

NEWSLETTER

OF THE EUROPEAN MATHEMATICAL SOCIETY



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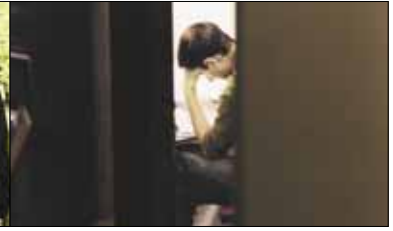
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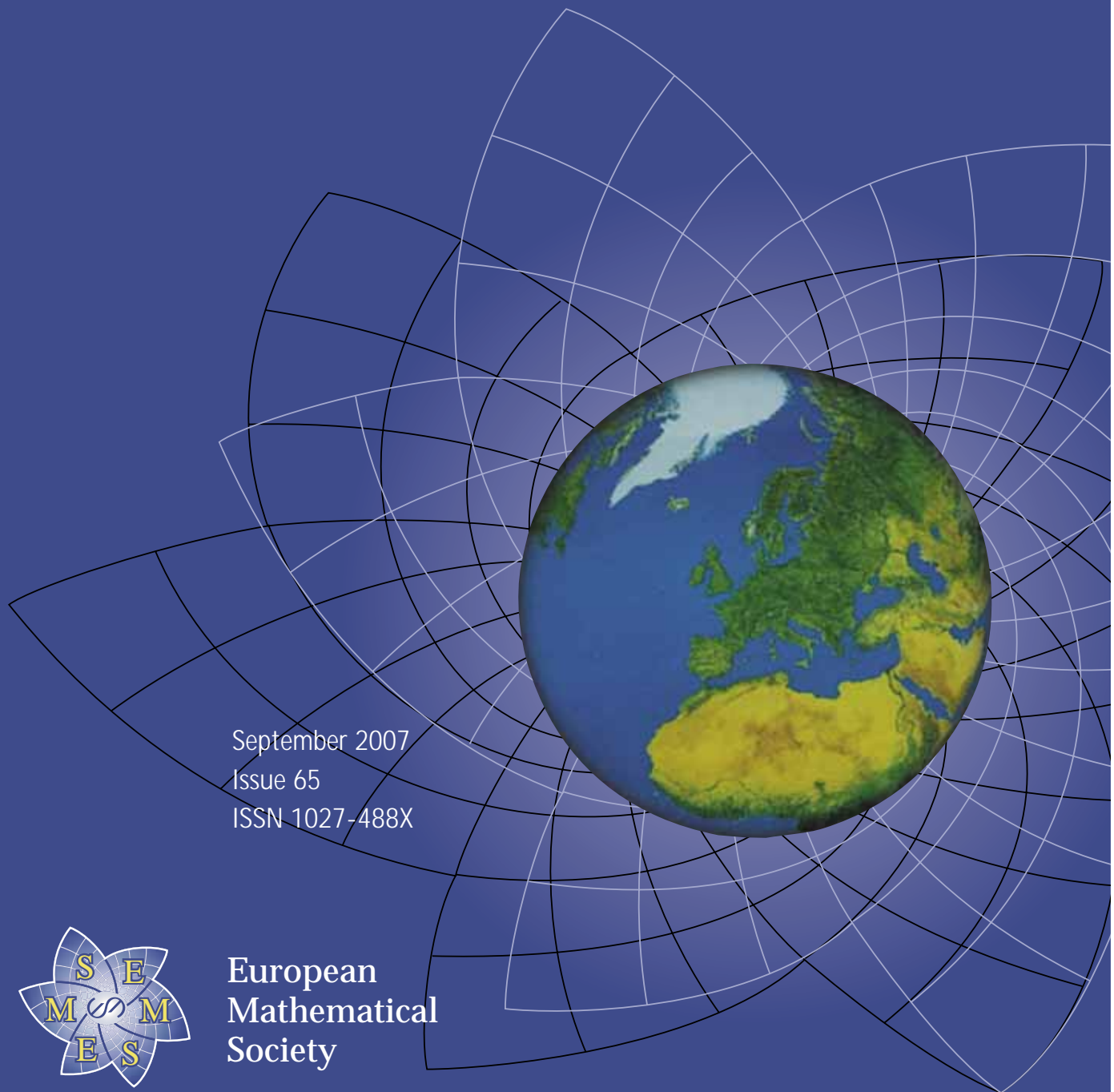
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September 2007
Issue 65
ISSN 1027-488X



European
Mathematical
Society

Leonhardi Euleri Opera Omnia: a centenary project

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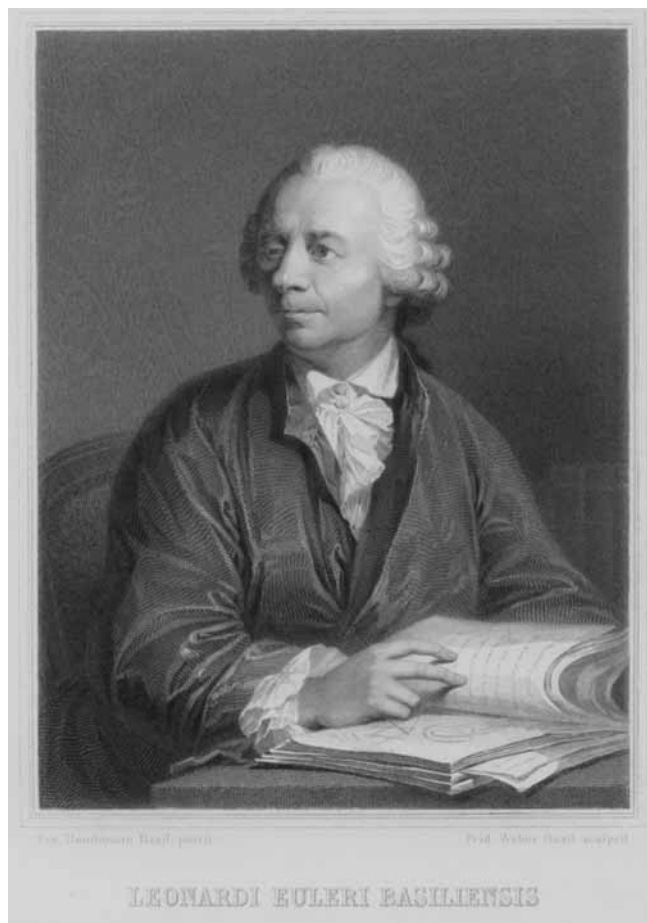
During his long career as a mathematician and scientist, Leonhard Euler published more than 500 research papers and about two dozen books. When he died in 1783, he left behind about 300 more articles in manuscript form; most of these were haphazardly printed during the following eighty years. Several 19th century projects for the publication of Euler's collected works failed; only in 1907, at the celebrations of Euler's 200th birthday, an initiative taken by Ferdinand Rudio led to the establishment of the Euler Edition under the wing of the Swiss Naturalist Society (now the Swiss Academy of Sciences). The current Euler Tercentenary Year therefore sees the 100th birthday of the edition of Euler's Collected Works, which is nearly completed.

Euler's life and writings

Leonhard Euler was born in Basel on 15 April 1707. At the age of 13 he attended Basel University where he progressed rapidly in mathematics and physics. In 1727 he was appointed to the newly founded Russian Academy at St. Petersburg. In 1741 he moved to the Berlin Academy, which was revived by Frederick II, and in 1766 he returned to Petersburg, where he died on 18 September 1783.

Euler was a tremendously productive scientist: the works published during his lifetime comprise more than 500 research papers, published mainly in the journals of the most prestigious scientific academies throughout Europe. Although he never had regular teaching obligations, he authored influential textbooks on a great variety of subjects including differential and integral calculus, mechanics, ballistics and acoustics, astronomy, the theory of music and ship-building, as well as the *Letters to a German Princess*, a three-volume compendium of his century's views on natural science. The flow of Euler's creativity was not even curbed by the almost complete loss of his eyesight in 1771.

There is no doubt that Leonhard Euler belongs among the great scientists of all time. His work exhibits a unique combination of broad interests and brilliant insights. It displays original ways of tackling challenges and incredible persistence in the pursuit of his ideas and it shows a profound yet sympathetic appreciation of his predecessors' and colleagues' achievements. Euler is chiefly remembered as the leading mathematician of his time but his works also comprise ground-breaking contributions to physics, astronomy and engineering. Moreover, his vast correspondence yields fascinating insights into the



Leonhard Euler. Engraving by Friedrich Weber (1851) after Emanuel Handmann's 1756 portrait in the Old Aula of Basel University (courtesy of Emil A. Fellmann, Basel)

development of his ideas and into the scientific community of the 18th century.

Shortly before his death, Euler predicted that the Petersburg Academy would take at least twenty years to publish all the manuscripts he was leaving behind. It turned out that this prediction was too optimistic: only in 1830, nearly fifty years after Euler's death, was the stock of unpublished Euler manuscripts exhausted. In 1844, Euler's great-grandson Paul-Heinrich Fuss found another 60 manuscripts in his attic, which he published in 1862 in two volumes under the title *Opera postuma*.

In the early 20th century, the Swedish mathematician Gustav Eneström compiled the standard inventory of Euler's writings. This inventory, which is generally referred to as the Eneström Index, was published between 1910 and 1913. The 866 publications listed by Eneström include a certain number of correspondences published

in the 19th and early 20th century that were not really printed publications of Euler. When we omit these, the number of Euler's publications – not counting second editions, translations and the like – amounts to about 850. Since the publication of the Eneström Index, only one more printed publication by Euler has been identified: an anonymously published paper on gravity that had escaped the attention of the Swedish mathematician.

First attempts at editing Euler's works

The first attempts to publish Euler's complete works go back to the 1830s. Two such initiatives were launched simultaneously. One of them was started by Paul-Heinrich Fuss, who was the permanent secretary of the Petersburg Academy of Science. Although Fuss was encouraged by many prominent mathematicians, including Carl Gustav Jacobi, the project was finally abandoned when it turned out that it would surpass the financial capacities of the academy's budget. The only result of Fuss's and Jacobi's initiative was the publication, in 1849, of two volumes of *Commentationes arithmeticae*, which include 94 articles that had already been published and five unpublished manuscripts.

At the same time, a group of Belgian mathematicians was undertaking a similar project, and they were more successful than the Russians in that five volumes of this edition were indeed printed (*Œuvres complètes de L. Euler*, 5 vol., Bruxelles 1838–1839). However, this edition has been sharply criticized, in particular by the Belgian historian of mathematics Henri Bosmans who qualified it as a very poor piece of workmanship¹. With the intention of making Euler's works accessible to a large section of the public, the editors had arbitrarily manipulated the original texts, even where the original was already written in French.

All these would-be editors of Euler's works had one thing in common: their main aim was to make Euler's work accessible to contemporary scientists and in particular to mathematicians. They believed that Euler's writings would still stimulate mathematical research and that mathematicians should study his works with unremitting intensity, according to Laplace's famous invitation, "Read Euler, read Euler, he is the master of us all."

At the beginning of the 20th century, with the approach of the bicentenary of Euler's birth, the Russian Academy of Science launched a new initiative for the publication of Euler's complete works. Bearing in mind the failure of previous attempts, the Russians looked for allies with whom they could share work and expense; of course the institution that came to mind with regard to Euler was the Prussian Academy of Science in Berlin, where Euler had served for 25 years. Initially the Berlin academicians were quite enthusiastic about this plan but when it turned out that the Russians wanted to divide the task so that they would publish the mathematical works,

¹ Henri Bosmans: *Sur une tentative d'édition des œuvres complètes de L. Euler faite à Bruxelles en 1839*, Louvain 1909.



Title page of Euler's German algebra textbook (1770), Part 2 (Euler-Archiv Basel)

while leaving the physical writings to the Germans, the Berlin Academy asked the most distinguished physicist among its members, Max Planck, for advice. In a famous statement, Planck said that it might be true that mathematicians still get inspiration from Euler's writings but that was no longer the case with the physicists. He argued that the publication of Euler's physical writings was "not in the interest of physics as a science of our time" and as a result of this statement, the Prussian Academy declined to participate in funding the project. Since a complete edition was too expensive for the Russian Academy, this initiative also ended in failure.

The Euler Committee and the beginnings of the *Opera Omnia* edition

Meanwhile, a professor of mathematics at the Zürich Polytechnicum, Ferdinand Rudio, had untiringly lobbied for an initiative that ultimately turned out to be successful. On every occasion, and most particularly at the First International Congress of Mathematicians, which was held at Zürich in 1897, Rudio had urged the worldwide community to honour its obligations toward the great scientist by undertaking the edition of Euler's complete works. When the city of Basel commemorated Euler's 200th birthday in 1907, Rudio delivered a thrilling speech in which he appealed to Swiss patriotism and to international solidarity in favour of an edition of Euler's works: "Switzerland will always be grateful to the academies of Berlin and St. Petersburg for having given our Euler, to whom his native country was too narrow,

the opportunity to perform his outstanding work”². He addressed his speech in particular to the representatives of the Swiss Naturalist Society (Schweizerische Naturforschende Gesellschaft, SNG, now the Swiss Academy of Science, SCNAT) and to the representatives of the academies of Berlin and St. Petersburg who assisted at the ceremony.

These were the right words on the right occasion. The Naturalist Society decided that the publishing of Euler’s work was a duty of honour (“Ehrenpflicht”) for them and they installed a committee (Euler-Kommission) that was in charge of realizing the project. One year later, their plan was strongly encouraged by the 4th International Congress of Mathematicians in Rome. In an official resolution, the congress declared that it would be of the greatest importance for pure and applied mathematics to make Euler’s works available in a new and complete edition.

The first step taken by the Euler Committee was a fund-raising effort. They printed so-called *Zeichnungsscheine* (subscription bills) that were sent to public institutions, enterprises, companies and individuals. The addressees of these *Zeichnungsscheine* were requested to indicate the amount that they would be prepared to contribute and they were informed that the society’s decision to launch the project would critically depend upon the total amount of funds promised by the donors.

The response to this campaign was noteworthy: 93,500 Swiss Francs were offered by donators in Switzerland and 31,500 Francs from other countries. A great number of individuals subscribed to the edition in advance and each of the three academies of Berlin, Paris and St. Petersburg signed a subscription for 40 copies. The total amount promised by the subscribers was nearly three times as much as the donations, i.e. about 300,000 francs. So the finances were assured at least for a mid-range perspective.

Money was not the only precondition for realizing such a project; a certain number of qualified people able and willing to do the work would also be needed. In this respect, the Euler Committee was equally successful: twenty mathematicians of international reputation spontaneously agreed to serve as editors of one or more volumes, including Jacques Hadamard from Paris, Gustaf Eneström from Stockholm, Tullio Levi-Civita from Padova, Gerhard Kowalewski from Prague and Heinrich Weber from Strasbourg (he was to be the editor of the first volume published in 1911). A Redaction Committee was established, composed of the scholars who were working on the individual volumes.

When work on the edition started in 1908, the committee optimistically envisaged that there would be 43 volumes altogether and that a single volume would cost

no more than 25 Francs. However, a few years later, after the publication of the Eneström Index, it turned out that they had considerably underestimated the size of Euler’s written legacy. In 1913, the estimated number of volumes was increased to 66 and within the following years the number of volumes needed was raised to 72.

The edition was divided into three series:

- I. Mathematics (29 volumes)
- II. Mechanics and astronomy (31 volumes)
- III. Physics and miscellaneous (12 volumes)

The first volume was published in 1911: it comprised Euler’s *Vollständige Einleitung zur Algebra*, with Lagrange’s supplements to this work, and the *Eulogy of Euler* by Nicolaus Fuss. Before the outbreak of World War I, twelve volumes were published.

Completing the Collected Works series

Inevitably, the impulse the huge enterprise had been given by the enthusiasm of its founders did not carry it over all the obstacles presented by the 20th century. The first generation of editors passed the work on, to name just a few of the most prominent contributors, to Georg Faber, Henri Dulac, Rudolf Fueter and Constantin Carathéodory in mathematics, and Charles Blanc and Clifford Truesdell in physics. Andreas Speiser (in 1928), then Walter Habicht (1965) and Hans-Christoph Im Hof (1985) succeeded Rudin as “General Redactors”.

The continuous publication of the Euler volumes was not only burdened and slowed down by the effects of two wars: in 1931, the Christ-Paravicini bank, where the Euler Committee had deposited its funds, crashed and the committee lost 80,000 Francs. For political and financial reasons, the publisher also had to be changed several times. Until 1935, the publisher Teubner in Leipzig was in charge of the edition. The volumes printed between 1935 and 1950 were published jointly by Teubner and Orell Füssli (Zürich). From 1952 to 1974, Orell Füssli was the sole publisher and in 1975, the edition went on to Birkhäuser (Basel).

With time it became more and more difficult to find qualified editors: beginning in the 1950s, mathematicians



Shelf with *Opera Omnia* at Euler-Archiv Basel

² “Die Schweiz wird der Petersburger und der Berliner Akademie stets das Gefühl der Dankbarkeit bewahren, dass sie unserm Euler, für den das eigene Vaterland zu klein war, ein grösseres geboten und ihm die Möglichkeit bereitet haben, in ungetrübter Schaffensfreudigkeit sein grosses Lebenswerk zu vollenden.” In *Vierteljahrsschrift der Naturforschenden Gesellschaft zu Zürich*. 52 (1907), p. 541.

who could read Latin were rapidly becoming a threatened species. This led to the consequence that for the volumes published after 1960, mathematicians and physicists were increasingly replaced as editors by professional historians of science like Emil Fellmann, Otto Fleckenstein, Clifford Truesdell, David Speiser, Eric Aiton, Patricia Radelet-de Grave and Karine Chemla.

With the background of the editors the scope of the edition itself also underwent a change. In the beginning of the edition its promoters had mainly intended to make Euler's works accessible to scientists and in particular to mathematicians, but for several reasons this justification has lost much of its importance.

On the other hand, the Euler edition has increasingly become a valuable reference tool for professional historians of science who have, in a certain way, taken over from mathematicians as readers as well as in the role of editors. As a consequence of this change, the more recent volumes are characterized by more thorough introductions and more extensive footnotes and commentaries.

For the founders of the Euler edition and for the first generation of editors, the main purpose of the edition had been to make the original text widely available; commentaries were kept to a strict minimum. In one paragraph of the Editorial Outline of 1910, it was clearly said the annotations should not degenerate into long historical treatises. This sound principle was increasingly abandoned as historians of science replaced scientists as editors. Some of them used this occasion as an opportunity for presenting all their knowledge and erudition, and there is even one 435-page volume (II/11.1 by Truesdell) that does not include a single line by Euler: instead it contains just an, admittedly important, historical treatise on the history of elastic bodies between 1639 and 1788.

The distribution of the volumes published over the years is given in the following table:

1911–1912:	12 volumes
1915–1919:	2 volumes
1920–1927:	8 volumes
1928–1931:	–
1932–1940:	4 volumes
1941–1946:	4 volumes
1947–1960:	21 volumes
1961–1979:	16 volumes
1980–1990:	–
1990–2004:	3 volumes
2008/09(?):	2 volumes
Total	72 volumes

In the present year, which sees both the Tercentenary of Leonhard Euler's birth and the Centenary of the Euler Committee, the edition of Euler's printed works in the *Opera Omnia* is nearly finished. The missing volumes 26 and 27 of series II, comprising Euler's papers on pertur-

bation theory in astronomy, are currently being prepared for the press. Hopefully the editor Andreas Verdun will finish his manuscript this year and the volumes will be out in 2008/09.

Editing Euler's correspondence and manuscripts

In the first project of 1910, it was mentioned that Euler's scientific correspondence should be included in the publication of the *Opera Omnia*. But the plan did not specify what should be defined as "scientific" correspondence and it was decided to postpone the issue to a later date. Priority was given to the publication of Euler's printed works.

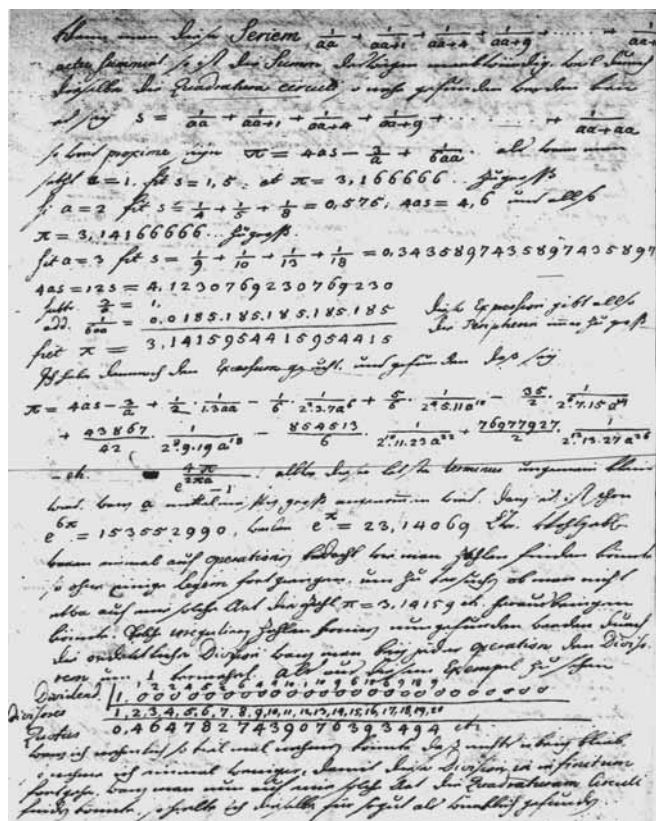
Euler's extant correspondence contains approximately 3100 letters exchanged with nearly 300 correspondents; about 1000 letters are by Euler. Most of the letters are from the time when Euler lived in Berlin (1741–1766).

The people he corresponded with most include (the numbers in parentheses are the letters written by/addressed to Euler): Daniel Bernoulli (19/81), Christian Goldbach (102/94), Pierre Louis Moreau de Maupertuis (124/5), Gerhard Friedrich Müller (111/101), Johann Daniel Schumacher (176/131) and Johann Andreas Segner (0/159). Only three of these are of interest for historians of mathematics: Bernoulli, Goldbach, and Segner. The remaining three mostly talk about academy business matters; Schumacher and Müller were officials of the Petersburg Academy and Maupertuis was the president of the Prussian academy.

The first 20th century initiative for publishing part of Euler's correspondence started in the 1960s. It was not related to the *Opera Omnia* edition but resulted from a cooperation between the Leningrad Section of the Soviet Academy of Science and the Academy of Science of the German Democratic Republic, which considered itself the successor to the Prussian Academy. On the occasion of Euler's 250th anniversary, these two academies decided to publish all those letters of Euler that were related to their cooperation in the 18th century. The resulting three volumes, with more than 600 letters, were published by Adolf P. Juškevič and Eduard Winter between 1959 and 1976 under the title "Die Berliner und die Petersburger Akademie der Wissenschaften im Briefwechsel Leonhard Eulers".

In 1965, the same editors republished the correspondence between Euler and Christian Goldbach, which had already been printed by Fuss in the 19th century. Furthermore the Soviet Academy of Science published three other volumes concerning Euler's correspondence: *Pis'ma k učenym* (edited by T. Klado et al. in 1963: 49 letters addressed by Euler to 19 scientists); *Relations scientifiques russo-françaises* (edited by A.P. Juškevič et al. in 1968: including Euler's correspondence with Delisle); and *Perepiska* (edited by A.P. Juškevič et al. in 1967: an inventory with summaries of all the correspondence at the Leningrad Archive).

Encouraged by these Soviet and East German activities, the Swiss Euler Committee finally decided in 1967 to start an additional series of the *Opera Omnia*, which was



Manuscript page from a letter by Euler to Christian Goldbach (Euler-Archiv Basel)

to contain Euler's correspondence and manuscript heritage. It was planned that this series IV should be divided into two sub-series: IVA for the correspondence and IVB for the unpublished manuscripts.

Since most of the original letters addressed to Euler were preserved in the Leningrad Archive of the Soviet Academy of Science, and there was a considerable number of Euler experts living in the Soviet Union, the new Series IV was set up as a joint project of the Swiss and the Soviet Academies. A second redaction committee was established, composed of four members from the USSR and four from Switzerland. This committee, which was to be exclusively responsible for Series IV, was chaired by Walter Habicht and then in 1985 by Emil Fellmann, who was also the director of the Euler Archive in Basel.

The first decision of this committee was to postpone the publication of the manuscript sub-series IVB and to focus on the correspondence. The following guidelines for the publication of Euler's correspondence were set up:

1. The correspondence is **not** published in a general chronological order; instead every volume will include the exchange of letters with one or more correspondents.
2. Earlier decisions, in particular concerning the scientific or non-scientific character of some letter, have been revised several times; therefore **all** the letters to and from a certain correspondent will be edited if a correspondence is published.
3. For each volume, there will be a "working language" for the introduction, footnotes and commentaries. As

a general rule, this will be the language of most of the letters in the respective volume. Consequently, German was chosen as the working language for volumes 2, 3 and 8 and French for volumes 5, 6 and 7.

4. The text of the letters will be published in full (including the phrases of civility at the beginning and at the end, which had often been omitted in former editions) and in the original language. Only letters in Latin will additionally be translated into the working language of the volume.

An exception was made for the Goldbach correspondence. The redaction committee and the editors were convinced that this correspondence includes so many ideas and suggestions that are of interest for modern mathematicians (in particular in number theory) that it ought to be accessible to a worldwide community of scientists and not only to historians of science. Hence it was decided to choose English as the working language for this volume (volume IVA/4) and to translate all the letters into English, in addition to the original text, which is written in a curious mixture of German, Latin and French.

The first volume of series IVA was published in 1975: it is an inventory of all Euler's correspondence known at that time. For each letter, it gives a short summary and some information about date, language, existing copies, where the original is located and whether it has already been published.

Five years later, the first "proper" correspondence volume appeared: volume IVA/5 includes Euler's correspondence with Clairaut, d'Alembert and Lagrange, edited by René Taton and A.P. Juškevič. In 1986, Pierre Costabel, Eduard Winter, A. T. Grigorjan and A.P. Juškevič published Euler's correspondence with Maupertuis and Frederick II (volume IVA/6) and in 1998 volume IVA/2 presented Euler's correspondence with Johann and Nicolaus Bernoulli, edited by Emil Fellmann and G.K. Mikhajlov.

Due to problems with funding and the recruitment of qualified editors, no further volume of series IVA has been published since 1998. The funds gathered at the beginning of the 20th century, fed from time to time by donations and by revenue from the sale of the printed volumes, were originally **not** intended for salaries. Their purpose was to cover the expense for collecting the sources and for the actual printing of the volumes. But nobody was paid at that time for their time spent in collaborating: the editors of series I-III were mostly mathematicians who had stable positions as researchers or university professors and who considered it an honour to contribute to the Euler Edition.

When the correspondence series started, it became more and more difficult to find fully qualified editors: there are simply not so many people around who possess the special skills required for this work. They should be familiar with the mathematics, physics and/or astronomy of the 18th century, have a solid knowledge of Latin, French and German and be able to read 18th century handwriting, which is often a challenge in itself.

So it turned out that all of the editors and most of the collaborators of the correspondence volumes were retired

university professors; some of them began cooperating with the Euler Committee shortly before their retirement, hoping that they would soon be free from other obligations and could concentrate on this work. In principle, this is a good concept: such people have long experience with these matters and are financially independent. The major disadvantage of this principle, however, is that the Euler Committee has virtually no leverage in motivating them to finish their work within a reasonable amount of time and regrettably many of them pass away before the work is done.

A typical example is afforded by the history of volume IVA/7, which was delayed by a long series of misfortunes. About twenty years ago, one of the authors (A.K.) was asked by the editors A.P. Juškevič and René Taton to take care of Euler's correspondence with the Geneva physicist Georges-Louis Lesage (9 letters) to be published in this volume. He submitted his manuscript in 1992. At that time, Pierre Speziali, a retired mathematician and historian of mathematics at the University of Geneva, was working on the correspondence with Gabriel and Philibert Cramer. In 1993 Juškevič died, and on the request of René Taton, Andreas Kleinert was made co-editor of the whole volume. Speziali died in 1995 and Taton, who was taking care of several correspondences of that volume, passed away in 2005, not to mention other deceased collaborators like Mirko Grmek, Roselyne Rey and Pierre Costabel, who all left piles of unfinished manuscripts behind. Last year, the Euler Committee finally decided to charge a young scholar, Siegfried Bodenmann, with the task, giving him a half-time paid position in Basel. He is a native speaker of French and grew up near Geneva and we hope he will bring the work to an end in 2007 or 2008. Acquiring the money for this half-time position was, however, not an easy task.

For the work to be done on the other outstanding volumes, the committee has obtained funds for two more part-time positions: Martin Mattmüller, besides serving as the secretary of the committee, participates in editing the Euler-Goldbach correspondence together with Günther Frei, a retired professor of the University of Québec and a specialist in number theory. The other paid editor Thomas Steiner is working on the Segner correspondence.

In view of the vast amount of letters remaining to be published, the perspectives for the future are not very promising. Funding is now secured for volumes IVA/3 (Daniel Bernoulli), IVA/4 (Goldbach), IVA/7 (various correspondence in French) and IVA/8 (Euler's correspondence with Segner and other scientists from Halle). All these volumes will hopefully come out before 2012.

But the Swiss National Science Foundation, which is now paying for much of the editorial work, will probably not continue to finance collaborators after 2012. This is regrettable because some of the unpublished correspondence is a real treasure.

As an example, let us mention the Euler-Knutzen correspondence, which could easily fill a whole volume of series IVA. Martin Knutzen (1713–1751) died at a young age and apart from his publications we have very few original sources or documents about him. However, as a professor of philosophy at the University of Königsberg, Knutzen

was one of the most influential academic teachers of Immanuel Kant and, as far as we know, it was through Knutzen that Kant became familiar with Newtonian physics and with the philosophy of Leibniz. The topics of his letters to Euler include physics, astronomy, philosophy and also details about Knutzen's private life and various events at the university of Königsberg. The correspondence consists of 72 letters from Knutzen and two letters from Euler.

Thus there are important and interesting parts of Euler's correspondence that we will probably not be able to publish on the same basis as the four volumes already in print and the four that are currently being prepared. Moreover, the series IVB comprising the rest of Euler's manuscript heritage cannot at present be tackled with confidence. It is the fate of large-scale projects like the edition of Euler's collected works that their aims, the standards in realizing them and the means available are constantly changing.

So will we have to leave the project outlined in 1907 unfinished? Yes and no. Unless some new way of financing the editorial work and the actual printing is found, no more volumes will be added to the imposing row of *Leonhardi Euleri Opera Omnia* after 2012. However, the new possibilities of electronic publishing give us a chance to realize the principal goal set by Ferdinand Rudio and his colleagues, i.e. making all of Euler's writings available to the scientific community.

The Euler Committee is currently working on a project to present this important heritage in an electronic database of scans on the Internet, made accessible by a reliable inventory. Hopefully the task that the mathematical community undertook a century ago will be completed in a few years, for the benefit of 21st century mathematicians and historians of science but also as a monument to the lasting glory of Leonhard Euler.



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Martin Mattmüller [euler-archiv@unibas.ch], born in 1957, studied mathematics at Basel. Since 1987, he has been working on editing projects in 17th- and 18th-century science. He is currently the secretary of the Euler Committee and the Euler Archive at Basel and co-editor of vol. IVA/4 of the *Opera Omnia*, which comprises Euler's correspondence with Christian Goldbach.