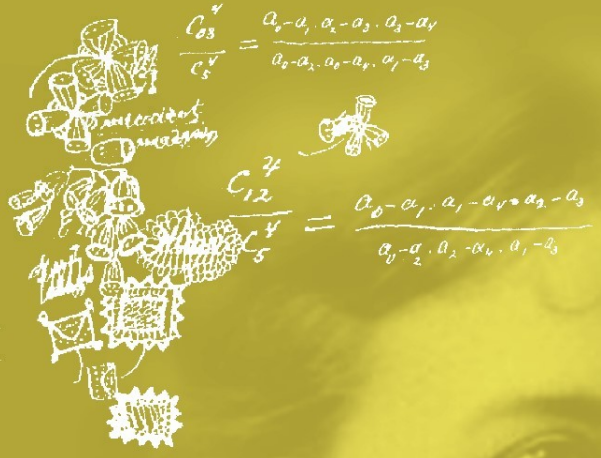
Michèle Audin

Remembering Sofya Kovalevskaya



Springer

Remembering Sofya Kovalevskaya

Michèle Audin

Remembering Sofya Kovalevskaya

Springer

Michèle Audin
Institut de recherche mathématique avancée
Université de Strasbourg et CNRS
7 rue René-Descartes
67084 Strasbourg Cedex
France
michele.audin@math.unistra.fr

ISBN 978-0-85729-928-4 e-ISBN 978-0-85729-929-1
DOI 10.1007/978-0-85729-929-1
Springer London Dordrecht Heidelberg New York

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Control Number: 2011935730

Mathematics Subject Classification: 01-00, 01455, 14H70, 70Hxx, 70Exx, 35A10

Translation from the French language edition:
'Souvenirs sur Sofia Kovalevskaya' by Michèle Audin

Cover design: deblik, Berlin

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Oh! Happy time! Dominated by new ideas, we were persuaded that the existing social conditions could not long endure; that a glorious era of enfranchisement, universal civilization, all our dreams, seemed so close, so certain!

Sofya Kovalevskaya

For Sonya's friends, it was not her greatness that was precious to them. What made her unequaled in their eyes was that she possessed those rare qualities which Goethe said a human being should pursue:
Grosse Gedanken und ein gutes Herz

Ellen Key

Why then not represent science by the features of an attractive young woman, brash and self-assured, pursuing her way without caring what will be said about her, able to obtrude on a man's world, loving to please, happy?

Françoise Balibar

CONTENTS

INTRODUCTION

This is not a history book. Proof: I am not a historian. Nor is it a novel, since I am not a novelist either. And it is not even a mathematics book, although I am a mathematician. It is a personal book and it is a serious book. It deals with serious matters, with the work and life of a woman, of a serious woman, brilliant, professional, tenacious, and with the scientific reputation of this woman. I approach her story, sometimes with humor, often with jubilation, and always with pleasure. And with seriousness.

The first woman? Sofya Kovalevskaya was not the first woman to obtain a doctorate, even in mathematics: before her there was Maria Agnesi, in the 18^{th} century, in Bologna. She is perhaps not even the first woman to obtain a university position; the same Maria Agnesi undoubtedly preceded her (but it seems never took up her position and devoted herself to religion and charity). In this book we will even witness one of the most eminent Swedish mathematicians of our time confirm (although in a rather ambiguous way) that, yes, Sofya Kovalevskaya was indeed the first woman to obtain a professorial position ... in Sweden. She was not the first woman to receive a prize from the Académie des sciences: Sophie Germain, another Sophie, another mathematician, had received one in 1816. She is very likely the first woman to have served on the editorial committee of a scientific journal.

I know neither the form nor the content of Maria Agnesi's doctorate. It is not even completely clear that what was called a doctorate corresponded in this case to original mathematical work.

Why Sofya Kovalevskaya? She is without doubt the first woman to have had a professional university career in the way we understand it today: she proves original theorems that earn her the title of doctor, she gives courses, she concerns herself with politics, she believes in the responsibilities of scientists,

M. Audin, *Remembering Sofya Kovalevskaya*, DOI 10.1007/978-0-85729-929-1_0,

she travels, she proves more theorems, she participates (without much enthusiasm) in committee meetings, she has a daughter, she is editor of an international journal (*Acta Mathematica*), she fights for women's rights, she attends and contributes to scientific meetings, she's up for promotion, she writes reports and letters of recommendation, she travels to meet with colleagues at other universities. As was done in the 20$^{\text{th}}$ century, as we continue to do in the 21$^{\text{st}}$. It is in this sense that she is close to us and it is why her life, her work and what she said touches us. Especially when we add that she led her professional life under very difficult conditions and in a wide variety of personal situations (married, separated from her husband, widowed, mother and head of the family).

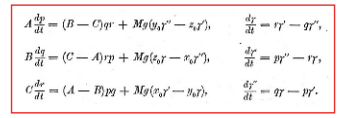
I also want to emphasize the profound unity of the various facets of Sofya Kovalevskaya's personality, brilliantly summarized under the nice title (*A convergence of lives*) of the biography that Ann Hibner Koblitz dedicated to her. The fact of her being a mathematician *and* a writer is inseparable from her political convictions. Sofya was a nihilist. Many people think of nihilists as dangerous anarchists (as they were called before the word terrorist was made fashionable by the Nazis). In reality, the nihilists wanted to reform society with the notion that they, men and women equally, should contribute to raising the level of knowledge of society, which, in 19$^{\text{th}}$–century Russia, was no small undertaking. In this regard, I refer the reader to the excellent preface of the book by Ann Hibner Koblitz [1993].

Where did this book come from? My association with Sofya's mathematical work (I explain on page 27 how and why I call her "Sofya") is long-standing, my association with her personality (see chapter XII) much less so: Sofya, her appearance, her life, her romances, her writings, the things she is thought to have experienced, Sofya, with all her facets, entered my life definitively at the end of 2004, for reasons both personal and mathematical, and actually took over my life after I got to know Jean-François Peyret and the cast of the theater production *The Case of Sophie K* in the Spring of 2005. It was in order to "go beyond" that I decided to write this book. Its title comes directly from having been present with that "troop", so many times did I hear Jean-François Peyret say that his play displayed "memories of someone who was never known".

What will you find in this book?

Three parts.

– First, what we should know about Sofya Kovalevskaya, the chronological benchmarks, her identity, some anecdotes about her that have often been repeated and that I too will tell, in my own way. These are chapters I, II and III.

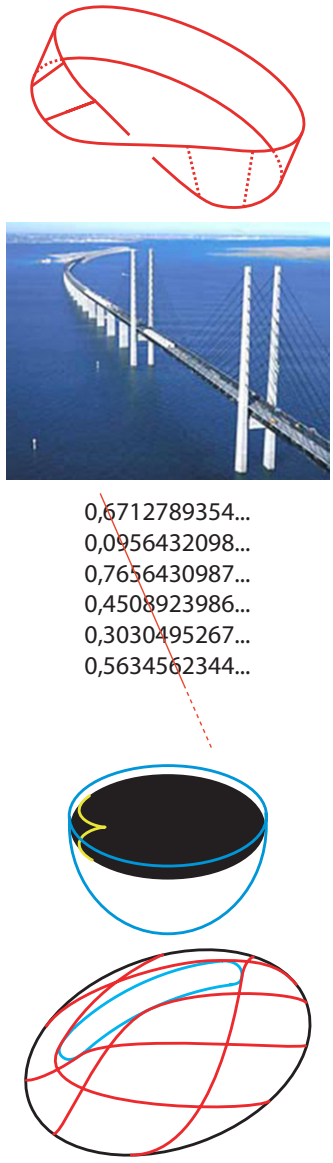


– Next, about her mathematics. I will come rather quickly in chapter IV to the three papers from her thesis. It is perfectly possible to skip the parts with formulas. We cannot pretend that there are not any mathematical formulas in this book. Often they are pretty by themselves, like those that decorated the nursery at Sofya's house (see chapter IV) and which turned out to be useful. Failing—or while trying—to understand them, we can attempt to appreciate their aesthetics. It is about mathematics (even though I know very well that it will not be accessible to everyone) but not just that. I talk extensively about "the solid" in chapter V: a subject in which I am truly competent even before beginning to think about Sofya, it is the subject that I most often have occasion to explain, more or less on all levels, but which I also explain there, once again, on all levels. I then discuss in chapter VI a letter of Sofya Kovalevskaya that contains mathematics related to the problem of the solid.

$$\iint_{\Sigma} F \cdot dS = \iiint_{V} \operatorname{div}(F)\, dx\, dy\, dz$$

$$\iint_{\Sigma} F \wedge dS = -\iiint_{V} \operatorname{rot}(F)\, dx\, dy\, dz$$

– I return to stories in chapters VII and IX, where I tell how Sofya Kovalevskaya obtained her various positions in Stockholm, the award of the Bordin prize and what I call Sofya's misfortunes, her posthumous misfortunes, her reputation. In chapter VIII, I interpose another letter of Sofya, addressed to Vollmar, which I think clarifies this whole story. I talk at length about Sofya's reputation in Paris, in particular because I cannot resist the temptation to mention the delightful letters from Hermite. We often read that Sofya did not have the reputation that she deserved, because of Bell, or Klein, or both of them, but it is never stated exactly why. I study Bell's text in detail in chapter X. We will find Klein's in chapter XI, taking its place among other opinions and memories of Sofya, which I attempt to arrange in a somewhat humorous and contrasting, although rigorous, manner. The "memories" of this chapter are (within translation) authentic, but their choice and the way they are juxtaposed are completely my own. In



Some of the digressions to be found in this book ...

the following and final chapter, I relate my encounter, my encounters, with Sofya.

It happened that Sofya Kovalevskaya would break off her mathematical work in order to write novels and plays. Here and there you will find, under the heading *Pause*, some tributes to her taste for literature. If I have based the arguments and certain details of these texts on facts and accounts given in this book, it is because I too am permitted all the fantasies, including a writer's license, creativity, embellishments of reality and anachronisms. These *pauses* have the nature of a pastiche and come from my own imagination. I have solicited four writers who have expressed an interest in science: George Eliot and Jules Verne (contemporaries of Sofya), Italo Calvino—a bit closer to us—and finally our contemporary A. S. Byatt.

The book was not conceived to be presented in a completely linear fashion. Perhaps you will find it difficult, but it seems to me that everyone should be able to find things they like—a bit like when we watch a top spin, with a rather naive pleasure depending on whether we are a child, Lagrange or again Sofya. It contains numerous internal cross-references and is provided with an index of persons and places to help us find our way.

Digressions. There are lots of digressions in this book, parenthetical remarks, footnotes and marginal commentaries. I haven't been able (or even tried) to resist the pleasure of providing a mathematical diagram or explanation, or a remark about the context.

On rigor. I have tried to apply a methodical rigor, a quality befitting both a historian and a mathematician. You will find enough examples of non-rigor quoted in this book to clarify what I mean. I have been very struck by reading all that I have read (the serious and above all the less serious, the abundantly less serious) by a number of authors, mostly contemporaries alas, mostly mathematicians alas, who practice the method "I didn't see it, I didn't read it, but I've heard it said that ..." which I find totally unacceptable. So I have given my sources systematically, occasionally having to cite a lack of sources. Perhaps you will find this policy a burden, but what can I do?

A caution, and sources. As I am not a historian, I haven't combed through any archive, I haven't discovered any new source (if the letter reproduced here in chapter VI was without doubt unpublished in French, it was published in Russian by

Pelageya Kochina [Yushkevich 1984] and excerpts have been quoted here and there, just as for the letter to Vollmar that is found in chapter VIII). I have of course used as much as possible available information and above all the two biographies of Sofya, those of Pelageya Kochina [1] [1985] and of Ann Hibner Koblitz [1993], the book of Roger Cooke [1984] and the letters of Weierstraß edited by Reinhard Bölling [1993], books that are well documented, serious and rigorous (in spite of the stupid title *Love and mathematics* for the English translation of that of Pelageya Kochina), [2] and which I recommend reading.

There are nonetheless two newcomers in this book. Nanny Lagerborg, whom I have never seen mentioned in any book on Sofya, and Dorothea Klumpke, who barely appears in that of Cooke [1984, p. 174]. It was in rereading the study [Gispert 1991] by Hélène Gispert that I had the curiosity to find out about this Finnish woman without profession (who had become a member of the French mathematical society in 1890), and this first woman doctor of mathematics in France, and I was surprised to find that both were scientifically tied to Sofya.

Pelageya Kochina (1899–1999)

As I was interested above all in Sofya's image, I have read many other books. In principle, all references to these "sources" should be found in the bibliography (at the end of the book).

Translations. I must confess first that I can read neither Russian nor Swedish. For this book we use the translation from Russian to English [Kovalevskaya 1898], which appears in a single volume together with [Leffler 1898], which is a translation from Swedish to English, together with the more modern translation of Beatrice Stillman [Kovalevskaya 1978].

I have attempted to avoid multiple translations to the greatest extent possible, so that in the typical instance a translation is made directly into English from the source language. The very few exceptions were unavoidable and do not threaten to damage the accuracy of our text.

We need to be on guard against nonsense due either to mistranslation or carelessness on the part of authors. E.g., in the English translation [Kozlov 2000, p. 1178] we find the quotation attributed to Felix Klein:

1. Note that the Russian mathematician and historian Pelageya Kochina appears here and elsewhere under the two names Kochina and Polubarinova-Kochina.

2. I have unfortunately only read Pelageya Kochina's book in the English translation [Kochina 1985].

During World War I, when I was a student

Speaking of inexact dates: you would not even imagine the number of authors who believe that the Paris Commune took place in 1870 or who think that it was possible to have

"spent several months in Paris during the Commune".

(which is, by the way, an accurate rendition of the Russian), whereas Klein in fact studied at the time of the war of 1870. In the book [Kennedy 1983] the same Klein is presented as a student of Weierstraß, the result of an error produced by double translation, as was pointed out to me by Roger Cooke.

In all instances I have attempted to specify the source of the texts that I have used. I also attempt, even when I just isolate a phrase or a part of a phrase, to give its context, so as not to bend it into just about anything one would like.

Acknowledgments to institutions. I thank

– The Mittag-Leffler Institute and its director Anders Björner for permission to reproduce the letter that is the subject of chapter VI: I point out that all letters addressed to Sofya or to Mittag-Leffler from which excerpts appear in this book belong to the Mittag-Leffler Institute; likewise for the original photographs of these two mathematicians and the original of Sofya's manuscript reproduced here.

– The *Internationaal Instituut voor Sociale Geschiednis* (International Institute for Social History) in Amsterdam and its archivist Mieke IJzermans for sending me a copy of the letter to Georg von Vollmar and giving permission to publish a translation (in chapter VIII).

– The archival service of the Academy of sciences of Paris, in the person of its Curator, Florence Greffe, for information on the Bordin prize.

I love books, the feel of books and I certainly would never have had the idea of writing a book having anything to do with history if I had not the possibility and the habit of frequenting the rich library of the IRMA (Mathematics Research Institute) in Strasbourg. It is certain that the volumes of *Acta Mathematica* removed to the coffers of the library have lost some of their dust, however tenacious, since I performed this work! But this is no reason for not thanking the institution.

It was at the library of the Henri Poincaré institute in Paris that I read some of the books and articles that I have used, especially the volume of the *Comptes rendus* of the Academy of sciences where there is an account of the award of the Bordin prize (see our chapter IX). The richness of this library is now so accessible that it is truly a pleasure to rush there whenever I find myself in Paris.

I thus thank these two institutions as well as Christine Disdier and Liliane Zweig and their staffs for their hospitality and their help. Thanks to her knowledge network and her confidence with Gallica (the French digital library), Christine succeeded in obtaining for me some of the extra-mathematical articles that I have used here.

Regarding this translation into English. I thank Lester Senechal for his enthusiasm in translating this book, and I thank, at Springer UK,

– Lauren Stoney, associate editor, for her help at every stage of this project

– Lyn Imeson for doing a wonderful job of copyediting the near-final maunscript.

Thanks to my friends and colleagues. Those who have read this text will not be surprised that I begin by thanking Jean-François Peyret, without whom it likely would not exist. In addition to everything else, Jean-François read and commented on a preliminary version, encouraged me to remove a few rather cumbersome passages and pointed out some connections and contexts of which I was unaware or had overlooked.

I also thank the writers I solicited without requiring their advice. And in truth it was also thanks to Jean-François Peyret that I read (and met) A. S. Byatt—and thanks to her that I read (and did not meet) George Eliot, whose novels make their appearance in this book. These encounters were not due to chance, for example Sofya Kovalevskaya is obviously—in the guise of Frederica Potter, the heroine of A. S. Byatt's tetralogy, a "whistling woman".

There are also more diffuse reminiscences of other texts in this book:

– writers that I have already quoted, of *Possession* [Byatt 1990] for example, in the story of the burned letters,

– or others, Perec's *Species of spaces* [Perec 2008] in the story of the asteroids or *A Void (la Disparition)* [2005], used appropriately on page 239 (not to mention [Perec 1978] or [Senon, Evero, Eben & Trovato 1982]),

– or the trilolgy by Vallès [2006] in the story of the Commune.

I thank the authors of these texts.

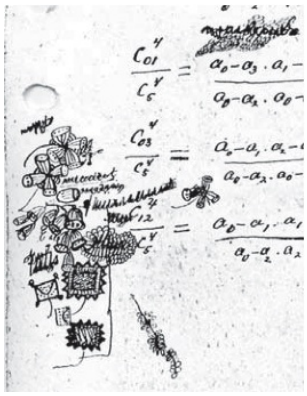
The coffers of the IRMA library do not contain any volume of the *Comptes rendus* prior to 1908; of course, in case of the impossibility of accessing the thick and dusty volumes, there is a digital version on the *Gallica* site:

http://gallica.bnf.fr

of the *Bibliothèque Nationale de France*.

Readers witnessing the upheaval of another investigator discovering other drafts, were able to read *Possession* the same year (1990) that Reinhard Bölling found and decrypted Sofya's burned letter.

The page of formulas, with its scrawls, some of which represent flowers, is from Sofya's hand. It belongs, as I have said, as does the accompanying photo, to the Mittag-Leffler Institute.



It is thanks to Reinhard Bölling that these two documents could be reproduced. In particular, he went to collect Sofya's flowers in the middle of a midsummer night. He should be thanked for that too!

I thank:

– Dimitri and Lidia Anosov for authorizing me to reproduce the photo of Andrei Bolibrukh,

– Marcel Bénabou, the definitively provisional and provisionally definitive secretary of the Oulipo, for giving me permission to use the photograph of Italo Calvino,

– Reinhard Bölling for the copy of the letter that he kindly sent me and the answers he provided to all my questions: without him chapter VI could not exist; I thank him too for the photo on page 63 and for his comments on (and for pointing out some errors in) a preliminary version of this book,

– Véronique Chauveau, for her commentary on a very preliminary (even embryonic) version of this text,

– Roger Cooke for all the details he sent me, his permission to reproduce some of these here, the documents he sent me, letters from Sofya to Gösta, from Weierstraß to Schwarz, poems by Sylvester and by Sofya and even the photo on page 181, for his enthusiasm and for his encouragement,

– René Cori for his careful reading, for the numerous kind remarks and the innumerable improvements that are due to him,

– Jacqueline Détraz, for her commentary on the entire first version of the text and for the photo on page 246,

– Jean-Denis Eiden for his reading and his suggestions,

– Catherine Goldstein for her availability, the criticisms that she provided, the information that she gave me, the references and the copies of letters of that "delightful letter writer", Hermite, that she communicated to me,

– Anna Helversen-Pasotto, for information and advice that she provided,

– Else Høyrup for having shared her knowledge about the Danish friends of Sofya Kovalevskaya and especially for the texts by Georg Brandes that she sought out and translated for me, as well as for her careful reading of a version of this book,

– Eero Hyry for her help regarding the Finnish student of Sofya Kovalevskaya,

– Ilia Itenberg for his help with Cyrillic fonts and with Russian names,

– Clio Lacroix for her interview [2006] of Jean-François Peyret,

– Christine Le Bœuf, one of the rare cordial contacts I have had with the publishing world, for her encouragement,
– Natalia Miasnikova for the first names and patronymics of Russian authors that she found for me,
– Ian Monk who deserves a special mention for his help with poetry,
– Mary-May Nielsen for translations of Brandes's texts,
– Ragni Piene for the articles she sent me and for the Norwegian and Finnish contacts,
– Agneta Rahikainen, producer at the *Svenska litteratursällskapet i Finland* (society of Swedish and Finnish literature) for information about Nanny Lagerborg,
– Bernard Randé for his reading and suggestions,
– Martin Raußen for sending me the article [Høyrup 2004] and for helping me contact its author,
– Peter Richter for the image of the Bremen top—I redrew the one that turns in his office, for the photo of the bust of Sofya Kovalevskaya in Bordeaux and for his friendly remarks and encouragement,
– Rebecca Rogers, an authentic historian, 19th-century expert and specialist in the education of young women, for her confidence and support,
– Norbert Schappacher for having lent me several books that I quote here, for his help with reading printed and manuscript German, especially that of the letter to Vollmar that appears here in chapter VIII, for his suggestions and for his enthusiasm and support,
– Robert Silhol for his cordial commentary and for the photo on page 244,
– Arild Stubhaug for Norwegian information,
– Cordula Tollmien for details she provided me on the letter from Sofya to Vollmar from which she quotes an abstract in her book [Tollmien 1995, p. 109] and of which there is a complete translation here in chapter VIII.

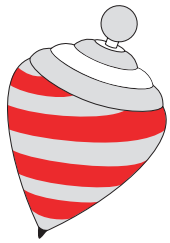
Finally, I thank Juliette Sabbah for her photo of the horse show jumping competition on page 173, for the photo of the Communards' wall that she took for me one morning in July 2006, and for her musical accompaniment, especially for the beautiful preludes by Scriabin that she played while I wrote this text—it even happened, in total innocence, that she interpreted the *Sonate Pathétique*.

The bust was made by Jan-Erik Björk and can be seen in the mathematical library at Bordeaux university. It was Sebastian Richter, Peter Richter's son, who took the photo that appears on page 222.

Many thanks to Rached Mneimné at Calvage & Mounet, who enthusiastically welcomed this book after I had despaired of finding a publisher, who patiently accepted my frustrations and who provided the counsel

"never lose your temper"

good advice that I have not always been able to follow.



Illustrations. The mathematical figures I drew by myself, with the exceptions of the top, which is due to Raymond Séroull, a top which has accompanied me since Raymond illustrated [Audin 1996], and the beautiful "landscape", in color, of the Weierstraß $\wp$-function that can be found in chapter V and which was realized by Olivier Elchinger. I thank both of them.

The photographs of mathematicians come from the Saint Andrews website http://www-groups.dcs.st-and.ac.uk/~history/.

Regarding LaTeX-nique, I once more thank Claude Sabbah who helped me achieve the rather intricate formatting that I wanted for this book.

IMAGES

Although mathematicians hardly know Sofya Kovalevskaya's work, they have all seen her portrait (generally the one reproduced here on page 168 or in the upper left of the above checkerboard) and they are all able to recognize her. And she is deemed

to be rather pretty. Other mathematicians are considered to be rather ugly. And it is discussed. The fact that one is pretty is a somewhat negative point for a scientific reputation because one cannot be simultaneously a woman, a real woman and a good scientist. The fact that someone else has been called ugly authorizes that person to be a good mathematician, by the same principle. Sofya Kovalevskaya is one of the victims of these prejudices. Emmy Noether is another. Readers who see the latter's portrait for the first time, for example the one placed at the right end of the fourth row (and shown again on page 242) will no doubt be astonished that mathematicians have learned to see an ugly and masculine woman. I have never seen anyone reproach Weierstraß for being ugly (which is disputable) nor that anyone described Mittag-Leffler as rather cute (which is however incontestable).

Here is an opinion of one of the protagonists of this book (Sofya Kovalevskaya) on the physique of another (the English writer George Eliot):

> I am absolutely unable to describe and explain what precisely constituted that peculiar, indisputable charm, to which everyone who came near to her had involuntarily to yield. [...]
>
> Turgenev, who is well known as a great admirer and connoisseur of female beauty, speaking once with me about George Eliot, expressed his opinion of her thus: "I know she is ugly, but when I am with her, I don't see it". He also said that George Eliot was the first woman to make him understand that one can fall madly in love with an unquestionably ugly woman. [Chapman & Gottlieb 1978]

It is for this reason that I have illustrated this book with numerous portraits of diverse and varied men and women, mathematicians, writers and revolutionaries, elderly and beautiful women, a very seductive young misogynist, a beautiful and serious young chemist with glasses, a mustached man whom age does not impede from remaining elegant, scientists, militants, writers, Sofya's friends and colleagues, young and ugly men, smiling and severe, Russians with beards, an Englishman with side whiskers, women of the 18^{th} century, woman in statues, gentrified or framed in postage stamps, the diverse humanity to which we belong, about which we ought to recall that we carry it wholly within ourselves and for which we would do well to feel solidarity.

⋆

The portrait of Sofya Kovalevskaya that appears on the cover of this book was produced by a Swedish photographer (who signed with a monogram inspired by the German artist Albrecht Dürer) in 1883 or 1884. A more precise dating can be found in the book by Reinhard Bölling [1991]—in homage to Sofya Kovalevskaya for the centenary of her death.

The one that begins our checkerboard and which can be found also on page 168 appears at the beginning of the issue of *Acta Mathematica* in which the biographical sketch [Mittag-Leffler 1892–93] is published and where Mittag-Leffler informs us that it is a

> photograph dating from the year 1887, a period in which Sofya Kovalevskaya was at the height of her career as mathematician, professor and scholar.

CHAPTER I

SOFYA'S CHRONOLOGY

In this chapter I say a few words about Sofya Kovalevskaya's origins (in the first section, which deals with her genealogy), then I make a chronological list of some of the highlights of her life.

Genealogy

Her mother is Елизавета Фёдоровна Шуберт (1820–1879), the great granddaughter of Johann Ernst Schubert, whose son Theodor (Фёдор Иванович), thus the grandfather of Elizaveta), emigrated to Russia and became an astronomer, later elected to the Academy of Sciences of Saint Petersburg. She is the daughter of Фёдор Фёдорович Шуберт, geodesist. (1)

Elizaveta Fyodorovna Schubert

Fyodor Ivanovich

Fyodor Fyodorovich Schubert

Her father is the artillery general Василий Васильевич Круковский, a descendant of the Hungarian king Matthias Corvinus. Starting in 1858, the family had rights to the name Корвин-Круковский. (2)

Vassili Vassilievich Krukovski

Korvin-Krukovski

They were married in 1843 and their first daughter Anna (Aniuta) was born in 1844.

1. Mentioned by Weierstraß [1861], to whom I will return.
2. The name Corvinus signifies "crow", so a crow appears in the family crests.

M. Audin, *Remembering Sofya Kovalevskaya*, DOI 10.1007/978-0-85729-929-1_1,

Chronology

In order to place the events of Sofya Kovalevskaya's life in their historical context, I have drawn up a list of contemporary facts. This is a personal and thus very incomplete list. I have included the books that I love or that I find important or that relate to things that are important for Sofya, names of persons or events that seem to me useful for determining the chronology. For example, those that show the world becoming modern during Sofya's short life, the first automobile, the first airplane flight, bridges ... I clearly had to include some mathematical events and some of Sofya's friends (Dostoyevsky, George Eliot ...).

1850. Birth in Moscow on 15 January (3 January by the Julian Calendar) of Софья Васильевна Круковская (Sofya Vasilevna Krukovskaya).

Death of Balzac, of Gay-Lussac. Birth of Maupassant, of Stevenson. Karl Marx's *Class Struggles in France, 1848 to 1850.*

1851

End of the second republic in France. Death of Turner. Verdi's *Rigoletto*, Heine's *Romanzero*, Melville's *Moby Dick*, Bolzano's *Paradoxes of the Infinite.* Riemann's inaugural lecture.

1852

Death of Gogol. Harriet Beacher Stowe's *Uncle Tom's Cabin*, August Comte's *The Catechism of Positive Religion*, Karl Marx's *The Eighteenth Brumaire of Louis Napoleon.* Foucault invents the gyroscope.

1853

Crimean War begins, birth of Van Gogh, Hugo's *Les Châtiments*, Verdi's *Il trovatore* and *La traviata*, Liszt's *Sonata.*

Arthur Rimbaud, is born four years after Sofya, dies in the same year as she

1854

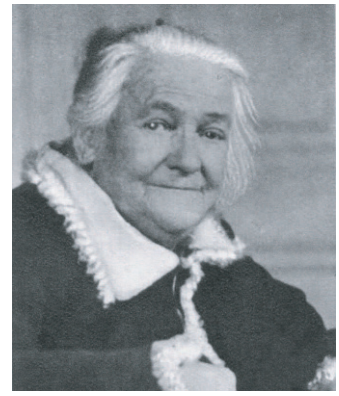
Birth of Arthur Rimbaud. Birth of Henri Poincaré. Work of Cayley on group theory.

1855. Birth of younger brother Фёдор (Fyodor).

Death of Nicolas I and accession of Alexander II. Death of Gauß and Nerval. Courbet's *Artist's Studio* is presented at the Exposition universelle. Менделеев's (Mendeleev's) thesis.

1856

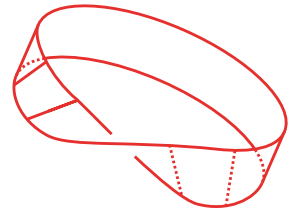
Death of Лобачевский (Lobachevsky), of Schumann and of Heine. Birth of Freud, Pétain and Picard. Hugo's *Contemplations*, Baudelaire's translation of Poe's tales (*Histoires Extraordinaires*). Discovery of Neanderthal Man. Weierstraß is appointed to a professorship at Berlin.



Clara Zetkin (1857–1933)

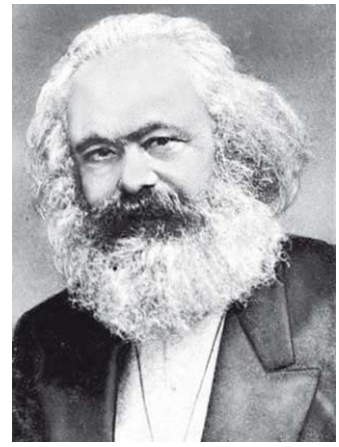
1857

Revolt of the Cipayes in India. Birth of Ляпунов (Lyapunov) and of Clara Zetkin. Death of Arthur Cayley, Cauchy and Auguste Comte. Flaubert's *Madame Bovary*, Baudelaire's *Les Fleurs du mal*. Riemann's *Theory of Abelian Functions*.



1858. Sofya's father enters retirement and realizes the ignorance of his daughters. English governess Margaret Smith and Polish tutor Joseph Malevich. Move to Palibino. Story of the wallpaper. Sofya's paternal uncle tells her about asymptotes and squaring the circle.

Birth of Selma Lagerlöf, of Puccini, of Peano, of Max Planck. Offenbach's *Orphée aux enfers*, Paul Féval's *Le Bossu*. Invention of crinoline and the Möbius band. Nordenskiöld's first polar expedition.



Karl Marx (1818–1883)

1859

Birth of Pierre Curie, of Conan Doyle, of Jaurès, of Alfred Dreyfus. Death of Dirichlet. Battle of Solferino. Goncharov's *Oblomov*, Darwin's *On the Origin of the Species*, Marx's *Contribution to the Critique of Political Economy*, Gounod's *Faust*, Liszt's *Years of Pilgrimage*. First oil wells.

	1860	Birth of Mahler, of Herzl, of Чехов (Chekhov), of Volterra, of Hugo Wolf. Death of Bolyai. George Eliot's *Mill on the Floss*, Тургенев's (Turgenev's) *Fathers and Sons*. Beginning of the American Civil War. First internal combustion engine.
	1861	Enfranchisement of the Russian serfs. Birth of Méliès. Dickens' *Great Expectations*, Dostoyevsky's *The Insulted and Humiliated*.
	1862	Birth of Debussy, of Hilbert. Hugo's *Les Misérables*, Dostoyevsky's *The House of the Dead*, Michelet's *Sorceress*.
	1863. Sofya is passionate about Poland and learns Polish with Malevich. The journal *Epoch* of Достоевский (Dostoyevsky) publishes two novellas by Aniuta.	Uprising in Poland, founding of the Red Cross. Birth of Edward Munch, of Painlevé. Gautier's *Captain Fracasse*, Renan's *The Life of Jesus*, Jules Verne's *Five Weeks in a Balloon*, Manet's *Olympia*.
	1864. The family passes the winter in Saint Petersburg. Sofya is in love with Dostoyevsky. Story of the *Pathetique sonata*.	Birth of Louis Lumière, Richard Strauß, Toulouse-Lautrec, Hermann Minkowski, of the First International. The right to strike in France. Offenbach's *Belle Hélène*, Jules Verne's *Voyage to the Center of the Earth*.
Here I ponder that Hadamard, who like Sofya was born in the days of stagecoaches, should live to learn of Yuri Gagarin's flight around our blue planet.	**1865.** A physicist neighbor, Н. Н. Тыртов (N. N. Tyrtov), is astonished that she has read a book on optics given her by her father and that she has invented a definition of the sine function.	Birth of Hadamard. Death of Hamilton, Lincoln. End of the American Civil War. Lewis Carroll's *Alice in Wonderland*, first performance of Wagner's *Tristan and Isolde*. Mendel's discovery of the laws of heredity.
	1866. Sofya and Aniuta travel with their mother to Germany and Switzerland.	Battle of Sadowa. Birth of Kandinsky. Death of Riemann. Dostoyevsky's *Crime and Punishment*, Verlaine's *Poèmes saturniens*.

1867. Sofya studies mathematics systematically with a new teacher, А. Н. Страннолюбский (A. N. Strannoliubski).

Death of Baudelaire, Ingres, Poncelet. Birth of Toscanini, Maria Skłodowska (Marie Curie). Marx's *Das Kapital*, Ibsen's *Peer Gynt*, Verdi's *Don Carlos*.

1868. "White" marriage on 27 September with Владимир Онуфриевич Ковалевский (Vladimir Onufrievich Kowalevski), born in 1842, a political radical interested in biology. Sofya meets Чебышёв (Chebyshev) in Saint Petersburg.

Death of Rossini. Birth of Gorki. Dostoyevsky's *Idiot*. Discovery of the first Cro-Magnon specimen.

1869. April. Departure with Aniuta and Vladimir for Vienna, then for Heidelberg. Study with Du Bois-Reymond, Königsberger. Bunsen story.
October. Visit to London, where Sofya and Vladimir meet Darwin, George Eliot, Huxley. Aniuta leaves Heidelberg for Paris.

Death of Lamartine. Birth of Gandhi, Élie Cartan, Gide, Matisse. Brahms' *German Requiem*, Tolstoy's *War and Peace*, Lautréamont *Maldoror*, Flaubert's *Sentimental Education*, Jules Verne's *Twenty Thousand Leagues under the Sea*. Mendeleev's periodic table. Suez Canal opens.

Oh severe mathematics, I have not forgotten you, ever since your living lessons, sweeter than honey, filtered into my heart, like a refreshing wave.

Lautréamont [1869].

1870. End of the summer. Berlin. Sofya begins study with Weierstraß. Hat story.

Franco-Prussian War, fall of the Second Empire. Death of Dumas, Dickens. Birth of Rosa Luxembourg, of Lenin. First performance of Wagner's *Die Walküre*, Hugo's *Les Châtiments*, Jordan's *Treatise on Substitutions and Algebraic Equations*.

Rosa Luxemburg (1870–1919)

1871. Sofya and Vladimir rejoin Aniuta during Paris Commune, leaving Paris a few days before the end of the massacres, returning there in June with Sofya's parents.

Paris Commune. Proclamation of IInd Reich and the IIIrd Republic. Death of Delescluze (and of many others). Zola's *The Fortune of the Rougons*, Rimbaud's *The Drunken Boat*.