Number crunchers

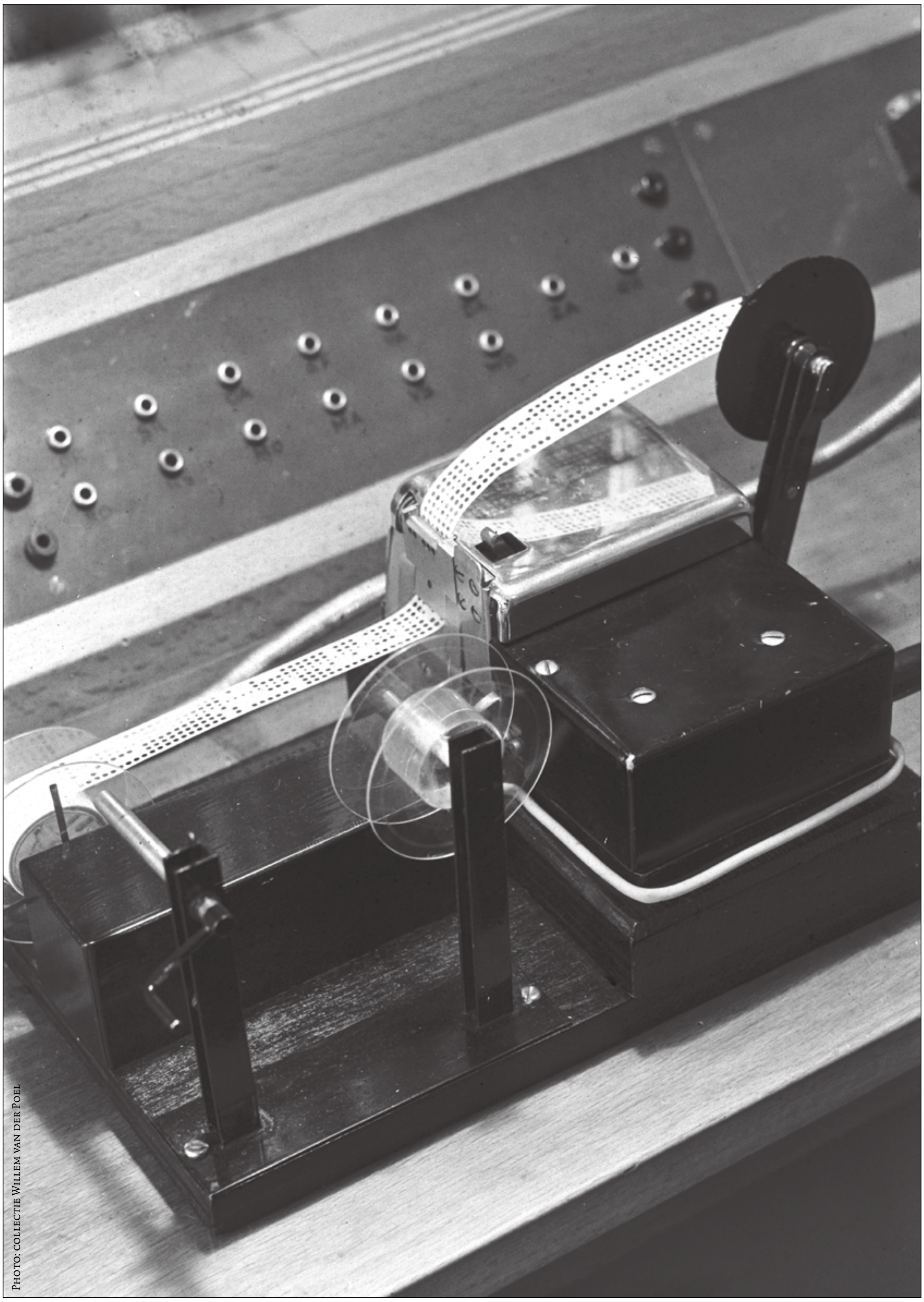

Photo: collectie Willem van der Poel

`At the Amsterdam Mathematics Centre, they turned their noses up at the 'trickology' of Delft computer pioneer Willem van der Poel. Even so, his early computers were reliable and efficient – most of the time.

Frans Godfroy

It was students who presided over the birth of the first Dutch computers. In 1947, Delft graduate Ad van Wijngaarden hired two mathematics and physics students - Carel Scholten and Jan Loopstra - for his recently founded Amsterdam Mathematics Centre. The students, given the daunting task of building an 'automatic calculator', never hesitated for a moment, before embarking on a great adventure that ultimately resulted in the Automatic Relay Calculator Amsterdam (Automatische Relais Rekenmachine Amsterdam, or ARRA).

Meanwhile, elsewhere, a student in Delft, Willem van der Poel, had spent the last few years dreaming of building his own automatic calculator. During the Second World War years, Van der Poel spent his days trawling through the library searching for information, and his nights drawing designs by the light of an oil lamp. His graduation supervisor of applied optics, Professor Bram van Heel, who designed lenses in partnership with local optics companies, was searching for ways of automating his time-consuming calculations. Van Heel had great expectations for his student's pioneering ideas, and thus, in 1947, he asked Van der Poel to work out his ideas into a practical application that could be used for lens calculations. Van der Poel's subsequent invention was called the Automatic Calculator for Calculations in Optics (Automatische Rekenmachine voor Calculaties in Optica, or ARCO), which others later renamed Testudo ('Tortoise'), because of its sluggishness.

The first

"There is some debate about which was the very first Dutch computer," Van der Poel, now 82, recalls. "The ARRA in Amsterdam was in use a bit earlier than ours, but it never worked as promised, and after just fourteen days they decided to modify it into the ARRA II. The Testudo, meanwhile, stayed in use for 12 years, starting in 1952." Van Heel certainly wasn't inconvenienced by the Testudo's lack of speed: "Testudo does its calculations at night, when I'm asleep."

But was Testudo a real computer? Some say no, because it worked by means of relays. Nonsense, replies Van der Poel: "Computers have been constructed that used water. You can direct a water jet left or right to create a flip-flop [elementary digital circuit, ed.]."

Van der Poel argues that Testudo was indeed a real computer, because it satisfied the Von Neumann criterion: "It used an instruction set for calculations. But limited capacity meant that it was used exclusively for the calculation of lenses."

Amsterdam mathematics and information technology historian Gerard Alberts disputes the Von Neumann claim for Testudo: "It's not a computer, it's a calculator, and was programmed by turning a telephone dial, which selected a different set of cables. You could call that a programme, but it was hardwired nonetheless."

But which was the country's first computer is not an important question, according to Alberts, who regards the introduction of calculators and computers as, above all, a step in the development of information technology. In the Netherlands, the history of this field dates back to the start of the 20th century, when calculation became a serious field in its own right.

The hosting of the International Congress for Applied Mechanics in Delft, in 1924, marked a milestone. Two junior Delft professors, Cornelis Biezeno and Jan Burgers, put Delft firmly on the map of world mathematics and mechanics. In one fell swoop, they had managed to get their names noted by the ZAMM community, the scientists affiliated with the authoritative Zeitschrift für Angewandte Mathematik und Mechanik (Journal of Applied Mathematics and Mechanics). In Delft, however, the importance of these proceedings went largely unnoticed: Biezeno and Burgers were and remained teachers in a field that didn't even offer graduate degrees. "The ZAMM community was a subculture in international terms," Alberts explains.

Even earlier, in 1913, a frustrated professor, Frederik van Iterson, after teaching for three years in Delft, decided to resign his post, because the university's Supervisory Board had not only refused him the use of a research laboratory, but had also informed the Dutch Minister of Education that the grant request the professor supported for a establishing a laboratory in Delft, which would also benefit the Dutch Aeronautical Society, did not serve any educational purpose. The concept of a research university in those days was a remote one. Alberts: "The prevailing ideology was that education must serve a practical purpose."

Events during the First World War however would soon drive home the importance of aeronautics, and with it the importance of aerodynamics. In 1918, Burgers was appointed the first professor of aerodynamics and hydrodynamics, and he was given use of a laboratory, in which he also temporarily accommodated Van Iterson's successor, Biezeno, until he too was eventually given the opportunity to set up his own lab.

Burgers and Biezeno used their calculations to tackle the technical challenges of the new age. "Burgers was a totally dedicated number-cruncher," Alberts wrote in his book on the rise of information technology in the Netherlands. Nevertheless, the professors simply lacked computational power: mathematical models often proved to be too simplified to serve as the basis for reliable predictions. In other fields as well, such ▸▸

'In 1953 Van der Poel completed Ptera, the first Dutch electronic computer'

as research on tidal currents, engineers were similarly hindered.
Van Wijngaarden, who in the early 1940s spent long days and nights doing calculations in support of his tutor Burgers' hydrodynamics research, eventually gave up. He later said of this period: "It didn't yield the degree of insight I was looking for." He'd had it. It was time for a different approach. After the Second World War ended, Van Wijngaarden went to work at the Amsterdam Mathematics Centre, where he would help develop the ARRA.

Computer nursery

In 1947, Leen Kosten, head of the mathematics department of the central laboratory of Dutch telephone company PTT, was asked by his bosses to build a computer. This computer's intended purpose was to help test the capacity of the telephone network. Kosten regarded Van der Poel as the ideal person to help him realise this project. Kosten had also helped Van der Poel in the past, by supplying 600 relays from the PTT laboratory for Van der Poel's Testudo machine. Once the youthful researcher had graduated in 1950, Kosten hired him. Van der Poel completed the assignment in 1953, when the first Dutch electronic computer, the PTT Electronic Calculator (PTT Electronisch Reken Apparaat, or Ptera), entered service, with 700 vacuum tubes serving as the Ptera's humming brain. Memory capacity was provided by a rapidly rotating drum that could store and retrieve magnetic signals.

Unfortunately, Ptera proved to be rather unreliable. Problems with falling valve emission levels required constant attention, which, in practice, meant 50 percent uptime and 50 percent downtime. Van der Poel dedicated himself to designing a successor, the Very Simple Binary Calculator (Zeer Eenvoudig Binair Reken Apparaat, or Zebra). Gone were the days when a designer could cobble together a computer by himself. Van der Poel therefore considered producing his design in a series. He went in search of a company that could see the commercial benefits of such an undertaking. Electronics giant Philips passed on the offer, "due to lack of vision", Van der Poel says. In exchange for a guaranteed purchase of components, Philips had agreed with IBM not to market any computers of its own.
Opportunity beckoned abroad, however. While designing the Zebra, Van der Poel had been in regular contact with the company of German computer pioneer Konrad Zuse, whose chief designer, Theodor Fromme, was working on the Minima and the Z22. Van der Poel and Fromme exchanged many ideas, and it therefore was no coincidence that the Z22 and the Zebra were similar in many ways. Zuse, however, was not interested in producing the Zebra, preferring instead to stick to his own line of designs.
Van der Poel was more successful at the British company, Standard Telephone and Cables, which started series production of the Zebra in 1957. Van der Poel remained responsible for the software. His star rose. He had gained his doctorate in 1956, and in that same year had taken over Kosten's job of running the mathematics department of PTT's central laboratory. Kosten meanwhile had accepted a post as professor of pure and applied mathematics at TU Delft.
The launch of the Zebra sounded the death knell for Ptera. The concept of computer heritage had not yet been developed. Van der Poel: "The room that housed Ptera had just about enough space left to accommodate the Zebra. But then we thought how much better and how much faster Zebra was, so that same day we demolished Ptera with a fair degree of sadistic pleasure."
Between 1958 and 1967, some 55 Zebras were sold worldwide, nine of them in the Netherlands. TU Delft was one of the first customers: in 1958, a Zebra computer was installed on the second floor of the main administration building on the Julianalaan. Other institutions followed: the universities of Groningen and Utrecht, TNO, the Dutch navy, the National Aeronautics Laboratory, Philips, Heemaf, and, of course, PTT, where the computer had started life. Together with the manufacturer, Van der Poel continued working on improvements. This resulted in the Zebra II, which featured the addition of extra fast registers, and transistors instead of vacuum tubes.

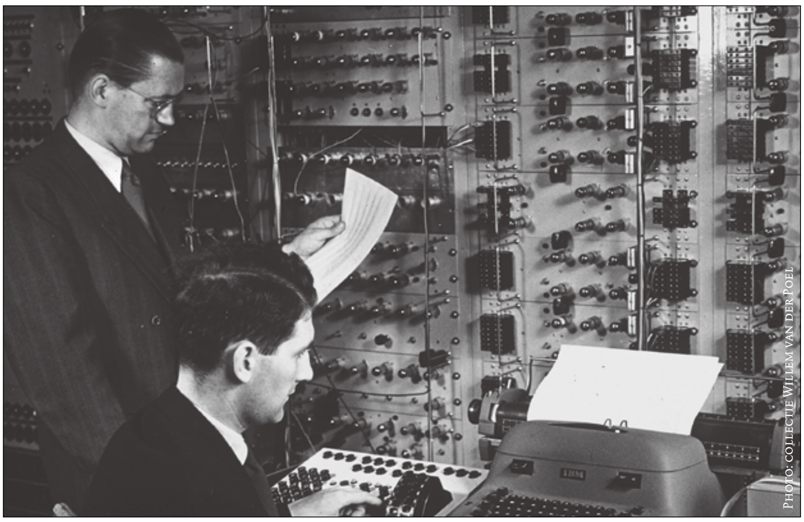
Photo: collectie Willem van der Poel

Underwater programming

The rivalry between the Amsterdam Mathematics Centre and TU Delft did not compromise the mutual respect Van der Poel and Van Wijngaarden had for each other, and it was self-evident that Van der Poel would ultimately pursue a doctorate in Amsterdam, which he did in 1956, under the supervision of TU Delft trained Van Wijngaarden. Years later, Van der Poel would return the favour, acting as honorary supervisor when TU Delft bestowed an honorary degree on Van Wijngaarden in 1979.
Such was the special relationship between these two men that they also travelled together to Cambridge in 1950 to attend a computer programming course, a new phenomenon at the time. The knowledge Van der Poel gained there stood him in good stead when he came to build the Zebra. A prerequisite for the Zebra was that the hardware should be as simple

as possible, and that the software should conduct the majority of the calculation work. While the Zebra was under construction, Van der Poel wrote a programming language, called Simple Code, which was followed soon thereafter by an Algol compiler. In his work, Van der Poel was assisted by a deaf and blind assistant, Gerrit van der Mey. To make it easier for these two men to communicate, the PTT laboratory built a variety of instruments, including a Braille telephone and a mechanical Braille typewriter. The highly gifted Van der Mey remained with Van der Poel up to his retirement in 1978, even after the latter had been appointed professor at TU Delft in 1962.
Van der Poel followed a different course than his colleagues at the Amsterdam Mathematics Centre. He had bet everything on simplicity of design, not

'Cobol may be an awful language, but it works'

least of all because of the fragility of the computer's physical construction. Van der Poel: "Radio tubes would suffer from falling emission levels, so you had to do as much as possible with the least number of tubes. This meant that we had to pull out all the stops, use every trick in the book." An amateur magician himself, Van der Poel coined the term 'trickology' and its synonym, 'underwater programming'.
One of the principles successfully applied in the Zebra was the use of functional bits, a technique Van der Poel had tried earlier in 1952 on the Very Simple Calculation Device (Zeer Eenvoudig Reken Orgaan, or ZERO), a temporary small test computer he had constructed from parts intended for the Ptera. The ZERO machine used four functional bits, while Zebra had 15, each of which controlled its own port with an attached function. Every combination of bits was allowed, providing access to a vast number of different operations.
Like the Ptera, the Zebra featured a drum memory device; however, the access time presented a real problem, because each additional revolution between writing and reading operations increased the delay. Van der Poel sidestepped this problem to some extent through clever programming: he allowed the instructions and data to be written to alternate memory lines on the drum, which considerably reduced the access time. At the Amsterdam Mathematics Centre, such optimised programming techniques were frowned upon. Van der Poel's counterpart in Amsterdam, Edsger Wybe Dijkstra, regarded programming tricks that worked around hardware delay problems as inelegant. To the more pragmatic Van der Poel, this was amply offset by another ideal of beauty: optimum efficiency.
Conflicting opinions about the principles of programming would feature high on the agenda over the ensuing years, in particular when different languages evolved to vie for supremacy. In 1961 and 1962, a committee of the International Federation for Information Processing (IFIP), which included Van Wijngaarden and Van der Poel, met to discuss the Cobol programming language. Dijkstra did not attend.
Van der Poel: "Dijkstra absolutely loathed Cobol. But let's not forget that Cobol is still the most used language. Practically every banking institution and all financial administrations run on Cobol. It's easy to say that Cobol is an awful language, but creating columns and tables, which is what banks want, simply works. Pretty or not."
In 1962, the IFIP established a study group to further develop the Algol scientific programming language. Friend and foe alike attended this time. The Dutch delegation included the patriarch Van Wijnbergen, Dijkstra, who had since been promoted to a professorship at TU Eindhoven, and Van der Poel, who was made chairman. For the next six years, until 1968, the group worked on establishing rules for Algol60 and an improved version, Algol68. Unfortunately, the group failed to agree on the introduction of Algol68, so Swiss IFIP member Niklaus Wirth, Dijkstra, and five others split from the group and developed Pascal. Dijkstra severed all contacts with his former boss, Van Wijngaarden. Wirth was able to write a machine-independent compiler relatively quickly, and this greatly contributed to Pascal's popularity. Algol68 never made it, although it did much to influence the C programming language, which was used to write Linux, among other software.
Van der Poel, the IFIP's former chairman, recalls the era with mixed feelings: "Van Wijngaarden, Bauer from Munich, Dijkstra, they all had such huge egos. The way they fought over semicolons, you wouldn't believe it. It certainly taught me how big a role emotion can play in a scientific committee."
◂◂

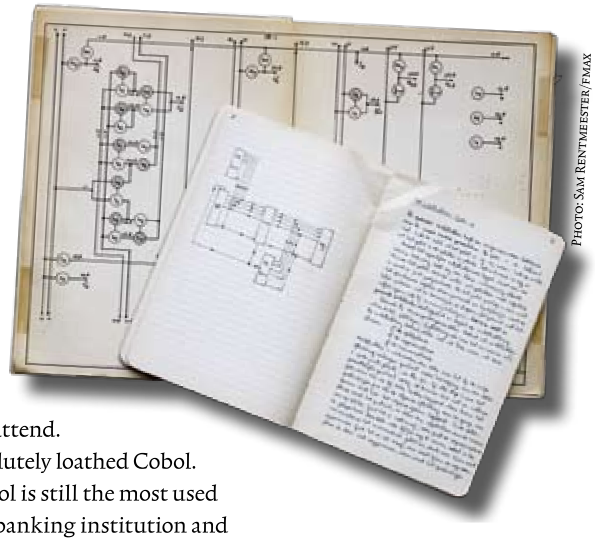
Photo: Sam Rentmeester/fmax

Graduate report and orginal design drawing of W illem van der Poel.

More information:

A. van den Bogaard (ed.), H. Lintsen, F. Veraart, and O. de Wit, *De eeuw van de computer. De geschiedenis van de informatietechnologie in Nederland* (Deventer, 2008)

E. van Oost, G. Alberts, J. van den Ende, H. Lintsen, *De opkomst van de informatietechnologie in Nederland* (Den Haag, 1998)

J. van den Ende, The Turn of the Tide. *Computerization in Dutch Society, 1900-1965* (thesis Delft, 1994)

www.math.leidenuniv.nl/~naw/serie5/deel06/dec2005/pdf/vanderpoel.pdf

Prof. Dr W.L. van der Poel
w.l.vanderpoel@tudelft.nl