THE PIONEER ERA IN NORWEGIAN SCIENTIFIC COMPUTING (1948 -1962)

Drude Berntsen

Director of the Norwegian Computing Center 1970 – 1989; drudeb@broadpark.no

Abstract: This paper gives a survey of the pioneer era in Norwegian scientific computing. Right after the Second World War research councils and research institutions were established and young scientists got scholarships to study abroad. Many caught interest in the new mathematical machines. In 1950, the Royal Norwegian Council for Scientific and Industrial Research decided to build a Norwegian computer, later called NUSSE, and by 1952 the Norwegian Computing Center for pure and applied research, was organized. The paper describes activities at the universities in Oslo, Bergen, and Trondheim, as well as at the Norwegian Defense Research Establishment at Kjeller. In the late 1950s, both the Central Bureau of Statistics and the Norwegian Meteorological Institute installed their first general-purpose computers. This was before such computers were installed at the University of Oslo and at the NTH, the technical university in Trondheim. The paper closes noting the contract signed in 1962 for the first UNIVAC 1107 to Europe.

Key words: Scientific computing, pioneers, NUSSE, Norwegian

1. THE PERIOD BEFORE 1949 (BEFORE THE REAL START)

The Central Bureau of Statistics in Norway ordered their first Hollerith tabulator in 1894. Norway used it for the censuses in 1900 and 1910. When the war broke out in 1940, there were 27 punched card installations in the country mostly in public offices, insurance companies, and in industry, but also some in the universities.

Professor Svein Rosseland at the Institute of Theoretical Astrophysics at the University of Oslo (UiO) searched for tools and new methods for solving

differential equations. In 1934, he got the permission to build a differential analyzer based on drawings from Vannevar Bush, a professor at the Massachusetts Institute of Technology. This was a mechanical device to solve differential equations. When it was ready for use in 1937-38, it was the most advanced in the world. It occupied about 100 square meters in the basement of the institute.

Early in the war, the Germans asked Rosseland for a meeting to see if they could use the analyzer to calculate ballistic formulas. When they later wanted to use it, Rosseland had gone to the US "on vacation". He became a professor at Princeton University for five years. Professor Brahde who had been present at the meeting could not help the Germans. They soon decided to dismantle important parts of the machine and bury them in the lawn in front of the institute. Without these parts, the machine would be of no use to the Germans. After the war, they reassembled and further developed the analyzer. Ole Amble, who later became a key person in the software development for Norway's first electronic computer, made it possible to multiply on the machine.

However, the economists and the chemists at the University of Oslo, as well as the meteorologists in Oslo and Bergen found interest in punched card calculators as well as desk calculators. So also did the researchers at the newly established Norwegian Defense Research Establishment (FFI). Jan V. Garwick, who had been an assistant to Professor Rosseland, moved to FFI in 1947 and as leader of the mathematical section, he became a key person in the development of scientific computing in Norway in the 1950s. FFI preferred equipment from Frederic Rosing Bull—machines they could modify according to their needs. Bull was a Norwegian inventor who died in 1925, but his patents resulted in the foundation of the French "Compagnie des Machines Bull" in 1933.

2. THE PERIOD 1949–1955 (THE VERY BEGINNING)

The Royal Norwegian Council for Scientific and Industrial Research, called NTNF, was established in 1946. This Council was to promote research and development. Quite a few young scientists received scholarships to the US as part of the Marshall Aid program.

One of those young scientists was Henry Viervoll. In 1948, he wrote home from USA to his professor of physics at the UiO about the modern computers developed during the war. Because of this letter, three professors at UiO proposed to NTNF in November 1948 that they should set up a "Committee for Mathematical Machines". By January 1949, they

established the committee. Most of the eight members of the committee were active researchers who themselves were performing heavy computations and therefore were very interested in these new mathematical machines. Viervoll was the secretary for the committee while Professor Halvor Solberg from the Institute of Theoretical Meteorology, UiO, became its chair. The committee had the task of studying the new electronic calculators and estimating their possible use in industrial and scientific applications.

Already in their first year, the committee proposed to NTNF the building of a Norwegian computer and the establishment of a national computing centre for civil use. They proposed to coordinate the use of all available equipment, including punched card equipment at the universities and at FFI. Some funds were also made available, but only just enough to construct an electromechanical machine, estimated to cost NOK 200,000.

In 1950, they engaged Thomas Hysing to be in charge of the construction. First, they planned for a Zuse machine, but after a visit by Professor D.R. Hartree from Cambridge, they discovered that, within budget, they could afford an electronic computer based on components from Dr. Andrew D. Booth who had constructed the APEX C. Construction of the input/output devices could take place in Norway at the Central Institute for Industrial Research (SI) that NTNF had established a year earlier. By this shift in strategy, they extended the time schedule by a year to 1954. They named the computer NUSSE.

The Committee also supported further development of the differential analyzer at the institute of Professor Rosseland, and initiated construction of another differential analyzer in Trondheim at the Norwegian Technical University, NTH. Jens Glad Balchen, who returned in 1951 from a scholarship in the US, constructed DIANA, an analogue computer well suited for his work within the field of automation. He started in 1952; by 1955, this specialized machine was available. They further developed DIANA well into the 1960s.

For the other users NTNF decided, in January 1952, to establish the Norwegian Computing Center for pure and applied research (NCC) as an organization with branches at the university sites and at FFI at Kjeller. The main branch got offices together with SI in Oslo. For the local branches, they appointed contact persons. The NCC had at its disposal various punched card equipment, the differential analyzer at UiO, and later NUSSE and DIANA.

Already by the beginning of 1954, they had installed a new tabulator, reproducer, collator, and sorter at NCC's premises in Oslo. With this equipment, the main branch of NCC could better fulfill its obligations and undertake a variety of jobs for industry and scientific institutions, mostly numerical calculations of mathematical and mathematical-statistical nature.

In those days, IBM rented machines for scientific use at a special discount. Per Gotaas, an insurance mathematician became director of NCC. He himself worked mainly on these IBM machines.

In Bergen, they wanted to be just as advanced as the Oslo branch. In 1952, the Institute of Geophysics at the University of Bergen (UiB) rented an IBM 602 A. By mid-1955, they expanded this business to a centre for the whole university. Professor Carl Ludvig Godske was an important person in Bergen. He was a member of the NTNF Committee for Mathematical Machines, and one of his colleagues was Kåre Fløisand. Already in 1952 Fløisand had published papers in the NCC series on subjects such as "Punched card equipment and their use in scientific computations" and "The mark sensing method and a survey of its accuracy".

The staff at NCC in Oslo also expanded. Ole Amble and Tor Evjen engaged to undertake the mathematical coding and programming of NUSSE, together with Werner Romberg from Trondheim. From 1953, they made routines from scratch for all general functions on the machine, for instance; "subroutines" in machine code on paper tape for calculation of sinus and for square root. In 1954, the machine was ready for use by others, but the programming was not easy. Amble was a good mentor; he made documentation and helped new users to get started.

The physicist John Midtdal at UiO was one of the pioneers using NUSSE. When Hysing and his assistant Kjell Kveim went home at night, he started his own work on the machine. He was searching for "the zeroes in the zeta function". He used NUSSE to get within an accuracy of 55 decimal places. Odd Hassel, who in 1969 received the Nobel price for chemistry, worked within crystallography, making a series of two-dimensional Fourier-syntheses for crystal structures. NUSSE could invert matrices and do matrix multiplications. Amble and Evjen also developed a program for linear programming that could solve 15 equations with 15 unknowns, but Professor Ragnar Frisch, to receive the Nobel Prize for economics in 1969, wanted a program for 100 unknowns.

NUSSE required very stable current. Every day when a big iron foundry, Christiania Spigerverk some 5 km away, turned on or off its ovens, NUSSE failed. Its use needed modification for this and nighttime usage proved best.

Since NUSSE was quite unstable, it was not suitable for commercial jobs at NCC. In 1955, NTNF also put restraints on NCC that they should have users that were willing to pay for their services and especially for programming. NCC had to rely on the punched card equipment for most of its income.

When, in 1956, NCC moved from its premises at UiO to the new institute building for SI, they decided to improve NUSSE. They eliminated many of the weaknesses when it once more became operative in February 1957. By

then the scientific community needed more power and they were looking for other possibilities.

3. THE PERIOD 1955–1961 (IMPORTED COMPUTERS)

The construction of NUSSE had been a research task, but after its completion, SI regarded it as a tool for industrial development. They invented a special purpose device for numerical control, called ESSI. They installed it to control a flame cutter at the Stord shipyard in the autumn of 1960. The Autokon system for the shipyard industry was an important result later on, as addressed by Trygve Reenskaug in this publication.

In 1956, NCC rented a new electronic calculating punch from IBM, an IBM 626. This machine could add, subtract, multiply, and divide and it could execute a program. Being a real mathematical machine, it could automatically do a series of numerical calculations.

They transferred a big job from Bergen to NCC in 1957. The job was to make monthly statistics for the Meteorological Institute. Every month 30,000 punched cards were read and they used a special alphanumerical tabulator with special "weather characters" to present the results.

While NUSSE was under construction, Garwick at the military computing centre at FFI was preparing for an electronic computer. At that time, they used punched card equipment from an improved Bull to solve their special mathematical problems. In 1954, they decided to order a Mercury machine from Ferranti Ltd, a British firm that collaborated with the University of Manchester. As was the norm in the 1950s, it had taken two years from the time of order to the date of delivery. During that time both Garwick and Ernst S. Selmer (who later became professor in mathematics at the UiB) had worked with the development team and influenced the design and instruction set. They therefore knew the machine very well on its arrival. They named the FFI machine FREDERIC and it was one of the biggest at that time.

Few programming tools followed FREDERIC from the supplier and the users became impatient. Among them was Kristen Nygaard who from 1956 was head of a group for operational research. A very active programming group developed at FFI including Svein A. Øvergaard who later became the leader of the next computing centre at Kjeller, and Ole Johan Dahl who developed the language MAC based on Algol. He made an efficient compiler for MAC. FREDERIC was in active use for seven years. The users came from many scientific groups in the Oslo region.

Another impatient user was Professor Godske at the UiB. The University had had support from NTNF for their punch card installation for four years, but this support ceased in 1956, when they joined in with ten firms in Bergen to establish EMMA (Electronic Mathematical Machine A/L) with the intention of renting and operating an IBM 650. They then also experienced that a newly established state committee with the purpose of coordinating government use of computers, did not allow the University to enter into this enterprise. UiB made this a political matter by using the media, and the Ministry of Finance gave in and allowed the use of NOK 130,000. By April 1958, the IBM 650, the only one installed in Norway, had arrived. They advertised it as the first computer suited for both scientific and commercial use.

Hans W. Gullestad who from 1953 had been in charge of the West Coast Punched Card Centre became the Director of EMMA. Later in the 1950s, similar centers appeared in other places. The EMMA became famous by the summer of 1958 when it was used to calculate the taxes for the about one million Norwegians. Punched cards with taxation data for each person were sent to EMMA and after the operation, punched cards with the result per individual were returned. Newspapers all over the country were telling about this "beautiful EMMA with all her attributes, who does everything that has to be done. This wonderful "girl" is an electronic computer that jerks and works and spits out results that are indisputable – maybe?" One of our famous entertainers, Einar Rose, became upset by this talk about his wife and especially when they announced she was available to the whole country.

The staff at the NCC in Oslo also wanted an IBM 650, since IBM offered it on rent at 40% of the normal price for the industry. By 1957, contact had been made between the Central Bureau of Statistics (SSB) and the NTNF. SSB wanted to buy a modern electronic computer. Their choice fell in December 1957 on DEUCE (Digital Electronic Universal Computing Engine) made by English Electric. A committee appointed by the Ministry of Finance was in favor of buying the machine for SSB, if NCC could take over 50% of its capacity for the use of other institutions. The decision was based on a special study of the need for electronic computers in government public service. The director of SSB, P. J. Bjerve was a strong man and he wanted NCC reorganized as an independent research institute under NTNF, an institute that could help run the computer and that could also receive research grants from NTNF. The deal between NTNF and SSB was made and by 1 July 1958, NCC became an institute and the NTNF Committee from 1949 dissolved. In February 1959, DEUCE arrived. SSB was the first statistical bureau in Europe to get an electronic computer, at the cost of 1.1 million NOK. DEUCE had only punched cards as input and output and no line printer at the time of delivery.

NCC moved all its punched card equipment to the premises of SSB in down town Oslo and all together the installation was considerable. They installed DEUCE on the same premises and NCC was the operator and had the responsibility for technical maintenance. They carried out this responsibility partly by the technicians at SI who had been involved in the construction of NUSSE. There were many problems with the operation of DEUCE, not only in the initial phase, and programming was difficult. The machine was better suited for SSB with their production of statistics based on lots of data and limited calculations than with NCC's more complicated mathematical calculations based on limited input data. The initial contract outlined collaboration for six years, but after two to three years, NCC wanted to cancel the agreement and SSB was looking for additional equipment. In 1961, SSB itself installed an IBM 1401, the first one in Norway, used for the census of 1960.

NCC's first task on DEUCE was really a struggle. Ole Amble was responsible. They were to calculate the income for all the forest owners in Østerdalen. The data about how much timber had been delivered in the winter of 1958-59 was on 60,000 to 70,000 punched cards and they should calculate volume, prices, and income for everybody. The deadline was April 1959 just during the installation period. Amble and the programmer Svein Bækkevold worked hard through the Easter vacation and succeeded.

In 1959, the Norwegian Meteorological Institute (DNMI) also decided to get a computer that they could use for weather forecasting. They ordered a FACIT from Sweden and it became operative in June 1961. It was then the biggest electronic computer in Norway. DNMI was the third national weather institute to get a machine of their own. The cost was 4.5 million NOK. All input and output was on punched paper tapes or cards. After some time the machine got a very good ALGOL compiler.

By 1959-1960, NTNF was worried because NCC had developed into just a commercial computing centre. The scientific community had lost their centre, a place for requesting support and getting access to modern technology. Therefore, they asked Kristen Nygaard at FFI to come to NCC to build up a research group in operational research there. In May 1960, he left FFI and that summer four other members of his group followed. They did not want to be involved in punched card calculators or DEUCE. Therefore, they kept on using FREDERIC while they were looking for other possibilities. In the spring of 1961, the ideas for a language that could serve the dual purpose of system description and simulation programming originated at NCC.

At the UiO physicists and chemists continued to use NUSSE, but some of them had moved to FREDERIC. In 1960, a journalist from the newspaper Aftenposten made a portrait interview with the Swedish financier Axel Wenner-Gren. By that time, he had given a Swedish made computer

Wegematic to some Swedish universities and he suggested doing the same for Oslo. The UiO was surprised when an offer arrived, but they accepted. In December 1960, the machine arrived. Programming tools were scarce. John Midtdal and Åmund Lunde made a small operating system for it and they made a compendium that they used for teaching programming. Wegematic was at first very unstable, partly due to unstable current. They built a special stabilizer. Ole Amble, from NCC, was in charge of the computing centre that became part of the Institute of Mathematics. Chemists became the main users and after some time, the only users. The machine needed two full-time technicians as the cooling system broke down very often and many tubes needed replacement.

4. THE PERIOD 1961–62 (EDUCATION EXPLOSION)

In 1962, the University of Oslo rented an IBM 1620 to replace the Wegematic, which they turned over to the chemists. They had many programs running on it and continued to use it for several years.

With the 1620, they used FORTRAN and life became easier for the users. The usage of the machine exploded and two years later, they installed another 1620. This time, the UiO was not offering any courses in computer science, just short programming courses for those who were to use the computer. The offered some courses in numerical analysis as an extension of a technical insurance seminar. Per Gotaas and Ole Amble were the lecturers. The UiB also installed an IBM 1620 and in 1963, they withdrew from EMMA, which became a pure service bureau.

NCC gave a full year course on "programming, system analysis, and quantitative methods" from 1962 and they gave short programming courses in Algol as the lack of skilled programmers was severe.

What about the activities in Trondheim? Svein A. Øvergaard had in 1957-58 been a visiting professor at NTH and he claimed that he gave the first computer science courses there. The year after, seminars started. Lars Monrad Krohn wrote the first master's thesis in digital techniques. He later became one of the founders of Norsk Data. In 1960, he moved to FFI where Yngvar Lundh with strong support from the director of research Karl Holberg, was active in building the electronic computer LYDIA for military use. They completed LYDIA in 1962 when this group undertook to develop SAM, a general-purpose computer.

By 1961, students wrote other theses on programming at NTH. Knut Skog presented his work "Heuristic programming" and they established a group for "Electronic Data Processing" at NTH. They received funds from

NTNF to build a digital computer, but decided instead to enter into collaboration with Regnecentralen in Copenhagen. In March 1962, they signed a contract and in November 1962, a GIER computer was on campus. Knut Skog, Olav B. Brusdal and Nils Michelsen participated in the construction.

NTH discussed whether their computer installation should be linked to the Institute of Applied Mathematics, as was the case in many places or whether it should be a more independent computing centre, that could do jobs also for private industry. They chose the latter and made it part of the foundation SINTEF, that came into being in 1950 just a few months after SI in Oslo.

They hired a British scientist, Norman Sanders, who worked for Boeing, to build up the Centre and persuaded Knut Skog to stay. Together they made the Centre flourish. The first year more than 500 students and employees at NTH had taken programming courses on the GIER. Algol dominated. Data and programs had to be loaded into GIER through paper tape produced on Flexowriters. Output was on paper tape and printed out on the same Flexowriters. Secondary storage was lacking and they had ordered magnetic tapes on a carrousel. They all strongly felt the lack of a line printer. At Easter time, Bech in Copenhagen agreed to supply the line printer and bill them for the carrousel, so that they did not get into trouble with government bureaucracy.

In March 1962, NCC also had entered into an agreement with Regnecentralen in Copenhagen for obtaining a GIER. Scandinavian cooperation was planned connected to this medium size computer. However, the scientists at NCC working on large simulation models felt they needed even more computer power. The possibility for this materialized when in May 1962 Kristen Nygaard was invited to the USA on an "executive tour" by UNIVAC and he was told about the new UNIVAC 1107. On this tour, UNIVAC became interested in the Simula language that Kristen Nygaard and Ole Johan Dahl were defining and in the linear programming work carried out by Sverre Spurkland based on a new method called parametric descent. In June, NCC received a half price offer from UNIVAC. Included in the deal was the delivery of a Simula compiler and a LP package. On 24 October, a contract was signed between NTNF and UNIVAC. NTNF arranged for a loan of 7 million NOK, that NCC should repay over eight years. By doing it this way, NCC did not have to go through normal governmental approval channels and the plans for a new computer to FFI were not disturbed. Consequently, they cancelled the contract for the GIER.

When it arrived in August of 1963, the UNIVAC 1107 was the largest and most modern civil computer installation in Europe. With this very strong tool and a surplus of capacity, a new era for NCC and Norwegian

computing started, including the development of Simula and object-oriented programming. You will hear more about that in other presentations in these Proceedings.

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Abbreviations for mentioned Norwegian institutions

DNMI	Norwegian Meteorological Institute
EMMA	Electronic Mathematical Machine A/L in Bergen
FFI	Norwegian Defense Research Establishment
NR	Norwegian Computing Center (NCC)
NTH	Technical University in Trondheim
NTNF	Royal Norwegian Council for Scientific and Industrial Research
SI	Central Institute for Industrial Research in Oslo
SINTEF	Research foundation linked to NTH in Trondheim
SSB	Central Bureau of Statistics
UiB	University of Bergen
UiO	University of Oslo