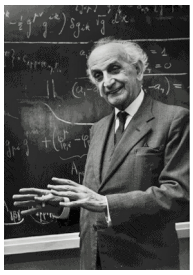
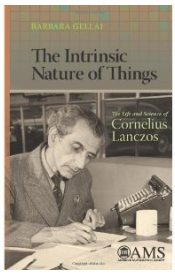
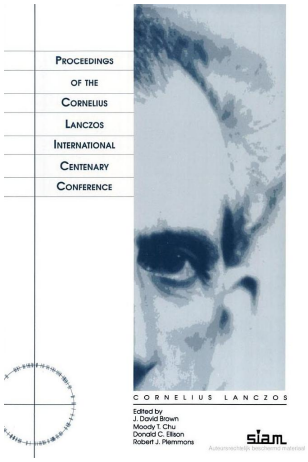
The intrinsic nature of things. Life and science of Cornelius Lanczos. *Barbara Gellai*, AMS, 2010 (xv+168 p.), soft cover, ISBN 978-0-8218-5166-1.

Cornelius Lanczos  



Barbara Gellai

Cornelius Lanczos was in the front lines of the scientific (r)evolutions of the twentieth century. Always seeking new challenges, he became a cosmopolitan, both geographically and scientifically. He has contributed to theoretical physics as well as to applied and computational mathematics. He survived two world wars and helped shaping Einstein's relativity theory and invented numerical techniques as computers gradually entered the daily lives of scientists.



Proceedings C. Lanczos centenary conference NCSU, Raleigh, 1993

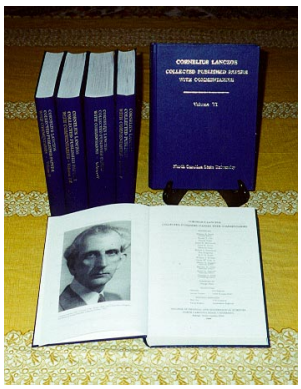
Lanczos was born on February 2, 1893 in Székesfehérvár, Hungary, some 100 km South-East of Budapest. Kronél Löwy, as he was called then, was the eldest of five children in a Jewish family. His father was a well-respected cultured man and his mother was a gifted pianist, something that Cornelius Lanczos inherited from her.

Out of respect and solidarity with their home country, the Löwy children decided in 1906 to change their name into Lanczos (pronounced 'lantsosh'), which sounded much more Hungarian, and means something like "fitted with chains". At first Lanczos kept his first name Kornel, but since 1935, he signed his papers with Cornelius. Lanczos was raised bilingual and spoke German as well as Hungarian.

After attending the Gymnasium, Lanczos went to the university in Budapest where he took physics, mathematics and philosophy. His math teacher was Leopold (Lipód) Fejér. After his graduation he became an assistant of Károly Tangl at the Budapest Institute of Technology where he had to supervise a chemistry laboratory.

Scientifically, this was a most exciting time that changed the world view: the interplay of Maxwell's equations (1861-62), special (1905) and general (1907-15) relativity theory, and the foundations of quantum physics being shaped and reshaped in this period. All this formed a boiling mixture that was at the focus of interest of all the big shots of the scientific community of that time.

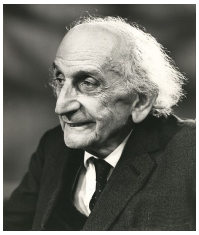
Lanczos too got interested in these topics and worked on a PhD on relatively using quaternions. He asked Einstein in 1919 to supervise it. However, Einstein replied that he, not being connected to a university, could not supervise. So Lanczos finished his doctoral degree with a thesis *The function theoretical relationships of the Maxwellian aether-equation. A contribution to the theory of relativity and electrons* in 1921 at the university of Szeged under the supervision of Rudolf Otvay. Because of a bad political climate and discriminating laws against Jews, it got never properly published. Soon afterwards Lanczos left Hungary to take a position at the university of Freiburg, Germany. Later he moved to Frankfurt am Main, where he attended several seminars that attracted scientists from all over the world.



Collected works Cornelius Lanczos, NCSU, 1999

Lanczos has always be a scientific loner not so good in teamwork. So when he was invited by Einstein in 1928 to spend a year with him in Berlin, Lanczos and Einstein had different ideas about what to research during that period and while so much was expected from their collaboration, not much, and not even a single joint publication came out of this.

In 1927 Lanczos married Maria Rupp, who had a delicate health, because of a tuberculosis condition. Nevertheless, Lanczos couldn't resist an invitation to come to Purdue University. So he left his wife with his parents and moved to the States in 1931. This was a whole new start since he switched form theoretical physics to applied mathematics, or "workable mathematics" as he called it. This is a characteristic of his. He often used his own terminology, which made his papers sometimes difficult to understand for others. In those days of desktop calculators, finding efficient methods and designing fast converging series was an absolute must (well, it still is with supercomputers, only the problems are many magnitudes bigger). In that period he designed his technique of telescoping series, the tau-method for solving differential equations, and used truncated Fourier series for noise reduction. He also joined for a while the Mathematical Tables Project of the National Bureau of Standards (NBS) (which most of us will know from the Abramovitch and Stegun's *Handbook of mathematical functions*). In 1939 he brought his son to the US, his wife being sick and his family hoping to escape the German hunt for Jews. However, shortly after, they were all transported to Birkenau and none of them survived. After his return in the US, Lanczos worked on his doubling algorithm (1942), which was closely related to the Cooley-Tucky algorithm (1965) for the fast Fourier transform.



Lanczos joined for a while the Boeing company in Seattle (1946-49) and later the Institute of Numerical Analysis (INA) of the NBS in Los Angeles (1949-1952). That institute had John Todd as the chief of the Computational Laboratory and Olga Tausky-Todd as a consultant. During that period, his most important contribution to numerical analysis was made. The Lanczos algorithm (1950), by which he is best known in computational mathematics, is an iterative method to compute the eigenvalues of a matrix, or, after discretization also of a differential equation. Because he didn't read Russian, and he could only look up the summary in the *Zentralblatt*, Lanczos denied that his method was part of the family of Krylov methods published by Alexei Nikolaevich Krylov in 1931.

In 1953, with an increasing pressure of McCarthyism, Lanczos was interrogated under the pretext of disloyalty. Lanczos knew that he should leave the US. Eventually, the INA in Los Angeles was closed down anyway. So he accepted an invitation of the Irish Prime Minister to become a senior professor at the School of Theoretical Physics of the Dublin Institute of Advanced Studies (DIAS). His son, who was then 20, decided to stay in the US. Whereas in the US he had to divide his time between teaching and research, here he was completely free to do research. Erwin Schödinger was the first president of DIAS. Lanczos and Schrödinger were not the best of friends. There had been disagreements on scientific matters before. In Dublin, Lanczos and his second wife Ilse Hildebrand were very popular, often organizing parties at their home that usually ended up with Lanczos playing the piano. Lanczos disliked arrogance, and Schrödinger, being president of the DIAS considered this position as the "most appropriate" for him caused 'some friction'. Although Lanczos had some disagreements with Einstein as well, his admiration for Einstein was so big, that they stayed in correspondence.

Although his position required that Lanczos switched back from applied mathematics to theoretical physics, he still did some of the latter now and then. He did re-invent the singular value decomposition (which he calls 'the decomposition form') completely independently and is involved in generalized inverses and in the discretization (he calls it 'algebraization') of differential equations.

He retires at the age of 75 from the Institute in 1968. He still travels and visits universities in the US and Germany. However a third heart attack was fatal. He became ill during an appointment with a journalist and dies the next day on June 25, 1973 in a Budapest hospital.

This is a very quick overview of Lanczos' life, just mentioning some basis 'facts'. This biography that was compiled by Barbary Gellai, also is mainly hooked up on facts, but in much more detail of course and with a lot more back-ground information. The scientific achievements of Lanczos are placed in a rudimentary but appropriate summary of the mathematical or the physical theory. There are also chapters of a more philosophical nature, Lanczos' vision of teaching, on mathematics and on nature. This booklet expands considerably her lecture at the Lanczos International Centenary Conference, held in North Carolina State University in Raleigh, December 12-17, 1993. She was also a driving force in publishing Lanczos' *Collected published papers with commentaries* (4 volumes), NCST 1999. The list of references, of Lanczos' publications, and time table, as well as the detailed index make it a useful tool.

Adhemar Bultheel