Traces of the Impact of the Works of the Wittenbergian Mathematician Johann Friedrich Weidler on Textbooks and Academic Teaching of the 18th Century

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Abstract

In the 18th century the term Mathematische Anfangsgründe *appeared in the titles of introductory textbooks that are mainly designed to support the academic teaching of mathematics. They include allmost all the disciplines associated with contemporary mathematics. By historians, especially Abraham Gotthelf Kästner's and Christian Wolff's* Anfangsgründe *have been studied in the context of traditions of textbooks written in German. The aim of this article is to classify Johann Friedrich Weidler as one of the first generation of* Anfangsgründe*-authors and to get a first exemplary synopsis about his influence and impact in academic publishing and teaching.*

Keywords: German mathematicians of the 18th century, university teaching of mathematics, academic textbooks, University of Wittenberg

Introduction

The University of Wittenberg, called Leucorea, was a beacon of the Reformation and has always been one of the most important universities in Protestant Europe. In the last decade mathematics research and teaching of the 16th and 17th centuries at the Leucorea has been investigated by historians of mathematics, especially the academic activities of Ambrosius Rhodius (*1577, †1633)[1*] and Christoph Nothnagel (*1607, †1666) have been studied (Schöneburg, 2010; Krohn, 2013). Less attention has been paid to the 18th century mathematics at the Leucorea, even though Wittenberg along with Leipzig and Halle was an important place of the Central German Enlightenment. Besides Rhodius and Nothnagel, Johann Friedrich Weidler (*1691, †1755) was an eminent author in the field of textbook writing. Weidler held a professorship for mathematics at the Leucorea for more than 40 years. There he was not only *qua Amt* the all-dominant figure of his subject in the first half of the 18th century.

First we will have a brief look at Weidler and the reflection of his works, in order to get an impression and overview of his life and achievements. Then we will focus on an important part of his academic activities: publishing textbooks,

[1] To avoid too many citations, dates of lifetime are generally taken from ADB, NDM, BBKL, SäBi or ЭСБЕ. N. B. The sign † is independently used from religious denomination. Non-classical quotations are translated. A list of abbreviations &c. is placed at the end of this article.

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especially his *Inſtitutiones Matheſeos*. Aspects of this textbook will be presented in the context of the *Anfangsgründe* literature. Finally, we will exemplarily analyse Weidler's influence and impact upon other textbooks and academic teaching in the 18th century. The analysis and contextualisation follows the spirit of Schubring (2005), Sciba & Schreiber (2010), and Wußing (2013).

Johann Friedrich Weidler as a University Professor

Johann Friedrich Weidler was born on 23rd April 1691 in Großneuhausen, Thuringia, as the third son of a Lutheran pastor, by whom he was taught in Latin and Greek at home, before entering what is now the Gymnasium Ernestinum in Gotha in 1702 (RFBW, Fun. 647). In 1708 the young Weidler was enrolled at the University of Jena, where his academic teachers were the mathematician and natural philosopher Georg Albrecht Hamberger (*1662, †1717), who was also a teacher of Christian Wolff (*1679, †1754), the physicist Georg Wolfgang Wedel (*1645, †1721) and the jurist Johann Philipp Slevogt (*1649, †1727). Three years later he was awarded a master's degree.

The following year he moved to Wittenberg and started teaching at the Leucorea. At first he was a *Privatdozent* for philological, mathematical and historical courses. Subsequently, he became *extraordinarius* (1714) and *ordinarius* (1715) for *Mathematica inferior*. The division of mathematics into two cathedrae had been one of the specialities of the Leucorea since 1525, and was the manifestation of the importance of mathematics for epistemology based on Melanchthon's didactic programme during the first century after the foundation of the university (Schöneburg, 2010, pp. 13 sqq.). For a better overview about the Wittenbergian professors for mathematics, see Tab. 1. Weidler competed for the ordinate with Christian Wolff, the candidate of the Saxonian elector's court (UAHW, Rep. 1, Nr. 4955, pp. 105 sq.), but Weidler was the favourite of the university *collegium*: so they outwitted Wolff, and Weidler obtained the position (UAHW, Rep. 1, Nr. 1539, foll 105 sq.; Friedensburg, 1917).

Tab. 1. Mathematic's professors at the Leucora (1709–56), cf. Schöneburg (2010, p. 44)

Prof. mathem. inf.	Prof. mathem. sup.
Ernst Christian Schrödter (1709–15)	Johann Andreas Planer (1709–14)
Johann Friedrich Weidler (1715–19)	Heinrich Klausing (1715–19)
Johann Matthias Hase (1720–42)	Johann Friedrich Weidler (1719–55)
Georg Friedrich Bärmann (1745–56)	

In the following years Weidler significantly upvalued the cathedra: While his predecessor, the theologian and mathematician, Heinrich Klausing (*1675, †1745) had taught *Matheſis biblica*, and especially *Chronologia eccleſiaſtica* in Higher Mathematics after the death of Johann Andreas Planer (*1665, †1714), Weidler augmented the *Mathematica inferior* with *Geometria univerſa*, *Geometria practica et Architectura civilis militarisque*, and further with *Optica*, *Hydroſtatica* as well as *Aerometrica*,

and thus with much more and various mathematical content than it had been usual during the previous decades.

In 1718 the *editio princeps* of Weidler's *Inſtitutiones Matheſeos* was published, and the following year Weidler became *ordinatius Mathematicae ſuperiori*. Therefore he also added astronomy and its attributes – especially trigonometry, chronology, geography – to his lecture portfolio, with the consequence that Johann Matthias Hase (*1684, †1742), who succeeded Weidler in the chair of inferior mathematics, could initially only read *Geographia ad hiſtoricam et politicam* in order to fulfil his teaching duties. This cumulation was unproblematic as long as there was only one true *mathematicus* in one of the chairs, but with Hase – a disciple of Wolff – the situation changed. At least after Weidler's educational journey in 1726/27 to Western Europe, Western Germany and Switzerland – where he also among others met Isaac Newton (*1642, †1727), Edmond Halley (*1656, †1742) and Jacques Cassini (*1677, †1756) – an intersection of lecture topics can be seen in the lecture's announcements (UAHW, Rep. 1, Nr. 367). The later discussion concerning the teaching topics of the two chairs also involved the Faculty Council, and the division of topics became disjunct: Weidler concentrated on *Aſtronomia* and *Trigonometria ſphaerica* in his public lectures.

One year before his long journey in 1726/27, Weidler made a trip to Freiberg, and after his return he published the first edition of his *Inſtitutiones Geometriae Subterraneae*, an influential compendium of mining mathematics that opened up this subject to the academic public. The same can be stated about the hydraulic machines in London and Versailles: Weidler was the first scholar to present them to a German public in his *Tractatus de Machinis Hydraulicis* (1727).

At the end of his journey to Switzerland in 1727, where he also met his pen friend Johann Bernoulli (*1667, †1748) in Basel, Weidler was promoted to *Doctor iuris utriusque*. This was the basis on which he was appointed as an assessor of the Faculty of Law at the Leucorea, in addition to his professorship of Higher Mathematics, in 1735 (RFBW, Fun. 647).

In 1730 and 1732 he was elected a fellow of the *Königlich-Preußische Akademie der Wiſſenſchaften* in Berlin and of the *Royal Society* in London.

His *Inſtitutiones Mathematico-Phyſicae*, one of the first textbooks on "mathematical physics" was published in 1738. By the time of his death on 30th November 1755 in Wittenberg, his *Inſtitutiones Matheſeos* had gone through five editions, and he had completed his opulent monograph *Hiſtoria Aſtronomiae*, a much-respected source for historians of astronomy, as Johann Rudolf Wolf (*1816, †1893) judges:

> "It has in fact more the character of a chronological and dry collection of biographical notes and book titles than of a real hiſtory, but it reſcues an amazing collection of material of ſuch ſcope that it is an inexhauſtible treaſure trove." (Wolf, 1877, pp. 773 sqq., author's translation from German)

Weidler's *Inſtitutiones Matheſeos* as an *Anfangsgründe* Textbook

In 1802 – more than 80 years after the first edition – the philosopher Johann Christian August Grohmann (*1769, †1847) gave an assessment of Weidler's *Inſtitutiones Matheſeos*

> "as the beſt textbook that was publiſhed in theſe times for uſe as a compendium in lectures, and that can be placed without diſcuſſion next to the Wolffian ones." (Grohmann, 1802, pp. 93, author's translation from German)

Here, Grohmann is referring to Christian Wolff's *Anfangs-Gründe aller Mathematiſchen Wiſſenſchafften* (1710) or *Elementa Matheſeos Univerſae* (1713–15), respectively, which was indeed widely used in German universities (Sommerhoff-Benner, 2002, pp. 271 sqq.). It is considered as one of the first *Anfangsgründe* textbooks (Kröger, 2014, pp. 9 sqq.). Grohmann's quote should serve as a motivation to investigate more about Weidler's textbook and the *Anfangsgründe* textbook tradition.

In her dissertation Desirée Kröger (2014, abstract) characterises the *Anfangsgründe* as

> "introductory textbooks, which were created to assist teaching mathematics at German-speaking universities and for the use by students at any level. They contain all subjects which were associated with mathematics at the time".

The first edition (1718) of Weidler's textbook includes *decem et ſex Purae Mixtaque Matheſeos Diſciplinas*, as listed in Tab. 2. *Matheſis mixta* is designated *applicata* for the first time in an academic textbook (Reimers, 2020, pp. 33–55):

> *"Matheſis applicata*, quam nonulli mixtam appellant, complectitur ſpecialia quaedam naturalis ac ci[v]ilis ſcientiae argumenta, quae, absque purae matheſeos principiis, digne tradi exponique haud poſſunt." (Weidler, 1718, p. 5.)

Weidler's textbook is a good example as a result of a certain process of emancipation, which emerged in the ancient beginnings to *ſubalterna*te sciences as *Scientiae ſubalternae* to other sciences, and upgraded them in medieval transformation as *Scientiae mediae* to be assigned to *Mathematica*, from which these sciences increasingly emancipated themselves, although mathematical methods still had an important function in them, or in some even the decisive (epistemic) function (Reimers, 2020, pp. 33–55). From this point of view, the Weidlerian *Inſtitutiones* is an opportune initial of an analysis of the correlation and interrelation between pure and applied mathematical disciplines, as the ones in Tab. 2, at the beginning of the Enlightenment.

Tab. 2. Weidler's adjunction of mathematical disciplines, cf. Weidler (1718, pp. 4 sq.)

Mathesis pura	*Arithmetica,* *Geometria,* *Analysis,* *Algebra,* *Trigonometria plana*, and *Trigonometria sphaerica*
Mathesis applicata	*Optica, Catoptrica, Dioptrica, Perspectiva,* *Astronomia,* *Geographia,* *Chronologia,* *Gnomonica,* *Mechanica,* *Hydrostatica,* *Aerometria,* *Hydraulica*, and *Architectura civilis et Militaris*

Apart from the Latin language and therefore also the title *Institutiones* – which by its very name refers to the scholastic textbook tradition and marks it as *rigorous* – the characteristics of Kröger's (2014, pp. 27–52.) mathematical *Anfangsgründe* – such as time period, content and structure, audience, circulation and use, intention, and didactic approach – are also appropriate for Weidler's textbook, as will be shown.

At the beginning of the 18th century, Latin was still the academic *lingua franca* and language of instruction at universities, even though limited exceptions in specific contexts can be found, e. g. at the Leucorea (cf. Schöneburg, 2010, p. 46; Krohn, 2013, pp. 95 sqq.) or the University of Leipzig (cf. Kühn, 1987, pp. 15 sqq.). The development towards German-written textbooks and lectures in German was still in its infancy, and Latin was used in research monographs until the 19th century. So it is not unusual that Weidler published his textbook in Latin. In fact, all his publications are in Latin: This choice provided him not only with a wider spread of international circulation, but he was also convinced to be better understood; he argued against the use of German language in science and philosophy and therefore was in opposition of Christian Thomasius, (*1655, †1728) who was arguing for germanophony in Leipzig (Weidler, 1716).

Weidler's comprehensive first edition, running to almost a thousand pages, is didactically structured according to the Leibniz' principle *theoria cum praxi*: e. g. trigonometry is divided in *Trigonometria plana* and *sphaerica,* and the former precedes *Optica* and the latter *Astronomia.* Each paragraph is strictly related to be either a *definitio*, *axioma*, *postulatum*, *theorema*, *lemma*, *demonstratio*, *hypothesis*, *problema*, *resolutio*,

confectarium or *ſcholion*, reflecting Weidler's intention to make his book an example of the application of the so-called mathematical method:

> "*Methodus Mathematica*, ſecundum quam mathematicarum diſciplinarum materies ordunatur, tota eo redit, ut a notitiis primis ac ſimpliciſſimis, per[v]eniatur ad ea, quae ignota, magisque compoſita ſunt, atque, ut quaelibet propoſitio fundamentis antea poſitis, certa ubius initatur." (Weidler, 1718, p. 5)

When it comes to the *Methodus Mathematica*, discussions tend to focus on Wolff's work. Its impact on 18th century science is undeniable (Frängsmyr, 1975), especially for the mid-century philosophy, but a closer look at the first decade of the *Methodus Mathematica* and its proponents is still missing (cf. Cantù, 2018, pp. 372–5). Weidler refers to Wolff's *Anfangsgründe* and *Elementa*, but distinguishes his own work from them:

> "[…] et in principio celeberrimi Domini Consiliarii Wolf[f]ii elementa, [v]el germanica, [v]el latinorum quoque primam partem, deſiderantibus explicare, ac deinceps, cum germanica, ob ſermonem patrium, latina [v]ero, ob amplitudinem et pretium, non omnium inſtituto fortunaeque convenire [v]iderentur, alias a me digeſtas poſitiones, in publicis pri[v]atisque, recitationibus proferre aggreſſus ſum […]." (Weidler, 1718, Praefatio ad Benevol[u]m Lectorem, p. 4.)

Theory and application of the Wolffian and Weidlerian mathematical method should be investigated in more detail: Both agree upon the importance of definitions and deduction as well as on following the conceptual analysis. Weidler's work is commended by contemporaries for the application of the method, Wolff's work is judged to be inconsistent: The alleged disadvantage – Weidler's aim to write a textbook, that means a book with a didactic focus on teaching – seems to possibly be an advantage over writing a mathematical encyclopaedia in this special case as Wolff regarded his *Elementa* (Frängsmyr, 1975), even though it was used as a textbook and can be classified as *Anfangsgründe* literature (Sommerhoff-Benner, 2002, pp. 42 sqq.; Kröger, 2014, pp. 9 sqq.). It was with his *Philosophia Rationalis* (1727) that Wolff became more assailable, as Giorgio Tonelli (1959, pp. 36 sqq.) points out.

Weidler's report to the Philosophical Faculty on 25th September 1733 shows (UAHW, Rep. 1, Nr. 4984.) that he used his textbook for his lectures and took (again) his experience and the *dubia* of his students as a basis to develop and improve the next (the third) edition, published three years later. In a similar way Georg Matthias Bose (*1710, †1761), who is most famous for his work on electricity, and Georg Friedrich Bärmann (*1717, †1769), Hase's successor as professor for *Mathematicae inferiori* from 1745, based their lectures on Weidler's *Inſtitutiones* (Kathe, 2002, p. 483.). Especially Bärmann's use is significant, because he was (like Hase) a student of Wolff, who had his own successful *Elemanta*. Johann Jacob Ebert (*1737, †1805), the last professor for Mathematics at the Leucorea, published the sixth (and last) edition of Weidler's *Inſtitutiones* in 1786.

Circulation and Impact of Weidler's Textbooks

Of course, it is not surprising that the textbook of a professor at the Leucorea like Weidler, had a high reputation and long tradition of use. The fact, that Grohmann, the editor of the university annals, who wrote that Weidler's textbook was "the beſt textbook, that was publiſhed in theſe times", and Ebert were contemporaries, gives rise to the suspicion, that Grohmann's assessment may have been more a reflection of Ebert, and that Weidler's *Inſtitutiones* was only in Wittenbergian orbit of importance. But an amplified view dissipates and vitiates this sneaking suspicion:

The review of the *Acta Eruditorum* of June 1718 to Weidler's *Inſtitutiones* is very commendatory (AE, 1718, pp. 283 sq.):

> "[…] nec Sturmianis praecemtionibus nimis conciſis, nec opere Latino Wolf[f]iano, paulo ampliori, uti commode poſſet, ipſe applicuit animum ad Inſtitutiones univerſae Matheſeos in ordinem, pro auditorii ſui uſibus, redigendas."

It also points out the breadth – from *De Natura & Conſtitutione Mathematica* via arithmetic to geometry, and even the principles of analysis –, the stringency of the *methodus Mathematicae* and the practical connexion between theory and application.

In fact, for more than half a century the Weidlerain *Inſtitutiones Matheſeos* was used as frequently as the Wolffian, especially abroad:[2] One example is the Germano-Russian mathematician and physicist Johann Joachim Julius Rost (*1726, †1791), who studied in Göttingen and became an adjunct professor in 1757, and an *ordinarius* at the Moscow University in 1761, where he worked with Dmitri Sergeyevich Anichkov (*1733, †1788) in the Department of Applied Mathematics and Experimental Physics (Бобынин, 1899).

> "R[ost] read applied mathematics according to the work of Weidler: *Inſtitutiones Matheſeos ſelectis obſervationibus illuſtratae in uſum academicarum*, consisting of separate parts devoted to both pure and applied mathematics. The latter was represented by the following sections: *Optica proprie dicta*, *Ars perſpectiva*, *Catoptrica*, *Dioptrica*, *Aſtronomia ſphaerica*, *Aſtronomia theorica*, *Geographia generalis*, *Chronologia*, *Gnomonica*, *Mechanica*, *Hydroſtatica*, *Aërometria*, *Hydraulica*, *Architectura civilis*, *Architectura militaris*. All these sciences in the lectures of R[ost], with the exception of astronomy, took not one year, but several, and no definite order was observed among them." (Бобынин, 1899, author's translation from Russian)

This shows the high academic reputation of Weidler's textbook not only for Rost, but for the whole *кафедра* at the Imperial University: All Weidlerian topics of *Matheſis applicata* were taught, and, because of the didactic arrangement Weidler intended with regard to the solitude of topics of applied mathematics, these disciplines could be taught in a modular way based on the principles of Weidler's pure mathematics (Шевырёв, 1855, pp. 57 sq.). Anichkov translated Weidler's *Inſtitutiones Matheſeos* into Russian, see also Tab. 3. He also edited the single parts

[2] This is indicated by translations into several European languages of Weidler's textbooks (e. g. Mört, 1727; Fuchsthaler, 1765; Барсов, 1795)

for the particular lectures and later also for grammar and special schools, several times.

Tab. 3. A collection of Weidler translations into Russian.[3]

#	Short title
1	Іог. Фридерика Вейдлера *аритметика теоретическая и практикая*, переведенная [...] Аничковымъ, Москва, 1765.
2	[…] Вейдлера *аналитика или алгебра*, [...] Аничковымъ, новое изданїе […] Барсовымъ, Москва, 1795.
3	[…] Вейдлера *военная архитетура или фортификація,* [...] Аничковымъ, Москва, 1766.
4	[…] Вейдлера *геометрія теоретическая и практикая* переведенная съ латинскаго языка магистромъ [ч]то нынѣ Профессоромъ Экстаординарнымъ и обѣихъ Гимназій Инспекторомъ Дмитріемъ Аничковымъ, Москва, 1776.
5	[…] Вейдлера *наставленія къ подземной геометріи или маркшейдерской наукѣ* […] Матровымъ, [Санкт-Петербург], 1777.
6	[…] Вейдлера *плоская тригонометрія*, изданіе второе, вновь переведенное А. Ж., Москва, 1805.

This phenomenon correlates with the emerging contemporary trend in German-speaking Europe from the mid-eighteen century onwards, where specific mathematical disciplines were separately published in *Anfangsgründe*-style, such as those of Wolff's successor in Halle, Johann Andreas von Segner (*1704, †1777), who published his *Elementa Arithmeticae, Geometriae et Calculi Geometrici* (1756). It may not be a coincidence, but in order to speak of a co-development in Russia and Germany, a detailed comparative meta-study focusing on mathematics would be necessary (cf. e. g. Grau & al., 1997). In Germany this trend fostered a more distinct specialisation, which was intended by the educational reforms in the late 18th and early 19th century.[4] But compared to these specialised textbooks, the *Anfangsgründe*-authors were more general with an encyclopaedic academic claim in the age of Enlightenment (Kröger, 2014, pp. 11 sq. & 315 sqq.). The translated parts on elementary mathematics – such as *Arithmetica* or *Geometria* – in the Weidlerian *Institutiones* experienced the same fate as most of the *Anfangsgründe*: Their usage diffused into grammar schools (Kröger, 2014, pp. 114 sqq.). Anichkov was later appointed *extraordinarius* and imperial inspector of grammar and special schools, where he introduced his translations of the elementary topics of the theoretical and practical mathematical disciplines from Weidler's *Institutiones* (cf. e. g. #4 in Tab. 3.).

[3] In the Imperial Library of St. Petersburg in 1918 there were at least 13 Russian translations of Weidler's textbooks.

[4] For the specialisation of Mathematics in Saxony, cf. Morel (2013).

Abraham Gotthelf Kästner (*1719, †1800) is a representative of the second generation of *Anfangsgründe*-authors and is well studied by Kröger (2014, pp. 55 sqq.) in the context of German textbooks. Kästner was influenced not only by Wolff's works, but also by his teacher Christian August Hausen (*1693, †1743). Besides both, he often refers to Sturm and Weidler in his textbooks. One example is Kästner's specialised textbook *Anmerkungen über die Markſcheidekunſt* (1775) which is mainly a commented extension of Weidler's mathematical-historical, not in scientific detail studied *Inſtitutiones Geometriae Subterraneae* of 1726 (Reimers 2021, p. 121):[5]

> "The current annotations had been developed on the occaſion of the lectures that I read ſome years ago on Weidler's book." (Kästner, 1775, Vorrede, author's translation from German)

It may not be a coincidence, that the topics in Kästner's *Mathematiſche Anfangsgründe* (1758–89) follow more the Weidlerian than the Wolffian structure (cf. Kröger, 2014, pp. 337 sq.).

Conclusion and considerations for further research

Like Wolff, Weidler should be seen as one representative of the first generation of *Anfangsgründe*-authors: The German language does not seem to be the most important criterion for the first generation; more importantly it is the diversity of mathematical disciplines, which was relevant for academic teaching, the didactic presentation, the scientific approach and a rigorous mathematical argumentation in relation to theory and application. These reasons combined with the Latin language gave Weidler's *Inſtitutiones Matheſeos* a strong impact as a textbook among his other 100 publications.

This article exemplarily shows that Weidler's textbooks were influential not only in Central Germany but also abroad: His *Inſtitutiones Matheſeos* became the basis for the mathematical study programme of the Department of Applied Mathematics and Experimental Physics at the University of Moscow in the mid-18th century. A broader view on Germano-Russian mathematical exchange, or even of the entire Baltic region[6] could frame this case of personal and textbook-based educational knowledge transfer.

Because of its strictness in reasoning, especially as textbook, the Weidlerian *Inſtitutiones* are a convenient initial for studying the relation of pure and applied mathematics of the 18th century: A more detailed and expanded comparison could lead *a fortiori* to revealed results.

However, with the exception of a few case studies (e. g. Kühn, 1987, for Leipzig), little is known about the lectures, their content and also the used literature at German universities in the 18th century. A structured (meta-) study would help to evaluate the connexion between lectures and books as well as to develop a

[5] This book has also been translated into Russian [#5 in Tab. 3] and German (Fuchsthaler, 1765).
[6] Weidler's publications has also been reflected in the Swedish Empire.

deeper understanding of mathematical academic teaching and its relevant disciplines before the French Revolution.

With his textbooks and their international circulation Weidler had a formative and lasting influence on the genesis of applied mathematics and the mathematical presentation of practical and applied sciences which began to be emancipated from their mathematical origins in the second half of the 18th century through a process of "mathematisation" (Stichweh, 1984, pp. 173 sqq.).

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Siglia and Abbreviations

ADB – Allgemeine Deutsche Biographie.
AE – Acta Eruditoum, Leipzig.
BBKL – Biographisch-Bibliographisches Kirchenlexikon.
NDM – Neue Deutsche Biographie.
RFBW – Reformationsgeschichtliche Forschungsbibliothek Wittenberg
SäBi – Sächsische Biographie.
SieB – Siegener Beiträge zur Geschichte und Philosophie der Mathematik
UAHW – Universitätsarchiv Halle-Wittenberg
ЭСБЕ – Энциклопедический Словарь Брокгауза и Ефрона

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