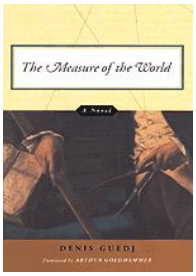
Denis Guedj *La Méridienne*, Robert Laffont, Paris, 1988/1999; *The Measure of the World*, The University of Chicago Press , 2001; *De medidiaan: het meten van de wereld*, Bert Bakker, 1999.







The metric system, as we know it today finds its origin in the French revolution. The "égalité" among people should also hold for the measures they use. A commission was installed consisting of Borda, Condorcet, Laplace, Legendre, and Lavoisier who wrote a report "Des poids et de mesures" that was presented in 1790. Romme, a mathematician had to design a new calendar (it was finally decided to keep 60 minutes in an hour, but weeks should have 10 days, and new names were invented for the months). Lavoisier was mainly concerned with the definition of the kilogram, the meter was defined to be the 40 millionth part of the meridian that passed through Paris. An effort to measure the length of this meridian had already been undertaken by Thury Cassini some 50 years earlier, but is was decided that a new commission would undertake this and measure the meridian between Dunkerque and Barcelona. The members were Méchain, Legendre and Dominique Cassini. The practical measurements should be done by two astronomers: Pierre Méchain and Jean-Baptiste Delambre. Delambre took the larger part from Dunkerque to Rodez, since that part had been prepared by Cassini and Méchain took the part from Barcelona to Rodez. So on June 24, 1792 they took off for what turned out to be an adventure of several years. They had to search for high buildings or towers, that should be the visual signals at the vertices of a triangulation of the area. To measure the angles, they used the repeating circle, an instrument invented by Borda.

This instrument consisted of two small telescopes each fixed to rings which could rotate independenly against a scale. To measure the angle between two points A and B, one scope was pointed at A, the other at B. The angle θ could be read off from the scale. Then the rotating circles were fixed together and rotated so that the second scope pointed at A. Detaching the circles again and turning the first scope to B now measured the angle 2θ. Repeating the process continued to double θ, so that the angle θ was finally computed as the last angle measured divided by the number of doublings. In theory this could make the error arbitrary small.

However, given the chaotic political situation, measuring a distance across the whole of France was a nontrivial task. They needed credibility letters from politicians that were changing all the time, not in the least because of the guillotine of Robespierre threatening almost everyone that had any power with the wrong political background or past (Lavoisier being one of the victims, Romme and several others took their own lives in prison when they had fallen from grace). Delambre was taken on and off the job, he was called to Paris but reinstalled after a while. Also the Northwestern region of France around Dunkerque was threatened by the English. The physical circumstances for Méchain in the mountains between Spain and France were very hard. Moreover, when he tried to save a friend who got stuck in an hydraulic pump, he was hit himself and barely survived. He regained the use his right arm only after a long revalidation period. He was not allowed to return to France because of the Spanish-French war going on and he fled to Italy where he stayed

for about a year. After his return he was summoned to Paris, but he refused to go, fearing for his life but he resumed his measurements instead. He became more and more detached from the world, living in a world of his own. He refused to send in his measurements for two years. When an international congres took place in 1798 to install the new measures, the measurement of the meridian was not finished. Even a visit of his wife, whom he hadn't seen for about six years, could not convince Méchain to hand over his numbers. Finally Delambre came over to help him measure the basis of his triangulations. This was another exercise in precision. Such a basis had already been measured near Dunkerque. Some sticks were placed one next to the other on some wooden traject. Thus took several days and not only the instruments had to be guarded during the night, they should also be protected against changing weather conditions.

The reason for Méchain's reluctance to collaborate was that he had made two measurements of the latitude of Barcelona, and he had found two different results. A disaster for someone like him, obsessed by precision. This would destroy all his work! He could not accept that he had made an error and decided not to report this difference, which was in fact a kind of fraud. He was afraid that when he gave his numbers, this fraud would be discovered. He finally returned to Paris and collaborated reluctantly.

It had always been a dream of him to extend these measurements even further South. So somewhat later, his project to extend his measurements from Barcelona to the Baleares was approved, but he got stuck again because he could not get a passport. He finally died of malaria during that expedition. After his death Delambre discovers the different measurements, that could actually be explained by error analysis, but as his lifetime friend, Delambre presents this as a discovery of Méchain.

Napoleon said about the achievement of these two astronomers: "Conquests will come and go, but this work will endure".

This novel by Denis Guedj, who is professor of Mathematics and Science History in Paris VIII, got the "Prix de l'Institut". Guedj succeeds in evoking a real life painting of the quest of these scientists and the agony of a tormented Méchain against a background of political revolution in a very intriguing way.

A. Bultheel



Pierre Méchain and Jean-Baptiste Delambre