**The Foundations of a Technological Revolution**

When we think of computing pioneers, our minds generally turn to the likes of Bill Gates, Steve Wozniak, and Steve Jobs; the most recognizable figures seem to be those that have promoted innovation over the last few decades. These pioneers have made a name for themselves tweaking and building upon the established foundations of computing at large (often doing so in a way that makes for great consumer electronics). While no doubt notable in the way that they have changed our perceptions and expectations of computing, it is equally important to recognize that the early and foundational basis for computer science occurred well over a century to go. Without the early discoveries founded by the many intellectuals discussed in other sections, there would be no basis for the revolutionary technologies emerging in the present.

Though the integrated circuit was founded after 1920, the foundations that laid its logical basis were created far earlier. George Boole’s “Boolean Logic” has paved the foundation for nearly all of the computers and microprocessors currently being utilized. Expanding upon simple “yes or no” messages, Boole made an easily digestible system of “logic gates” that allow logical operations and arguments to be performed with absolute certainty. He did not create this system solely for its use in computerized systems; on the contrary, it is unlikely that he had the foresight to perceive such a monumental shift in technology. However, it is universally agreed that it’s most important purpose has been in the realm of integrated circuitry. Nearly all of today’s electronic devices utilize George Boole’s system to perform basic operations, and more complex ones through the chaining of multiple logic circuits. It has provided an indispensible process for modern data processing. Without this fundamental understanding of logical manipulation, it is unlikely that our technological advancements would have expanded at anywhere near the rate that reality has blessed us with.

The actual mechanical computing devices conceived before the twentieth century have also had tremendous impacts on the evolution of systems that we’ve seen over the last several decades. Obviously, there was no such thing as a graphical user interface during this time; television was an emerging technology at best. The earliest pioneers had the daunting task of creating visual systems for both displaying and storing data. The first of these ideas spread and evolved into the modern interfaces and storage systems that we now consider normal (but of course, on a significantly more advanced and compact level). For example, the Analytical Engine was able to print its findings in the form of numbers. The ability for an unintelligent machine to display accurate characters in a language easily understood by humans is one the primary purposes that we use computers at large, and makes their utility wholeheartedly worthwhile. The use of punch cards as input, and often output laid the groundwork for modern data entry. At the most basic level, these punch cards were nothing but a bunch of ones and zeroes conveying bits of data to the machine. This purely analog method of data entry inspired the processes that are now used to store data digitally; whether that be through flash memory, hard drives, floppy discs, CD ROMS or otherwise, every bit of media is fundamentally stored with the same “on or off (punch or no punch)” premise. Though the density has expanded exponentially, the theory remains largely the same.

Hand in hand with the concept of diverse input is the ability to dynamically program a machine to preform a vast array of tasks. This process was first conceived by the likes of Ada Lovelace and Charles Babbage. They succeeded in creating unique algorithms intended to be run solely on programmable machines. Though exceedingly basic by todays standards (Babbage’s Analytical Engine was said to be capable of finding the product of two, twenty figure numbers in three minutes. For comparisons sake, a basic cell phone can perform the same operation in a matter of milliseconds), the concept of a machine with a wide array of programmable inputs was nothing short of revolutionary at the time. It’s akin to machine code; less of a language easily understood by humans, and more the fundamental basis in which the machine operates. These basic concepts have paved the way for the far more complex programming systems of today, including those that are more easily learned and understood by the end user and developer. By creating a basis for which the machine accepts data, the gates have been opened to languages such as Java, Visual Basic, and C (Many of which are object oriented, and therefore more understandable in everyday usage scenarios).

Early mechanical computers also delivered a basis of precision and complexity necessary in completing tasks with indisputable accuracy. The Antikythera Mechanism is perhaps the best example of this incredible complexity. Using an intricate and intertwined series of small gears, this mechanism was capable of predicting and analyzing very specific solar cycles. It is the very first known analog computer, dating back over 2000 years. Charles Babbage had a similar understanding of the precision required in creating an accurate decision when creating the plans for his Analytical engine. Every gear, dial, and number had to reside in perfect alignment at all times, else the machines accuracy and overall utility would be all but sacrificed. The same is true in today’s microprocessors. Individual paths, components, and structures are so meticulously put together, and so amazingly small, that the smallest bit of latency or error can end up causing long term performance issues. Many chipsets require completely sterile and dust free environments to be produced. There is a mechanical and structural integrity that must be upheld, and that is rarely seen in other mechanical processes (this is mostly attributed to the incredibly small scale of individual circuits.

To reiterate, it is far more than the recent technological entrepreneurs of late that we have to thank for the computers sitting before us. It is a culmination and a summation of vast amounts of information, transcending many generations.