

# Stages towards a German mathematical Journal (1750-1800)

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When August Leopold Crelle started up his *Journal für die reine und angewandte Mathematik* in the year 1826, the title of the journal echoed both Joseph Gergonne's *Annales des mathématiques pures et appliquées* (since 1810) and Carl Friedrich Hindenburg's *Archiv für die reine und angewandte Mathematik* (1795 - 1800). This last journal together with the *Leipziger Magazin für die reine und angewandte Mathematik* (1786 - 1789) are generally known to belong to the first specialised, mathematical journals worldwide. In this paper, we will retrace the evolution that led up to Hindenburg's journals. Instead of focussing on mathematical journals *per se* we will describe and analyse the forms of mediation and communication that prepared the way for a specialised journal.

## **1. Forms of learned communication concerning mathematics anno 1750**

Until late in the XVIIIth century mathematical research articles were mostly published in the local proceedings of an academy or university, the language mostly Latin or French. The Berlin Academy had its *Histoire* and *Mémoires*, the St Petersburg Academy its (*Novii*) *Commentarii*, the Paris Academy its *Histoire* and the *Journal des Savants*, the Royal Society its *Philosophical Transactions*, the Munich Academy its *Abhandlungen*, Göttingen its (*Novi*) *Commentarii*, Leipzig its *Nova acta*, Basel its *Acta Helvetica* etc. Their content outside the learned environments (and libraries) was mostly made accessible through learned journals that appeared weekly or even more often and presented the news from the Republic of Letters in their pages.

As Albrecht von Haller noticed in 1747 when he was reorganising the *Göttingische Zeitung von gelehrten Sachen* into the *Göttingische Anzeigen von gelehrten Sachen* (1753 – 1801), a learned journal thrives when it is produced in an environment that has “a steady import of books” and authors with “extensive correspondence”.<sup>1</sup> Indeed, the *Göttingische Anzeigen von gelehrten Sachen* (GGA) and others journals, all modelled after Leipzig's *Neuen Zeitungen von gelehrten Sachen* (NZG, 1715 – 1784), contain excerpts from learned correspondence, latest news from the Republic of Letters, including announcements and heaps of reviews of the latest appearances.<sup>2</sup> These journals were published two or three times a week.

This format left the academic environment around 1760 when independent publishers such as Friedrich Nicolai, Christian Felix Weisse and Friedrich Justin Bertuch started publishing review journals. From 1757 until 1765 Nicolai together with Moses Mendelsohn edited the *Bibliothek der schönen Wissenschaften und der freyen Künste*, after 1765 Nicolai started his *Allgemeine deutsche Bibliothek* (1765–1796, ADB), and Weisse

1 Original quote: “die genugsame Zufuhr der nöthigen Bücher”, “Der Verfasser selber muß über dem einen so viel möglich ausgedähnten Briefwechsel haben” (Albrecht von Haller (1747): “Vorrede zum Jahrgang 1747”, *Göttingische Zeitung von gelehrten Sachen*.)

2 On the *Neuen Zeitungen von gelehrten Sachen*: Rüdiger Otto (2004), Johann Gottlieb Krause und die Neuen Zeitungen von gelehrten Sachen, in : Hanspeter Marti and Detlef Döring (eds.), *Die Universität Leipzig und ihr gelehrtes Umfeld 1680–1780*, (Texte und Studien, 6), Basel, p. 215–328. In general on the “Gelehrte Zeitung”: Gierl, Martin, “The 'gelehrte Zeitung' and the social presentation of knowledge. Self-reviews in the Goettingischen gelehrten Anzeigen.”

took over the *Neue Bibliothek der schönen Wissenschaften* (1765–1806). Later in the XVIIIth century, Bertuch published the *Allgemeine Literatur-Zeitung* (1785-1803, ALZ).

The influence of these academic and non-academic review journals can hardly be underestimated. M. Prüsener<sup>3</sup> has shown that the *Allgemeine deutsche Bibliothek* was present in the libraries of all German *Lesegesellschaften* (reading societies). From 1785 onwards, also the *Allgemeine Literatur-Zeitung* was found very often in those libraries. It can be assumed that these review journals were likewise represented in private libraries. The avidity with which the readers went through these review journals was apparently so great, that many uttered their concern about the bad influence of review journals. Johann Heinrich Lambert spoke of the fact that “the current fashion and epidemic to read journals relieves people of the obligation to read the books themselves”; Adolph Freiherr von Knigge described the review journals as “Recensir=Fabriken” and the philosopher Johann Gottlob Fichte in an aptly entitled text, *On the characteristics of our current age*, drew the only logical conclusion, that these journals “could do without books, if only reviews could be written without books”.<sup>4</sup>

Mathematics, to come back to our main topic, was not particularly present in these learned review journals. Only about two percent of the reviews are devoted to mathematical literature, a number consistent with the amount of mathematical books published, also about two percent of the whole production.<sup>5</sup> What is perhaps more remarkable that only a few persons are responsible for nearly all mathematical reviews. Of the approximately 300 reviews in the ADB, 59 are by A.G. Kästner, 58 by A.L.F. Meister, 39 by J.H. Lambert. In the GGA, the distribution of reviewers is even smaller: Of the about 624 reviews, 470 are by Kästner's hand.<sup>6</sup> In addition to this, starting from the year 1750, most of the mathematical reviews in the learned journals published in Leipzig, the *Nova acta eruditorum* and its German counterpart, the *Zuverlässige Nachrichten*<sup>7</sup>, are also written by Kästner. As may be clear, the mathematics professor Abraham Gotthelf Kästner (1719-1800) of the University Göttingen occupies a central position in the network of

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3 M. Prüsener (1972), *Lesegesellschaften im 18. Jahrhundert. Ein Beitrag zur Lesergeschichte*, *Archiv für Geschichte des Buchwesens* volume 13, numbers 1 & 2.

4 Original quotes: “Die herrschende Mode und Epidemie Journale zu lesen, macht, daß man die Bücher selbst fahren läßt” (J.H. Lambert an Holland, 16. Nov 1768, in: *Deutscher gelehrter Briefwechsel* (1781-1787), Johann III Bernoulli (ed.), Volume 1. Berlin: Selbstverlag, p. 299); “Recensions=Fabriken” (Adolf Freiherr von Knigge (1793) , *Ueber Schriftsteller und Schriftstellerey*. Hannover: Ritscher, p. 298); “Noch ist zum Beschlusse der Vortheil aus Errichtung des Recensirwesens zu erwähnen, dass derjenige, der nicht besondere Lust, oder ausserordentlich viel Zeit hat, gar kein Buch weiter zu lesen braucht; sondern, dass er durch die blosser Lectüre der Gelehrtenzeitungen die gesammte Literatur des Zeitalters in seine Gewalt bekommt; und dass in diesem Systeme die Bücher lediglich gedruckt werden, damit sie recensirt werden können, und es überhaupt keiner Bücher bedürfen würde, wenn sich nur Recensionen ohne Bücher machen liessen.” (J.G. Fichte (1806), *Die Grundzüge des gegenwärtigen Zeitalters*. Berlin: Realschulbuchhandlung, pp. 88-9).

5 These numbers are valid for the latter half of the XVIIIth century, cfr. Thomas Habel (2005), “Deutschsprachige Rezensionszeitschriften der Aufklärung. Zur Geschichte und Erschließung”, in: Peter Albrecht and Holger Böning (eds.), *Historische Presse und ihre Leser. Studien zu Zeitungen und Zeitschriften, Intelligenzblättern und Kalendern in Nordwestdeutschland*. Bremen: edition lumière, pp. 42–77, here page 75. The percentage of mathematical reviews in the GGA and ADB is the same as one can learn using the search machine on review journals: [adw.sub.uni-goettingen.de/idrz/pages/Main.jsf](http://adw.sub.uni-goettingen.de/idrz/pages/Main.jsf).

6 The numbers were obtained with the help of the search machine of the preceding footnote. It should be noted that for most of the remaining reviews the reviewer's identity could not be found. For the ADB there are 98 anonymous reviews, for the GGA 97.

7 The *Nova Acta Eruditorum* (1732-1782) are the continuation of the *Acta Eruditorum* (1684-1732). The *Zuverlässige Nachrichten von dem gegenwärtigen Zustande, Veränderung und Wachstum der Wissenschaften* (1740 - 57 ) are the continuation of *Deutsche Acta Eruditorum* (1712 – 39). These journals appeared monthly.

mathematical communication from 1750 onwards.<sup>8</sup>

Kästner's reviews were mostly summaries of the book content, together with copious references to other works, often historically important works, often English works<sup>9</sup>, and very often his own works. As a general rule, Kästner kept a middle position between Leibnizian and Newtonian views on the calculus, but he used his reviews often to voice his opinion that proofs should be more precise, more complete, more according to the Euclidean tradition.<sup>10</sup> His reviews set a standard form of mathematical review that Meister and Lambert would follow. Kästner reviewed the (mathematical) contents of journals of learned societies at length, describing the main new results. He also, together with J. A. Unzer, published the *Hamburgisches Magazin* (1747 - 1781).<sup>11</sup> This journal appeared two times a year and contained translations of articles published in the journals of learned societies together with some original, popularly written articles. However, as the undertitle "aus der Naturforschung und den angenehmen Wissenschaften überhaupt"<sup>12</sup> makes clear, mathematical articles but rarely figured in these volumes.<sup>13</sup>

Another mathematics professor, Wenceslaus Karsten (1732-1787), would be the first to try and start a mathematical journal. From 1757 to 1760 Karsten was professor in Rostock, from 1760 to 1778 in the close-by Bützow, and finally from 1778 until his death in Halle. During his years in Rostock Karsten published the *Beyträge zur Aufnahme der theoretischen Mathematik*, a first volume in 1758, two other volumes in 1759 and a final volume in 1761. In the preface to the *Beyträge* Karsten writes that, since a mathematics professor can only teach the fundamentals of his science, he conceived of the idea to publish a periodical that supplemented his teachings, for the clarification and augmentation ("Erläuterung" and "Wachsthum") of mathematics.<sup>14</sup> If his undertaking would turn out successful Karsten proposed to add announcements, reviews and extracts of mathematical papers appearing in the pages of learned societies in future issues.

Karsten used his periodical volume to counter some criticisms on his *Praelectiones matheseos theoreticae elementaris* published earlier that same year. Other contributions in the first two volumes, all authored by Karsten, concerned the clarification of differential calculus and some propositions in Euclid. At the end of the third volume Karsten appended a list of articles that had appeared in the *Commentarii* of St Petersburg, and the fourth and last volume contained an article not by Karsten but by his student Johann Niklaus Tetens.<sup>15</sup>

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8 C. H. Müller (1904), *Studien zur Geschichte der Mathematik insbesondere des mathematischen Unterrichts an der Universität Göttingen im 18. Jahrhundert*, *Abhandlungen zur Geschichte der Mathematischen Wissenschaften mit Einschluss ihrer Anwendungen*, p. 51–143, here p. 120 & 132.

9 This is in line with Göttingen's function as the portal of English knowledge into Germany, cfr. Wilfried Enderle (2005), "Britische und europäische Wissenschaft in Göttingen - Die Göttingischen Anzeigen von gelehrten Sachen als Wissensportal im 18. Jahrhundert", in: Elmar Mittler (ed.), *„Eine Welt allein ist nicht genug“ Großbritannien, Hannover und Göttingen 1714–1837*. Göttingen: Niedersächsische Staats- und Universitätsbibliothek Göttingen, pp. 161-184.

10 His reviews of Euler's *Institutiones calculi differentialis* (1755) nicely display all these characteristics, *Zuverlässige Nachrichten* 1757, pp. 809-836 and 894-913; *GGA* 1757, pp. 1145-1152.

11 Viz., *Hamburgisches Magazin, oder gesammelte Schriften, zum Unterricht und Vergnügen, aus der Naturforschung und den angenehmen Wissenschaften überhaupt* (1747- 1767) and *Neues Hamburgisches Magazin oder Fortsetzung gesammelter Schriften, aus der Naturforschung, der allgemeinen Stadt- und Land-Oekonomie, und den angenehmen Wissenschaften überhaupt* (1767-1781).

12 Translation: "from physics and the agreeable sciences".

13 About three percent of the articles published are about mathematical topics.

14 Original full quote: "Ein Akademischer Lehrer kann seinen Zuhörern nur die Anfangsgründe der Wissenschaften, darin er sie unterrichten soll, vortragen. [...]Diese Gedanken haben bey mir den Vorsatz rege gemacht, in der periodischen Schrift, wovon gegenwärtig das erste Stück die Presse verläst, zur Aufnahme der Theoretischen Mathematik zu arbeiten." (W. Karsten (1758), *Beyträge*, pp. 3-4)

15 J.N. Tetens (1761), "Abhandlung von dem Maß der lebenden Kräfte". *Beiträge zur Aufnahme der Theoretischen Mathematik*, 4. Stück, pp. 320-372.

Unfortunately, probably caused by Karsten's transfer to Bützow, his *Beyträge* never really evolved into a genuine mathematical journal. Karsten lacked collaborators, a research community at his university, a research network in Germany and failed to develop his *Beyträge* into anything more than a vehicle that supplemented his own teachings and writings.

## 2. J.H. Lambert's projection of a research community

Karsten's failure to establish a journal illustrates an important problem of XVIIIth century mathematics in Germany: there is a large gap between the fundamentals of mathematics that students learn at university and the mathematical research done mostly in learned societies. This forecloses the birth of a mathematical research community that might possibly be interested in a specialised journal. Johann Heinrich Lambert (1728-1777), member of the Academy in Berlin, criticised Karsten's attempt precisely on this front. Whereas Karsten had merely proposed to teach and clarify the fundamentals of mathematics, Lambert wanted to augment mathematical science, stressing its applications.<sup>16</sup> Lambert's aim was to archive and concisely present what is known in science and to augment and promote science (in the spirit of Bacon). The archiving makes the existing knowledge and the present state of the art available to a large group of people, the development of a research project helps to organise a research community.

Lambert's ambitions on the level of the transmission and progress of science can be followed most clearly in his enterprise to get rid of the eight calendars the Berlin Academy published and to replace them by one, scientifically based *Ephemeriden*. Lambert had already published an ecliptic table in 1765, with a user's manual, aimed at a public that consisted not only of astronomers, but also of people "without time to dig into the details", but wanting to "obtain some knowledge" about the nature and calculation of moon and sun eclipses.<sup>17</sup> Around 1772 Lambert had obtained the financial support of the Berlin Academy to pursue and extend this project, that would make all astronomical knowledge available to both astronomers and the interested public. This resulted in the publication of *Sammlung astronomischer Tafeln / Recueil de tables astronomiques* published in three volumes simultaneously in German and French. This *Sammlung* contained the most useful astronomical tables, collected and corrected out of the various extant works with additions and comments by the Academy members J.H. Lambert, J.E. Bode, Johann III Bernoulli, J.K. Schulze and J.L. Lagrange. This work alone could replace a complete astronomical library for the amateur.<sup>18</sup> Parallel to this table work, Lambert and Bode started to publish the *Astronomisches Jahrbuch oder Ephemeriden für das Jahr X nebst einer Sammlung der neuesten in die astronomischen Wissenschaften einschlagenden Beobachtungen, Nachrichten, Bemerkungen und Abhandlungen*, first published for the year 1776 in 1774. The *Astronomisches Jahrbuch* as its long title expresses did not only contain the ephemerides but also new observations and small articles on new techniques and discoveries within astronomy. It was published under the protection of the Berlin Academy

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16 Johann III Bernoulli (ed., 1781-1787), *Joh. Heinrich Lambert's Deutscher gelehrter Briefwechsel*, 5 volumes, Berlin, Selbstverlag. Here volume I, p. 160.

17 Original quote: "die, die zwar die Musse nicht haben, darinn zu vertiefen, dennoch einigen Begriff davon erlangen [wollen]" (J.H. Lambert (1765), *Beschreibung und Gebrauch einer neuen und allgemeinen Eccliptischen Tafel*. Berlin: Realschulbuchhandlung, Vorbericht)

18 Quotes: "un astronome est donc obligé d'acheter une bibliotheque, tandis qu'il ne demandoit qu'un recueil choisi de tables" (*Recueil des tables astronomiques* (1776). Berlin: Decker, volume I, p. IV); cfr with Lambert's quote in a letter to Hindenburg: "Wenn die besten astronomischen Tafeln [...] sollten verlohren gehen, so würden sie aus unserer Sammlung wieder hergestellt werden können." (Lambert, *Briefwechsel*, volume V, p. 154).

and it would become one of the first astronomical journals, continued by Bode deep into the XIXth century and surviving until this day.<sup>19</sup>

Simultaneously with the astronomical project, Lambert also envisaged a similar project for pure mathematics.<sup>20</sup> Contrary to the astronomical project, Lambert did not receive any institutional and/or financial aid from the Berlin Academy for this project, its development is therefore completely different, but particularly instructive as to communicative context of the 1770s. Lambert cleverly used books, learned journals, letters as well as the network of the academy and that of his personal correspondence as the communicative substrata of this project for the advancement of mathematics.

Lambert launched the project in 1770 with an essay in the second volume of his *Beyträge zum Gebrauche der Mathematik und deren Anwendung*.<sup>21</sup> The article detailed how to produce a table of the divisors of all natural numbers and made an appeal to all amateurs of mathematics to join in the work of extending this table.<sup>22</sup> The same appeal was repeated in the introduction to the *Zusätze zu den Logarithmischen und Trigonometrischen Tabellen* (1770), again a collection of tables that brought together the descriptions, comments and tables useful in pure mathematics. A table of divisors of all numbers up to 102.000 was printed in this collection, and in the introduction to this table Lambert broadened his project. The idea was not only to extend this factor table to the million or further, but also to contribute to the theory of integer numbers, to prepare - in modern terms - the fundamentals of a theory of numbers.<sup>23</sup> Lambert finished with an emphatic appeal to the journalists

I would like to make a request to all journalists and all other writers that will meet this book. They will act out of humanity and do good service to mathematics if they will help to make this book as well-known as possible.<sup>24</sup>

In the same year 1770 Lambert also added a postscript to all his letters that ran as follows:

There are amateurs of mathematics that love to calculate. And I hope that my appeal will bear fruit. [...] If you, dear Gentleman, would happen to find someone who likes to calculate in your surroundings, I would be most happy to hear it.<sup>25</sup>

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19 Wolfgang Kokott (2002): "Bodes Astronomisches Jahrbuch als internationales Archivjournal", in: Wolfgang Dick/Jürgen Hamel (eds.), *Astronomie von Olbers bis Schwarzschild*, Frankfurt a. M. : Harry Deutsch, pp.142-157.

20 More (mathematical) details and references on the factor table project are in M. Bullynck (2009): "From Anatomia Numerorum to Higher Arithmetics A History of Factor Tables with Notes on the Birth of Number Theory 1668-1817" (sections 3, 4 and 5), to appear in *Revue d'histoire des mathématiques*.

21 J.H. Lambert (1770) "Vorschlag die Theiler der Zahlen in Tabellen zu bringen, nebst einer solchen Tabelle von 1 bis 10200", in: *Beyträge zum Gebrauche der Mathematik und deren Anwendung*, vol. II, pp. 42-53. Remark that Lambert uses a title for the aperiodically appearing collection of his mathematical work that is reminiscent of Karsten's attempted journal.

22 Quote: "Vielmehr werde ich anmerken, daß ich die Tabelle vorzüglich deswegen durch den Druck bekannt mache, daß etwann jemand durch die so geschmeidige Einrichtung derselben sich bewegen lasse, noch 9 andere, oder wenn er sich einen recht unsterblichen Namen machen will, noch 99 andere beyzufügen. [i.e. bis 1020000]" (Lambert, *Beyträge*, II, p. 49)

23 Quote: "Ich habe mich zu diesem Ende [der Primzahlerkennung] so wie auch zu andern Absichten um die Theorie der Primzahlen näher umgesehen, und da fand ich freylich nur einzelne abgebrochne Stücke, ohne sonderlich Anschein, daß dieselbe so bald sollten zusammengehängt und zum förmlichen System gemacht werden können." (J.H. Lambert (1770), *Zusätze zu den logarithmischen und trigonometrischen Tafeln*. Berlin: Realschulbuchhandlung, p. 20)

24 Quote: "[Ich] werde an die Herren Journalisten und an jede andere Schriftsteller, denen dieses Werckchen vorkommen wird, eine Bitte thun. Sie werden nemlich aus Menschenliebe handeln, und den mathematischen Wissenschaften einen guten Dienst thun, wenn sie zur Bekanntmachung dieses Werkchens so viel möglich beytragen." (Ibidem, pp. 4-5)

25 Original quote: "Es gibt hin und wieder Liebhaber der Mathematik, die gerne rechnen. Und ich habe

Lambert's appeal was moderately successful. In the general public Lambert was able to attract some amateurs into the calculation of various mathematical tables. In the Berlin Academy, the theoretical part of the project (the theory of numbers) was taken up by his colleagues. Already in 1771 Lambert received additions to his mathematical tables. Ensuing this Lambert inserted a small announcement in the most widely read review journal, the *Allgemeine deutsche Bibliothek*<sup>26</sup>, yet another year later, he also inserted a list of progress, corrections and a renewed appeal in the introduction to the third volume of his *Beyträge*.<sup>27</sup> His announcement in the ADB closed with an invitation to send him tables:

Meine Adresse ist :

A Monsieur Monsieur [sic! ] Lambert, Professeur Royal, Membre de l'Acad. R.  
de Berlin et diverses Academies et Sociétés des Sciences, à Berlin.

Indeed, a large part of Lambert's correspondence in the years 1770 until his death in 1777 dealt with these calculations and tables.<sup>28</sup> Through his correspondence Lambert organised and synchronised the joint effort of these amateurs-calculators, but also reflected on ways to publish these tables. In particular, Lambert thought of contacting publishers at the Leipziger Messe, the most important meeting of book-related things, who were in need of new manuscripts or had just had bad experiences with allegedly fashionable but badly selling books, but were now willing to invest time and money in the slow and hard sell of mathematical works.<sup>29</sup>

In the Berlin Academy some of his colleagues published number theory related essays and referred to Lambert's plan to found a theory of numbers. Johann III Bernoulli, Niklaus von Beguelin and Joseph-Louis Lagrange all allude to Lambert's project. Indirectly, some of these texts would inspire Leonhard Euler, again in St Petersburg, to take up some old themes in his own work on the theory of numbers. Letters from Euler (or his assistant Niklaus Fuss) to Bernoulli, Beguelin and Lagrange on their work followed, and Euler presented papers on topics related to their essays to the St Petersburg Academy. This resulted in some ten to fifteen texts by Euler that indirectly relate to Lambert's project.<sup>30</sup>

Lambert's project accelerated in 1776. In January of that year Lambert received the first letter from Anton Felkel (1740-1800?), a teacher of Vienna. In this letter, Felkel claimed he had built a machine for producing a large factor table, and he prayed Lambert to support him in his venture and to publish an announcement of his machine and plans. Although somewhat annoyed by Felkel's demanding tone, Lambert inserted the announcement in the *Neuen Zeitungen von gelehrten Sachen* (5 August 1776, 63 St., pp. 507—510). Upon reading Felkel's announcement, a *Magister* from Leipzig, Carl Friedrich Hindenburg

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Ursache zu hoffen, daß die Einladung [...] nicht ohne Frucht seyn werde. Sollten Sie, mein Herr, in dortigen Gegenden jemand finden, der zu solchen Berechnungen Lust hätte, so würde es mir sehr angenehm seyn." (Lambert, *Briefwechsel*, vol. I, pp. 367-368)

26 ADB, vol. 14, nr. 1, pp. 305–306. Similar statements were inserted in the GGA and the NGZ.

27 Lambert (1772), *Beyträge*, vol. III, *Vorrede* non-pag.

28 See especially large parts of parts III and V of *Lambert's Deutscher Gelehrter Briefwechsel*, posthumously edited by Johann III Bernoulli in five volumes (1782 - 1787).

29 Quote: "[ich] muß auf verschiedene Mittel bedacht seyn, sie nach und nach herauszugeben. Ich dünkte inzwischen, daß sich auf der Leipziger Messe die beste Gelegenheit anbieten sollte, Verleger zu finden, zumal solche die, weil sie an abgelegenen Orten wohnen, in ihrer Gegend nicht immer genug Manuscripte aufbringen können. Zuweilen läßt sich ein Buchhändler, dem ein Mode=Buch fehlgeschlagen, leicht bereden, mehr auf die Dauerhaftigkeit als auf die meistens sehr mißliche Schnelligkeit des Verkaufs zu setzen. Dieses war auch in der That immer mein bester Beweggrund." (Lambert an Schönberg, *Briefwechsel* IV, p. 313)

30 For more details on the interactions on Lambert's project in the Academies, see Bullynck, "History of Factor Tables", sections 3.2 and 5.1, and M. Bullynck (2008), "Leonhards Wege zur Zahlentheorie", in: W. Velminski, H. Bredekamp (eds.), *Mathesis & Graphé. Leonhard Euler zum 300. Geburtstag*. Berlin: Akademie-Verlag, pp. 67-85, especially pp. 78-83.

(1741–1808), asked his publisher E.L. Crusius to insert a counter announcement, because Hindenburg also (independently) had come upon a mechanisation of the sieve process needed for producing factor tables. Crusius published the announcement (NZG, 8 August 1776, 64. St., pp. 515–522) and Hindenburg wrote at the same time to Lambert with a description of his own plans (August 1776).

Lambert engaged in a correspondence with both Felkel and Hindenburg and tried to convince them to calculate both a separate part of a factor table to three million. Both, however, preferred to calculate a new factor table from scratch alone. Around Mid December 1776 Lambert wrote to all his correspondents involved in calculating a part of the factor table, informed all of them of the developments, the individual progress and Felkel's and Hindenburg's respective projects, and begged all of them to work together for the greater honour and progress of science. Around that same time, Lambert also consulted with Lagrange in the Berlin Academy, communicating through slips of paper (*Zettel*), on the value of Felkel's and Hindenburg's proposals.<sup>31</sup> Lambert's mediation attempt failed. End of 1776 Felkel published a first specimen of his factor tables.<sup>32</sup>, and Hindenburg a book long description of his factorisation device.<sup>33</sup> Lambert dies in 1777 but the ADB posthumously published his review article on both publications.<sup>34</sup> Both Felkel and Hindenburg would remain active in the literary and mathematical community.<sup>35</sup>

Lambert's mathematical research project did not result into a neat periodic journal such as the *Astronomisches Jahrbuch* because it was not institutionally backed. Instead, Lambert used the media available (review journals, letters) to communicate progress and synchronise the joint labour in a semi-periodic way. The project also (indirectly) generated research articles, published in learned journals (Bernoulli, Euler, Felkel). Lambert's project, however, had shown that there was a public interested in mathematics and its progress.

### 3. Hindenburg's mathematical journals

Hindenburg had studied in Leipzig where he had obtained his *Magister* with a philological work. Afterwards, he became the *Hofmeister* (private tutor) of Freiherr von Schönberg and accompanied him on a voyage along the German universities. This allowed Hindenburg to pursue his studies. During this time, Hindenburg started to devote himself to mathematics. He had already studied under Chr. Bortzsch in Leipzig, and now under A.G. Kästner in Göttingen. His first public appearance within mathematics was with his book on the sieve mechanism in 1776. In 1778 Hindenburg obtained his PhD and the *venia legendi* (the privilege to teach at a university) with the work *Infinitinomii Dignitatum indeterminatarum*

31 Johann III Bernoulli added these slips in footnotes to his edition of the fifth volume of the *Briefwechsel* that contains Lambert's correspondence with Felkel and with Hindenburg. See pp. 51–52; 120–121; 194).

32 A. Felkel (1776) : *Tafel aller Einfachen Factoren der durch 2, 3, 5 nicht theilbaren Zahlen von 1 bis 10 000 000. I. Theil : Enthaltend die Factoren von 1 bis 144000.*, Vienna: Ghelen..

33 C.F. Hindenburg (1776) : *Beschreibung einer ganz neuen Art, nach einem bekannten Gesetze fortgehende Zahlen, durch Abzählen oder Abmessen bequem und sicher zu finden, nebst Anwendung der Methode auf verschiedene Zahlen, besonders auf eine darnach zu fertigende Factorentafel, mit eingestreuten, die Zahlenberechnung überhaupt betreffenden Anmerkungen.* Leipzig: Crusius.

34 J.H. Lambert (1778) : “Hindenburg : Beschreibung & Felkel : Tafel”, ADB, 33 (2), p. 494–497.

35 For Hindenburg, see *infra* (we may remark that a complete *Stück* of the *Leipziger Magazin für die reine und angewandte Mathematik* (1787, vol. 2, number 2) was devoted to factoring). Felkel published on factoring and some other mathematical topics in the *Abhandlungen der Böhmischen Gesellschaft der Wissenschaften* (1785) and later emigrated to Lissabon where he published a Latin translation of Lambert's *Zusätze*. We may add that the 1782 volume of the *Abhandlungen einer Privatgesellschaft in Böhmen* contained 3 essays on factor tables (by Schaffgotsch, Beguelin and Tessanek). For these journals, we refer to Meise, H. (2008), “Le rôle culturel des périodiques scientifiques en Bohême, 1769-1789”.

*Leges ac Formulae*, the founding text of combinatorial analysis.<sup>36</sup> Hindenburg became extraordinary professor in Leipzig in 1781, five years later, ordinary professor for physics.<sup>37</sup>

Upon becoming extraordinary professor, Hindenburg also became co-editor of the *Leipziger Magazin zur Naturkunde, Mathematik und Oekonomie*, together with his colleagues Funke and Leske, professors in Leipzig for physics and economy respectively. In the first issue an important distinction between *Bände* (volumes) and *Jahrgänge* (years) was made:

We have deemed it better and for the enthusiast even more agreeable to divide this periodical writing not in volumes (as we originally planned) but in years, and to give each year-volume of four separate pieces an individual title. Because year-volumes do not relate to each other as volumes do through their ordinal numbers, one may view the year-volume as an independent and autonomous whole; this way, those who want it can start with whichever year-volume without being obliged to read the preceding ones first.<sup>38</sup>

Indeed, contrary to e.g. Karsten's or Lambert's *Beyträge* a genuine periodical journal can be read per year-volume. The *Leipziger Magazin's* first *Stück* (number) was announced in the popular, general journals *Teutscher Merkur* and *Allerneueste Mannigfaltigkeiten*. In the announcement the editors promised “new observations, that we made ourselves or made by our learned friends and correspondents”, “translations”<sup>39</sup>, and reviews and extracts from new or badly known books.<sup>40</sup> The announcements finished with the at the time usual invitation for *Pränumeration*, i.e., to pay in advance for a fixed number of volumes. When at the end of 1781 the four *Stück* were bound together as one year-volume to be sold separately, it included a list of *Subskribenten* (subscribers). This gives an interesting insight in the readership of this journal. First in the list came the institutional subscribers such as the duke of Brunswick, the Duke of Weimar, the Berlin and St Petersburg Academy. Then follows a five-page list of individuals, mostly aristocrats and teachers at the better *Gymnasia* and/or *Fürstenschulen*. The journal ran for five years (1781-1785) publishing the then very popular travel accounts, observations from nature, articles on economic issues and some mathematical essays (about 17 per cent of all articles).<sup>41</sup>

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36 For more information on combinatory analysis see Eugen Netto (1907), “Wahrscheinlichkeitsrechnung. Reihen. Imaginäres”, in: Moritz Cantor (ed.), *Vorlesungen zur Geschichte der Mathematik*, volume IV, part 2, 1907, pp. 199-238; H.N. Jahnke (1990), *Mathematik und Bildung in der Humboldtschen Bildungsreform*/ Göttingen: Vandenhoeck & Ruprecht, pp.161-232.

37 Biographical details after *Allgemeine deutsche Biographie*. Leipzig: Historische Commission bei der Kgl. Akademie der Wissenschaften, vol. 12, p. 456-7 and Ersch et Gruber (eds.), *Allgemeine Encyclopädie der Wissenschaften und Künste*. Leipzig: Gleditsch, vol. 33, pp. 252-3.

38 Original quote: “Wir haben es vortheilhafter und selbst für die Liebhaber bequemer zu seyn erachtet, diese periodische Schrift, nicht, wie wir anfänglich gesonnen waren, in **Bände**, sondern in **Jahrgänge** abzuthellen, und jedem Jahrgange von vier einzelnen Stücken einen eignen Titel zu geben. Da die Jahrgänge nicht so wie die Bände durch vorgesetzte Ordnungszahlen eine Beziehung auf einander haben, sondern als unabhängige für sich bestehende Ganze mögen angesehen werden: so können die Liebhaber um so freyer, bey welchem Jahrgange sie immer wollen, antreten, ohne verbunden zu seyn, die vorhergehenden mitzunehmen.” (“Vorbericht”, *Leipziger Magazin für Naturkunde, Mathematik und Oekonomie*, 1. Stück, 1781, pp. 1-2.)

39 Though not from publications from the Academies, the editors add, because they are already translated in other publications (such as Kästner's *Hamburgisches Magazin*).

40 *Teutscher Merkur* 1781, 2. Viertelj., pp. 180-181 and *Allerneueste Mannigfaltigkeiten* 1782, 1 Jg., pp. 239-240.

41 It may be interesting to add that, two years before a pure mathematical journal was published, the *Leipziger Magazin* (1784, 1. Stück, cover) contained an announcement by G.F. Petersen to publish a *Magazin für die Arithmetik*. This journal indeed appeared a year later as *Versuch eines Magazins für die Arithmetik*. It contained merely exercises for students that wanted to train their elementary arithmetic. Only two volumes appeared (1785 and 1787).

In 1786, on request of the readership<sup>42</sup> and on the occasion of Funke's death, the *Leipziger Magazin zur Naturkunde, Mathematik und Oekonomie* was split up in two journals: the *Leipziger Magazin zur Naturkunde und Oekonomie* (edited by Leske and Müller) and the *Leipziger Magazin für reine und angewandte Mathematik*. This last journal was edited by Hindenburg and Academy member Johann III Bernoulli, Lambert's friend and literary executor.<sup>43</sup> Among Lambert's inheritance there were a number of essays in German. Bernoulli could not publish them in the *Mémoires* of the Academy because of the language, and to edit them as a collection, Bernoulli did not find a publisher. Therefore, the new *Leipziger Magazin* proved an interesting medium of publication.

It will probably be nice to know for the readers, especially for the friends of Lambert's writings, that Professor Bernoulli wants to communicate in this publication (2. Stück and the following) some essays and near completed texts that Lambert wrote for the continuation of his *Beyträge zum Gebrauch der Mathematik und deren Anwendung* and for other purposes;<sup>44</sup>

In the end, five texts by Lambert appeared in the *Magazin*.<sup>45</sup> Remarkably, Hindenburg could count upon a steady number of contributors to his new journal. Of course, there was Hindenburg himself and the inevitable Kästner, but also quite some mathematics professors and enthusiasts from Northern Germany as well as some foreigners that were contributors.<sup>46</sup>

On the appearance of the first volume of the *Leipziger Magazin für reine und angewandte Mathematik*, Kästner wrote in his review for the GGA:

Although nearly every part of erudition has now its own journal, and some even more than one, only the martial part of mathematics has thus far its own journal thanks to Prof. Böhm.<sup>47</sup> It honours Leipzig that they now cure this defect. Hopefully, there will be enough people who value mathematics in Germany so that this venture will last.<sup>48</sup>

Hindenburg managed to publish the *Magazin* without interruptions from 1786 until 1789,

42 Quote: "Da Mehrere gewünscht haben, daß die mathematischen Aufsätze, Uebersetzungen, Recensionen und Nachrichten im *Leipziger Magazin*, von denen zur Naturkunde und Oekonomie gehörigen, in der Folge abgsondert, und jede in einer eigenen Quartalschrift, mit ihrem eigenen Titel abgedruckt herauskommen möchten: so erscheint hier der Anfang des *Magazins für reine und angewandte Mathematik*, mit Beybehaltung der vorigen Einrichtung und Abtheilung in Abhandlungen, Recensionen und kürzere Nachrichten." (Vorrede zum *Leipziger Magazin für die reine und angewandte Mathematik*, 1. Band, 1. Stück, 1786)

43 Bernoulli had reported on his work as the executor of Lambert's scientific inheritance in *Teutsche Merkur* (1782), 2. St., pp. 279-284, and in *Allgemeine Mannigfaltigkeiten* (1782), 1 Jg. pp. 632-634 + 647-648. He had announced his plans to publish the correspondence and the logical essays, and had added a list of Lambert's manuscripts.

44 Complete original quote: "Auch wird es hoffentlich den Lesern, besonders aber den Freunden der Lambertschen Schriften, angenehm seyn, hier zu vernehmen, daß Herr Professor *Bernoulli* gesonnen ist, ihnen auf diesem Wege, im zweyten und einigen in der folgenden Stücke, mehrere Abhandlungen und brauchbare angefangene Aufsätze nach und nach mitzutheilen, die von *Lambert* theils zur Fortsetzung seiner *Beyträge zum Gebrauche der Mathematik und deren Anwendung*, theils zu anderm Behufe niedergeschrieben worden; indem Zeit und Umstände Herrn B. sonst noch lange hindern würden, alles dies, wie anfangs beschlossen war, in einem eigenen Bande gesammelt, herauszugeben. (Vorrede zum *Leipziger Magazin für die reine und angewandte Mathematik*, 1. Band, 1. Stück 1786)

45 Five more appeared later on in the *Archiv für die reine und angewandte Mathematik*.

46 This includes W.G. Karsten (Halle), G.S. Klügel (Helmstedt/Halle), J.A. Pasquich (Buda), J.F. Hennert (Utrecht), W. Olbers (Altona), A. Bürja (Berlin), J.A. Ritter (Göttingen), Chr. Kramp (Strassbourg).

47 Andreas Böhm (1720-1790), professor in Giessen and editor of the *Magazin für Ingenieure und Artilleristen*, 11 volumes from 1777 to 1795.

48 Original quote: "Da fast jeder Theil der Gelehrsamkeit jetzo sein eignes Magazin hat, und manche mehrere, so hatte bisher nur der kriegerische Theil der Mathematik dergleichen durch Hrn. Pr. Böhm Bemühung. Es gereicht Leipzig zur Ehre, daß von daraus dieser Mangel ersetzt wird. Hoffentlich werden

but because of editorial and financial problems<sup>49</sup> and after that the first war of the Coalition against revolutionary France (1792-1795) the *Leipziger Magazin für reine und angewandte Mathematik* stopped to appear in 1789.

After the first French-German War came to an end in 1795 Hindenburg started a new editorial adventure. He now published (as sole editor) the *Archiv für reine und angewandte Mathematik*. Instead of 4 *Stück* per year (bound in one *Jahrgang* at the end of the year) the *Archiv* appeared only twice a year (two *Hefte*).<sup>50</sup> The format of the *Magazin* was kept (original articles, news, extracts, reviews), but the face of its contributors had changed. Next to the old generation (Kästner, Klügel, Hennert) a new generation had arrived. Under Hindenburg's wings, a generation of mathematics students had matured and had taken up their own researches, often in the vein of combinatorial analysis, but every so often in other domains. More even, in the aftermath of the war, the young generation had become not only more nationalistic, but also very susceptible to new (German) trends such as the philosophy of the so-called Idealists (Fichte, Schelling) and also Hindenburg's new kind of mathematics.

Hindenburg's mathematics had become widely known thanks to a dispute between one of Hindenburg's students (and Kant enthusiast) H.A. Töpfer and E.G. Fischer, professor in Berlin. In 1792, Töpfer had inserted an accusation in the *Neue Zeitungen von Gelehrten Sachen*, claiming that Fischer had plagiarised Hindenburg in his book *Theorie der Dimensionszeichen* (Halle, 1792). There followed a drawn-out literary battle, with a book by Töpfer in 1793, a reponse-book by Fischer in 1794, the dispute was only settled with the publication of J.F. Pfaff's assessment of Fischer's manuscripts in the *Intelligenzblatt der Allgemeinen Litteratur-Zeitung* September 1802. This public dispute attracted the attention of quite some young students across Germany, and helped in making Hindenburg's combinatorial analysis fashionable.<sup>51</sup>

Contrary to the *Leipziger Magazin* the new *Archiv* contained more articles on combinatorial analysis. As Hindenburg explained in his preface to the first volume

I have, according to the wish of many, included some articles on combinatorial analysis in this volume, to scatter the darkness that still hovered over it, as many have told me in oral or written communications. One can understand these isolated articles without further ado.<sup>52</sup>

The *Archiv* did, however, not become a mere vehicle of combinatorial analysis. It included a large variety of contributions and contributors. Not only did the old generation that already wrote for the *Magazin* (Kästner, Klügel, Hennert) continue to contribute, but also professors, teachers and enthusiasts from the new generation filled the *Archiv*'s pages. This includes people from all over (Northern) Germany and its borders: H.A. Rothe, J.K. Burckhardt (Leipzig); E.G. Fischer, J. P. Gruson (Berlin); J. Bernoulli, J. Trembley

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doch so viel Kenner des Werthes der Mathematik in Deutschland seyn, daß das Unternehmen Dauer erhält." (GGA, 67. Stück, 29 April 1786, p. 668)

49 A review in the ADB (1795, volume 27, Band 1, Stück 3, p. 172) mentions "Mangel des Absatzes" as the main problem. Kästner in his review of the last issue claims it is not "Mangel des Absatzes" but "Unordnung, die der Bediente der Buchhandlung verursachte" that caused the disappearance of the *Magazin* (GGA, 54 St., 4. April 1795, p. 544).

50 Viz., "zu Michelismesse" and "zu Ostermesse" the data of the *Buchmesse*, the main events for book-related things in Leipzig.

51 D.M.C. Stahl in Jena and F.W.A. Murhard in Göttingen are examples of mathematicians attracted to Hindenburg's style through this dispute.

52 Original quote: "Ich habe, nach dem Wunsche mehrerer Kenner, einige Aufsätze über combinatorische Analysis in diesem Bande mit eingetrückt, um die Dunkelheit zu zerstreuen, die über der Sache, wie man mich schriftlich und mündlich versichert hat, noch schwebte. Man kann diese isolirten Abhandlungen ohne Schwierigkeit für sich verstehen" (*Archiv für die reine und angewandte Mathematik*, 1. Bd. 1. Heft, p.3 verso of the *Vorrede*)

(Academy Berlin); A.F. Lüdicke (Meissen), J.F. Pfaff (Helmstedt), C.F. Pfliederer (Tübingen), J.K.F. Hauff (Marburg), Chr. Kramp (Köln), F.G. Busse (Dessau), Rosenthal (Nordhausen), Martin Bürmann (Mannheim), C.E. Bruinings (Utrecht) and L. Euler (posthumously, St Petersburg).<sup>53</sup> The writings on combinatorial analysis mainly stemmed from Hindenburg himself, his student H.A. Rothe and from J.F. Pfaff, but the *Archiv* also included articles from sceptics or opponents of the combinatorial method such as E.G. Fischer and G.S. Klügel. Two thirds of the journal were devoted to classic topics that did not relate to combinatorial analysis in any way. Most of these classic topics are comments or discussions on (the presentation of) standard mathematical textbook contents. Research articles in the *Archiv* were for the larger part those articles dealing with combinatorial analysis, for a smaller part the articles on crystallography, probability/actuarial questions and astronomy.

Hindenburg received many texts on combinatorial analysis, but instead of publishing them in the *Archiv* he bundled them in a separate publication *Sammlung combinatorisch-analytischer Abhandlungen*.<sup>54</sup> A first collection appeared in 1796, a second one in 1800 and in 1803 another collection appeared, this time with a different title, *Über die Kombinatorische Analysis und Derivationskalkül*.<sup>55</sup> The *Sammlung* may be appraised as a first step towards a specialised journal within a discipline, within mathematics.

In 1800 Hindenburg was again forced to stop with the publication of the *Archiv*. This was due to the beginnings of the Napoleonic Wars. Although Prussia (and Saxony) were neutral in the second Coalition War (1799-1802), the war hindered the export to Russia and France. In the last *Heft* the printer Schäfer had to write that “partly the troubles of war, partly the inhibition of literary communication, especially with Russia” had diminished the public and sales of the *Archiv* and that he therefore had to appeal to the readership to pay 16 *Groschen* instead of 12 per *Heft* to save the journal.<sup>56</sup> As Hindenburg sadly wrote some

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53 The titles of their contributions are: Rothe: “Localformeln für Produkte von Potenzen der Reihen”, “Localformeln für höhere Differenzen”, “Local- und combinatorisch-analytische Formeln”, “Ausrechnung schiefer abgeschnittener Prismen”; Burckhardt: “Tafel, jedes Jahr der julianischen Periode aus seinen Kennzeichen zu finden”; Fischer: “Wegschaffung der Wurzelgrößen aus Gleichungen”; Gruson: “Potenzsumme und Summenformeln für veränderliche Recten”; Bernoulli: “Historisch-Kritische Abhandlung über die verschiedenen Auflösungen des Problems von den schingenden Saiten des Jacob Bernoulli”; Trembley: “Anwendung seiner Methode, ein allgemeines Glied einer wiederkehrenden Reihe zu finden, auf die Lehre der Wahrscheinlichkeit”; Lüdicke: “Aufgabe aus der unbestimmten Analytik”, “Eintheilung des Horizonts bey den Griechen und Römern”; Pfaff: “Analysis einer Aufgabe des Hrn. De la Grange”, “Localformel für die Reversion der Reihen”, “Allgemeine Summirung einer Reihe”; Pfliederer: “Definitionen und Lehren von Verhältnissen in Euklids V. Buche”, “Über Lamberts Aufgabe ...”, “Ausführliche Behandlung einer wichtigen Aufgabe aus der praktische Geometrie”; Hauff: “Berichtigung über die euklidische Theorie der Parallelen”; Kramp: “Geometrische Betrachtungen des Krystals Hyodon”, “Mittelpunkt der Schwere im Kugeldreyecke”, several letters to the editor; Busse: “Bemerkungen für Eulers, Karstens und auch Kästners Vortrag der Mechanik”, “Erinnerungen gegen Karstens Theorie des Spritzenbaues”; Rosenthal: “Kettenregel aus einem alten Rechenbuche”, “Beitrag zur Geschichte des Kalenders in Deutschland”; Bürmann: “Numerische Berechnung der Kreisperipherie”, several letters to the editor; Bruinings: “Bewegungen des doppelten Kegels”; Euler: “Druck eines mit einem Gewichte beschwerten dreyfüßigen Tisches”.

54 Quote from the *Vorbericht (Sammlung combinatorisch-analytischer Abhandlungen*. Leipzig: Fleischer 1796): “Die folgenden Aufsätze waren mir nach und nach zum Einrücken ins Archiv [...] zugesendet worden. Die Wichtigkeit ihres Inhalts wegen und der Umstand, daß, wegen der nöthigen Abwechslung der Materien, nicht alle in Ein Heft kommen konnten, brachten mich zu dem Entschlusse, selbige [...] besonders herauszugeben.”

55 The contributors to the first collection were: J.N. Tetens, G.S. Klügel, Chr. Kramp, J.F. Pfaff, C.F. Hindenburg; for the second collection: C.F. Hindenburg, J. Trembley, G.S. Klügel, J.F. Pfaff, J.W. Pfaff, M.C.F. Hauber, H.A. Rothe, Chr. Kramp. The last collection from 1803 consists of a part of Martin Bürmann's book *Traité d'Analyse fonctionnaire-combinatoire* (the book itself was never published) and an essay by Hindenburg.

56 Original quote: “theils durch die Kriegsunruhen auf der einen Seite, theils durch die Sperrung alles

five years later, this decision on the side of the printer was the cause that “a special journal in the service of mathematics [...] that was dedicated in part to the knowledge and augmentation of the too badly known combinatorial analysis and that had lasted for many years with approval of those versed in mathematics, that this journal was arrested and stopped in its course all too suddenly!”<sup>57</sup>

#### 4. Conclusions

The main obstacle for establishing a genuine mathematical journal in (Northern) Germany was for a long time the absence of institutional backing and of a research community, especially since the gap between the mathematical training at universities and the actual mathematical research was large. This changed during the last decennia of the XVIIIth century, mathematics got better established at universities and *Gymnasia*.<sup>58</sup> Karsten's and Lambert's attempts to start a journal or a research community failed in the 1760s and 1770s, but Hindenburg could reap the benefits of the evolution Kästner and Lambert had helped to bring about. His journals could appear regularly and were supported by a mathematical community, strengthened by a research program. External causes (editorial and war-related problems) put an end to Hindenburg's journals, but he had shown that a mathematical journal was viable in Germany.

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literarischen Verkehrs, vornehmlich mit Russland” (*Archiv*, 11. Stück, 1800, Deckbogen).

57 Original quote: “Und so ward denn eine eigene, zum Gebrauch für die Mathematik besonders angelegte Zeitschrift, [...] die zum Theil der Kenntniss und Erweiterung der viel zu wenig gekannten combinatorischen Analysis gewidmet war, und mehrere Jahre hindurch mit Beyfall der Kenner fortgedauert hatte, plötzlich und auf einmal in ihrem Laufe gehemmt und aufgehalten!” (C. F. Hindenburg (ed.), *Johann Friedrich Hennert's der Mathematik Professor's zu Utrecht Mathematische Abhandlungen nebst eines Verzeichniss seiner sämtlichen Schriften*. Leipzig: Fleischer, 1805, p. IV-V)

58 See the contributions by H. Mehrtens and B. Rong-Dudzik in H.N. Jahnke and M. Otte, M. (1981, eds.), *Epistemological and Social Problems of Sciences in the Early 19<sup>th</sup> Century*. Dordrecht, Boston: Reidel.