

## Chapter 3: The “cône parabolique”, the parabolic cone

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### 3.1. Objective and research question

This chapter continues on the path set forth in Chapter 2, specifically concerning the construction of saxophones.

Adolphe Sax first described the shape of his new instrument, the saxophone, as a "cône parabolique", a parabolic cone, in his 1846 patent. Right from that moment, confusion arose about what this meant exactly. Within the Raschèr tradition, this "cône parabolique" was in the past regularly referred to as one of the things tying this tradition to the ideas of Adolphe Sax. However, a clear description of the "cône parabolique" is not available, which makes it unclear whether this is the connecting factor between the ideas of Adolphe Sax and the Raschèr tradition, or whether this link can be found in other elements. All the more reason to, based on historical and organological research, for the first time in history, answer these questions in a clear, scientific way. The aim of this part of the study is therefore to answer the question, both historically and geometrically (1), as to what exactly Adolphe Sax meant by his "cône parabolique" and (2), to what extent it appeared in later instruments, from other manufacturers such as Buescher. This second question is important since, as mentioned above, it constitutes an important link to the Raschèr tradition identified in this thesis. To fully answer these questions, available insights in the acoustic field surrounding the "cône parabolique" will also be addressed.

The period relating to the "cône parabolique" studied in this thesis starts in 1846, the year of Sax's first patent on the saxophone, and runs until 2016, the year of the appearance of the most current publications regarding this topic.

### 3.2. Organisation of the research

As is the case in many parts of this thesis, it feels like a culmination of 25 years of collecting and research.

This research is based on the following sources and methods:

### **3.2.1.** *Analysis of primary and secondary sources*

### **3.2.2.** *Analysis of instrument measurements*

**3.2.2.1.** X-ray and CT scans of instruments : Adolphe Sax tenor saxophone nr. 21238, and Adolphe Sax Jr. alto saxophone nr. 17042 from my collection.

I specifically chose these instruments because the Adolphe Sax tenor saxophone is a first-generation Adolphe Sax instrument, offering a direct line to its origins.

I chose the instrument of Adolphe Sax Jr. since Jaap Kool, see Appendix 16, bases his visual observations on exactly such an instrument.

In addition to Appendix 15, these X-ray and CT images will upon request be available digitally for further research.

**3.2.2.2.** Measurements of instruments from my collection and Leo van Oostrom's collection by Marten Postma. Appendices 11, 14, 18 and 19 contain several charts of these measurements. These include instruments by Adolphe Sax Sr., Adolphe Sax Jr., Gautrot, Buescher and Yamaha, among others. A bore profile of these instruments could be determined, but perhaps more importantly, in the overview provided by Marten Postma, the bore profiles of these instruments, relevant to my research, can be compared.

### **3.2.2.3.** *The results of these measurements are subsequently compared to the analysis of the available literature*

### **3.2.3.** *Furthermore, the research will also be focussing on acoustics*

## **3.3.** Status quaestionis

The discussion about the "cône parabolique" is one that regularly raises tempers within the saxophone world, as it is part of a discussion about the "right or correct instrument".

A large number of studies have since been conducted, that deal with the life and works of Adolphe Sax from different perspectives.

The works of Malou Haine<sup>200</sup> and Frederick Hemke<sup>201</sup> are in this sense still leading and very complete studies. Hemke, compared to Haine, adopts in his thesis (translations of!) many sources in their entirety, which is of great significance in terms of offering information. However, for building a clear historical framework, Haine offers more clarity for a researcher. Londeix<sup>202</sup> provides interesting insights and new information. Leo van Oostrom<sup>203</sup>'s work is valuable because of all the photos of historical instruments linked to relevant information. In line with this, catalogues of exhibitions such as SAX200<sup>204</sup> at the 2014 MiM Brussels, Tromp Muziek Biënnale<sup>205</sup>, "Adolphe Sax and the Saxophone"<sup>206</sup>, "Adolphe Sax exhibition"<sup>207</sup>, and the works of Dullat<sup>208</sup>, Schölch<sup>209</sup>, Haine & De Keyser<sup>210</sup> and the 1987 KRO saxophone competition<sup>211</sup> provide well-organised information. The *Belgisch Tijdschrift voor Muziekwetenschap*<sup>212</sup>, by means of several articles, provides an overview of the July 3-5 conference about Sax in 2014. Robert Howe<sup>213</sup> and Albert Rice<sup>214</sup> published relevant articles in the *Journal of the American Musical Instrument Society*. The aforementioned work by Howe is of particular value and is regularly cited. McBride<sup>215</sup> compared patents on the saxophone during the period of 1838-1850. Howe's article is clearer and more complete in this respect.

Also important are the works of De Lajarte<sup>216</sup>, Dullat "Faszination Saxophon"<sup>217</sup> and "Woodwind instrument making"<sup>218</sup>, Haine's "Musical instrument makers in 19th century Paris"<sup>219</sup>

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<sup>200</sup> Malou Haine, *Adolphe Sax, sa vie, son œuvre, ses instruments de musique* (Brussel, éditions de l'Université de Bruxelles, 1980)

<sup>201</sup> Frederick L. Hemke, *The Early History of the Saxophone* (PhD diss., University of Wisconsin-Madison, 1975)

<sup>202</sup> Jean-Marie Londeix, *Pour une histoire du saxophone et des saxophonistes : Livre 1 (1814-1899) Adolphe Sax* (Sampzon, Delatour, 2017)

<sup>203</sup> Leo van Oostrom, *100+1 Saxen* (Amsterdam, Edition Sax, 2009)

<sup>204</sup> Géry Dumoulin et al., *Catalogus SAX 200* (Brussel, Éditions du Perron, 2014)

<sup>205</sup> Rien de Visser et al., *Tromp Muziek Biënnale 1994, de Saxofoon* (Eindhoven, Stichting Dr. J. Th. P. Tromp Muziek Concours voor de Benelux, 1994)

<sup>206</sup> Leo van Oostrom, Peter Thoben, *Saxofoons* (Eindhoven, Museum Kempenland, 1994)

<sup>207</sup> Ygnace De Keyser, *Adolphe Sax expositie* (Utrecht, Muziekcentrum Vredenburg/Brussels Instrumentenmuseum, 1981)

<sup>208</sup> Günter Dullat, *Saxophone* (Wilhelmshaven, Noetzel, 2011)

<sup>209</sup> Hartmut Schölch, *Sax Couples* (Waldshut-Tiengen, Kulturamt, 2014)

<sup>210</sup> Malou Haine, Ygnace De Keyser, *Saxinstrumenten* (Brussel, renaissance du Livre/MiM, 2013)

<sup>211</sup> Bureau Bordon, *KRO-saxofoonconcours* (Hilversum, KRO 'zin in muziek', 1988)

<sup>212</sup> *Belgisch Tijdschrift voor Muziekwetenschap*, vol. 70, 2016

<sup>213</sup> Robert Howe, *The Invention and Early Development of the Saxophone*, in: *Journal of the American Musical Instrument Society* (Vol. 29, 2003), 97-180

<sup>214</sup> Albert Rice, *Making and Improving the Nineteenth-Century Saxophone*, in: *Journal of the American Musical Instrument Society* (Vol. 35, 2009), 81-122

<sup>215</sup> William McBride, *The Early Saxophone in Patents 1838-1850 Compared*, in: *The Galpin Society Journal* (Vol. 35, 1982), 112-122

<sup>216</sup> Théodore de Lajarte, *Instruments-Sax et Fanfare Civiles* (Paris, Librairie des Auteurs et Compositeurs, 1867)

<sup>217</sup> Günter Dullat, *Faszination Saxophon, der Saxophonbau auf Deutschsprachigem Gebiet* (Markneukirchen, Verein der Freunde und Förderer des Musikinstrumenten-Museums Markneukirchen e.V., 2016)

<sup>218</sup> Günter Dullat, *Holzblasinstrumentenbau* (Celle, Moeck, 1990)

“Instrument makers at the "National et Universelles" exhibitions in the 19th century”<sup>220</sup>, Haine & Meeùs<sup>221</sup> and Haine & De Keyser<sup>222</sup>. These address a partial aspect of Adolphe Sax' life and/or his creations, providing important data and information. In my Master's thesis<sup>223</sup> I researched, among other subjects, the introduction of the saxophone in the Netherlands. The survey of serial numbers of Sax' instruments, compiled by Eugenia Mitroulia and Arnold Myers<sup>224</sup>, is a source I consulted regularly during my research. This list is based on the work of Haine & De Keyser and Robert Howe:

*“The dating of instruments follows the scheme of Robert Howe until 1853. From 1854 onwards Howe's scheme, and that of Malou Haine and Ignace De Keyser have been refined according to new information that has since come to light ”.*<sup>225</sup>

Comettant's<sup>226</sup> role is a very special one. It is a fascinating source because the author is very close to Adolphe Sax, which makes it a unique source reflecting the times. However, precisely because of the author's friendship with Sax and the flowery language, a critical look at this source is of importance when conducting historical research.

Deans<sup>227</sup> provides translations of many relevant sources, including Adolphe Sax's own texts. Very recently, José-Modesto Diago Ortego<sup>228</sup> wrote his dissertation on Adolphe Sax, in which he not only discusses the saxophone on an organological level, but also the historical and economic context at the time of its creation. Diago Ortego<sup>229</sup> interprets the “cône parabolique” that Sax used to draw attention to his new instrument. He cites Scavone<sup>230</sup>, discussed later in this text, in

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<sup>219</sup> Malou Haine, *Les facteurs d'instruments de musique à Paris au 19<sup>e</sup> siècle* (Brussel, éditions de l'Université de Bruxelles, 1985)

<sup>220</sup> Malou Haine, *Les facteurs d'instruments de musique français aux expositions nationales et universelles du XIX<sup>e</sup> siècle* (Haine, 2007) retrieved from: <https://www.iremuscns.fr/fr/publications/les-facteurs-dinstruments-de-musique-francais-aux-expositions-nationales-et>

<sup>221</sup> Malou Haine, Nicolas Meeùs, *Dictionnaire des facteurs d'instruments de musique en wallonie et a bruxelles, du 9<sup>e</sup> siècle à nos jours* (Luik/Brussel, Mardaga, 1986)

<sup>222</sup> Malou Haine, Ygnace De Keyser, *Le musée instrumental d'un artiste inventeur: la collection privée d'Adolphe Sax* in : *Belgisch Tijdschrift voor Muziekwetenschap* (vol. 70, 2016), 149-164

<sup>223</sup> Andreas van Zoelen, *De ontwikkeling van de klassieke saxofoon in Nederland* (Tilburg, Fontys Hogeschool voor de Kunsten, 2013)

<sup>224</sup> Eugenia Mitroulia, Arnold Myers, *List of Adolphe Sax Instruments*, <http://homepages.ed.ac.uk/am/gdsl.html>, retrieved 11-12-2020

<sup>225</sup> Ibid.

<sup>226</sup> Oscar Comettant, *Histoire d'un Inventeur* (Parijs, Pagnerre, 1860)

<sup>227</sup> Kenneth N. Deans, *A comprehensive performance project in saxophone literature with an essay consisting of translated source readings in the life and work of Adolphe Sax* (PhD diss., University of Iowa, 1980)

<sup>228</sup> José-Modesto Diago Ortego, *La música como elemento legitimador de las Revoluciones Burguesas del siglo XIX: studio histórico, económico y organológico del saxofón* (PhD diss., Universidad de Cádiz, 2020)

<sup>229</sup> Ibid., 552

<sup>230</sup> Gary Scavone, *An acoustic analysis of single-reed woodwind instruments with an emphasis on design and performance issues and digital waveguide modelling techniques* (PhD Diss., Stanford University), 1997

terms of the observation that this concept does not exist in physical form.

Furthermore, Elsenaar<sup>231</sup>, Deans<sup>232</sup>, Chautemps et al<sup>233</sup>, Hochheim<sup>234</sup>, Harvey<sup>235</sup>, Perrin<sup>236</sup>, Ottaviano<sup>237</sup>, Cottrell<sup>238</sup>, Billard<sup>239</sup>, Ingham<sup>240</sup>, Delage<sup>241</sup>, Dombrowski<sup>242</sup>, Segarra<sup>243</sup>, Kochnitzky<sup>244</sup>, Horwood<sup>245</sup>, Marzi<sup>246</sup>, Samol<sup>247</sup> and Gilson/Remy<sup>248</sup> conducted studies on Adolphe Sax, his life and his creations, starting entirely from the perspective of the saxophone, which essentially do not add much to above works. Don Ashton<sup>249</sup> in the "Cambridge Companion to the Saxophone", depicts a very clear outline, which if developed further could have been enlightening for many readers. Segell<sup>250</sup> stands out for the polemic and ill-informed outline of his chapter describing the connection between Adolphe Sax and the Raschèr tradition. And further, after initially following Kool and Kelly<sup>251</sup>, he argues, contradicting their theories without explanation, that Sax indicated that the "cône parabolique" is located in the upper third of the saxophone's tube. Rorive<sup>252</sup> points out a small number of imperfections in Haine's work, but otherwise presents few new insights.

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<sup>231</sup> E. Elsenaar, *De Saxophone* (Hilversum, Lispet, 1947 (2<sup>nd</sup> edition), 1943 (1<sup>st</sup> edition))

<sup>232</sup> Kenneth N. Deans, *A comprehensive performance project in saxophone literature with an essay consisting of translated source readings in the life and work of Adolphe Sax* (PhD diss., University of Iowa, 1980)

<sup>233</sup> J.L. Chautemps, D. Kientzy, J.M. Londeix, *Le Saxophone* (Paris, J.-C. Lattès/Salabert, 1987)

<sup>234</sup> Matthias Hochheim, *Saxwelt, das Deutsche Saxophonbuch* (Norderstedt, Books on Demand, GmbH, 2004)

<sup>235</sup> Paul Harvey, *Saxophone* (London, Kahn & Averill, 2002)

<sup>236</sup> Marcel Perrin, *Le Saxophone* (Paris, l'Harmattan, 1994)

<sup>237</sup> Roberto Ottaviano, *Il Sax* (Padova, Franco Muzzio Editore, 1989)

<sup>238</sup> Stephen Cottrell, *The Saxophone* (New Haven/London, Yale University Press, 2012)

<sup>239</sup> François & Yves Billard, *Histoires Du Saxophone* (Castelnau-le-Lez, Climats, 1995)

<sup>240</sup> Richard Ingham et al., *The Cambridge Companion to the Saxophone* (Cambridge, Cambridge University Press, 1998/2008, 6<sup>th</sup> edition)

<sup>241</sup> Jean-Louis Delage, *Adolphe Sax et le Saxophone* (Lyon, Editions Josette, 1992)

<sup>242</sup> Ralf Dombrowski, *Saxofon* (Kassel, Bärenreiter, 2010)

<sup>243</sup> Miguel Asensio Segarra, *Adolphe Sax y la fabricación del saxofón* (Valencia, Rivera Mota, 1999)

<sup>244</sup> Leon Kochnitzky, *Sax and his saxophone* (North American Saxophone Alliance, 1949/1985, 4<sup>th</sup> edition)

<sup>245</sup> Wally Horwood, *Adolphe Sax, 1814-1894, his life and legacy* (Bramley, Bramley Books, 1979)

<sup>246</sup> Mario Marzi, *il saxofono* (Varese, Zecchini Editore, 2009/2016)

<sup>247</sup> Dariusz Samol, *Adolphe Sax i muzyka saksfonowa XIX wieku* (Szczecin, Dariusz Samol, 2018)

<sup>248</sup> Paul Gilson / Albert Remy, *Les Géniales Inventions d'Adolphe Sax / La Vie Troumentée d'Adolphe Sax* (Brussel, Institut National Belge de Radiodiffusion, 1939)

<sup>249</sup> Don Ashton, *In the twentieth century*, in: *The Cambridge Companion to the Saxophone*, 6<sup>th</sup> edition (Cambridge, Cambridge University Press, 1998/2008), 26-27

<sup>250</sup> Michael Segell, *The Devil's Horn* (New York, Picador, 2005), 236-253

<sup>251</sup> *Ibid.*, 175-177

<sup>252</sup> Jean-Pierre Rorive, *Adolphe Sax* (Brussel, Racine, 2004)

Eugenia Mitroulia and Arnold Myers<sup>253</sup> published their views on Sax' inventions in the field of brass instruments, and Mitroulia<sup>254</sup> wrote her PhD thesis on this subject, with a focus on Saxhorns.

The work of Gee<sup>255</sup> constitutes a practical reference point for information on saxophonists between 1844 and 1985: it often provides a good starting point for further research. Uwe Ladwig<sup>256</sup> put together a very comprehensive book on the saxophone in which he also speaks about Sax. More so because of its extensive global information, it provides a good starting point for studies of a specific brand, not so much about Adolphe Sax the person.

In recent years, a number of books have been published, in which the same type of information is combined, in a more concise sense, with extensive photographic material and a modern design: the Selmer edition "Saxophones, the essentials"<sup>257</sup> and the works of Zermani<sup>258</sup>, Lunte<sup>259</sup> en Lindemeyer<sup>260</sup>.

Recently, a number of projects have been conducted by different conservatoires, focusing on the work of Adolphe Sax, such as SAX.OV, as part of Erasmus+<sup>261</sup> in Amsterdam and Cadiz, amongst others. In addition, a large number of celebrations took place in the Sax year 2014, amongst others at the Fontys Conservatoire in Tilburg, the Netherlands, now the Academy of Music and Performing Arts.

"The story of the saxophone"<sup>262</sup>, published by the Buescher company in 1926, outlines the story of Sax's life with great romantic freedom (even containing pictures of actors dressed as Adolphe Sax!). This document is of more significance for acquiring an overview of Buescher history. Raschèr described the construction of the saxophone (without specifically mentioning a brand or time period)

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<sup>253</sup> Eugenia Mitroulia & Arnold Myers, *Adolphe Sax: Visionary or Plagiarist?*, in: Historic Brass Society (vol. 20, 2008), 93-141

<sup>254</sup> Eugenia Mitroulia, *Adolphe Sax' Brasswind Production with a Focus on Saxhorns and Related Instruments* (PhD Diss., University of Edinburgh, 2011)

<sup>255</sup> Harry R. Gee, *Saxophone Soloists and Their Music* (Bloomington, Indiana University Press, 1986)

<sup>256</sup> Uwe Ladwig, *Saxofone, ein Kompendium* (Wahlwies, Ladwig, 2016)

<sup>257</sup> Yves Guilloux, Selmer Paris, *Saxophones, the Essentials* (Paris, Éditions Selmer, 2006)

<sup>258</sup> Andrea Zermani, *Saxo, l'instrument mythique* (Paris, Gründ, 2004)

<sup>259</sup> Frank Lunte, Claudia Müller-Elschner, *Saxophone, ein Instrument* (Berlin, Nicolai, 2014)

<sup>260</sup> Paul Lindemeyer, *Celebrating the Saxophone* (New York, Hearst Books, 1996)

<sup>261</sup> Mobiliteitsproject voor personeel in volwassenenonderwijs in het kader van het EU-programma Erasmus+ Project 2015-BE02-KA104-012187

<sup>262</sup> Buescher Band Company, *The Story of the Saxophone* (Elkhart, Buescher Band Company, 1926)

as “conical-parabolical”<sup>263</sup> and “a half parabolic conical shape”<sup>264</sup>, but again writes in his article on mouthpieces “This mouthpiece is designed for a conical instrument”<sup>265</sup>.

The above studies do mention the “cône parabolique” but do not elaborate on this. However, the number of studies dealing specifically with “cône parabolique” is significantly smaller.

In the 20th century, Jaap Kool<sup>266</sup> and John Edward Kelly<sup>267</sup> presented their findings, but always from a single perspective. In broad terms, the Ventzke, Raumberger and Hilkenbach<sup>268</sup> consortium followed Kool's explication, as did Abraham de Villers<sup>269</sup> in his dissertation. Instrument builder Benedikt Eppelsheim<sup>270</sup> contradicts Kool's train of thought. Ferron<sup>271</sup> presents yet another view of the “cône parabolique”. His aim was to provide an introduction into the technical/mechanical background of the saxophone for players of the instrument, from the perspective of an experienced repairman, which, in my opinion, he partially succeeded in doing. At times, he suddenly dives very deep into the subject matter, which will still make it difficult for many to follow. Ignace DeKeyser<sup>272</sup> discusses the “cône parabolique” in his article “*The paradigm of industrial thinking in brass instrument making in the nineteenth century*”. He indicates that at the time, it is unclear what is meant by this, but states:

“Unlike Jaap Kool, I believe that this parabolic cone is restricted to the main tube and the beginning of the bell section. I believe this because Sax had already patented a *réflecteur sonore* for his bass clarinet”.

De Keyser goes on to explain how, in addition to Adolphe Sax, Theobald Boehm (1797-1881) and Victor-Charles Mahillon (1842-1924) used the parabola in their instruments.

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<sup>263</sup> Sigurd Raschèr, *Justice for the Saxophone*, in: *the Raschèr Reader*, compilation Lee Patrick (Fredonia, State University of New York, 2014), 17

<sup>264</sup> Sigurd Raschèr, *About the Essence of Wind Instruments* in: *the Raschèr Reader*, compilation Lee Patrick (Fredonia, State University of New York, 2014), 24

<sup>265</sup> Sigurd Raschèr, *Saxophone Mouthpieces* in: *the Raschèr Reader*, compilation Lee Patrick (Fredonia, State University of New York, 2014), 99

<sup>266</sup> Jaap Kool, *Das Saxophon* (Leipzig: J.J. Weber, 1931, Faks.-Ausg. Erwin Bochinsky, 1989)

<sup>267</sup> John Edward Kelly, *The Acoustics of the Saxophone from a Phenomenological Perspective* (Daedalian Music Publications, 2006)

<sup>268</sup> Ventzke, Raumberger, Hilkenbach, *Die Saxophone* (Frankfurt/Main, Erwin Bochinsky, 1987/2001)

<sup>269</sup> Abraham Albertus de Villiers, *The development of the saxophone 1850-1950: its influence on performance and the classical repertory* (Magister Musicae Diss., University of Pretoria, 2014)

<sup>270</sup> Benedikt Eppelsheim, *Parabolische Bohrung*, in: *Saxofone, ein Kompendium* (Wahlwies, Uwe Ladwig, 2016), 12

<sup>271</sup> Ernest Ferron, *The Saxophone is my voice* (Paris, International Music Diffusion, 1997)

<sup>272</sup> Ignace De Keyser, *The Paradigm of Industrial Thinking in Brass Instrument Making during the Nineteenth Century*, in: *Historic Brass Society Journal* (Vol. 15, 2003), 233-258

From an acoustic and geometrical perspective, Marten Postma<sup>273</sup>, preceded by Nederveen<sup>274</sup> and Scavone<sup>275</sup> explain their findings. For the first time, this thesis aims to provide a fully substantiated answer as to what Adolphe Sax meant by this term from all perspectives.

### 3.4. The term “cône parabolique” – parabolic cone

#### 3.4.1. 19<sup>th</sup> century

##### 3.4.1.1. Sources citing the term “cône parabolique”

The confusion regarding the term "cône parabolique" actually starts immediately, with the first patent on the saxophone, issued to Adolphe Sax on March 21, 1844<sup>276</sup>. In it, Sax writes: "*I have made the saxophone from brass with the shape of a parabolic cone*". Here he uses the term without explaining it any further. Patents of the time, by the way, are in no way comparable to current patents, that elaborate in great detail on inventions. A patent in the mid-19th century was rather succinct.

The patent on the saxophone taken by Adolphe Sax<sup>277</sup> in Belgium in 1850 provides more information than the 1846 patent. The differences between the two patents are specified by McBride<sup>278</sup>. The text is almost the same under "*Exposé*". In the Belgian patent, however, another text follows under the header "*Mémoire descriptif*". This states that the construction of the saxophone is "... *slightly convex on the outside*...". As will be seen later in this part of the study, here Adolphe Sax already hints at what he meant by the "cône parabolique"!

Also interesting in this text is the fingering table that Sax provides with a table of numbers. This shows that the change between the two octave keys should not be done in the same place on every saxophone! See section 5.5. on my experiences playing Adolphe Sax saxophones.

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<sup>273</sup> Marten Postma, *Le cône parabolique*, in: Belgisch tijdschrift voor muzikwetenschap (Vol. LXX, 2016), 77

<sup>274</sup> Cornelis Nederveen, *Acoustical aspects of woodwind instruments*, (Diss., Technische Hogeschool Delft), 1969

<sup>275</sup> Gary Scavone, *An acoustic analysis of single-reed woodwind instruments with an emphasis on design and performance issues and digital waveguide modeling techniques* (PhD Diss., Stanford University), 1997

<sup>276</sup> Adolphe Sax, *1<sup>e</sup> patent on the saxophone (France), patent number 3226*, March 21, 1846

<sup>277</sup> Adolphe Sax, *patent on the saxophone (Belgium), patent number 5469*, December 7, 1850, in: Günter Dullat, *200 Jahre Patente, Privilegien und Gebrauchsmuster im internationalen Holz- und Metallblasinstrumentenbau* (Wilhelmshaven, Noetzel, 2010), 27-30

<sup>278</sup> William McBride, *The Early Saxophone in Patents 1838-1850 Compared*, in: The Galpin Society Journal (Vol. 35, 1982), 112-122

After Sax' first patent, a number of sources from this period can be found adopting the term literally: Fétis<sup>279</sup> writes:

*“No sooner had Sax completed his acoustic reform of the clarinet than a stroke of light from his genius made him realise the possibility of applying the system of this type of instrument to a new form of brass instrument, for which he adopted the parabolic cone to shape the bore.”*

Fétis<sup>280</sup> also uses this wording in the 1867 report on the "Exposition Universelle", where the exact text from the 1855 report is quoted.

Furthermore, in both sources, Fétis<sup>281</sup> quotes:

*“This instrument is new in terms of the proportions of its tube, its bore, its mouthpiece and particularly its timbre.”*

Oscar Comettant<sup>282</sup> does the same:

*“The saxophone's tube is a parabolic cone; the batyphone is cylindrical throughout, except for the bell. The saxophone works in octaves, like the flute; the batyphone works in twelfths, like the clarinet. Above all, there is world of harmonic difference between the sound of the two instruments. The batyphone was obviously nothing more than a detestable imitation of Sax's bass clarinet or contrabass clarinet, patented in 1838, as the experts declared in 1847.”*

Comettant refers here to the 1847 Rouen lawsuit, brought against Sax to have his 1846 patent declared invalid.<sup>283</sup> Hemke<sup>284</sup> also refers to these legal proceedings in his 1975 dissertation

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<sup>279</sup> François-Joseph Fétis, *Biographie Universelle des musiciens*, deuxième édition (Paris, Librairie de Firmin Didot Frères, Fils et Cie, 1867 (volume 7), 414

<sup>280</sup> Fétis, *Exposition Universelle de 1867 à Paris - Rapport du Jury International – Instruments de Musique* (Paris, Paul Dupont, 1867), 64

<sup>281</sup> François-Joseph Fétis, *Biographie Universelle des musiciens*, deuxième édition (Paris, Librairie de Firmin Didot Frères, Fils et Cie, 1867 (volume 7), 418 en François-Joseph Fétis, *Exposition Universelle de 1867 à Paris - Rapport du Jury International – Instruments de Musique* (Paris, Paul Dupont, 1867), 65

<sup>282</sup> Oscar Comettant, *Histoire d'un inventeur au dix-neuvième siècle, Adolphe Sax, ses ouvrages et ses lutes* (Paris, Pagnerre, 1860), 215

<sup>283</sup> Richard Ingham, *The Cambridge Companion to the Saxophone* (Cambridge, Cambridge University Press, 1998/2008, 6<sup>th</sup> edition)

<sup>284</sup> Frederick L. Hemke, *The Early History of the Saxophone* (PhD diss., University of Wisconsin-Madison, 1975), 61

and raises the question of the parabolic cone. Hemke quotes the expert committee's ruling.

*"...what then was a parabolic cone? A panel of experts selected for Sax' first court case was confronted with the same question when they examined his claims. On November 2, 1847 they reached this conclusion:*

*[...] but above all the tube of the instrument, in place of being cylindrical as the clarinet and the batyphone, forms a cone of which the walls have a specific curvature and which the Sax patent designates under the name of parabolic cone"*

Hemke also quotes Henri Blanchard, in an article called "Adolphe Sax" in the "Revue et gazette musicale" of September 10, 1843<sup>285</sup>, who notes:

*"This instrument [the saxophone] which has been played for us, has a low, noble, and mellow voice: it is made of brass and is close to eight feet in length. By the proportions of its tube it forms a parabolic cone along its length and is equipped with nineteen keys..."*

Note: Hemke did cite quotes, but not in the light of this chapter's research question.

Hector Berlioz (1803-1869), who devoted a large number of texts to the achievements of Adolphe Sax, and the saxophone in particular, does not mention the "cône parabolique" in his 1844 instrumentation treatise. Starting with the revision of this work in 1855, he does include this description.<sup>286</sup>

Incidentally, I noted during my research that there is frequent confusion around the order of Berlioz's publications. The publication of June 12, 1842<sup>287</sup> is often cited as the first publication on the saxophone. Berlioz, however, writes about the instrument as early as March 1842<sup>288</sup>, without mentioning it by name. The often-quoted flowery description of the sound of the saxophone - see section 5.4.2.- is not to be found in the June 1842 text, but in an article from 1849<sup>289</sup>!

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<sup>285</sup> *Ibid.*, 28

<sup>286</sup> *Ibid.*, 60

<sup>287</sup> Hector Berlioz, *Théâtre [sic] de l'opéra-comique*, in: Feuilleton du Journal des Débats (June 12, 1842), 1-3, <http://www.hberlioz.com/feuilletons/debats420612.htm>, retrieved July 23, 2020

<sup>288</sup> Robert Howe, *The Invention and Early Development of the Saxophone*, in: Journal of the American Musical Instrument Society (Vol. 29, 2003), 108

<sup>289</sup> Hector Berlioz, *Exposition de l'industrie*, in: Feuilleton du Journal des Débats (August 21, 1849), 1-2, [www.hberlioz.com/feuilletons/debats490821.htm](http://www.hberlioz.com/feuilletons/debats490821.htm), retrieved July 23, 2020

### 3.4.1.2. Sources only mentioning the term 'conical'

There are also sources in the 19th century that describe the saxophone as having a conical tube, such as Mahillon<sup>290</sup> and Gevaert<sup>291</sup>. However, as De Keyser<sup>292</sup> argues, Mahillon was indeed, alongside Sax and Boehm, one of the more progressive manufacturers who used the parabola as their theoretical paradigm. In Sax's case, this is also evident from other projects in which the parabola played a leading part, such as his proposal for a concert hall<sup>293</sup>, the bell with a parabolic section<sup>294</sup>, the parabolic bell of the sax tuba<sup>295</sup> and the bell of the Aïda trumpet<sup>296</sup>. For the sake of completeness, it should be noted that Mahillon preferred the hyperbole in terms of shape as a premise<sup>297</sup>. In Gevaert's case, the multitude of descriptions we find through the various references is exemplary of the semantic confusion that arises.

In 1881, Gevaert writes:

*“A famous maker of our time has found a really new type of instrument, the saxophone, by adapting the simple reed to conical tubes; but the construction of this instrument is even more state of the art than anything reached by the Greeks. - This is a unique exception to the rule among all known instruments.”*

Note the wording here: Gevaert speaks of 'conical tubes: plural!

Also, in a 1908<sup>298</sup> catalogue of Adolphe Sax (Jr.), a page dedicated to Adolphe Sax (Sr.) reads:

*“The saxophone by adapting the simple reed to conical tubes...”*

It will be shown later why this choice of the plural form is important.

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<sup>290</sup> Victor-Charles Mahillon, *Éléments d'acoustique musicale et instrumentale* (Brussel, Mahillon, 1874), 176

<sup>291</sup> François-Auguste Gevaert, *Histoire et théorie de la musique de l'antiquité*, II, livre 4 (Gand, Annoot-Braeckman, 1881), 282 (footnote)

<sup>292</sup> Ignace De Keyser, *The Paradigm of Industrial Thinking in Brass Instrument Making during the Nineteenth Century*, in: *Historic Brass Society Journal* (Vol. 15, 2003), 240

<sup>293</sup> Adolphe Sax, *Salle de théâtre [sic]-Sax : son but et ses avantages* (Paris, 1873)

<sup>294</sup> Malou Haine, *Adolphe Sax, sa vie, son œuvre, ses instrument de musique* (Brussel, éditions de l'Université de Bruxelles, 1980), 85-86

<sup>295</sup> Eugenia Mitroulia, Arnold Myers, *Adolphe Sax: Visionary or Plagiarist?*, in: *Historic Brass Society* (Vol. 20, 2008), 116

<sup>296</sup> *Ibid.*, 130

<sup>297</sup> Ignace De Keyser, *The Paradigm of Industrial Thinking in Brass Instrument Making during the Nineteenth Century*, in: *Historic Brass Society Journal* (Vol. 15, 2003), 244

<sup>298</sup> Malou Haine, *Adolphe Sax, sa vie, son œuvre, ses instrument de musique* (Brussel, éditions de l'Université de Bruxelles, 1980), 134

Interestingly, the same Gevaert is referred to by Victor Thiels<sup>299</sup> in the *Encyclopédie de la musique et dictionnaire du conservatoire*, but there it says:

*“ «The saxophone», by adapting the simple reed to a parabolic conical tube.”*

It is unclear whether Gevaert changed this description in a later text as the one from 1881, one that may have been written between 1881 and his death in 1908, or whether Thiels did not quote the source correctly.

Gilles Tressos<sup>300</sup> writes in 2014 about the method book Thiels wrote, citing the following quote from Gevaert regarding the Thiels method:

*“A famous instrument maker of our time found a new type of instrument, the saxophone, by adapting the simple reed to a conical tube.”*

In this quote, the word parabolic is omitted.

Thiels himself adds:<sup>301</sup>

*“Before Adolphe Sax, it had never occurred to anyone to use the properties of the parabola in instrument making. The parabolic cone shape of the tube was a novelty. It is to this that the saxophone owes its timbre and sound qualities, which are so different from those of other instruments.”*

However, Tressos does not quote Thiels' teaching method<sup>302</sup> entirely correctly.

In fact, it states there explicitly:

*“Before Adolphe Sax, indeed it had never occurred to anyone to use the properties of the parabola in instrument making [1]. The shape of a parabolic cone given to the tube forming the body of the saxophone was a novelty, and it is to this novelty, this exception to the rule referred to by Gevaert [sic], that the saxophone owes its timbre and sound qualities, which are so different from those of other instruments.*

*[1] Adolphe Sax also applied the properties of the parabola to the construction of theatre and concert halls. Projects and plans have been printed, but nothing has yet been built.”*

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<sup>299</sup> Victor Thiels, *Encyclopédie de la musique et dictionnaire du conservatoire* (Paris, Delagrave, 1927), 1662

<sup>300</sup> Gilles Tressos, *Le saxophone et ses méthodes. Une histoire de l'enseignement de l'instrument (1846-1942)*, in: *Une histoire du saxophone par les méthodes parues en France, 1846-1942, sous la direction de Pascal Terrien* (Sampzon, Delatour, 2014), 224

<sup>301</sup> Ibid.

<sup>302</sup> Victor Thiels, *Méthode complete pour tous les saxophones* (Paris/Bruxelles, Lemoine, 1903), I

As will be shown further on in this text, the part that was omitted (underlined by me) contains an important key in the identification of the "cône parabolique".

For the sake of completeness, it should be noted that Tressos refers to the first two volumes of Gevaert's 1875 edition. The last two volumes were written in 1881.

At many points during my research, Kastner's Method<sup>303</sup> from 1846 has proven very valuable, as is the case in this section. An important reason for this is the fact that Kastner and Sax collaborated on this method, see section 5.4.1. On the construction of the saxophone, it states:

*"The first peculiarity of the Saxophone is that its cone is parabolic along its entire length, whereas the tubes of the other instruments form a curved cone and are generally cylindrical in a large part. As a result, in the first instrument (the Saxophone), the vibrations are produced by undulations against the wall along its entire length, whereas in the second mentioned instruments (Ophicleide, Trumpet and Trombone) they strike directly from one end to the other."*

I have underlined the phrase "*along its entire length*" because it constitutes an important element of the answer to the question of what the "cône parabolique" actually is.

In "Organographie, Essai sur la Fabrication Instrumentale", Pontécoulant<sup>304</sup> allows Sax himself to speak, in a letter to Wilhelm Wieprecht, who, as a reformer of German military wind music, was, like Sax, involved in instrumentation. This further answers the research question.

*"I want to believe that your articles were inspired by a feeling of patriotism: that may be; but that is no excuse at all: the first element of patriotism of a man of honour is the worship of justice and loyalty! Now, Sir, I am justified in saying that you have failed in both. Before we met, you had attacked me in the newspapers; that was a mistake on your part, as I soon found out in Koblenz. There, in fact, after a few generalities, you told me that the saxophone was nothing other than the tuba (which, incidentally, you did not invent, as you agreed), and that it should therefore not be called the Saxophone, but the Wieprechtophone."*

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<sup>303</sup> Jean-Georges Kastner, *Méthode Complète et Raisonnée de Saxophone* (Paris, Troupenas-Brandus), 22 (The 1st edition is from 1846, the 'Brandus' date from after 1850)

<sup>304</sup> Le Comte Ad. De Pontécoulant, *Organographie ; Essai sur la Fabrication Instrumentale ; Art, Industrie et Commerce* (Paris, Castel, 1861), 308

*It seemed to me, at first, to be a bit much to want to always give an instrument ones name without having had anything to do with it, without even knowing it; however, I contented myself with replying that the new instrument, invented by me and called the saxophone, differed from the tuba in that:*

- 1. The tuba is a member of the trumpet and trombone family, while the saxophone forms a new family*
- 2. The tuba has a cylindrical tube from the mouthpiece to about half its total length, and a curved cone from this point to the bell; the saxophone, on the other hand, has a parabolic cone from the mouthpiece to the bell. “*

I underlined the last phrase. So, the "cône parabolique", according to Sax himself, runs from the mouthpiece to the bell! And is thus not, as the 20th-century sources following in 3.4.2. claim, found in only one part of the saxophone.

In his second patent<sup>305</sup> on the saxophone from 1866, Sax notes:

*“A sixth improvement concerns the instrument's bore. Although up to now I have given the saxophone bore approximately the shape of a parabolic cone, I have found two new bore types, one in the form of a straight cone and one in the form of a reentrant or concave cone, i.e. the inversion of the parabolic cone.”*

This provides confirmation that the "cône parabolique" can be seen along the entire length of the instrument. This is made clear further on when discussing the fact that the saxophone actually consists of three different tubes, whose curves, as representations of conicities, together approximate the parabolic cone mentioned by Sax.

### **3.4.2.** *20<sup>th</sup> century*

So how did things progress in the 20th century? After we saw that semantic confusion concerning the "cône parabolique" arises almost immediately after Adolphe Sax' first patent in the 19th century, ambiguity about it only increases in the 20th century. A major role in this is played by the author Jaap Kool<sup>306</sup>, who specifically addresses the matter of Adolphe Sax' "cône parabolique" in his 1931 work "Das Saxophon". Today, this work is still referenced.

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<sup>305</sup> Adolphe Sax, *2<sup>nd</sup> patent on the saxophone, patent number 70894*, March 19, 1866

<sup>306</sup> Jaap Kool, *Das Saxophon* (Leipzig, J.J. Weber, 1931, Faks.-Ausg. Erwin Bochinsky, 1989)

Lawrence Gwozdz<sup>307</sup>, long serving as Professor of classical saxophone at the University of Southern Mississippi in Hattiesburg, U.S.A. translated this publication into English and annotated it, making it available to a large group of students. John-Edward Kelly<sup>308</sup>, alto saxophonist in the Raschèr Saxophone Quartet from 1981-1990, then based his contribution largely on Kool's.

Very little is known about Kool as a person. In the biographical outline on Kool in his English translation, Gwozdz states:

*"Kool's interest in the sciences – namely physics, chemistry and biology – matched his affinity for music"*<sup>309</sup>

Sigurd Raschèr concludes in the preface to this translation that Kool himself did not play the saxophone.<sup>310</sup>

Hilkenbach<sup>311</sup> provides some biographical info in his afterword to Kool's facsimile edition. Born in 1891 in Amsterdam, Kool grew up in Germany and Switzerland. He worked as an educator at a school and as artistic director with the *Vox Recording Company*. After 1945, he seems to have resided alternately in the Netherlands and Germany, but he also had a home address in Sèvres, near Paris. He died in The Hague on December 1, 1959.

Before Jaap Kool, three sources can be found in the 20th century, that discuss the "cône parabolique". The texts of Henri Radiguer<sup>312</sup> and Curt Sachs<sup>313</sup> provide no further insight. The aforementioned Victor Thiels<sup>314</sup> is the first to discuss what happens in the mouthpiece.

A separate role is adopted by Ernest Ferron<sup>315</sup>. He is the only one who assumes that the parabola is located in the neck, the first conicity of the saxophone. He provides no further explanation for this.<sup>316</sup>

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<sup>307</sup> Jaap Kool, translated by Lawrence Gwozdz, *Das Saxophon, the Saxophone* (Herts, Egon Publishers Limited, 1987)<sup>308</sup> John Edward Kelly, *The Acoustics of the Saxophone from a Phenomenological Perspective* (Daedalian Music Publications, 2006)

<sup>309</sup> Jaap Kool, translated by Lawrence Gwozdz, *Das Saxophon, the Saxophone* (Herts, Egon Publishers Limited, 1987), 17

<sup>310</sup> *Ibid.*, 1

<sup>311</sup> Dietrich Hilkenbach, in: Jaap Kool, *Das Saxophon* (Leipzig, J.J. Weber, 1931, Faks.-Ausg. Erwin Bochinsky, 1989), 281

<sup>312</sup> Cited in Fred L. Hemke, *The early history of the saxophone* (PhD diss., University of Wisconsin, 1975), 62

<sup>313</sup> Curt Sachs, *Real-Lexikon der Musikinstrumente* (Berlin, Julius Bard, 1913), 334

<sup>314</sup> Victor Thiels, *Encyclopédie de la musique et dictionnaire du conservatoire* (Paris, Delagrave, 1927), 1662

<sup>315</sup> Ernest Ferron, *The Saxophone is my voice* (Paris, International Music Diffusion, 1997)

<sup>316</sup> It should be noted that Bodewes found a parabolical shape in the first conicity of a Feuillet soprano. This instrument is presumably built by Adolphe Sax. See paragraph 4.5. Leo van Oostrom, personal communication (e-mail), January 10, 2021

### 3.5. Kool's versus my findings

Jaap Kool<sup>317</sup>, see *Appendix 16*, bases his conclusion purely on optical observations:

*"[...] the saxophone [...] "octavates". This is related to the acoustically very special shape of the saxophone. In his patent, Sax speaks of a parabolic-conical shape without giving details. If we remove the mouthpiece and neck from an alto saxophone so that we can look into the tube of the body, we can easily see that the inner circular wall, which is turned forwards <i.e. the side on which most of the tone holes are located>, is not completely straight, but represents a curve <Fig. 28, 28a> [...] When we turn the instrument a quarter of a circle on its own axis we now notice that an absolute straight line leads into the interior. This side wall thus extends downwards in a straight line. Again, after a quarter turn, we see another outward curve, while the next side wall is again an absolute straight line. This means that the almost circular shape of the tube at the top becomes more and more elliptical towards the bottom. Furthermore, the tone holes do not lie on a straight line, but on a parabolic curve moving outwards. This means that the diameter of the body does not grow evenly, but slower and slower in percentage. Sax chose this parabolic shape on purpose."*

An optical observation, as implemented by Kool, is, of course, far from a reliable point of reference. A bigger problem with Kool's analysis, however, lies in the fact that the image (*Appendix 16*) clearly shows that Kool is examining a saxophone by Adolphe Sax Jr., and not one by the actual inventor of the saxophone, Adolphe Sax, Sr. Meaning he makes no distinction between the different generations of saxophones built by Adolphe Sax Sr. (referring to the patents of 1846, 1866 and 1881, respectively), either.

My own optical observations on Adolphe Sax (Sr.) instruments from my own collection, that were taken apart during the restoration process are different, as shown in the photos in *Appendix 17*.

The part where the straight section of the saxophone is connected to the lower bend is simply a circle. Restorer Nico Bodewes<sup>318</sup>, who spent his working life restoring Adolphe Sax saxophones, confirms this, while

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<sup>317</sup> Jaap Kool, *Das Saxophon* (Leipzig, J.J. Weber, 1931, Faks.-Ausg. Erwin Bochinsky, 1989), 59

<sup>318</sup> Nico Bodewes, personal communication (interview), August 31, 2018

noting that an elliptical shape could in no way guarantee the necessary physical stability<sup>319</sup>.

Kool<sup>320</sup> also elaborates on how the parabolic construction supposedly enhances the sound.

*“ Sax chose this parabolic shape on purpose. We know that sound waves, just like light waves <for example from a mirror>, are reflected. From echoes, for example, we know that under certain circumstances the emitted sound is reflected back to the point of origin. This reflection is greatest, i.e. most complete, when the sound is reflected from the focal point of a parabolic body to the focal point of another parabolic body <Fig. 29a>. Practically, this means that the direction of the sound waves can be directed as desired. A nice example of this can be seen in the « Salle des Cariatides » of the Louvre in Paris, where the ceiling is shaped with parabolically curved surfaces. Two vases are placed in the focal points of this curvature, and if someone speaks softly into one vase, another person listening into the second vase hears the whispered words as if they were coming out of the vase, while nothing is heard in the rest of the room.”*

*„In the saxophone, Sax has used all these parabolic surfaces and their effects.*

*<Figs. 30, 30a, 30b u. 30c>. Firstly, the parabolically running outward inner walls, similar to the convex mirror, have a sound-diffusing effect, at the same time reflecting the sound into the interior of the tube.”<sup>321</sup>*

Kool<sup>322</sup> makes a further observation regarding the instrument he examined.

*„But as if that were not enough, Sax has added three other small parabolic hollow surfaces, slight curvatures. If we list the diameters of the tone holes one after the other, we notice that these diameters do not regularly increase, as the gradually increasing diameter of the tube would require. Three times we find that a lower tone requires a smaller tone hole than the preceding higher tone. At these three points Sax has again added small parabolic bulges in the opposite sense of the large curves extending over the entire length. At the bulges, naturally the diameter of the instrument is larger, which also requires a larger diameter of the tone hole, because only a larger hole is able to provide a good outlet for the larger air volume.*

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<sup>319</sup> Nico Bodewes, personal communication (e-mail), April 20, 2018

<sup>320</sup> Jaap Kool, *Das Saxophon* (Leipzig, J.J. Weber, 1931, Faks.-Ausz. Erwin Bochinsky, 1989), 60

<sup>321</sup> *Ibid.*, 62

<sup>322</sup> *Ibid.*, 62

*The next tone hole can be smaller again, and the size of the following tone holes increases regularly with the diameter of the tube. These bulges can easily be found on the instrument before it is fitted with keys by applying a straight pencil. Placed on the bulge, the pencil rocks; placed between two bulges, it shows a gap of light. These inward turned parabolic surfaces now act like concave mirrors, i.e. they concentrate the sound. Since there is a tone hole on the opposite surface, just at the apex of the parabola, these surfaces simultaneously cause the sound waves to escape slightly..“*

Based on similar instruments from my own collection (Adolphe Sax Jr., serial number 17042), I cannot confirm this observation either. There is no sign of bulges. Gwozdz, in the annotations to the translation of Kool's work, does not provide any information or new insights on this, either. In connection to the use of parabolas in instrument making, the fact that starting from page 201 of his work, Kool presents an idea for a new concert hall built using the parabola, without mentioning Sax, is noteworthy. Did he not know about the plans, as outlined by Adolphe Sax<sup>323</sup>?

### 3.6. Kelly's versus my findings

John-Edward Kelly's "The Acoustics of the Saxophone from a Phenomenological Perspective"<sup>324</sup> reaches the same conclusions as Jaap Kool's work. Kelly enjoyed great fame as Sigurd Raschèr's successor in the Raschèr Saxophone Quartet, where he played the alto saxophone from 1981 to 1990. His great virtuosity as a saxophonist was unique. He always defended the choice of an "old" saxophone as played in the Raschèr tradition very passionately. Meaning saxophones built by the Buescher company, in the first half of the 20th century.

Kelly addressed, with much eloquence in various languages, multiple themes surrounding the instrument and its history, and during his tenure in the quartet, took to writing 'liner notes' for the various recordings, among other things.

Kelly<sup>325</sup> writes about the "cône parabolique":

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<sup>323</sup> Adolphe Sax, *Salle de théâtre [sic]-Sax: son but et ses avantages* (Paris, 1873)

<sup>324</sup> John Edward Kelly, *The Acoustics of the Saxophone from a Phenomenological Perspective* (Daedalian Music Publications, 2006)

<sup>325</sup> *Ibid.*, 13

*“Speculation about Adolphe Sax’s parabola having anything whatsoever to do with the crook on the larger saxophones is completely nonsensical: the crook is semi-circular and by no means parabolic by any definition. In actual fact, the parabola of the saxophone’s bore is interrupted by the crook, whose technically awkward construction is one of the main reasons for the somewhat problematical qualities of the saxophone’s lowest tones.*

*Contrary to popular belief, Adolphe Sax’s application of the parabola in his parabolic cone is not at all mysterious. Just a peek down any one of Adolphe Sax’s saxophones (from the neck of a straight saxophone, or from the neck-joint of the altos or tenors) is revealing aplenty.”*

So, he relies entirely on Kool's theory, and subsequently describes the same construction as Jaap Kool mentions.

On the reasons for this build, Kelly<sup>326</sup> writes :

*“The answer lies in the acoustic-dynamic nature of the cone. While the cone offers many advantages as an instrumental bore-shape – great tonal flexibility, dynamic range, and an incomparable cantabile quality -, it’s inherent inability to produce acoustic resistance causes a dramatic imbalance in tone-color between tones produced with toneholes open and those produced with toneholes closed. The tones emitting from the “opened” cone will by nature be brighter [...] because less of the cone is resonating [...] and therefore less material-mass coloring of the overtone-spectrum can take place.”*

After this, Kelly<sup>327</sup> introduces Bernoulli's law, explaining the phenomenon of "lift", referring to his own career as a pilot.

*“an asymmetrical pressure differential is created within the bore: lesser static pressure exerted upon the parabolic side, greater static pressure upon the straight side. This asymmetrical pressure creates an unstable environment within the bore.”*

He then describes what he believes was the thought process behind this:<sup>328</sup>

*“the practical, acoustical advantages for the saxophone are very simple. Adolphe Sax used the basic phenomenon of pressure instability to induce as much vibration as possible within the instrument’s bore. [...] whereas the original saxophone mouthpiece design produces resistance to excess vibration, the parabolic bore actually encourages vibration. [...] consequently, the instrument’s entire length is encouraged to vibrate enthusiastically, regardless how many or*

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<sup>326</sup> Ibid., 14

<sup>327</sup> Ibid., 17

<sup>328</sup> Ibid., 18

*how few toneholes are opened. [...] This ingeniously-produced effect acoustically balances out the tonal discrepancies between open-tonehole (short cone) and closed-tonehole (long cone) pitches, allowing for the production of a beautifully consistent scale throughout the saxophone's registers."*

Kelly also indicates what he believes to be the connection between Adolphe Sax's instruments and the various 20th -century saxophone manufacturers:<sup>329</sup>

*"The saxophones built by Adolphe Sax had a pronounced parabola, and its advantageous effects were phenomenal. Most instruments built during the first 30 years of the 1900's (Buescher, Conn, Selmer, etc.) retained a less extensively arched parabola, but it was still present and its effect still considerable. In most contemporary so-called saxophones, the parabola – tragically – has disappeared altogether."*

With this last remark, Kelly's thoughts on modern (meant in this case: French) saxophone sound become evident. In his conclusion, he even goes as far as to say, *"On the plane of instrumental design, it is an aesthetic atrocity directly comparable to the horrors of genetic mutation."*<sup>330</sup>

From Adolphe Sax' texts , we can gather that the parabola is present in the entirety of the instrument, and not just in part of it. It is already concluded that the parabolic line that Kool/Kelly thought they recognised is not present in the saxophone. Hereafter, this would be investigated with the aid of acoustic means, and through measurement. However, we can already state that Kelly's hypothesis (although presented with much spirit as a scientifically supported conclusion) is incorrect.

## **3.7. Acoustics/measurements**

### **3.7.1. Acoustics**

Let us now examine this subject from an acoustic perspective. In this way, we can determine an answer to the question of how Adolphe Sax came up with the term parabola. We know from the historical source material that it can be found along the entire length of the instrument, but what exactly is parabolic about it? If we also consider the source material in this respect chronologically, it yields the following insights.

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<sup>329</sup> Ibid., 19

<sup>330</sup> Ibid.

Nederveen<sup>331</sup>, who does not specifically address the question surrounding the existence of the "cône parabolique" asks himself an important question for his research:

*"The number and magnitude of bore irregularities varies from instrument to instrument; this raises the question whether or not all these irregularities serve a definite purpose."*

He answers as follows:

*"We conclude that a straightening of the bore does not change the tuning. [...]"*

*This leads to the conclusion that, in the absence of compelling reasons, the simplest possible bore is preferable to any other shape because of easier manufacture – and perhaps because of a decrease in sound energy losses"* <sup>332</sup>

He then notes:

*"Deviations from the ideal bore need not yield an acoustically inferior instrument compared with an instrument with an ideal bore; these deviations may be preferable when they constitute conveniences for the manufacture of the instrument."*<sup>333</sup>

In fact, he is indicating that the construction of the straight part of the saxophone, with one of the walls extending like a parabola, as outlined by Kool and Kelly, would not only be without result, but that a "normal" conical bore is much easier to manufacture and generates a better acoustic result. With regards to manufacturing principles at the time of Adolphe Sax, this certainly holds true.

Scavone<sup>334</sup>'s conclusion in his thesis is similar. In his case, however, the question surrounding the identification and meaning of the "cône parabolique" plays a central role.

*"To this day, there are professional saxophonists that seek out old saxophones constructed with the parabolic sonical shape, claiming that they allow a more focused sound and better flexibility of tone quality."*

*Using the acoustic observations discussed in this previous section, it should be possible to estimate the effects that a parabolic cone, in contrast to a circular cone, has on the sound of*

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<sup>331</sup> Cornelis Nederveen, *Acoustical aspects of woodwind instruments*, (Diss., Technische Hogeschool Delft), 1969, 92

<sup>332</sup> *Ibid.*, 93

<sup>333</sup> *Ibid.*, 95

<sup>334</sup> Gary Scavone, *An acoustic analysis of single-reed woodwind instruments with an emphasis on design and performance issues and digital waveguide modelling techniques* (PhD Diss., Stanford University, 1997), 71

*the saxophone. [...] it is assumed that only the straight portion of the air column, between its neckpipe and lower bow, is shaped as the parabolic cone."*

Scavone thus clearly follows Kool and Kelly's train of thought. However, unlike both, he disproves the theory that this provides an essential part of the original sound of Adolphe Sax' saxophones. This also applies to the manufacturers who built similar saxophones according to Sax' methods (???)

*"It appears that the parabolic conical bore prescribed by Adolphe Sax produces negligible differences in resonance frequency placement versus a pure conical bore. [...] Thus, it is likely that the unique qualities associated with saxophones of this shape (and era) are most attributable to other factors, as well as further possible bore deformities. In general, saxophones which have the parabolic conical shape also have a "darker" tone quality. Such behavior might be attributed to a misalignment of higher partials, preventing these harmonics from fully co-operating in the regime of oscillation and thus creating a sound which has less high spectral energy."*<sup>335</sup>

The first phrase was underlined by me.

Although Scavone thus erroneously goes along with Kool's train of thought that the "cône parabolique" is located in the middle (straight) part of the saxophone (the 2nd conicity), he confirms my findings with his conclusion. Adolphe Sax would never have opted for a very complicated construction of a middle part of the saxophone with a parabolic line on one side, if it would not have had far-reaching advantages. Furthermore, these saxophones were certainly not only manufactured by Sax himself (an experienced instrument builder), but by a large group of workers, and at a certain point in the 1860s, even by inmates.

In my opinion, the dark tone, as described by Scavone, is mainly caused by the mouthpiece, and the choice of reeds which, because of the characteristics of the mouthpiece, is necessary to enable a balanced sound and good intonation, and to achieve connections between registers. The choice of a mouthpiece with a large chamber in Adolphe Sax's original plan was a necessity in order to be able to play the instrument properly, as is the case with Buescher instruments. See sections 2.6.3.2. and 2.6.3.3.

As an experienced instrument builder, Benedikt Eppelsheim<sup>336</sup> comes to the same conclusion:

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<sup>335</sup> Ibid., 72

<sup>336</sup> Benedikt Eppelsheim, *Parabolische Bohrung*, in: *Saxofone, ein Kompendium* (Wahlwies, Uwe Ladwig, 2016), 12

*„Paraboloids have no [...] musically usable resonances. Nevertheless, Adolphe Sax describes the saxophone bore as a "cône parabolique" in his patents.“*

*In my own experience, however, a concave cone is not useful. The octaves are too low and the response is severely impaired. [...]*

*In the segment with tone holes, the cone of all the instruments I measured had a straight course.“<sup>337</sup>*

### 3.7.2. Measurements

#### 3.7.2.1. Postma

In recent years, Dutchman Marten Postma dealt extensively with various issues surrounding the construction of saxophones. His research on bore profiles is particularly interesting for my research. Using manual measurements, he investigated the conicity of a large number of 19th-century, 20th-century and contemporary saxophones, and incorporated them into graphs. He too confirmed, based on his measurements of historical instruments from my collection and others, that the part of the saxophone that Kool and Kelly describe as the parabola is indeed a straight cone.<sup>338</sup>

On his website, he explains that every saxophone involves multiple conicities, not just one.

*“The profiles from the time of the first patent show the common tendency of a ‘multiple sword profile’, which is a profile with more than one bend and where the conicity of the neck is greatest and this first conicity is followed by several each time narrower ones.”<sup>339</sup>*

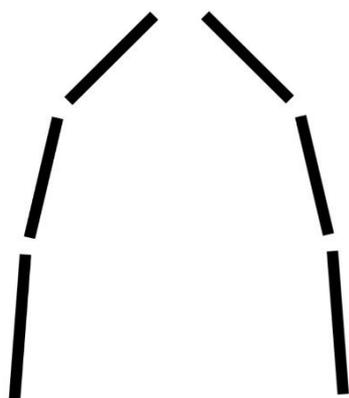
This clarifies not only how Adolphe Sax arrived at the term "parabolique", as Postma explained in 2016<sup>340</sup>, but also the properties of the bores that Sax describes in his second patent: in the case of the "cône droit" (straight cone), which is an instrument in which all three conicities are equal. In the case of the "cône rentrant" (concave cone), which refers to an instrument in which the conicities do not decrease as in the "cône parabolique", but rather increase in size. The sketch below serves to clarify.

<sup>337</sup> Ibid., 13

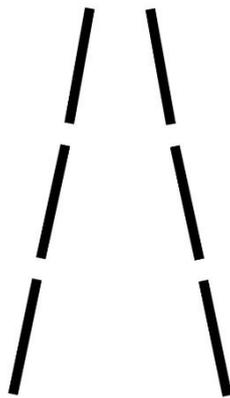
<sup>338</sup> Marten Postma, personal communication (e-mail), December 22, 2017

<sup>339</sup> <http://sax.mpostma.nl/CP/Inleiding.html>, retrieved February 9, 2018

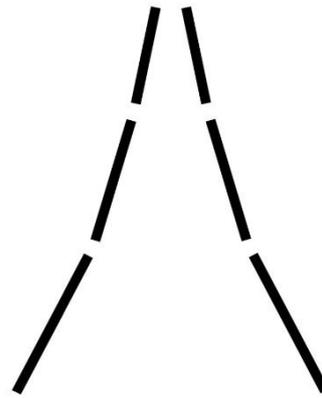
<sup>340</sup> Marten Postma, *Le cône parabolique*, in: Belgisch tijdschrift voor muziekwetenschap (Vol. LXX, 2016), 86



**Cône parabolique**



**Cône droit**



**Cône rentrant**

This "cône parabolique" can be best be observed in alto saxophones. In Appendix 18, I have drawn a line between starting and ending points of each conicity in Adolphe Sax no. 24495 (Leo van Oostrom collection). This produces a trajectory that indeed matches that of the the diagram above, under "Cône parabolique". Important note: for clarity, the gradient has been made more extreme in the figure above.

If you compare that to the trajectory of tenor saxophone nr. 15676 (Leo van Oostrom collection), you see, for example, that the third conicity is slightly less "straight" than the one in the alto saxophone. *See Appendix 19.*

Based on his measurements, Postma<sup>341</sup> concludes that there are major differences between the bore profiles of the different generations of Adolphe Sax saxophones. Furthermore, several additional differences can be observed for each member of the saxophone family. He also notes that Sax himself later deserted the parabolic cone shape in the construction of his saxophones. I do not want to discuss this in further detail in this thesis because it is irrelevant to the conclusions of this study, and moreover overlaps with Postma's research.

Why Adolphe Sax chose the specific sequence of three conicities is clarified by Ferron<sup>342</sup>, who points out that:

*"If the upper note of an octave is sharp, it is because the cone of the bore is not open enough.  
If it is flat, it is because the cone of the bore is too open."*

This would be the case if the conicities were not increasingly larger (seen from the bell to the neck). Postma<sup>343</sup> also provides a clear explanation:

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<sup>341</sup> Ibid., 88

<sup>342</sup> Ernest Ferron, *The Saxophone is my voice* (Paris, International Music Diffusion, 1997), 99

<sup>343</sup> Marten Postma, *Le cône parabolique*, in: *Belgisch tijdschrift voor muzikwetenschap* (Vol. LXX, 2016), 81

*“Sax [...] changes the conicity of his cone for different ranges of the instrument. So he moves the top of his cone and thus changes the instrument's need for truncated volume for the high and for the low”*

### **3.7.2.2. X-ray/CT**

With the cooperation of the staff of the Medical Imaging Department at the VieCuri Medical Centre in Venlo, the Netherlands, I have obtained several X-ray/CT images of instruments from my collection. Specifically the ones by Adolphe Sax Sr. (tenor, serial number 21238) and Adolphe Sax Jr. (alto saxophone, serial number 17042). These images confirm my aforementioned visual observations. In both instruments, the tube is straight; the parabolic shape on the side of the tube, where the tone holes??? are located, as described by Kool and Kelly, cannot be seen. On the CT image, moreover, it is easily established that the tube is circular in the lower part of the second conicity. A parabolic shape, as outlined by Kool and Kelly would produce an ellipse.

Further conclusions based on this material by means of e.g. computer analyses are not (yet) possible.

Some images are included in *Appendix 15*. As noted earlier, I am happy to make these JPG -and DICOM- images available for further research. Imaging took place on February 15 and June 6, 2018.

## **3.8. Conclusion**

For the first time in history, an exhaustive study of the "cône parabolique" was conducted through both historical source research and interpretation of geometrical data. Thus, also for the first time, it can be established what the connection between Adolphe Sax' instruments and the Buescher saxophones, as used in the Raschèr tradition is. The connection does not consist of an identical construction of the body of the saxophones in question, but the use of a large chamber mouthpiece.

In the 19th century, some authors adopted the term "cône parabolique", while others wrote about a conical tube as being the form in which the saxophone is constructed. The authors concerned were discussed and the semantic confusion in terms of terminology, that already arose during this time period, was outlined. From this part of the study, the conclusion can be drawn that the "cône parabolique" can be seen along the entire length of the instrument, i.e. from the beginning of the neck to the bell. The writings of Adolphe Sax himself were crucial for reaching this conclusion! Particularly, Adolphe Sax's letter to Wieprecht provided essential insight.

The findings of Jaap Kool and John Edward Kelly were previously discussed. They assumed that the "cône parabolique" is located in the part of the saxophone where the keys are mounted. Both authors base their theory purely on optical observations, Kool even doing so after studying the wrong instrument. My own observations of the same instruments contradict the proposed shape of construction.

Literature studies related to acoustics show that the tube as described by Kool/Kelly not only does not generate a better acoustic result, but would also be extremely complicated to build, even today, let alone at the time of Adolphe Sax' production process!

As the previous chapter also demonstrated: the specific sound that Adolphe Sax instruments possess results only partly from their construction. More decisive is the use of a mouthpiece with a large chamber. Adolphe Sax chose to use these mouthpieces to achieve the required volume inside it.

Marten Postma's geometric measurements show that the Adolphe Sax saxophones actually consist of three different tubes: the neck, the straight part of the instrument, and the part after that - the curved shape of the bell is left out. These three different tubes each have a different conicity: they all widen in different fashions. In Adolphe Sax' saxophones, the conicity decreases for each mentioned part of the instrument. Postma already concluded that this is what Adolphe Sax meant by the "cône parabolique". Checked against the literature review of historical sources and acoustics, we can conclude that this is correct. This debunks the findings of Kool and Kelly, in particular.

Briefly, the overall parabolic cone of the instrument (the "cône parabolique") is constituted by three conical tubes that are different from each other.

Consequently, we can also arrive to the conclusion concerning the meaning of the "cône droit" and "cône rentrant", as mentioned by Adolphe Sax.

X-ray and CT-scan images of relevant instruments from my collection provide visual information that confirm the aforementioned conclusion about the "cône parabolique". This data will upon request be made available for further research..

The differences and similarities between Adolphe Sax and Buescher saxophones have been discussed previously. Buescher saxophones do not have exactly the same bore profile as Adolphe Sax saxophones. The connection between Adolphe Sax and Buescher lies in the use of a mouthpiece with a large chamber, as a solution to achieve the necessary volume inside it. As cited in the previous chapter, this internal volume does not differ much between a modern Selmer mouthpiece and a Raschèr mouthpiece. The difference lies in the concept of how this volume is achieved. This is consistent with the fact that Sigurd Raschèr himself spoke little about the construction of his instrument, but did insist on the use of mouthpieces with a large chamber, as he considered this to be

defining for the sound of the saxophone.

Translation of the original chapter from my doctoral dissertation, 2021,

by Ade Nicolas, Joachim van Zoelen, Dr. Andreas van Zoelen FRSA, 2024.

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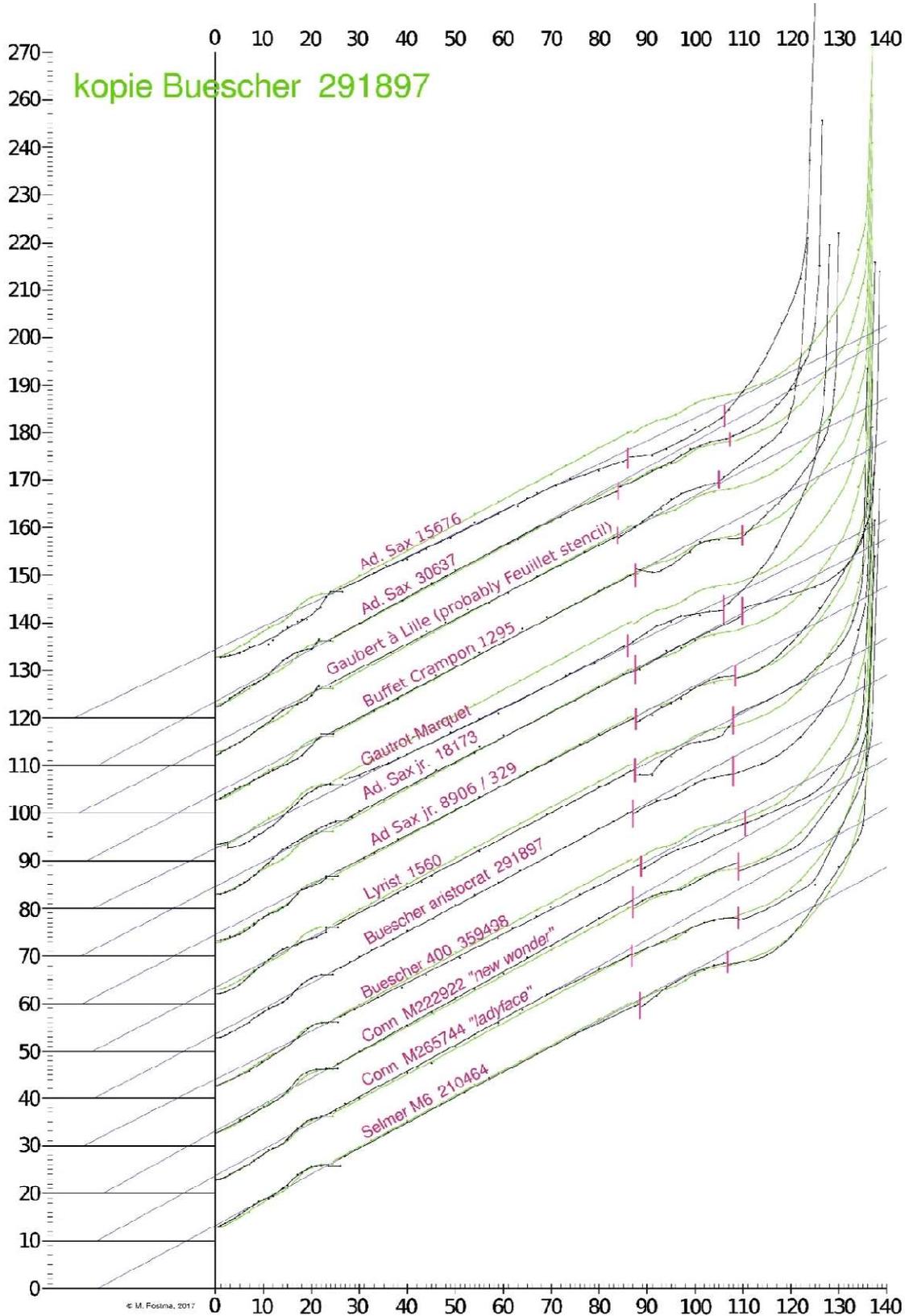
[www.saxophonemuseum.online](http://www.saxophonemuseum.online)

[www.raschersaxophonequartet.com](http://www.raschersaxophonequartet.com)

# Relevant Appendixes

## Appendix 11

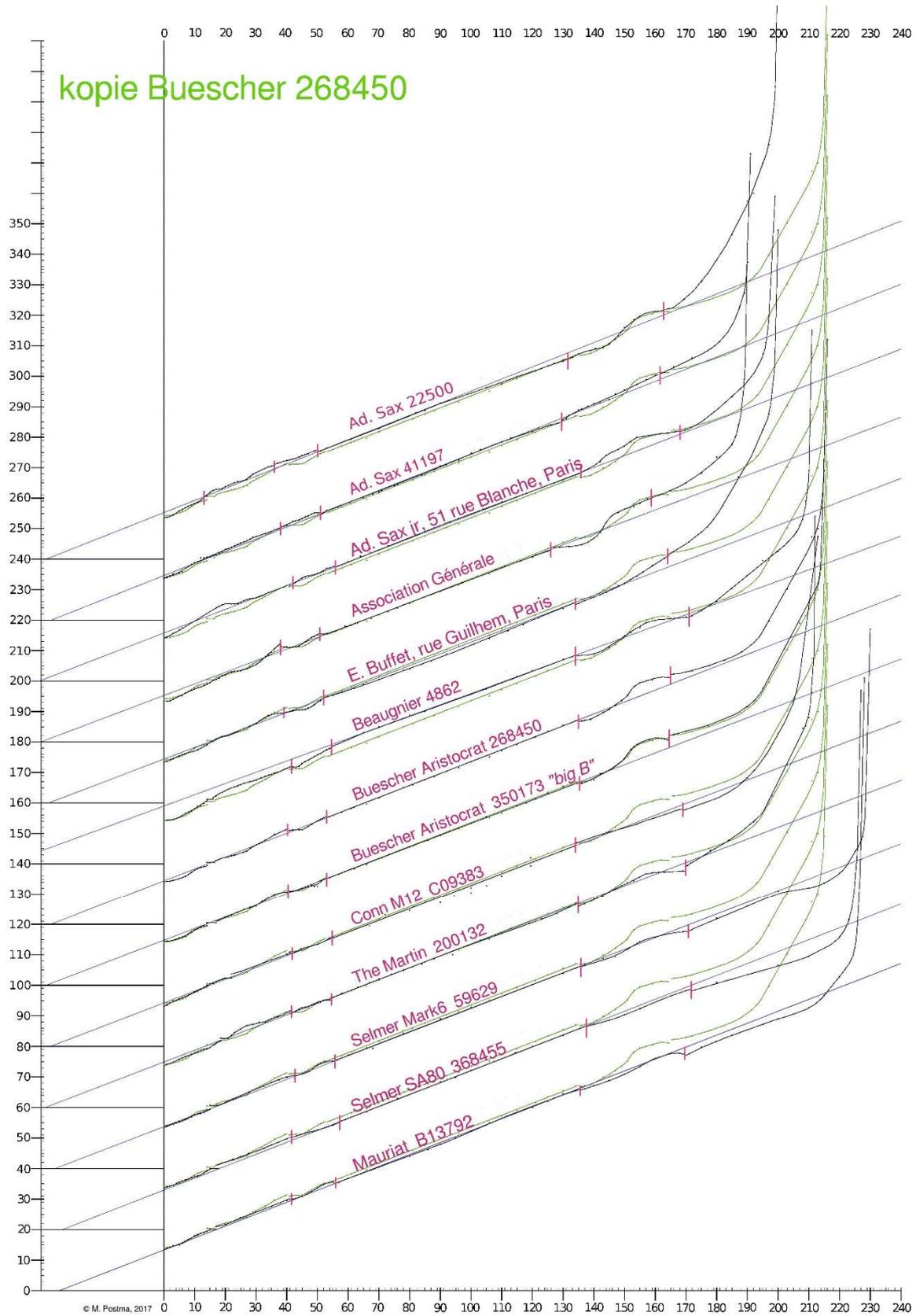
Measurements Marten Postma



Metingen Marten Postma. Voor het beste begrip zijn deze metingen met de pagina liggend te lezen.

# Appendix 14

Measurements Marten Postma



## Appendix 15

X-Ray image Adolphe Sax tenor saxophone no. 21238 [1861], Andreas van Zoelen collection

Image taken June 6. 2018, VieCuri Medical Center, Venlo, Netherlands



X-Ray image Adolphe Sax Jr. alto saxophone no. 17042 [1907-1928], Andreas van Zoelen collection

Image taken June 6. 2018, VieCuri Medical Center, Venlo, Netherlands



CT Scan Adolphe Sax tenor saxophone no. 21238 [1861], Andreas van Zoelen collection

Taken June 6. 2018, VieCuri Medical Center, Venlo, Netherlands

Screenshot of the 3D image:



Cross-section :



X-ray and CT images will upon request be available digitally for further research

## Appendix 16

From: Kool, Jaap. *Das Saxophon* (Leipzig: J.J. Weber, 1931, Faks.-Ausg. Erwin Bochinsky, 1989), 59



Jaap Kool: image and sketch, unknown photographer

Note : it is not at all sure that the person seen in the image is Jaap Kool himself

## Appendix 17

Pictures of Adolphe Sax tenor saxophone no. 22039 [1861], Andreas van Zoelen collection, in disassembled state. Taken August 31. 2018, atelier of Nico Bodewes, Amsterdam, Netherlands

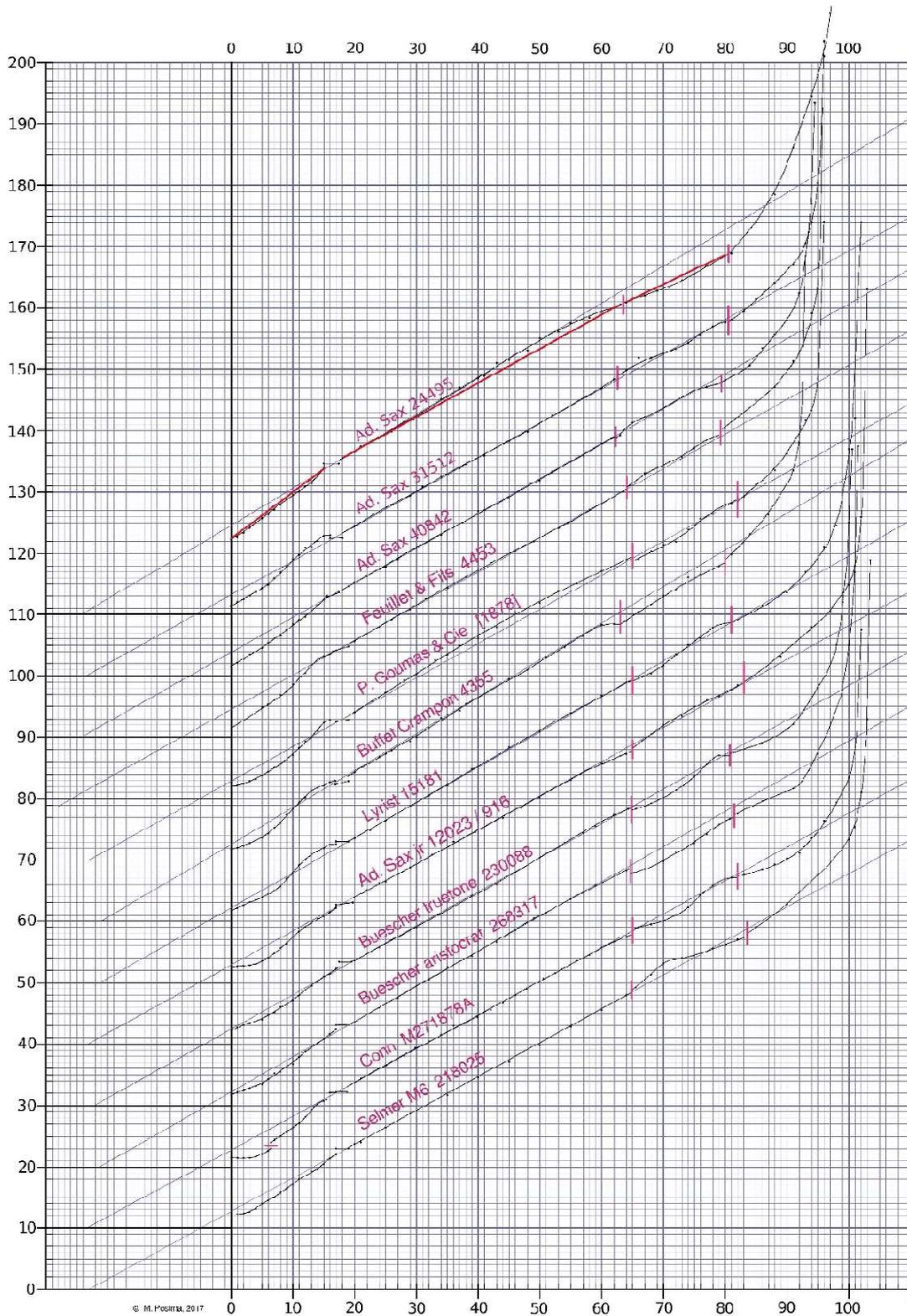




# Appendix 18

Measurements Marten Postma

The three red lines with Adolphe Sax no. 24495 were added by me

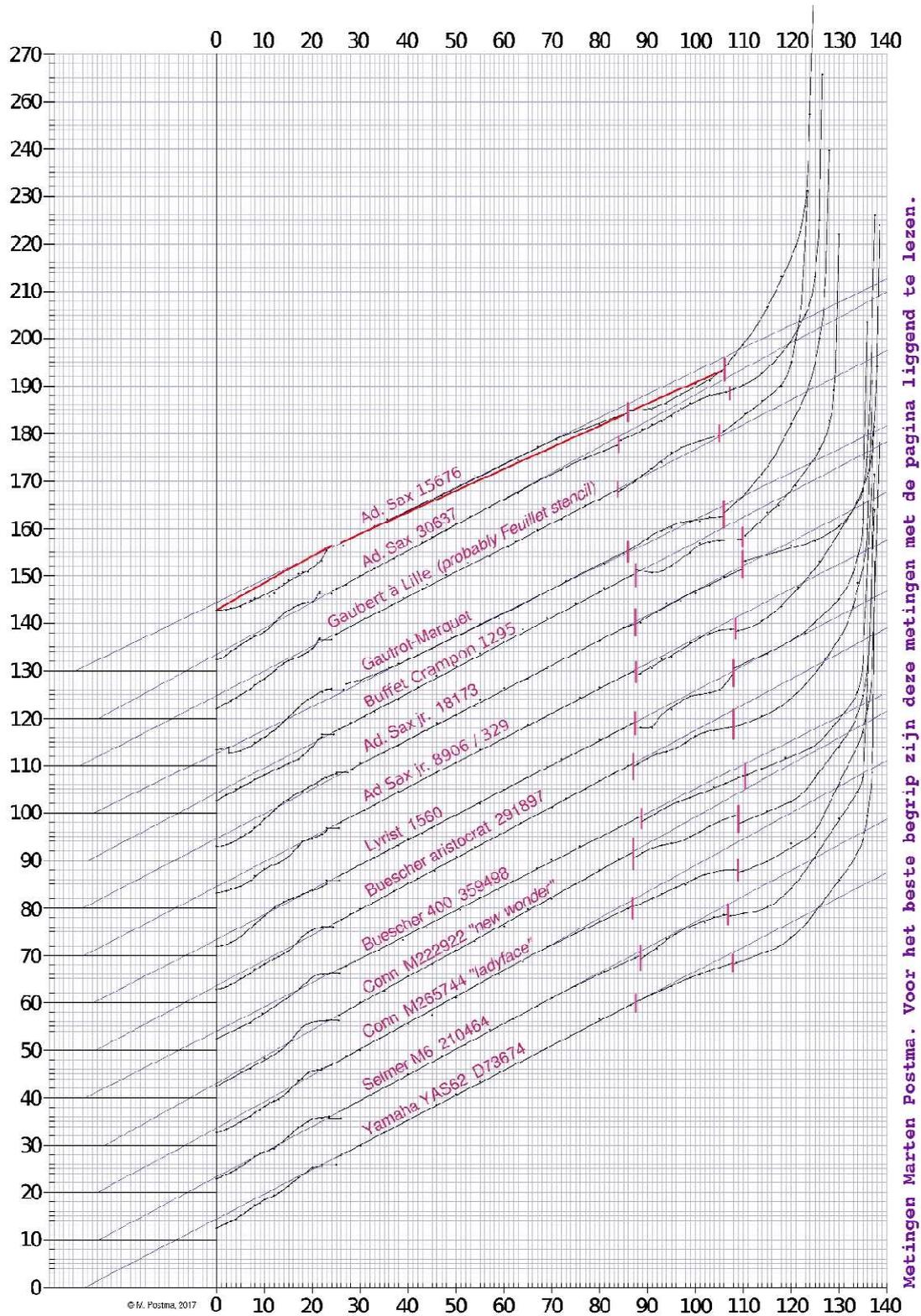


Metingen Marten Postma. Voor het beste begrip zijn deze metingen met de pagina liggend te lezen.

# Appendix 19

Measurements Marten Postma

The three red lines with Adolphe Sax no. 15676 were added by me



Metingen Marten Postma. Voor het beste begrip zijn deze metingen met de pagina liggend te lezen.