"I regarded the Computer as a rare Machine"

The development of electronic calculating machines in Germany began a good fifty years ago. One of the pioneers in this field is the now 87-year-old **Prof. Heinz Billing**, *Emeritus Scientific Member of the* **Max Planck Institute of Physics and Astrophysics** *in Munich. He reports here on the beginnings of scientific computers. The renowned "Heinz Billing Prize", named after Prof. Billing, has been awarded annually since 1993 with the aim of encouraging advances in scientific computing.*

MPR: *Professor Billing, you were one of the pioneers of computer development after the Second World War. How did that come about?*

Prof. Heinz Billing: In 1945, after the end of the War, we were initially pretty much isolated in Germany. I was working at the Aerodynamic Research Institute in Göttingen, where I was involved amongst other things with amplifier valves. At some point I read something about Eniac, the largest computer at the University of Pennsylvania, which worked with the help of 18,000 valves. I became immediately fascinated by the whole concept. I was on the lookout for a challenging project, and I was much more drawn towards developing computers than making little auxiliary devices for research.

MPR: *How did you then learn more about these new computers?*

Billing: In 1947 an English committee came to Göttingen to find out how far computing had developed in Germany. There were some famous people involved – including John R. Womersley, who had already worked as part of the war-time team on Colossus, the secret British computer. The renowned Alan M. Turing also visited as part of this committee. At the end of our discussions I asked Womersley to give me a little more information, and he obliged. I learned what a flip-flop was, and other circuits too. I received a forty-five minute tutorial from him. He also told me that they were working with binary numbers. This idea had never previously crossed my mind. I first learned during that tutorial that the binary system is far more convenient for computing than the decimal system.

MPR: *What kind of memory were the English computer scientists using?*

Billing: Womersley wouldn't reveal that to me at first – although I did ask him. I later learned that the English were working with an acoustic mercury memory. They used a mercury-filled device in which the numeric pulses circulated as sound pulses and were in turn amplified at the end.

MPR: *But then you hit on an entirely different method of storing information in a computer.*

Billing: Yes. Earlier on, during the War, I had had some contact with magnetic tapes. At first these tapes were used only for recording music. Then one night it occurred to me that it would also be possible to store numbers on them. I stuck the magnetic tape onto a rotating drum so that the stored information came back to the read head after each revolution. So now I had a fine storage system and started to build an adding machine. It wasn't long before Werner Heisenberg took an interest in my machine. He came to have a look at it and got me to explain everything. But at that time, immediately after the currency reform, there was initially no money, and I allowed myself to be lured overseas by the University of Sydney. A few months later, though, Heisenberg fetched me back to Göttingen.

MPR: *When did the first scientific problems come about that required a computer to supply the solution?*

Billing: It was not long after my return from Australia that researchers first began to come up with requests for help. The astrophysicist Ludwig Biermann, for example, wanted to calculate the paths of cosmic radiation in the earth's magnetic field, and he was in urgent need of a machine for that purpose. I therefore put the G2, which I was on the verge of optimising, to one side and quickly built a prototype of a smaller machine, the G1. This was capable of performing two operations per second and had a drum store which held 26 32-bit words.

MPR: *How was data entered on these computers?*

Billing: We modified a typewriter, which enabled us to enter data and commands via punched tape. These could be typed in directly in decimal form, and the computer itself converted them to binary numbers. We later used punched tape readers like the ones used with teleprinters.

MPR: *And how were the results put out?*

Billing: They were printed out properly in decimal form.

MPR: *Could you have believed at that time what powerful machines would develop from those first computers?*

Billing: No, I would never have believed it. When I went to Australia, I thought: yes, well, universities have a need for this kind of thing, there is a certain demand. I used to think of the computer as a rare and expensive machine which only a small number of institutes could afford, rather like large experimental facilities. What's more, the computers at that time were very unreliable. It would have been impossible to place that kind of thing in the hands of private individuals.

MPR: *Why were the computers so unreliable?*

Billing: Don't forget that we were working with amplifier valves at that time. A valve had an average service life of around 2000 hours, but unfortunately many of them broke before that. We developed our own procedure for finfinding and replacing any valves as they started to turn "deaf".

MPR: *Where did the valves come from?*

Billing: At first we had to get hold of them on the black market, but later on, by about 1950, I could already buy the same valves that Eniac had been built from.

MPR: *What is the function of the little lights on the outside of the computer?*

Billing: You could use those little lights to read what the computer had just done. They also made it easier to detect the development of faults. But this was difficult and required a great deal of intelligence.

MPR: *Your third model, the G3, which was completed in 1960, had a different kind of storage system.*

Billing: That's right, it used magnetic core storage. A minute ring of magnetisable ferrite was used to store each bit. Short surges of current running along the wires on which the ferrite rings were threaded resulted in magnetisation of the rings. Ferrite cores of this type enabled storage access times to be reduced considerably. I first got hold of ferrite cores as early as 1954.

MPR: *And did you recognise these ferrite stores immediately as a good idea?*

Billing: Oh yes, I certainly did. I was always on the lookout for suitable media to use as storage. I combed the entire field of physics hunting for suitable materials.

MPR: *Did your calculating machines actually generate much public interest?*

Billing: Yes, there was a great deal of public interest. Even the Federal President, Theodor Heuss, visited our institute in 1951 to see the G1. The entire German press covered the story. I have fond memories of his visit, and still to this day have some photographs of the event.

MPR: *Do you own a PC nowadays?*

Billing: Yes, my son gave me one as a present. I use it for writing and sending e-mails.

Interview: Brigitte Röthlein

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