the 1930's IBM has built a series of calculators in the 600 series that contributes to the versatility of the card processing equipment that was their major product. The early IBM computers (701 and 702) were incompatible with the punched card processing equipment but the IBM Type 650 EDPM, a natural extension of the 600 series used the same card processing peripherals thus making it upwardly compatible for many existing IBM customers.

The second World War spurred the development of electronics from what was essentially a small-scale analogue industry concentrating on radio circuits to its status as one of the leading technologies of our day. **Chapter 7** titled "The Electronic Revolution" presents the work for developing the electronic computing machines. It outlines the work of John Vincent Atanasoff, Clifford Berry & the ABC and tells us the story of the ENIAC (Electronic Numerical Integrator and Computer) and of the Colossus Machines used to decrypt the intercepted messages of the German forces during the Second World War. In the reviewed book it is said that some constructions of the Collosus would be still under the condition imposed by the Official Secrets Act. From the other literature sources it is known that the existence of Colossus was a secret until 1970 and that only the algorithms of decryption are still a secret today.

The University and City of Manchester are celebrating in the year 1998 the 50th Anniversary of the birth of the first stored program electronic digital computer. **Chapter_8** of the reviewed book is dedicated to the same issue and is titled "The First Stored Program Electronic Computers"

Chapter 9 of the reviewed book is titled "Later Developments" and it contains author's final remarks about the development in computing technology in the late 60's of our century.

The reviewed book presents the work of Grace M Hooper who made fundamental contributions to the development of the first compiler and to the later United States Navy Standardisation of COBOL, but it does not mention John Backus who in 1954 proposed the development of a programming language that would allow users to express their problems in commonly understood mathematical formulae- later to be named FORTRAN. Also there are no words about John McCarthy who in 1958 developed concepts of the programming language LISP for manipulating strings of symbols, a non numeric processing language.

Appeared in 1997, the reviewed book titled "A History of Computing Technology" has no words about the generation of computers (the first vacuum tube driven, the second using transistor, the third on the integrated circuits a.s.o.), has nothing about operating systems, has no words about microprocessors and personal computers, nothing about parallel computers, nothing about networks a. s. o. The reviewed book offers the reader an amount of data about the first steps in the development of the computing technology. The author's endeavours for selecting and systematising the information in the field were quite remarkable and rewarding. There are several groups of readers, interested in the history of technology, who will certainly benefit from studying this book.

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Stefan Iancu was born in Bucharest, Romania in 1939. He received the MSc. degree in Aeronautics Polytechnical Institute of Bucharest in 1962, and the Ph.D degree in 1993, from the same institute, for his contribution to Electronic Control and Governing of Spark Ignited Engines Operation. Stefan Iancu is the author of 5 books and of more than 60 scientific and technical papers in such fields as: Data Collection, Industrial Property, Mechatronics and History of Science and Technology. He has a good experience in the research field and works now at the Romanian Academy as Scientific Secretary to the Section for Information Science and Technology.