The Utrecht Ophthalmic Hospital and the development of tonometry in the 19th century

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Abstract. During the second half of the 19th century Donders, Snellen and co-workers of the Utrecht Eye Clinic played an important role in the development of clinical tonometry. These indefatigable researchers designed and built a number of tonometers of which most have been saved and which are now on display in a permanent exhibition in the Royal Netherlands Ophthalmic Hospital at Utrecht.

The need for a more accurate measurement of intra-ocular pressure became apparent when Albrecht von Graefe reported in 1857 his successful treatment of acute glaucoma by means of an iridectomy.

In 1862, von Graefe himself designed the first ophthalmotonometer (Fig. 1), which was, however, not published. In a paper which appeared several years later Monnik, a trainee of Donders (see below) described von Graefe's tonometer but he did not give an illustration of the apparatus. Most probably the only still extant specimen is in the collection of the Utrecht Eye Clinic.

Von Graefe tried to determine the depth of the indentation after applying a given force to the sclera. However, in order to be able to use the instrument, the patient had to be examined under general anaesthesia (chloroform).

Another serious drawback was the point of reference given by the frontal bone and the upper jaw bone, as during the measurement the plunger not only indented the sclera but also pushed the eye into the orbit. In short, this instrument was certainly inadequate. Most likely, it was never used in the clinic.

Unaware of the fact that a specimen of A. von Graefe's tonometer was kept in the Utrecht clinic, Draeger (1961) had a reconstruction made based upon the description published by Monnik. However, he presumed that it had to be placed on the closed eyelid although Monnik had stated that the instrument was designed to be used on the sclera.
Fig. 1. Ophthalmotonometer of A. von Graefe (1862).

Almost simultaneously with but independently of von Graefe, Hamer, a trainee of Donders (who suggested its construction: Donders 1863) designed a tonometer of which only the interior parts have been preserved (Fig. 2, left). The rod which indented the sclera was connected with a pointer via a small toothed bar and wheelwork. However, this instrument also was not successful because the bar had to overcome too much friction resistance which made the measurements unreliable.

In another attempt Hamer tried to reduce the friction by inserting tiny copper bars along which the toothed bar moved. However, again friction problems emerged so that the instrument could not function properly. Moreover, its use required too much cooperation of the patient, let alone a highly skilled examiner. Hamer’s second model (Fig. 2, center) still exists in its original form in the Utrecht instrument collection.

However, Donders, Hamer’s mentor, did not give up. He requested a third model to be constructed (Fig. 2, right), in which the wheelwork was replaced by small levers. Yet this instrument suffered from the same imperfections as the former ones (Monnik, 1868).

Draeger was convinced that this instrument was the first model of Donders/Hamer, but the detailed description of Monnik clearly showed that it was in fact the third model.