John Napier:
Mathematician And Inventor Of Early Calculating Devices

Introduction

The history of computing has developed in the rather recent past. The first computers were not invented until well into the twentieth century. Thus, computer history is a relatively new field in which many of the pioneers are still alive and may even still be working in the field that they assisted in developing. With this being the case, many of the contributions that were instrumental to the invention of the computer are sometimes overlooked or categorized incorrectly as having little to do with the history of computing. This is an unfortunate pattern for without these early contributions, inventions, and theories, the computer would not have been invented as quickly as it was, or it may not have taken the shape that it did.

One of those early contributors to the invention of the computer is John Napier. Napier is acknowledged as the inventor of Napier's Bones and logarithms, both of which are extraordinary inventions that have had significant effects in the realms of both computers and mathematics. The discussion below will provide a historical look at the man along with an in depth examination of his inventions and their impact upon the history of computing.

The Life And Times Of John Napier

John Napier was born in 1550 in Edinburgh Scotland. His family were wealthy land owners and were influential in both local politics and the Protestant church. Little is known about Napier's childhood, however, it is known that he enrolled in St. Salvator's College of the University of St. Andrews in 1563, at the age of 13, shortly after the death of his mother. While there, he studied both Latin and Mathematics and the other classic subjects of the day. He never received his degree from St. Andrew, yet it is thought that he went to England to continue his studies for several years. Nothing more is heard from Napier until 1571 when he took up residence at Gartness in Stirlingshire and built a mansion for himself. In 1572, he married a woman with the name of Elizabeth. Elizabeth died in 1579, but not before she gave birth to a son and a daughter. Napier married Agnes several years later and she provided him with five sons and five daughters. In 1608, John's father died and he moved to the family's home at Merchiston Castle near Edinburgh, where he lived for the rest of his life and died on April 4, 1617.[1]

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[1] Napier, John Rabdology, Translated by William Frank Richardson, Charles Babbage Institute Reprint Series for the History Of Computing, Vol. 15. Mit Press (Cambridge, Mass., 1990), p. xxxii.

Napier was born into a staunch protestant family, and he took this responsibility very seriously. He was appointed by the Presbytery of Edinburgh as one of their Commissioners to the General Assembly in 1588. His religious beliefs served as the basis for his first treatise, *A Plain Discovery of the Whole Revelation Of Saint John*. Napier wrote this treatise at a time when there were fears that Phillip II of Spain was going to invade Scotland and he believed that the invasion was resulting from the influences of the Catholic Church in Rome. In the treatise, Napier went so far as to conclude that the Pope was the Antichrist mentioned by the Johannine epistles in the last book of the New Testament.[2]

[2] Ibid.

Outside of his interest in the church, his other great passion was mathematics. He is considered to be the inventor of logarithms, both the concept and the word itself. *Mirifici Logarithmorum Canonis Descriptio* (A Description of the Wonderful Canon Of Logarithms) was first published in 1617. This was the world's first written introduction to the concept of logarithms and it has been a revolutionary aspect of mathematics ever since. This contribution simplified the long and complex calculations that people of his day had to do by hand with paper and pencil. These calculations usually had astronomy and navigation as a purpose and any single error could have had disastrous results. Logarithms made this procedure much more efficient, effective, and reliable. Napier's final treatise was also on the subject of logarithms, *Mirifici Logarithmorum Canonis Constuctio* (The Construction of the Wonderful Cannon Of Logarithms), and was published posthumously in 1619.[3]

In addition to his invention of logarithms, Napier also is the proud creator of Napier's Bones. The device was described in a treatise entitled *Rabdologia* (Rabdology, or Rod Reckoning literally) which was published in 1617. The device uses the gelosia method of multiplication in order to solve mathematical problems. Gelosia multiplication:

Consists of drawing a matrix like grid, placing one digit of the

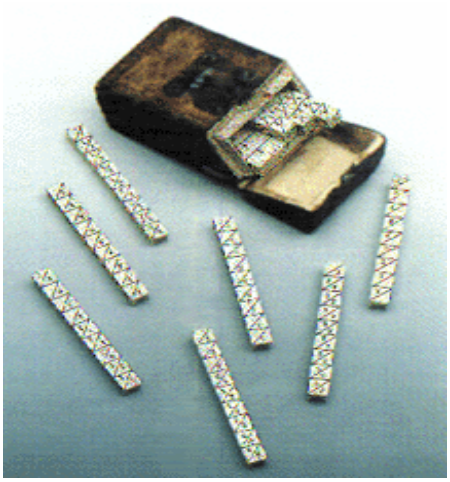
[3] Ibid.

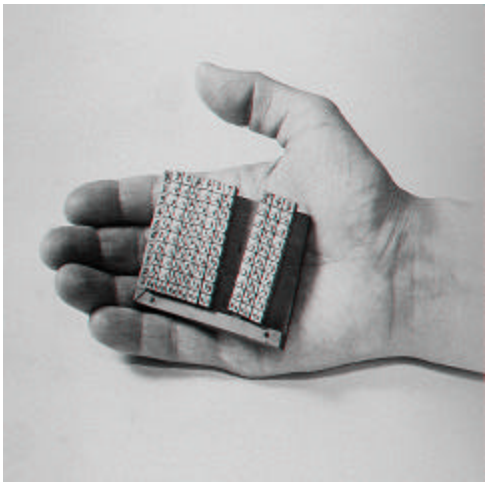
> multiplicand at the heard of each column and one digit of the multiplier beside each row, and entering the product of each row and column digit in the appropriate box of the matrix--the tens digit above the diagonal and the units digit below. The final product is obtained by starting in the lower right-hand corner and adding the digits in each diagonal, with any carry digits being considered as part of the next diagonal.[4]

Napier's Bones are a collection of rods made from bone, ivory, or wood, that encompass all of the possible columns involved in a gelosia table. These rods are used to conduct multiplication, division, square root, and cube root problems:

[4] Williams, M.R. "From Napier To Lucas: The Use Of Napier's Bones In Calculating Instruments," *Annals of the History Of Computing*, Vol. 5, Number 3. July 1983 (p. 279-296), p. 281.

The product of two numbers is found by setting up the rods on the table in a pattern described by Napier and then performing a series of simple addition sums. Division is slightly more difficult; one sets up the figures of the divisor on the rods, writes down the dividend on a piece of paper, and performs a series of subtractions. The rods do not replace pencil and paper but are an adjunct to them and greatly reduce the time spent on calculation...For the extraction of square and cube roots two inscribed plates are added to the rods...In extracting cube roots the side calculations on paper become somewhat complex (though confined always to addition and subtraction), but even so there is a considerable gain in ease over the traditional long method.[5] Two different sets of Napier's Bones can be seen below:





[5] Napier, John Rabdology, Translated by William Frank Richardson, Charles Babbage Institute Reprint Series for the History Of Computing, Vol. 15. Mit Press (Cambridge, Mass., 1990), p. xxxiv.

Napier’s Bones influenced many of the people that are generally linked, although somewhat indirectly, to being the forefathers to the invention of the computer through their work regarding mechanical calculating devices. Wilhelm Schickard modified Napier’s Bones for use in a mechanical calculating device in the early 1620's. Schickard’s calculator was the first to make use of the Napier’s Bones concept in order to develop a mechanical calculating device. In the mid 1600's Samuel Morland made use of Napier’s invention in three of his own calculating machines.

About the same time, Gaspard Schott and Athanasius Kircher, both of whom were Jesuit missionaries, developed the *Organum Mathematicum* (Mathematical Organ) which used the Napier’s Bones concept in a mechanical device that performed:

> Arithmetic--a standard set of Napier’s Bones together with addition and subtraction tables.

Geometry--tablets whose primary purpose is to solve problems encountered in survey work.

Fortification--tablets to help a soldier get the details correct when constructing the more standard types of military fortifications.

Calendar--tablets used in determining the date of Easter and the dates of the other major Christian festivals.

Gnomics--tablets to help in the calculation of the required parameters to construct sundials on all surfaces independent of their direction or inclination.

Spherics--tablets to help in the calculation of the movement of the sun, the times of sunrise and sunset for any given day of the year, and other similar problems.

Planetary movements--tablets to perform calculations to determine the motions of the planets and to cast horoscopes.

Earthworks--two sets of tablets dealing with the calculations involved in cut-and-fill problems for the construction of canals, etc.

Music--tablets to aid the novice in composing music and creating melodies.[6]

Napier's invention was still being modified towards the end of the nineteenth century when Henri Genaille and Edourard Lucas modified the concept for rulers that they

[6] Williams, M.R. "From Napier To Lucas: The Use Of Napier's Bones In Calculating Instruments," *Annals of the History Of Computing*, Vol. 5, Number 3. July 1983 (p. 279-296), p. 289-291.

invented that performed various mathematical functions.

Conclusion

Even though John Napier lived far before people were even beginning to think about the concept of the computer, his life has had a tremendous impact on its invention. Through the development of logarithms and his "Bones," Napier influenced many of the early inventors of calculation aids and devices. It was these devices that led to the advent of the computer. Computers were developed to ease the burden of performing long, complex mathematical calculations by hand or with clumsy, limited mechanical calculating devices. John Napier was accomplishing that same goal in his day. Logarithms and Napier's bones are both means of improving the process of finding the answers to cumbersome arithmetic in a more efficient, effective, and reliable manner. Computer technology owes a great deal of gratitude to John Napier, his inventions, and his foresight. Without them, the history of computing would be irrevocably altered.

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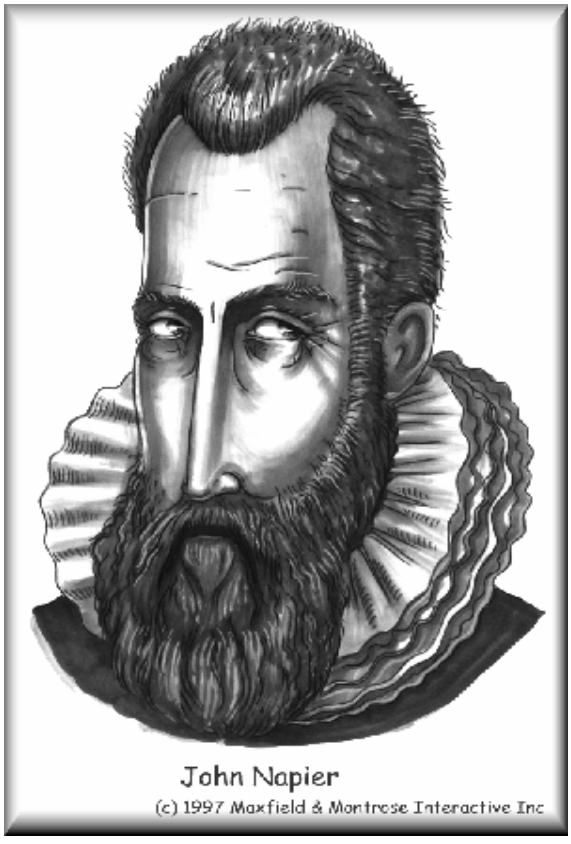

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