Introduction

Correspondences and editions of collected works: problems, situations, perspectives

Letter writing has always been very important for the spreading of scientific ideas, even in times of a great number of specialized journals.

The correspondences on mathematical issues or those of interest in the history of mathematics involve a vast field of topics, not only those of a scientific nature. They include letters between mathematicians and from mathematicians to politicians, publishers, and men and women of culture. Leibniz, Euler, D'Alembert, Lambert, Lagrange, Laplace, Gauss, Hermite, and Cremona are undoubtedly authors of great interest and their letters are precious documents, but the correspondence of less well-known authors can also make an important contribution to the history of science.

All of these kinds of correspondence constitute an essential component in the reconstruction of biographies, as well as the genesis of scientific ideas, in analyzing relations and debates and, ultimately, in the correct dating and interpretation of various memoirs. Their publication is, therefore, important for the success of critical editions of the works of great mathematicians (Galileo, Newton, Wallis, Huygens, Euler, the Bernoulli family, etc.).

In dealing with our subject, one must also take into account the varying editorial standards and formats for editions carried out in the past, especially in the nineteenth century, the most prolific period for collected works (Galileo, D'Alembert, Lagrange, Laplace, Huygens, Cauchy, Fourier, Weber, Gauss, Riemann, Kronecker, Dirichlet, etc.). They vary greatly in their presentation and structure; generally, they contain only printed works. At times, they are ordered chronologically, or according to discipline or type of publication. Only rarely are the correspondences, whether complete or partial, included in the edition.

Variety in editorial criteria is also to be found in twentieth-century editorial projects, some of which are still ongoing (Galileo *Edizione Nazionale*, Leibniz, Bernoulli, Brioschi, Betti, D'Alembert, . . .) and are gradually being supported by digitalization processes. In fact, the digital editions make mathematical works of the past increasingly available to a wider public and facilitate the research process of scholars by allowing them to easily access and browse rare texts. This poses new problems in addition to those of the traditional printed editions, particularly in the choice of the target audience and corresponding suitable technical tools.

The editors of the present volume invited scholars to reflect on these topics in a symposium within the frame of the 6th International Conference of the European Society of History of Science entitled "Communicating Science and Technology," held in Lisbon, September 4–6, 2014. The topic generated considerable interest and the symposium on "Mathematical Correspondences and Critical Editions" was a great success in terms of participation and debate. Subsequently, a project aimed at collecting these contributions came into being, and other scholars were invited to intervene on the theme, since the publication of collected works and correspondences is of major interest in the field of the history of mathematics.

This volume contains sixteen contributions by various researchers from five different European countries. It offers a fairly broad spectrum, albeit partial, of the research being carried out, as well as the arguments under debate, such as the complementary role of printed and digital editions, integral and partial editions of correspondences, reproduction techniques of manuscripts, pictures and formulas, and tools for identifying dates and correspondents. These problems may involve different approaches according to the period and the subject, in this wide-ranging volume that focuses on correspondences and works of the seventeenth-twentieth centuries with reference to all mathematical sciences.

Our intention was not to present a simple collection of various projects of editions, but rather to relate correspondences and works and compare the various types of edition, the problems encountered, and the solutions found to solve them. Of particular interest was the way in which the editions of correspondences and works should be linked and prioritized. For example, in the edition of Huygens, letters precede the works; for Lagrange, letters follow the works; and for Favaro's edition of Galileo, letters follow the works in the final volumes of the series, but were collected before and organized within a unique editorial plan. Important editions, however, like those of Laplace and Cauchy, do not contain the correspondence.

All of the contributions are related to editorial projects of correspondences or collected works. In some cases, the papers deal with projects of print editions (Leibniz, Wallis, Lagrange, Gauss) or online or mixed editions (Bernoulli, D'Alembert, Poincaré). In other cases, they refer to a correspondence between two mathematicians, relevant for specific mathematical contents (Germaine–Gauss, Betti–Brioschi, Hermite–Lipschitz), or are aimed at reconstructing a particular period for the history of mathematics (Cremona, Tardy), or a network of relations (D'Alembert, van der Waerden). Other articles discuss policy and methods for dating letters and discovering unknown correspondents (D'Alembert, Condorcet, . . .), or critically examine previous non-satisfactory editions (Lagrange, Gauss).

It is not our aim to create an exhaustive discussion of the best method for producing an edition, which depends on many variables, such as the historical period and range of correspondences, the multiplicity of correspondents and overlapping with other editions, as well as the contents and target audience. We believe, however, that a volume that allows us to compare various situations by presenting a reasonably wide picture may be a publication that arouses considerable interest for many scholars of the history of mathematics.

The very first article of the volume, for instance, poses fundamental questions regarding editions of correspondences: should they be complete or partial? Should they feature only unedited material? Should previously published material be included? In the case of a partial publication of selected letters, on what basis should the criteria be chosen: subject (scientific, political, private etc.), importance, or correspondents? Whatever the choice, a census of all existing documents must be as thorough as possible.

The author of the first article, Philip Beeley, describes the stages that led to the edition of the correspondence of John Wallis, beginning with Christoph J. Scriba's research carried out at Oxford in the early 1960s. Scriba's cultural and methodological background originated from the Leibniz edition in the German Academy of Sciences in Berlin, as well as from his protagonist, the Leibniz scholar Joseph Ehrenfried Hofmann. Beeley's paper outlines Scriba's profound and systematic investigation into Wallis's manuscripts, letters, and other materials, at Oxford, Cambridge, London, and Vienna, which produced a whole series of card catalogues and a list of Wallis's correspondence of 800 or so letters. From the initial idea of publishing only a significant selection of Wallis's letters, of interest for the history of science in general or the history of mathematics in particular, the project went in a new direction with the discovery of up to over 2000 new letters. After 30 years, this led to a collection of up to ten volumes, the first four of which were published from 2003 to 2014, with the fifth currently being printed. Philip Beeley entered the project when he was a doctoral student at the Technische Universität of Berlin, taking over as the successor of the previous collaborator, Sigmund Probst, at the beginning of November 1996. Together with Scriba, and after Scriba's death, he acted as editor of John Wallis's entire correspondence in chronological order, complete with a critical analysis and introductory essays on the themes discussed in the letters. Beeley explains, in his contribution, the various choices that had to be made during the course of the project, due to the development that took place within the methodology of the historiography of science in the last decades of the previous century, shifting from an internal historiographical approach to a more general survey of the history of ideas.

Eberhard Knobloch's essay introduces us to one of the biggest edition projects ever planned: the Leibniz edition, which cannot possibly be described in a few pages. It includes more than 50 published volumes of the expected 130 and has been a reference point for other edition projects. Eberhard Knobloch provides a detailed examination of its VII series, modified in 1975, and exclusively devoted to the manuscripts concerning mathematics (30 volumes), whereas the scientific, medical, and technical writings were to be published in a new series, the VIII, which was to follow. In 1976, Knobloch was assigned the editorial work on the first two volumes of Series VII, the first to be completed within 10 years, and the second within the following 5 or 7 years, with the help of a research assistant, Walter S. Contro.

Knobloch describes the difficulties and events involved in that edition, which accompanied the increasingly professional and academic growth of the young but already experienced researcher, and which were affected by the period of unification

of Germany. One of the first and foremost tasks was the identification and dating of Leibniz's writings during his stay in Paris, which were to fill eight volumes of the VII series. Owing to the fact that most of the handwritten manuscripts are not dated and that dating the manuscripts to a period of exactly half a year is generally not possible, it became clear that a strict chronological ordering of the handwritten manuscripts was impracticable. The solution came in the form of defining thematic groups for the entire Parisian period and developing a chronological order within these groups. In the case of volume VII1, the following groups were identified: geometry, number theory, and algebra.

With the assistance of various colleagues, Knobloch was able to publish the first four volumes of the VII series between 1990 and 2008 (the series was then completed in two other volumes). Knobloch was mainly involved in Leibniz's writings on actuarial and financial mathematics, also published in Series IV, Political Writings (IV, 4 (1680–1692), section VII Statistics, Life Insurance, Pensions). Knobloch's subsequent involvement in the VIII series further demonstrated how important it is for a historian of sciences and editor of old scientific texts to have not only the required scientific knowledge but also philological skills, since a lack of either one of these could lead to serious misinterpretations. A project of such dimension also revealed the need for international cooperation among scholars and institutional agreements with other countries (France and Russia in this case), as well as adequate funding. Digitalization of Leibniz's manuscripts was carried out first. Series VIII, leaving aside previously attempted editions of some manuscripts containing serious mistakes, includes up to ninety percent of unedited material. Knobloch points out these errors and presents significant examples (various apparatuses and instruments linked to pneumatics and mechanics) of Leibniz's procedure in the field of Natural Sciences and Technology. The first two volumes of Series VIII appeared in 2009 and 2016.

Sulamith Gehr describes the history of another celebrated edition project, namely, the publication of the letters by the mathematicians of the Bernoulli family. The project started in the 1930s in the form of a classical book edition and continued as an online edition in the past decade.

The Bernoulli family's correspondence includes a vast network of over 400 correspondents, among whom can be found the foremost scientists of the seventeenth and eighteenth centuries, and, as such, presents various problems of classification and organization. Gehr's work reminds us of the important role played by epistolary commerce in the transmission of knowledge and scientific debate in past centuries. In the specific case of the Bernoulli family, there is an important historical precedent: the publication edited by Gabriel Cramer of the *Commercium philosophicum et mathematicum*, which appeared in 1745 and featured the correspondence between Johann I Bernoulli and Gottfried Wilhelm Leibniz, following, as it did, just a few years after the publication of the *Opera omnia* by Johann I Bernoulli in 1742 may be considered as a completion of it. Further plans of epistolary publication followed, namely, the idea of publishing the correspondence between Johann I Bernoulli and the Marquis de L'Hôpital, begun by Johann III Bernoulli but never concluded. In the nineteenth century, the letter

exchanges of the Bernoullis with Leibniz, Euler, and further scientists who had been active at the Imperial Russian Academy of Science were edited, based on the manuscripts in Hannover and St. Petersburg, by Carl Immanuel Gerhardt and Paul Heinrich Fuss, in different projects. Other partial publications then followed from the manuscripts rediscovered in Gotha and Stockholm by Gustaf Eneström, among others.

So, a comprehensive project finally emerged at the beginning of the twentieth century with Otto Spiess in Basel, part of the wave of new understanding of the history of science: the Bernoulli edition, which included not only letters, but also manuscripts and printed works. Spiess started by organizing the institutional framework and collecting all of the manuscripts in Basel, then compiled an inventory of all known letters sent or received by the Bernoullis and by Jacob Hermann, and subsequently prepared the editorial plan and transcribed the letters. The first volume appeared in 1955, with 162 letters in total, reproduced in the original language and annotated and commented upon in German, and included a rich critical apparatus. After Spiess's death, three other volumes of letters were published in 1988, 1992, and 1993, the first one edited by Pierre Costabel and Jeanne Peiffer, the second by André Weil, and the last one by André Weil with the help of Clifford Truesdell and Fritz Nagel, all following the structural model, methods, and editorial standards set by Spiess. The correspondences of the Bernoullis with Leonhard Euler and Gottfried Wilhelm Leibniz were not included in the Bernoulli edition, because they were destined to be edited within two other important edition projects: the Euler edition and the Leibniz edition. Sulamith Gehr gives a short overview of the state of the Bernoulli correspondence in these further editions.

The contributions of Passeron and Guilbaud refer to the great edition project of the works of D'Alembert, which has involved roughly forty French scholars over several decades. The correspondence constitutes a section of this grandiose project, which is planned in about fifty printed volumes, seven of which have already come out. The edition is organized into five series: the first and third include mathematical works, the second, articles from the *Encyclopédie*, and the fourth, philosophical, historical, and literary writings. The organization of the edition is, therefore, partly thematic and partly chronological. Finally, the critical edition of the complete correspondence constitutes the subject of Series V.

The systematic study of the entire correspondence sent and received by D'Alembert was begun about 20 years ago, by Irène Passeron, in collaboration with A.-M. Chouillet and J.-D. Candaux, and led to the publication of an analytical inventory in 2009. Two thousand three hundred letters have been classified, of which about 500 are unedited, exchanged with over 420 correspondents. In 2015, the first volume of Series V, collecting the letters exchanged between 1741 and 1752, was published. The project aims at the publication of a further ten volumes, with the rest of the letters organized according to chronological periods.

Like his works, D'Alembert's letters also cover a vast domain of knowledge: mathematical sciences, music, literature, and philosophy, and editors have to deal with the twofold problem of research and reconstruction of the vast network of correspondents, as well as the organization of the entire correspondence in order

to make it available to scholars. Of particular importance is his correspondence with Gabriel Cramer, Euler, and Lagrange concerning questions of science, whereas matters of philosophy, politics, and morality are to be found in the correspondence with Frederik II and Voltaire. Further correspondences concern personal affairs, and many of his other letters concern academic issues related to his work as an influential member of the Académie royale des sciences in Paris and as secrétaire perpétuel de l'Académie française.

In her paper, Irène Passeron discusses the reconstruction of D'Alembert's network of correspondents and the way in which this research was carried out starting from information collected from D'Alembert's biography and various activities. Conversely, this reconstruction provides not only a deeper insight into his work, but also into scientific and literary debates, as well as the general way of thinking prominent in that century. Thus, all in all, it constitutes an essential contribution to the edition of D'Alembert's Complete Works.

The printed edition of D'Alembert's works is accompanied by a website providing information on its organization and progress and supplies documents such as a bibliography, chronology and studies on D'Alembert, other references and databases on the correspondence, academic reports, and so forth. A parallel project has been developed for the correspondence: *D'Alembert en toutes lettres*, which includes the uploading of the letters as soon as permission has been received for their publication. Alexandre Guilbaud's contribution describes the accomplishment of this project, and so he deals with such issues as the interface that allows for online access to both the description of metadata (place and date of the letter; reference number in the inventory; name of the correspondent; material description of the source; place of conservation; list of edited versions; other manuscript sources, if any; incipit; summary) and, when available, the reproduction of the original exemplars of the letters. The website is, moreover, enhanced by critical information on the letters and the history of the documents presented. Besides a continuously updated dynamic version, the site of the digital edition of D'Alembert's correspondence is intended as a support to the printed edition, allowing us to navigate within the index and, when possible, the text of the letters, equipped with specific research tools.

The next paper contains a contribution by Nicolas Rieucau, which is ideally a continuation of the previous papers, since it concerns the correspondence of the encyclopaedist, and protégé of D'Alembert, Nicolas de Condorcet, who wrote the long eulogy read at the Académie des sciences, on November 12th, 1783 (*Histoire de l'Académie royale des sciences—Année 1783*, Imprimerie royale, Paris, 1786, pp. 76–120). This was later inserted into the first of ten volumes of D'Alembert's selected works (*D'Alembert, sa vie, ses œuvres, sa philosophie*, Paris, Firmin-Didot, 1847).

The nineteenth-century edition of the works by Condorcet, (1847–1849) is also rather incomplete, particularly as far as the correspondence is concerned, as it reports less than 200 letters, most of which present little of scientific interest. However, the bicentennial anniversary of the French revolution and of Condorcet's death provided an occasion to publish some rare or unedited texts by Condorcet, above all those regarding political arithmetic and the philosophy of history. Moreover, various

letters from Condorcet to different interlocutors were published in connection with essays devoted to them.

There can be no question of the importance of correspondences in providing a better understanding of Condorcet's figure as a scientist, almost overshadowed by that of the philosopher as a defender of the core values of the Enlightenment and victim of their degeneration. Thus, around 2010, the project entitled "Inventaire Condorcet" focused on the construction of as complete an index as possible of Condorcet's correspondence, which amounts to more than 2100 letters. Over half of these are scientific in content and unedited, the originals of which still in existence are distributed over 130 different archives worldwide. More than 300 of them, either received or sent, concern integral calculus, calculus of probability, hydraulics, chemistry, and meteorology. A second group of over 150 are related to disciplines less frequently found in the Condorcet correspondence, such as meteorology, geodesy, mineralogy, optics, geology, botany, and agronomy. The number of correspondents rose to 250. Rieucau's paper gives an account of the goals, difficulties, limitations, and results of the ongoing work. The difficulty of making an inventory of Condorcet's letters was compounded by the lack of a register of correspondences and the multiplicity of his correspondents (given his position as permanent secretary to the Académie des sciences), but above all, by the dispersion of his letters after his condemnation and death. Many of them were sold on the market of autographed letters. Besides the difficulties involved in researching lists, catalogues of sales, archives, and libraries, there were also problems of identification, classification, and dating of the letters, for which methods of investigation had to be developed on the basis of various data, not only of an intrinsic nature but also deduced from original documents (like watermark and other characteristics of paper support, origin, location, and so on).

The paper by Luigi Pepe gives us a critical view of past editions, above all, the editions of collected works of the nineteenth century, which was the most prolific for this type of publication. The aim was to collect and make more accessible the works of great mathematicians, published in many volumes and academic journals, and finance them by public funds for the glory of the nation: the works of Lagrange, Laplace, Cauchy, Fourier, Arago, Galilei, Huygens, Gauss, and others. In particular, Pepe provides an in-depth analysis of the structure and criteria used for the publication of Lagrange's works, edited by Serret, Darboux, and Lalanne (1842–1917), taking up and developing the critique by George Sarton. Academic memoirs were grouped according to the journal in which they were published, and the annotations were modernized to fit contemporary mathematical writings; in the case of more than one edition, the latest was reprinted, with no historical-critical commentary. If such an edition could be useful from a mathematical point of view, it is, however, completely useless from the point of view of the history of science. Lagrange's correspondence with D'Alembert, Condorcet, Laplace, Euler, and other scientists, which takes up the last two volumes of the series (XIII–XVI), was, however, critically edited by the historian Lalanne, but many other letters were published later and still others remain unedited. Furthermore, the *Oeuvres de Lagrange* contain only a minimal part of the manuscripts by Lagrange conserved

in the library of the Institut de France set out in sixteen volumes. Several of these manuscripts were published at a later date, as were other unedited ones belonging to other archives. Pepe concludes with some suggestions for integration of the *Oeuvres* with other volumes containing newly found documents and hopes that a modern project similar to that being carried out in France for D'Alembert may be devoted to Lagrange and that at least a site with references to all printed materials after the publication of the *Oeuvres* could be set up.

Remaining within the context of editions of works and correspondences initiated in the nineteenth century, there follows the study by Karin Reich and Elena Roussanova, which deals with the works of Gauss, a series of 12 volumes (14 tomes) published between 1863 and 1933. This edition, which was to be the complete edition of the works by Gauss, does, in fact, collect almost all the works published by Gauss, as well as posthumous writings, or rather manuscripts, letters, and documents extracted from the archive of the State and University Library of Göttingen, with the addition of other material or comments on the part of the editor, material for a scientific biography, and writings by other authors. This is not the only case in which we find comments inserted by the editor (see, for example, the works of Fourier); however, the preponderancy of unsuitable material imposed upon Gauss's text is surprising, as pointed out by the authors, who also criticize the lack of precise references concerning the location of the unedited material reproduced.

Reich and Roussanova reconstruct the stages of the edition project, originally entrusted to a pupil of Gauss, Ernst Christian Julius Schering, who gained fame and inspiration from it, and under whose direction seven volumes were published between 1861 and 1873. In these, organized according to theme, were collected all the printed works and some manuscripts. Not only did Schering select from among Gauss's manuscripts those which he deemed worthy of publication, he also excluded some tables and charts from the reproduction of published works. There followed a second edition of the first five volumes (1870–1877) with the addition of a significant number of unedited writings. It was not until 20 years later that the edition was once again taken up with a new series, under the direction of Felix Klein with the collaboration of Martin Brendel and Ludwig Schlesinger. Klein was obliged to leave the direction of the work in 1922, due to ill health. He was succeeded by Max Born and then, in 1928, by Richard Courant. Between 1907 and 1933, the following items were published: an anastatic reproduction of Volume 6, a new edition of Volume 7 with the addition of many unedited works on astronomical matters, and Volumes 8–12, devoted to other unedited works by Gauss. The publisher also changed as the series progressed: from the Royal Society of Sciences in Göttingen to the publishing house Perthes in Gotha, then Teubner in Leipzig, and, finally, Springer in Berlin. Editorial plans constantly underwent changes under Klein's direction, as may be seen from the reports he periodically presented to the Royal Society of Sciences in Göttingen. Reich and Roussanova's analysis highlights his plans both for a scientific biography, to be set out in various chapters of Volume 11 and entrusted to experts in the field, and a general index, which was never carried out.

It would not seem possible at present to re-propose a new edition of the works of Gauss that follows modern criteria, especially considering the fact that some documents may no longer be traceable. So, in spite of their defects, recourse to anastatic copies of old editions took place (Georg Olms: Hildesheim, New York, 1973 and 1981), fortunately available nowadays in a digital version. As the authors suggest, the necessity of a complete table of contents of Gauss's works, as well as a keyword index for all available volumes, can now be solved by an online database, where bibliographic details should also be supplemented and improved upon.

The paper by Andrea Del Centina and Alessandra Fiocca focuses on a female figure, practically isolated in the overwhelmingly male-dominated panorama of the works and correspondences dealt with in this volume. Sophie Germain attempted, not always successfully, to communicate with some of the leading mathematicians of her day and to take part in mathematical research at the highest level. Because she was a woman, she was not allowed access to adequate university studies and was excluded from the academic career she so deserved, which would have enabled her to participate in the ongoing scientific debate. Recognition of her contributions to the theory of numbers and the theory of elasticity has been given further drive by the finding and analysis of her documents and manuscripts, which belonged to Guglielmo Libri. In this paper, the authors reconstruct the complicated phases of a progressive rediscovery of the correspondence between Sophie Germain and Gauss, as well as the mathematical notes attached to the letters, the unfinished publication project by Baldassarre Boncompagni and Angelo Genocchi, and the correspondence with Guglielmo Libri. The chapter finishes with some references to the publications of unedited letters and mathematical notes on the part of the authors, who have contributed to a reevaluation of Sophie Germain's life and the part she played in the field of the theory of numbers. All of the active and passive correspondence of Sophie Germain that has been published is classified in the appendix.

A set of contributions in this volume deals with the correspondences of the great protagonists of the Italian Risorgimento: Brioschi, Cremona, Betti, Tardy, etc. It was a period of extraordinary scientific, cultural, social, political, economic, and technological reawakening, which placed Italy at the same level as the most advanced countries in Europe. There are many correspondences that testify to this immense effort and success, which occurred over a relatively short period of time. The protagonists of this transformation corresponded with one another and with scientists from other parts of Europe. The fact that there is no single protagonist to whom others may be referred has meant that editorial choices have also been fortuitous and that correspondences linked to one another have come to light at different times with no comprehensive methodological plan. Similar correspondences are still being published nowadays. This situation can only be changed by means of an extensive national plan involving many researchers over a prolonged period of time in an attempt to recreate the transmission and evolution of ideas through diverse and interconnected epistolary networks.

The question arises as to whether it would be possible to organize, within the scope of a single project, the entirety of such intertwined correspondences among the mathematicians active during the Italian Risorgimento, by a group of researchers

who have devoted studies to them and even edited some of them. This would allow us close comparison of their contents, which are often found to be repeated.

Italy, on the other hand, has a solid tradition of publishing collected works of great mathematicians. Owing to the policy of nationalism in the first half of the twentieth century, Italy celebrated its glorious past with a national edition of the works of Galileo Galilei, edited by Antonio Favaro, nine volumes of which are devoted solely to the correspondences. Similarly, the protagonists of the Italian school of mathematics, which, at that time, was at the top of contemporary European research, had editions of their collected works printed (Betti, Brioschi, Cremona, . . .). The Italian Mathematical Union initiated a series of collected works of eminent mathematicians (above all, selected works), which still continues today, but only recently, and only occasionally, have we found correspondences inserted into these publications. This would explain why, in Italy, many scholars of the history of mathematics have directed their efforts toward editions of correspondences of the great protagonists of the Risorgimento, which constitute the completion of previous editions of works.

This volume on this theme collects papers by the following authors: Cinzia Cerroni, on the vast source of only partially published letters of Placido Tardy's correspondence; Ana ~~Millan~~ Gasca, Giorgio Israel, and Luigi Regogliosi, on the publication of the collection of 1122 letters received by Luigi Cremona from foreign correspondents; Maria Teresa Borgato and Iolanda Nagliati, on Francesco Brioschi's correspondence with Enrico Betti and Tardy, as well as all their correspondences with other foreign scientists; and Paolo Freguglia, Giuseppina Fenaroli, and Giuseppe Canepa, on the correspondence of Giusto Bellavitis. The collections come from the Polytechnic University of Milan, the Scuola Normale of Pisa, the Department of Mathematics of Rome, the Mazzini Institute and the University Library of Genoa, the Veneto Institute in Venice, and the Historical Archives of Göttingen University.

The main difficulty surrounding these editions lies in the selection of the material to be published, since it is linked to other correspondences in a wide network of intertwined relationships. The themes under debate are mainly of a scientific nature, but there are others that deal with politics, administration, culture, state education, university and higher education, academies, and so forth.

Cinzia Cerroni deals with important collections preserved in the archives of Genoa, and in particular, the correspondences of Placido Tardy and Luigi Cremona; Tardy's letters are preserved at the Genoa University Library and Cremona's letters at the Mazzini Institute of Genoa. The University Library of Genoa hosts an important archive, donated by the historian of mathematics Gino Loria, containing 784 letters sent by prestigious Italian and foreign mathematicians to Placido Tardy. Tardy was at the center of a wide network of correspondents, a fact that allows us to investigate "the connections between the development of Italian mathematics in the second half of the nineteenth century and the main political issues of Italian history." This correspondence has been partially published (letters sent by Beltrami, Bellavitis, Betti, Cremona), in some cases completed with the letters sent by Tardy contained in other Italian archives. The Mazzini Institute in Genoa possesses another

important archive, donated by Cremona's daughter, mainly consisting of Cremona's correspondence, part of which has also been published.

In her paper, Cerroni describes these funds and provides insight into the Cremona–Tardy, Betti–Tardy, and Cremona–Guccia correspondences, their substantialness, and, with abundant quotations, the main issues contained in those letters: the foundation of the journal *Annali di Matematica pura ed applicata*, the foundation of the Circolo Matematico of Palermo, the discussion on non-Euclidean geometry, Riemann's theory and Abelian functions, references to Giuseppe Garibaldi and the Italian wars of independence, the educational reforms, and university policy.

Luigi Cremona's correspondence is also preserved in different places. The principal sources in Italy are at the Mazzini Institute in Genoa, where the 6000 documents consist mainly of correspondences with Italian scientists and politicians or state officials, as well as with 34 foreign mathematicians, and at the Department of Mathematics in Rome, which houses letters addressed to Cremona from 176 mathematicians, most of whom are foreigners, and from representatives of three scientific societies. The latter archive source, presented in the paper by Ana ~~Millan~~ Gasca, Giorgio Israel, and Luigi Regoliosi, was the subject of a recent edition overseen by Giorgio Israel. Among those correspondents can be found Carl Wilhelm Borchardt, Alfred Clebsch, Eugène Prouhet, Olry Terquem, Maximilian Curtze, Rudolf Sturm, Heinrich Schröter, Arthur Cayley, Thomas Hirst, George Salmon, Rudolf Sturm, Elwin Bruno Christoffel, Wilhelm Fiedler, Johann Nicolaus Bischoff, Theodor Reye, Carl Friedrich Geiser, Ludwig Schläfli, Emil Weyr, and translators such as Eugène Dewulf.

The paper presents the distribution not only of the letters over time, but also of the correspondents according to their nation or geographical area, and discusses some aspects of the edition. It is not a complete collection, since more than half of the letters have been lost; the remaining 1122 are published in alphabetical order of the correspondents, with a chronological index, critical apparatus, and bibliography. A team of nearly 20 researchers from six European countries have contributed to the edition. Research on the letters sent by Cremona has not gone forward, given that the high number of correspondents from various countries would have greatly delayed the publication without any hope of completing it within a reasonable period of time.

The extensive network of correspondents and the multiplicity of the languages used in the letters and their countries of origin, especially those in Europe, provide a vivid picture of the mathematical community in the second half of the nineteenth century, which was actively involved not only in cultural, social, and political issues, but also in a process of modernization. This allows us to reconstruct the political thinking of the day, as well as its scientific interests and cultural goals. Mathematics itself was not merely a vehicle for scientific progress, but encompassed cultural and social issues as well.

Maria Teresa Borgato and Iolanda Nagliati focus their paper on the figure of Francesco Brioschi, who was instrumental in the scientific, political, and administrative development during the unification of Italy. He played many roles: editor of the *Annali di Matematica Pura ed Applicata*, founder of the Polytechnic Institute of

Milan, for many years senator and general secretary of the Department of Education, influential member of many ministerial commissions regarding the railways, fluvial hydraulics, and finance, and president of scientific societies and academies. This paper, however, mainly concentrates on the scientific themes discussed in his correspondences with Enrico Betti and Placido Tardy: the theory of invariants of binary forms, the resolution of fifth degree algebraic equations by elliptic functions, and the theory of fractional integrals.

Starting from references contained in the letters, the authors reconstruct the contributions made to these mathematical theories. Furthermore, they present the current picture of the epistolary relationships of these three mathematicians with their foreign correspondents, which allows for a reconstruction of the frequent journeys abroad undertaken by Italian scholars to further their studies, as well as the journeys of foreign scholars to Italy. Of particular importance for their number and contents are Brioschi's correspondences with Felix Klein and Charles Hermite. The documents studied for this paper come from the historical archives of the Polytechnic Institute in Milan, the Institute Library of Genoa, the Scuola Normale in Pisa, and the University of Göttingen.

The contribution made by Paolo Freguglia, Giuseppina Fenaroli, and Giuseppe Canepa explores another area of the variegated world of Italian mathematics during the Risorgimento, in particular that of the Veneto centering around the University of Padua. The region's previous political history (first as the Republic of Venice, and then under Habsburg dominion) gave rise to its cultural diversity, which is also reflected in the different interests represented by research studies. Giusto Bellavitis was an eminent mathematician of the "Studio Padovano," the University of Padua, and founder of the calculus of equipollences, originating from the study of geometric foundations of complex numbers, which is related to the works of Moebius, Hamilton, and Grassmann. He also represents a sort of link between the previous generation of Italian mathematical research of the universities of Turin and Pavia (Antonio Bordoni, Gabrio Piola, Felice Chiò, and Ottaviano Fabrizio Mossotti) and the new group of researchers whose outlook was more international (Enrico Betti, Francesco Brioschi, and Felice Casorati).

The present contribution provides a general survey of Bellavitis's letters, preserved in Venice, Genoa, Rome, and Piacenza. Among his best known correspondents are Luigi Cremona, Placido Tardy, Domenico Chelini, and Angelo Genocchi. Part of this correspondence has been published; however, most of his letters (about 1270 letters and minutes, donated to the Istituto Veneto in Venice) remain unpublished. Besides private subjects, the topics in the letters are related to academic questions (the role of the Società dei XL), social and political situations, opinions on scientific papers and their mutual exchange, and various mathematical and scientific items, in particular the calculus of equipollences.

Catherine Goldstein's paper also focuses on the second half of the nineteenth century and centers on the French mathematician Charles Hermite, who was one of the most important of the century. In the case of Hermite, the same problem of publishing the entire correspondence arises, since he wrote thousands of letters to dozens of correspondents, on different subjects: personal, political, academic,

and mathematical. Even if the letters received were lost during a fire, important collections of letters preserved in various archives and libraries survive, some of which have been published, for example, those sent or exchanged with Thomas Stieltjes, Paul Du Bois-Reymond, Andrei Markoff, Gösta Mittag-Leffler, Ernesto Cesàro, Angelo Genocchi, and Georg Cantor. Other selected letters sent to or received from James Joseph Sylvester or certain Italian mathematicians have been published. The problems to be dealt with and the choices to be made in the case of a complete edition are presented, starting from the correspondence between Hermite and Rudolf Lipschitz. After comparing the similarities and differences in the scientific and academic formation of the two protagonists, as well as providing a general picture of each one's published and unedited letters, there follows an analysis of the Hermite–Lipschitz correspondence, which is mostly preserved in the Lipschitz collection in Bonn, and consists of 148 letters and 9 postcards sent by Hermite, as well as 70 drafts of letters from Lipschitz. Two letters from Lipschitz to Hermite can be found in the Archives of the French Academy of Sciences. The letters were written in the last quarter of the century, 1877–1900, at the end of the two mathematicians' careers, with a peak around the year 1884.

The contents concern issues of publishing and dissemination of mathematics, mathematical research, and proofs of interest in regard to both political and scientific policies, university teaching, as well as personal matters and political opinions. Starting from a detailed analysis of some of the letters, Goldstein is able to give a general outline of the themes broached throughout the correspondence, many of which may also be present in just one letter, and which also provide further insight not only into personal and scientific relationships among the scientists of that period, but also the role of correspondence in the scientific community. In the second part of the paper, the author considers the influence this correspondence had on the scientific output of Hermite and Lipschitz; in particular, this correspondence also testifies to the resumption of Franco-German relationships following the Franco-Prussian War of 1870.

In the conclusion, the possibility of the digital edition of this correspondence is discussed. By taking some existing projects as examples, the creation of an open platform is hypothesized, to which new documents and references can be added in real time, with a selective display that allows users not only to access the text of the letters, but also to search for specific concepts and references, and with a "homoiconic" structure in which "links should be treated as data, as well as the texts of the letters, capable of receiving themselves links and commentaries."

Correspondences require recourse to external elements if they are to be faultlessly interpreted and edited, yet at the same time, they themselves give precious information not only on the lives and characters of the correspondents, but also on external events and the general historical and cultural situation of the time in which they lived. Furthermore, they help us to reconstruct the role played by the correspondents within the scientific community, as well as the type of research they carried out and their reciprocal influence. Scott Walter's paper leads us to the beginning of the twentieth century, when David Hilbert and Henri Poincaré were at the height of their renown and influence within the international scientific

community. Holding opposing positions concerning the foundation of mathematics and the relationships between mathematics and the physical world, the study of the correspondence between the two brings to light new details in the Hilbert–Poincaré relationship and in Poincaré's approach to questions of theoretical physics.

The Hilbert–Poincaré correspondence, transcribed here, is made up of seven letters written in the period between November 1908 and March 1909. It concerns Hilbert's invitation to Poincaré to hold a cycle of lectures at the Society of Mathematics of Göttingen (supported by the Paul Wolfskehl foundation). Topics discussed are the planning of themes to be treated, like the reduction of Abelian integrals, applications of Fredholm's method, the theory of tides and Fredholm's equation, Hertzian waves and Fredholm's equation, and the notion of transfinite cardinal numbers. Hilbert had asked that the themes of theoretical physics and mathematical logic be added, but in the end, Poincaré chose to add a conference on the theory of relativity instead.

This set of letters forms part of Poincaré's large correspondence of over 2000 letters, exchanged with over 290 interlocutors; it has been indexed and put online (in images or transcriptions) on the site Henri Poincaré Papers of the University of Nantes, together with manuscripts and publications by Poincaré, as well as sources relative to his work. A Sphinx search engine enables the user to find the documents.

Neuenschwander's paper brings us well into the twentieth century. It describes the extremely rich collection of van der Waerden's manuscripts housed at the Library of the Eidgenössische Technische Hochschule (ETH) in Zurich, including around 15,000 letters, stretching from 1943 until his death in 1996. Most of van der Waerden's papers have been catalogued and made available to the public. Neuenschwander was van der Waerden's last assistant and longtime coworker at the Research Center for the History of Science at the Institute of Mathematics at the University of Zurich. He is therefore able to provide a detailed reconstruction of van der Waerden's activity during his Zurich years, aided by personal memories. After a brief biography of van der Waerden, which clearly states his position with regard to the Nazi regime, Neuenschwander gives a brief overview of his ongoing research of van der Waerden's Zurich years, accompanied by a select edition of his correspondence. In the present paper, he provides a detailed list and discussion of the hundred most extended correspondences, which contain at least 25 letters. Among these are those with Hans Freudenthal, Edward S. Kennedy, Otto Neugebauer, and Clifford A. Truesdell, which comprise more than a hundred letters and which are discussed in more detail in the paper. The correspondence with Hans Freuenthal contains, in particular, information about van der Waerden's unpublished textbook *Introduction to Topology and Riemann Surfaces* and van der Waerden's views about synthetic a priori knowledge and its role in natural science. With Edward S. Kennedy, a specialist in medieval Islamic astronomy, van der Waerden discussed ideas about the transmission of Babylonian and Hellenistic astronomical notions. Otto Neugebauer was one of van der Waerden's oldest friends, with whom van der Waerden discussed the research into the history of astronomy in ancient cultures.

Van der Waerden also had important exchanges of letters with Walter Burkert, Richard A. Parker, David Edwin Pingree, William Kendrick Pritchett, Abraham

Sachs, Derek Thomas Whiteside, and Clifford A. Truesdell. The correspondence with the last of these contains a great deal of information about the journal *Archive for History of Exact Sciences*, of which van der Waerden was one of the coeditors. A particular focus is also devoted to van der Waerden's polemic with David Pingree, about the transmission of astronomical theories between the Near East and India.

We hope that this volume, which not only deals with the edition of collected works and the publication of correspondences of mathematicians, but also with the significance of correspondences within the context of editions of complete works, will provide interesting reading and that it may be of help and serve as a stimulus to historians of mathematics in their research.

A substantial commitment on the part of publishing houses involved in the field of science, combined with the financial aid of public bodies or institutes, is, however, of paramount importance to sustain this fundamental activity and avoid fragmentation of publication aimed at supporting specific historiographical theses.

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