CHAPTER VII

STOCKHOLM

Back before I had read the article on the solid in detail, I mentioned to a colleague that it must be an exceptional piece of work, since the Academy of sciences had increased the amount of the Bordin prize. "Oh, not at all, it was to help her out, because she did not have a position", was the reply he gave me. A bit of condescension once again and a subtle way of putting down work whose exceptional quality was, in fact, recognized by the Academy. And anyway, it was not quite true that Sofya did not have a position. At the time when the Bordin prize was declared in 1886, as well as at the time when it was awarded in 1888, Sofya had a professorial position in Stockholm and was receiving a salary, even if her position was not yet permanent.

Sofya's position in Stockholm

What we are calling "the" position of Sofya in Stockholm is in reality three positions. For which there is a story in three acts.

First act. Privatdozent. This is how Mittag-Leffler tells, in his obituary [1892–93], the history of Sofya's hiring in Stockholm.

> Some years before the death of her husband, Sophie Kovalevsky had expressed the wish to devote herself to teaching as a university professor. Knowing her wishes and having long shared M. Weierstraß' high opinion of his student's exceptional talent, in the autumn of 1880 I began a plan to have Sophie Kovalevsky appointed my *docent* (adjunct professor) at Helsingfors (Helsinki) University, where I held the mathematics chair. My plan failed;

I have used the German spelling *Privatdozent* (but Gösta writes *docent*, which is the Swedish word), mostly because it is said [Leffler 1898] that during her Russian years, Sofya had published a novel entitled *The Privatdozent*, in which she described life in a small German university town (I have never seen a precise reference to the text, which might be described as mythical).

M. Audin, *Remembering Sofia Kovalevskaya*, DOI 10.1007/978-0-85729-929-1_7,

> but when in the spring of 1881 I was called to the newly founded university in Stockholm, (1) I immediately began negotiations with the university authorities to the end of having M^me^ Kovalevsky named my assistant, if she consented.

I interrupt our Gösta's narrative to remind readers who may have forgotten that Russia still administered and controlled Finland at the time when Mittag-Leffler taught at Helsingfors (the tsar of Russia was Grand Duke of Finland) which means that Sofya's sex was not solely responsible for the failure of this first attempt—her expressed political opinions also contributed, the Finns fearing that her nomination could appear as a provocation. And I will take advantage of this break to point out too that Sofya, like Weierstraß, was completely aware of the historical importance of an appointment in Stockholm and the responsibility she would be assuming. Here in fact is what she wrote Gösta on 21 November 1881 (in fact, in reference to the letter that I have already quoted in part on page 116):

> You undoubtedly know as well as I how much respect and friendship bind me to M. Weierstraß and how much interest he consequently always shows in everything concerning me. You may well believe that in such a serious matter I allow myself to be completely guided by him. His opinion in this matter is the following: he thinks that the appearance of a woman in the role of docent to a chaired professor is a serious step, and could have serious consequences for the question of my eagerness to serve, and that I do not have the right to take a decision before showing my capabilities in purely scientific work. M. Weierstraß consequently thinks that it is absolutely essential that I complete the research that occupies me at the moment and to which I have devoted more than a year, and that before its completion I mustn't allow myself to be distracted by anything else nor accept such serious obligations as those you would propose to me. I must admit that I find M. Weierstraß' reasoning so correct that I cannot do other than conform to it entirely. You consequently see, dear Monsieur, that it is unfortunately out of the question that I take a position already this winter. But I repeat

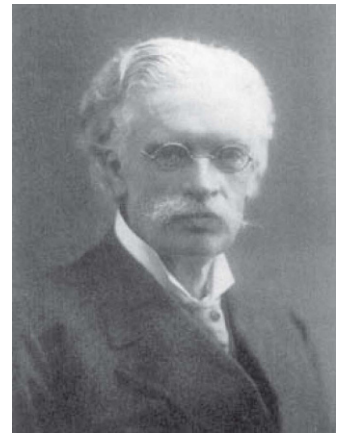
She was working on double refraction, but she was also thinking about the solid, as the portion of her letter already quoted on page 116 shows.

1. I have been calling this institution *Stockholm University* although it did not officially assume this name until 1960. Founded in 1878, this innovative semi-private institution was called *Stockholms Högskola* (Stockholm high school). See [Domar 1978]. A European high school is a post-secondary educational institution.

> that I would be very happy, once my research is complete, if you would once again take this affair in Your hands.

There is also—which she does not say, perhaps because she is not yet aware of it—the delicate status of a woman separated from her husband. Again, it is in 1883 that the situation has changed. We give Gösta the word again, still from [Mittag-Leffler 1892–93]:

> [...] the principal difficulties, which were until then opposing realization of her desires, were to disappear completely upon the death of her husband. In a letter dated 5 August 1883, M. Weierstraß informed me that she was prepared to offer a mathematics course in Stockholm, but at the outset she wanted nothing in the way of publicity given this course.



Gösta Mittag-Leffler

Sofya was thus appointed Privatdozent at Stockholm university in 1883. When today we say that she obtained a position in 1883, we may not know what that means exactly. Well, here it is: this position gave her the right to enter the university (recall that in Berlin she did not have this right and moreover still would not have in 1883) and even to teach a course. These rights were not obtained without some difficulty, and not because the Swedes were not more advanced than the Russians or the Germans, but because this university in Stockholm was new. Gösta Mittag-Leffler, the first professor to be appointed there, explains [1923, p. 191]:

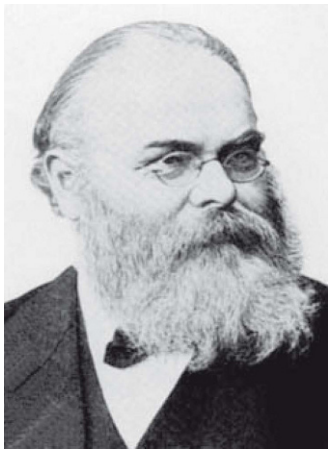
> This will always be an honor for Sweden, the young Stockholm University and the enlightened men and women who were a part of it having a hand in adding such a force as that of Sophie Kowalewsky. Would such a thing have been possible in any other European university? But on the other hand this would be an ill-placed boast to claim that Sonya's engagement was proof of a more advanced social culture from the feminist point of view in Sweden than in other countries. Her appointment above all succeeded by a sort of surprise that did not give the opposition time to organize sufficiently.

The weight of Weierstraß's support was certainly essential. Mittag-Leffler does not say it explicitly, but it is likely mostly due to his own political prowess that the operation succeeded.

Mittag-Leffler. It is more than time for a digression to include a few words on the political skills of Mittag-Leffler. He is without any doubt the first and perhaps to this day the greatest

strategist and tactician for scientific politics that the mathematical community has ever seen. His influence was increased by his marriage; his spouse Signe Lindfors was heiress to a great fortune—it was thanks to this fortune that he was able to get *Acta Mathematica* started—a fortune he used too for establishing his enormous library and for building their Djursholm villa which today houses the Mittag-Leffler institute.

This was an enthusiast for international contact: he knew everyone. He is responsible for the development of mathematics in Sweden, he created and ran the excellent international journal *Acta Mathematica*, to which I will return in more detail later in this chapter, he persuaded the king of Sweden, Oscar II, to establish prizes honoring European mathematicians, he found funds for some of these to come to Stockholm to give prestigious courses, as Painlevé did in 1895 (the *Leçons de Stockholm* [Painlevé 1897] to which allusion was made on page 106 constitute an edited version of his course) and Volterra in 1896, he instituted (that is the right word) the institute that bears his name and he was one of the instigators of the first International Congresses of Mathematicians which take place every four years. Recall (see note 1 on page 46) that the very first version of his article [1923] was the substance of a communication to the 1900 *Congrès* de Paris, the second of these International congresses, the one for which Hilbert drew up his famous list of problems for the 20th century. In homage to Mittag-Leffler, the 1916 Congress would have taken place in Stockholm ... if indeed it had taken place at all.



Hermann Schwarz (1843–1921)

He was not appreciated by everyone. It is known that he was at loggerheads with Schwarz—a rivalry between mathematicians—and also with Alfred Nobel—a rivalry between men of power. Those who knew him certainly describe him as a man of power, but also a man of integrity, and loyal. See [Cooke 1984, pp. 89–91].

It is certain the success in the affair of Sofya's position contributed to his fame, but this was far from being assured in advance and carried risk. Sofya understood this well and feared that his efforts would undermine his position. Gösta was Sofya's special admirer and very sincere friend. We will see, in his letters or in his diary, that he could get irritated with her—without the causes of his irritation ever diminishing the deep affection he found for this colleague and friend (and of which she is very aware, already in 1882, as the letter which is the object of chapter VIII will show).

End of digression. Thus Sofya obtained a position, but one which was not accompanied by a salary, as she ironically remarked:

> Just look at that! They have made me into a princess! I would have preferred that they give me a salary!

while commenting, in a letter she wrote her brother-in-law Alexander Onufrievich, on the following newspaper article (she mentions the same article [2] to Weierstraß in the "burned letter", see [Bölling 1993, p. 427]):

> Today we have to inform you *not* about the arrival of some prince or other equally highly placed but totally ignorant personage. No, it is instead a princess of science, Mme Kovalevskaia, who honors our city with a visit and who will become the first female privat docent in all of Sweden.

Her remuneration would come from her auditors and was thus dependent on their number and the extent of their satisfaction.

Second act. Associate Professor. We again take up the account of [Mittag-Leffler 1892–93].

> In December 1883 Sophie Kavalevsky arrived in Stockholm, and during the spring semester of 1884, and before a limited but attentive audience she expounded, in German, on the theory of partial differential equations. Thanks to the success of the course and the impression made on intelligent circles in Stockholm by the sympathetic personality and genius of the speaker, it was possible for me to come up with the funds for appointing Sophie Kovalevsky professor of higher analysis at Stockholm university for a period of five years. Despite the short time she had lived in Sweden, she already had a good enough command of our language to allow her to teach in Swedish from her debut as professor at the university.

She is thus rapidly appointed (28 June 1884) associate professor (extraordinary professor), but not quite as easily as Gösta seems to imply. There again the words are deceptive. Extraordinary does not mean exceptional and has nothing to do with what today is called *classe exceptionelle* of French professors, but rather to what has here been called, twenty years ago, an assistantship. Moreover, the position was temporary, with a five-year term.

2. The letter and article are quoted in [Koblitz 1993, p. 179].

I don't know precisely what were the standards of the time. The fact remains that when Sofya was appointed to this position, she had but one published article [Kowalevski 1875], that of the Cauchy–Kovalevskaya theorem. The two other memoirs of her thesis were not yet published and the remainder of her output was yet to come. Her work in progress was certainly taken into account. Here is an extract from the report that Hermite sent in support of her candidacy [Dugac 1985, p. 201]:

> Madame Kowalevski's mathematical talent is brilliantly revealed in her inaugural dissertation and in a work of great importance on the theory of light that I have presented to the Paris Academy of sciences. The exposition of Mr Weierstraß's method for establishing the existence of a function satisfying a partial differential equation which was the subject of the inaugural thesis shows a rare gift for extreme clearness of thought as well as of extensive knowledge of analysis at the highest level.
>
> This beautiful work fills in a gap in the science and takes its place in instruction alongside that of MM. Briot and Bouquet on an analogous topic concerning ordinary differential equations.
>
> The mathematical research of Madame Kowalevski in mathematical physics deals with the propagation of light in a crystalline medium. [...] Such a rare talent, such a superior intelligence cause me to wish that, in the interest of mathematical instruction, Stockholm university will enlist Madame Kowalevski's assistance.

This work was the topic of the note [1884a] that Hermite transmitted to the Academy on 11 February 1884.

Here I skip the compliments on a work that turned out to be wrong.

We add, more anecdotally and even if this has already been pointed out, that she and she alone was given the right to go hear Weierstraß lecture in Berlin and even the exorbitant right to enter all Prussian universities. See page 3 of the letter quoted in chapter VI (page 111).

Third act. Full professor. Continuation of Mittag-Leffler's report.

> Before the five years expired, Sophie had won the Bordin prize from the Institut de France [...] This circumstance eased my efforts to gather the funds necessary for permanently establishing the chair in higher analysis at Stockholm university. It was in the spring of 1889 that our university could be assured of the continued services of Sophie Kovalevsky by giving her tenure for life.

According to Jan-Erik Björk [2002, p. 13], the higher analysis chair was opened to competition (as we say today) in March. The two other mathematicians who were capable of occupying it and thus of competing, Lars Edvard Phragmén and Ivar Bendixson, declared that they considered Sophie superior and did not become candidates themselves.

The Bordin prize (to which I will return in chapter IX) helped her obtain a lifetime appointment (but she only had a short time

to live) on 6 June 1889, and although Sofya, to Gösta's great displeasure, did not return to Stockholm at the beginning of the year to celebrate her success (see [Björk 2002] for the details). The letters of recommendation sent by Beltrami, Bjerknes and Hermite, three independent specialists, an Italian, a Norwegian and a Frenchman, were also useful. Although I have trouble assessing the fame of Bjerknes, a Norwegian specialist in hydrodynamics (who is also the author of a biography of his compatriot Niels Abel), I can affirm that all mathematicians today still know the names of Beltrami and Hermite.

That same year, Sofya would receive a prize from the Swedish academy and would be elected corresponding member of the Russian academy of sciences. In France she was even decorated (on 13 July 1889) with the title of officer of public instruction.

Sofya was not the first woman to be elected member of an Academy of sciences, for it was our "first woman", Maria Agnesi, in Bologna.

Life in Stockholm—professional life

Appointed in this city, Sofya thus arrives in Stockholm on 17 November 1883. A few months later, having briefly left her adopted country for a trip to Russia, she writes ([Leffler 1898]):

> I seem to have found a new country in Sweden, a new family, at the moment of my life when I had the greatest need ...

In Stockholm, Sofya learned Swedish to the extent that, although she gave her first lecture series in German, she was able, beginning in September 1884, to do the following in Swedish, she started skating, riding, dancing, she sent for her daughter, she took up her work again. For the first time since her student years in Berlin she found herself doing the work for which she was competent, which she wanted to do, she could set to work in a narrow, but normal, university environment. It was not just that she had a new life, but her most creative period was now beginning.

She attracted attention wherever she went: in her much-admired lectures at the university, in society, in literary circles. The princess of science was accepted enthusiastically ... but not by everyone: for example, the posters announcing her lectures were torn down by her colleagues at Uppsala University.

She participated in the seminars (that were held at Gösta's house). She gave courses at the university—a dozen during the seven years she spent there—with enthusiasm, at least in the

See [Björk 2002, p. 23] for Gösta's description of her courses that he drafted when he wrote the University council nominating her to a full professorship.

According to Jan-Erik Björk [2002, p. 14], Sofya held her first class on 11 February, but Weierstraß writes 1 February in one of his letters (see [Bölling 1993, letter 128]).

beginning. Her first course focuses on the Dirichlet problem, an active subject where she could report on her own research (Cauchy–Kovalevskaya theorem). After her very first lecture on 30 January 1884, she writes in her diary [Kochina 1985, p. 131]:

> Gave the first lecture today. Don't know whether it was good or bad, but I know that it was very sad to go home and feel so lonely in this world. I feel especially lonely at such times. *Encore une étape de la vie derrière moi.* (3)

It is not surprising that Sofya felt alone. Recall that when she arrived in Stockholm two months before she knew no one except Gösta ... whom she had seen previously, if I am counting correctly, but three times: in 1876 and 1880 in Saint Petersburg and then, in Spring 1882, in Paris. In his diary Gösta notes, regarding that same lecture (quoted in [Björk 2002, p. 22]):

> At the outset, Sofya was nervous and had difficulty speaking—but she quickly improved. When the lecture ended, she received applause from her listeners. It was clear from the beginning that she would be an excellent lecturer.

If at the time of the first lecture she looked only at the blackboard and left the hall as soon as she had put down the chalk, she quickly came to feel more at ease. One of her female students relates [Kochina 1985, p. 132]:

> I always felt that Mrs Kovalevskiaya saw through me as if I was made of glass, but at the same time I felt at rest under her tender and sure gaze.

This is what Sophie writes to Gustav Hansemann in 1885. She excuses herself for not writing sooner because of everything she has to do and of which she makes him a list, beginning with [Leffler 1898, p. 223]:

> First I have of course to think about my three lectures on the algebraic introduction to Abel's theory and everywhere in Germany these lectures are considered most difficult. I have many auditors and have kept almost all of them, except for two or three.

Among the auditors of these classes, besides Mittag-Leffler, Bendixso and Phragmén (it was Phragmén who took Sofya's position after her death), we might also note the presence of Ivar Fredholm, whose name is well known to mathematicians today and who completed his thesis only in 1898. Sofya's first

3. Yet another stage of life is behind me.

students presented her, at the end of the course, with a framed photograph of herself [Cooke 1984, p. 103].

The salary issue

We go back several years, to 1881, when she leaves her husband and departs for Berlin and Paris. Weierstraß and Mittag-Leffler began to busy themselves with finding her a position. In June 1881 she writes to Mittag-Leffler from Berlin (quoted in [Leffler 1898, p. 204]): (4)

> I can assure you that if [the position as Privatdozent] were offered to me, I should gratefully accept. [...] Without being rich, I still have the means for living independently. The question of salary is, therefore, of no importance to me in coming to a decision. What I wish, above all, is to serve the cause in which I take so great an interest; and, at the same time, to be able to live for my work, surrounded by those who are occupied with the same questions—a piece of good fortune I have never enjoyed in Russia, but only in Berlin.

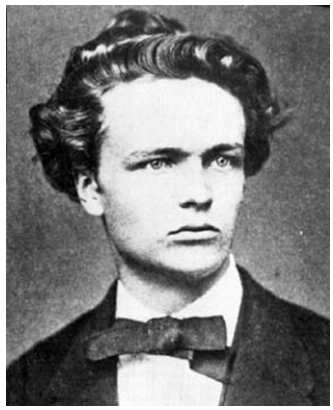
Two years later, as I have said, her husband's suicide finally eased her employment in Stockholm. But remember that the reasons for Vladimir's suicide, which made him bequeath debts to Sofya. In addition, Sofya had to help his younger brother (see [Koblitz 1993, p. 191]). We have seen (page 129) that she sees the question of salary a little differently but is happy to accept the position. In August 1883 she writes, still to Mittag-Leffler, this time from Odessa where she is passing the summer with her daughter at the home of Alexander Onufriévitch, Vladimir's brother ([Leffler 1898]):

Sofya's brother-in-law, Alexander Onufriévitch Kowalevski, was a prominent zoologist.

> I am truly grateful to Stockholm, which is the only European university that will open its doors to me, and I am already prepared to be in love with that city, and to attach myself to Sweden as though it were my native home. I hope that, if I do come there, it will be to find a new fatherland.

After she was appointed to the post for five years, the author August Strindberg wrote (in 1886) to a mathematician (quoted in [Domar 1978, p. 10]):

4. The original was written in French; I assume that Anne Charlotte translated it into Swedish, before it was translated in English.



August Strindberg (1849–1912)

Apparently Strindberg, who perhaps knew the writer Anne Charlotte Leffler better than her mathematician brother, did not know that the latter had attached his mother's name to his birth name.

> Since I have been given the task of writing for a French journal regarding Mrs. Kovalevski but have not the ability to judge her mathematical work, I am taking the liberty of requesting your statement as regards her ability. It would be especially useful for me to know in what relationship her dissertation stands to Professor Weierstrass, and if her mathematical merit is in any proportion to her great scientific reputation.
>
> Further, I would like to learn more about the appointment. Was Leffler's salary divided? And were two professors needed?
>
> With the hope that you will honor me with a frank answer, and with a promise of discretion,
>
> August Strindberg

After having read so many (recent) assertions devoid of the least rigor (some of which I have already cited, but there are more to come) and which have not made me proud of some of my colleagues, I am happy to be able to write here that according to my colleague Yngve Domar [1978], the mathematician in question, Gustav Eneström, who was also secretary of *Acta Mathematica*, did not respond to this letter.

Regarding the question of salary, let us say that the answer is "no", as we would suspect: "Leffler"'s salary was not affected by Sofya's appointment. And, for those who naively ask themselves whether Sofya earned as much as Gösta, why then the answer is, as should be expected: "no". Throughout the excepts from Gösta's diary quoted in [Hörmander 1991] we find the details: at the outset she earned 4,000 Kronor (according to [Björk 2002, p. 22], professors at Uppsala earned 6,000 Kronor per year) and in 1888 she earned 6,000 Kronor (of which 1,000 Kronor came directly from Mittag-Leffler—recall that the financing of the institution was predominantly private; recall too that Gösta was very wealthy (thanks especially to his marriage), independent of the fact that he drew a salary of 7,000 Kronor).

Requests by Sofya for increases eventually irritated her "big brother" Gösta, who comprehended no better (as we shall see) than his sister Anne Charlotte the difficulties faced by Sofya in her daily life. Sofya also experienced the (not yet classic) conflict between career and family life when she requested, in autumn of 1886, leave, which was refused her, in order to go care for her sister Aniuta. That same year her daughter was with her in Stockholm and Sofya experienced the life of a single mother and university professor who was, let us recall, completing an important research project.

Until this time, no professor ever had the idea of making such a request, undoubtedly for the simple reason that none of these great men would ever have gone to care for a sick sister, this is something women are good for.

When Gösta reproached her for complaining too much, she responded [Leffler 1898, p. 225]:

> When a Swedish woman is tired or in a bad mood, she pouts and does not talk. That is why her bad mood enters her organism and becomes a chronic disease. On the contrary, a Russian women moans and wails so intensely that it produces the same mental effect as a limeleaf tea produces physically on influenza. On top of that, I have to tell you that I only moan and start wailing when I am slightly pained. When I am in great distress, I too am silent and no one can detect my anguish.

Life in Stockholm—public opinion

In her sketchy autobiography which can be found in English translation in [Kovalevskaya 1978], Sofya writes:

> As I have said, I have been living in Sweden since 1883 and have adapted so completely to the lifestyle that I feel really at home. Stockholm is a lovely city and its climate is rather good—except for spring, which is unpleasant. I have a large circle of friends and an active social life. I am even received at court.

The Russian ambassador had Sofya received officially by King Oscar II on 28 October 1884, at the request of Sofya herself—she recounts in a letter to Mittag-Leffler that she even gave the King a lesson [Cooke 1984, p. 108].

But Stockholm is a small city, a quite small city in the depths of Europe, at best a provincial capital. And then Sofya, with her bohemian style, her freedom, her political opinions accords poorly with the conventional coldness and reserve of polite Swedish society, always ready to consider and comment upon what she did. She sensed this when she wrote Vollmar from Paris in 1882 the letter which is the object of chapter VIII. And her fears were justified. In the "burned letter", a few days after she arrived in Stockholm, she already wrote, as an accompaniment to the newspaper article where she was appointed princess [Bölling 1993, p. 427]:

> You must know that Stockholm is the funniest little town in the world, where everything is known about everyone and where the smallest incident takes on the proportions of a world event.

It is not clear that she found the situation amusing for long. Here is how she talks about it, *a posteriori*, but as soon as June 1884, in a letter to Mittag-Leffler (or to Anne Charlotte?) [Leffler 1898, p. 214]:

> I am quite willing to submit to the judgment of the Stockholm ladies in all that has to do with the minor details of life, but in serious questions, especially when I do not act in my own interests, but in those of my child, I think that it would be an unpardonable weakness on my part, were I to let myself be influenced by the shadow of a wish to play the part of a good mother in the eyes of Stockholm petticoats.

So there it is her life with her daughter that is in question. She likewise refused to hide her friendship with the socialist leader Karl Hjalmar Branting, which would still be used against her in the debate preceding her appointment as professor in 1889 (see the excerpt from Gösta's diary quoted in [Björk 2002]).

It should be noted that thirty years later Branting, a leader of the social democratic party, became prime minister. He even received the Nobel Peace Prize in 1921 (see again [Björk 2002]).

Life in Stockholm—Anne Charlotte Leffler

To imagine how the right-thinking bourgeoisie of Stockholm might look at Sofya's lifestyle, it suffices to read what her friend Anne Charlotte Leffler says about her interior decoration [Leffler 1898, p. 237]:

> The furniture sent from Russia was very characteristic. It came from her parents' home, and had the old aristocratic look about it. It had occupied a large drawing-room, and consisted in a long sofa, which took up a whole wall; a corner sofa of the old pattern, with floral decorations; and a deep armchair. It was all of rich carved mahogany, upholstered in a bright-red silk damask, now old and tattered. The stuffing was also spoiled, and many of the springs broken. It was always Sonya's intention to have this furniture repaired, newly polished, and newly upholstered; but this was never done, partly because, with Sonya's bringing up, tattered furniture in a drawing-room was nothing astonishing, and partly because she never felt sufficient interest in Stockholm to have things put to rights, feeling sure that her home there was but a half-way house, and she need not therefore trouble to spend money on it.

And we are told that Anne Charlotte was considered a revolutionary in Sweden. What a bourgeoise! And Sofya, who had her furniture sent from Russia, who never had enough money, and her best friend who does not in the least understand and whose respectability is perhaps shocked. In her recollections, Sofya's daughter expresses a similar opinion and comments on the above description thus (from [Kochina 1985, p. 319]):

> Possibly, it seemed so to her for she was accustomed to the respectable Swedish apartments of the well-to-do Swedish families ... However, our apartment seemed gorgeous to me. Our living room with its redwood furniture upholstered in red satin, furniture mother had brought from Russia, seemed magnificent to me, and I hardly noticed the defects that were striking for Anne Charlotte.

Such a small city. Nothing escapes anyone's eye in this hen house. In Heidelberg, in Berlin, in Paris she had her friends, Julia, Maria, Aniuta. In Stockholm she had Anne Charlotte. And it was not the same. From young revolutionaries and scientists—what Anne Charlotte called conspirators—to the stiff bourgeoisie the transition is rather harsh. Sofya certainly found herself isolated, spiritually isolated. It is also the place where she felt the most guilty for not being more militant. What political collusion could there be with Anne Charlotte?

A guilt that she often felt and expressed, as witnessed especially by her correspondence with Georg von Vollmar around 1882 (see e.g. the books [Koblitz 1993, pp. 167–168] and [Tollmien 1995, pp. 109–113]).

And furthermore, what collusion plain and simple? To Anne Charlotte, as she did habitually (see page 209 for what Maria Jankowska said about Sofya's facets), Sofya perhaps showed but one facet of her personality. In any case, Anne Charlotte's biography maintains but one. The brilliant scientist inspired by the beautiful mathematics she has achieved appears only inadvertently in Anne Charlotte's biography [Leffler 1898, pp. 232–233]:

> It now seemed to her [this concerns the meeting with Poincaré and others to whom Sofya spoke about her work on the solid] that nothing was worth living for but science. Everything else—personal happiness, love, and love of nature, day-dreaming—all was vain. The search after scientific truth was now to her the highest and most desirable of things. Interchange of ideas with her intellectual peers, apart from any personal tie, was the loftiest of all intercourse. The joy of creation was upon her [...]

Anne Charlotte, who passed for a champion of women's rights, seems to be persuaded that the quest for love was the ideal of a woman's life. We even see it in the passage where she cannot keep from putting "personal happiness" in opposition to the joy of scientific creation. She tends rather to present Sofya as an unhappy woman (especially in doing mathematics) when she does not wish to love and most of all to be loved. Anne Charlotte's book in fact fulminates with passages such as this [Leffler 1898, p. 231]:

> Sonya could not work, but she maintained with more and more eagerness that work—especially scientific work—was

> not good; it could neither afford pleasure nor cause humanity to progress. It was folly to waste one's youth on work, and especially was it unfortunate for a woman to be scientifically gifted, for she was thus drawn into a sphere which could never afford her happiness.

In the course of the narrations, we nonetheless discover that besides the skating and riding practiced by Sofya with pleasure and good humor, she had enthusiasm for activities such as an excursion into the mountains, for instance [Leffler 1898, p. 233]. It seems to me that if the psychologizing commentaries it contains were removed from the book, it would show a quite different image of Sofya. The book also presents Sofya as a dependent woman, which has certainly not been without influence on her scientific image itself [Leffler 1898, pp. 222-223]:

This supposed absence of practical sense in Sofya—a reputation that is well entreched—seems to me to accord poorly with the jams and embroideries that Sofya made, see page 236.

> She possessed to a high degree that feminine grace so highly appreciated by men. She loved to be protected. To a quite masculine energy and genius, and, in some ways, an inflexible character, she united a very feminine helplessness. [She needed some support—a friend to help her with small problems, and she would almost always find one. Otherwise, she felt miserable and forsaken as a child. She could neither buy a dress by herself nor put her things away.] She never learned her way about Stockholm. She only knew perfectly a few streets—those which led to the University or to the houses of her intimate friends. She could look neither after her money matters, her house, nor her child. The latter she was obliged to leave in the care of others. In fact, she was so impractical that all the minor details of life were a burden to her. When she was obliged to seek work that paid, to apply to an editor or get introductions, she was incapable of looking after her own interests. But she never failed to find some devoted friend who made her interest his own, and on whom she could throw all the burden of her affairs.
>
> At every railway station where she stopped on her many journeys, someone was always waiting to receive her, to procure rooms for her, to show her the way, or to place his services at her disposal. It was such a delight to her to be thus assisted and cared for in trifles that, as I said before, she rather liked to exaggerate her fears and helplessness.

She herself, in a letter to Weierstraß in August 1883, ridicules a young mathematician from Berlin because he had lavished her with advice for her trip to Odessa, "advice that was not the most practical" [Mittag-Leffler 1923, p. 190].

The account of Sofya's last trip and her difficult return across the Danish isles (see here page 61) brings out the same prejudice: because she had no practical sense, she didn't have any Danish money and couldn't pay for a porter, so that she, weak woman, had to carry her bags herself, fell ill and ended up dying.

Note too that Anne Charlotte implies that Sofya left Genova more or less consequent to a dispute with Maxim Kowalevski and that, no doubt desperate, she flung herself into this trip that becomes almost suicidal. This legend is resumed in a condensed, yet more spectacular manner by Marie-Louise Dubreil-Jacotin [1948, p. 265]:

> Not being able to do without him nor to live with him, exhausted, torn by the incessant fights, she waned and died in 1891 at age 41 from a brief attack of influenza.

In reality, as we have seen, Sofya travelled from Genova to Paris, then on to Berlin where she spent several days at the Vollmars in January 1891, and it is from there that she returned to Stockholm. Vollmar describes her as joyous and seemingly happy (see here page 218). The witnesses to her death even relate that her last words were: "too much happiness".

The ravages of this presentation remain amply obvious. The conclusions of Loria [1903, p. 391] concerning Sofya's scientific independence (see also here page 232) are deduced, explicitly, from quotations from Anne Charlotte. The long "psychological" paragraphs that conclude the recent [Kozlov 2000] (including the passage quoted here on page 241) themselves also doubtless come, via various intermediaries, from [Leffler 1898, pp. 222–223].

Another Swedish writer friend of Sofya, Ellen Key, criticized Anne Charlotte Leffler's book by saying that she limited her description to "the woman in the mathematican" while neglecting the "mathematician in the woman" and she did not understand the variable personality of the truly complex woman that was Sofya (see [Björk 2002, p. 41] and our page 226). Let us not be injust. Anne Charlotte's book is one-sided and its effects are pernicious, but it contains some nice things, such as the phrase attributed to Sofya by Anne Charlotte [Leffler 1898, pp. 160–161] and which prefaces our book.

Life in Stockholm—friends

Sofya has friends in Stockholm besides Gösta and Anne Charlotte. There is the writer Ellen Key whom we just mentioned. There is her colleague the explorer Nordenskiöld. There is the astronomer Hugo Gyldén and his family (it is Hugo and Thérèse Gyldén, by the way, that take care of Fufa upon Sofya's death, before she is sent to Russia and adopted by Julia Lermontova).

On 2 December 1889, the centenary of General Schubert's birth, Hugo Gyldén would receive a prize of 1,000 rubles—the biannual prize established in honor of our old friend General Schubert by one of Sofya's aunts, Sofia Schubert.

Hugo Gyldén is an astronomer and mathematician whose fields of interest are not so far removed from those of Sofya—he is moreover mentioned in the very first pages of Poincaré's *Méthodes nouvelles* [1987, p. 3]:

> But the scholar who has rendered the most outstanding service to this branch of astronomy [dealing with the Moon as a three-body interaction with Sun and Earth] is undoubtedly M. Gyldén. His work touches all aspects of celestial mechanics, and he skillfully employs all the resources of modern analysis. M. Gyldén has succeeded in removing entirely from his developments all the secular terms that so plagued his predecessors.

Poincaré was not always so enthusiastic about Gyldén's work; see his letters from 1889 to Mittag-Leffler [Nabonnand 1999].

Here is how Sofya's daughter recalls her mother's entourage in Stockholm [Kochina 1985, p. 320]:

> An old gentleman named Nordenskiöld would sit in this living-room [the living-room that Anne Charlotte and Fufa described to us on page 137] and tell us such interesting stories about his journeys around the shores of Siberia on the ship *Vega*, and we met here the young Nansen, who was just embarking on his career as an Arctic explorer. We were visited here by University Professors, such as Gyldén (an astronomer), Brögger (a geologist [a Norwegian professor in Stockholm]), Leche (a zoologist), Doctor of Medicine Medin (the Heine–Medin illness [polio] was named after him) and Mittag-Leffler, together with his sister, Ellen Key (a writer) and the editor of a newspaper (*Free-Thinker*) Branting, who became very famous later as a representative of the social democratic party in the Rigsdag, but then he was often in prison for his insulting remarks about the King.
>
> From 1888 onwards, Professor Maksim Maximovich Kovalevsky often visited us here; he came to give lectures on sociology. We would entertain Swedish and Norwegian artists, writers, and critics such as Brandes [a Danish critic to whom we will return] and Ibsen and there were many others whose names I've already forgotten.

In 1884 the old gentleman, Adolf Nordenskiöld (1832–1901), was fifty-two years old and he was extremely famous for having opened the *northeast passage* in 1878–79: he made the complete tour of the Eurasian continent: Norway – north of Siberia – Bering Strait – Yokohama – Suez ...

Friends, colleagues, colleagues and friends, but an ambiguous situation. All women mathematicians have, still today, experienced those dinner parties where the men talk about the particular subjects that interest them (mathematics) and the women (their spouses) about pottery, cooking or the garden—and where they have difficulty placing themselves. Alright, suppose you are the first person to whom this has happened. This is Sofya's case.

A remark on Ibsen. Pelageya Kochina begins her book by explaining that Sofya's personality was so very remarkable "that the great writer Henrik Ibsen said that to write her biography required writing a poem". This phrase has been reproduced here and there, but I haven't been able to find an exact reference in Ibsen's works.

There is also the *Nya Idun* society, a social club for women that imitates the masculine *Idun club* (parenthetically, Idun is a goddess, a woman, the one who dispenses the apples of eternal youth, astonishing that a masculine club would take her name). But at *Nya Idun* you get together, give or listen to talks on cultural subjects of general interest, you sing or play the piano. Sofya takes part, likewise Anne Charlotte and Ellen Key, who is the president. Likewise *Heimdall* (from a man's name this time, still a mythological hero but the son of nine women), a mixed club, in which she also participates, and the club of thirteen [Kochina 1985, p. 164] with ... always the same people.

As for love ... Pelageya Kochina mentions [1985, p. 247] the answer that Sophie gave to Maria Jankowska who asked her about her love life:

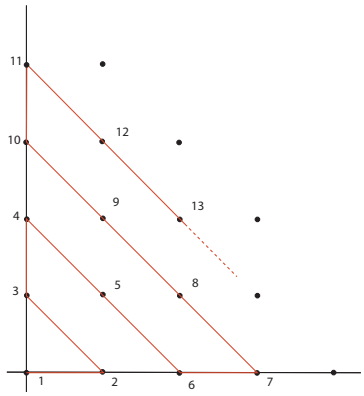
> In Sweden, all young men are born married—my admirers are all venerably old, the three of them totaling more than 200 years in age.

Friends and colleagues, but nonetheless quite a narrow circle. Sofya travels a lot, sees her mathematical friends in Germany, tries to get them to come to Stockholm (see the story of Runge on page 54), meets the French mathematicians, but Stockholm is so small. She begins to feel confined. Especially since her financial means are rather limited. She complains to her friend Gösta that she needs more money and he recounts these demands in his diary (some excerpts have been translated into English and published in [Hörmander 1991]). She even tries to find a position in France (see Hermite's letters quoted on page 165). Who would believe it, but Gösta is sensitive enough to the public opinion, I went to a lot of trouble to get you accepted here and now you threaten to leave, what would I look like. And it is one of the reasons that prompts Sofya to write two plays with Anne Charlotte while she is busy writing her paper on the solid: she hopes that this will bring in some money!

Acta Mathematica

Acta Mathematica is one of Mittag-Leffler's finest successes. He founds the journal in 1882; it is a Swedish journal, a Scandinavian journal, an international journal. The director is Swedish, the editorial committee is Nordic, comprised notably of Bjerknes, Lindelöf, Lie and Sylow, the authors are international. The articles are written in French or German.

It is no big surprise that the French authors would write in French, but it is also French into which Cantor's seven articles are translated in Volume 2 (see also note 5).



The fractions p/q are not more numerous than the pairs of integers (p, q) ... which are exactly as numerous as the integers, since they can be enumerated as shown in the figure: the set of rational numbers is *denumerable* and it is the same with the algebraic numbers. These are results of Cantor that were published in the first issues of *Acta Mathematica*, as was his first proof of the fact that the real numbers are not denumerable.

The fact that Mittag-Leffler is such a personality and above all has connections with the most powerful mathematical communities, the German and the French, is essential for the grandiose beginnings of the journal. Mittag-Leffler looks for articles, his French and German colleagues write them. Sofya will publish some old ones, write some new ones and, what is perhaps more important for the journal, she will attract several. She joins the editorial committee in 1884 and remains until her death. She adds Russian connections to the French and German. Mittag-Leffler also looks for money and the support of renowned institutions. Sofya succeeds in gaining the agreement in principle of the Grand Duke Constantin, president of the Russian Academy, but this institutional support never materializes—because of the Finnish question. The articles themselves arrive anyway, as we shall see.

The brilliant birth of the journal is rather impressive. We find interesting information in the article [Domar 1982]. The idea is supposed to have been suggested to our Gösta by the Norwegian mathematician Sophus Lie. The support of Weierstraß and Hermite played an important role, especially since the new journal seemed to be in competition with Crelle's journal (see the marginal note on page 80), with which Weierstraß was involved along with Kronecker.

Since we are concerned here with Sofya, we recall that the article [Kowalevski 1875] on Cauchy–Kovalevskaya had indeed appeared in Crelle's journal in 1875 ... but that practically all the rest would be published in *Acta Mathematica* (with the notable exception of the article [Kowalevski 1885b] on the rings of Saturn, which she gave upon his request to her friend Hugo Gyldén for the *Astronomische Nachrichten*, whereas he himself also published in *Acta Mathematica*).

Here are some precise data on the first issues of the journal. Volumes 1 through 16 published, from 1882 to 1892–93, articles by a hundred and three mathematicians. There are some regulars, notably Poincaré, who publishes ten articles or memoirs there, often very voluminous (in particular the one that won the prize of King Oscar II [Poincaré 1890], see the correspondence [Nabonnand 1999]) and Cantor, whose seven articles [5] appear in volume 2 and who will publish two others, in volumes 4 and 7.

5. The articles of Cantor are translations into French of articles that appeared in Borchhardt's (namely Crelle's, namely *Journal für die reine und angewandte Mathematik*).

The first volume is already very balanced; there are of course Scandinavian authors (Gyldén, Malmsten, Zeuthen), but Mittag-Leffler obtained German articles (by Fuchs, Netto, Reye, [6] Schering) and French collaborations (with two articles by Appell, two by Poincaré, two by Bourguet, others by Goursat, Hermite, Picard). With the thirteenth issue, an Italian article (by Beltrami).

Yngve Domar [1982] recounts that it was during Mittag-Leffler's honeymoon in 1882 that he made the rounds of his friends for gathering up all these manuscripts. We have already seen, and we will see again, Gösta in Paris in the spring of 1882. He and his wife pass through Berlin at the end of July, they pay a visit to Weierstraß, who recounts in a letter to Sofya, sent from Innsbruck on 5 August [Bölling 1993, letter 111]:

> Mittag-Leffler and Madame were here [in Berlin] last week, from Wednesday to Sunday evening; I have seen them a lot. The young woman pleased much; we admired her simple but remarkably elegant outfit. ML took a very mathematical trip—Straßburg, Heidelberg, Göttingen, Leipzig, Halle, Berlin—not to mention Paris. Very interesting for him—but whether for the young woman too, I really can't say.

In the same letter he also writes:

> Today I am preparing a short paper that I promised ML for the new Swedish journal,

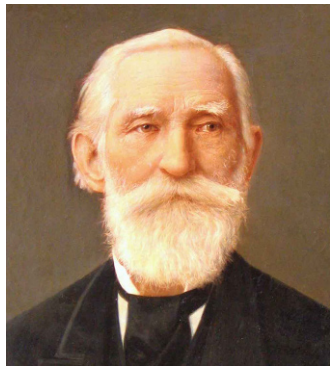
a short paper about which, forty years later, Mittag-Leffler [1923, p. 189] would say:

> This memoir was never written or never left Weierstraß's hands; in any case it must be lost.

Sofya comes onto the editorial committee in 1884 and presents one of the memoirs from her thesis [7] [Kowalevski 1884b] for volume 4; volume 5 witnesses the arrival of two short articles by the Netherlander Stieltjes and three from our old friend Runge, and it also publishes a translation into French of a memoir by Weierstraß on elliptic functions (after articles by Fuchs, Cantor, Du Bois-Reymond, Runge and Sofya,

6. Who writes from *Strassburg i/E* [*in Elsaß*, in Alsace].

7. She will publish a total of five articles in the journal. Besides [Kowalevski 1884b], these will be the article on refraction [Kowalevski 1885a], the two articles [Kowalevski 1889 ; 1890–91] on the solid, finally the short posthumous [Kowalevski 1891].



Chebyshev (1821–1894)

Acta Mathematica has always been one of the best journals that we mathematicians have had at our disposal. As I have already indicated, it is also one of the most beautiful journals in terms of its typography and layout, in particular its large margins.

Mittag-Leffler or Sofya, or both of them, have finally obtained an article by the master himself).

We note in passing the very first article in English, very isolated, due to Hill, arrives from Washington and appears in volume 8 in 1886 (the United States plays a very small role in the mathematical community). Little in English, but especially little by English in these first volumes: after the American Hill, Thomson (being Sir William Thomson, alias Lord Kelvin, who presents an article for volume 11) who is at the time in Glasgow, finally Sylvester, who is at Oxford, publishes an article on Buffon's needle in volume 14.

After the first article in English, the next volume (volume 9) witnesses the arrival in 1886 of the first articles from Russia, with Chebyshev's article already published in Saint Petersburg and translated from Russian into French by Sofya herself together with a letter he sent her, [8] the publication of the translation having renewed Chebyshev's interest in the subject. After Chebyshev, Markov, whom we have already mentioned and to whom we will return. Another Petersburger (but this time a Pole), Ptaszycki, publishes in volume 11. Two more articles by Chebyshev for our period, this time original and translated by I. Lyon, a student of Darboux.

From now on *Acta Mathematica* is one of the most international journals figuring in mathematical publishing.

In addition to the Russian articles, some of those by Poincaré, by Runge (on the Mittag-Leffler theorem, mentioned on page 56), by Minkowski, by Hurwitz (to wit, a function of several complex variables with only poles is rational) and by Beltrami, among others, were solicited and edited by Sofya. See the correspondence [Nabonnand 1999], the article [Koblitz 1984] and the letter to Mittag-Leffler quoted in [Cooke 1984, p. 105]: Sofya's correspondence with Mittag-Leffler displays the enthusiasm with which she dedicated herself to her editorial duties.

The article by Cantor that appears in volume 7, *Über verschiedene Theoreme aus der Theorie der Punctmengen in einem n-fach ausgedehnten stetigen Raume G_n. Zweite Mittheilung*, also passed by her, as evidenced by a letter Cantor wrote her on 7 December 1884 informing her that it would be ready in

8. Many of the short articles published by the journal are letters received by Mittag-Leffler (and, here, by Sofya).

the first months of the coming year "for you to publish in your periodical" (*um Sie in Ihrer Zeitschrift zu publiciren*). (9)

Birefringent media

This concerns a problem that was probably proposed to Sofya by Weierstraß when she was wanting to take up mathematics again following her bad Russian period. It also concerns the propagation of light in a crystalline medium and in particular double refraction. The problem was modeled by Lamé, there is a system of partial differential equations that can be written

$$\frac{\partial^2 u}{\partial t^2} + \operatorname{rot} a \wedge \operatorname{rot} u = 0 \text{ and } \operatorname{div} u = 0,$$

a system not unlike Maxwell's equations. Lamé found solutions for them. Weierstraß, who had an idea for a method for solving partial differential equations of this type, thought that Lamé's solution was not the most general possible and proposed to Sofya that she solve the equations.

The beautiful and precious French word *biréfringeant* comes to us here from the title of the article by Volterra ... and from a time where mathematicians used more than fifty words to write their papers, even if not in their native language.

Which she does. She is being distracted by the problem of the solid, for which she begins to have some ideas, as she writes to Mittag-Leffler on 21 November 1881 and as we saw on page 116. It is in this letter that she explains that she needs to complete the work she has started, that on double refraction, before taking up a *Privatdozent* position (see page 126).

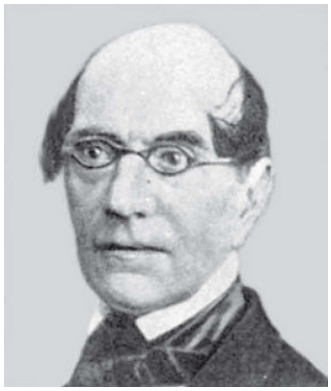
The double refraction problem is Weierstraß's, whereas the solid is truly Sofya's problem.

And then, she writes a note to *Comptes rendus* [1884a], communicated by Hermite, and an article whose first part is dedicated to Weierstraß's method (and is reproduced in the collected works of the master, see below). As I have said, this article was read, revised (see page 54) and then published in 1885. End of the first episode.

The second episode is posthumous. Shortly after Sofya's death, Mittag-Leffler receives a letter from the young Vito Volterra, who remarks that Sofya's formulas do not give, any more than those of Lamé, solutions of the equation in question and also that Sofya's solutions are no more general than Lamé's. He discovered where his two predecessors went wrong, a differentiation under the integral sign, always desired but not always legitimate. Gösta indicates the error in Sofya's obituary [Mittag-Leffler 1892–93]:

Vito Volterra (1860–1940)

9. This letter is reproduced in [Dauben 1990, p.310]. See this book too for the relations between Cantor and *Acta Mathematica*.



Gabriel Lamé (1795–1870)

> Toward the end of June [1883], recovering finally from her illness [following Vladimir's suicide], she went to rejoin her faithful friend and professor, Weierstraß. She ardently resumed her mathematical work and finished the research project that she published under the title: *Über die Brechung des Lichtes in cristallinischen Mitteln*, this Journal, volume 6. In the present volume of this publication, M. Vito Volterra has resumed this same problem: he has shown that the functions given by Sophie Kovalevsky as general integrals of Lamé's differential equations, do not satisfy those equations and he gave reasons for this fact.

And, as we see, he publishes the article by Volterra in his journal.

Returning to the first episode: Hermite transmitted the announcement of the result to the Academy of sciences, Weierstraß did not have the time to read the article in detail, Runge read and revised it, helping Sofya to correct her German, and the journal accepted it, perhaps after the advice of an expert. It seems to me irresponsible to say that this article is wrong because Weierstraß did not have the time to read it carefully, with all this implies regarding Sofya's other articles, as it would be irresponsible to minimize her responsibility by blaming the error on Weierstraß's schedule.

When she wrote this article, Sofya was a mature mathematician, independent and autonomous. She made a mistake, something that happens to the best mathematicians, which happened for example to Cauchy and to Poincaré, in particular in the memoir [Poincaré 1890] which won the prize of King Oscar II, to mention only some of those whose names appear in this book. Let us put the responsibility on those that commit the acts, the errors as well as the triumphs.

And let us leave to the journal the responsibility for the publication of this article, these are things that happen to the best journals and do not hold anything disastrous. In restricting ourselves to articles related to the subject of this book, we mention the article of Roger Liouville [1897], published in volume 20 of *Acta Mathematica* under the title *Sur le movement d'un corps pesant suspend par un de ses points* that comes up here on page 106 and in which a whole collection of integrable cases of the problem are determined, in contradiction to the results explained here in chapter V ... again an incorrect article published in this excellent journal.

The publication of Sofya's article was even a rather good move for the journal. A large part of the article (its pages 254–279) are in fact an edited version of notes of Weierstraß, investigations from the 1860s on partial differential equations with constant coefficients, cited as such (and even in quotation marks) by Sofya. The publication of these notes in *Acta Mathematica* was judged to be so little disastrous that they appear as is in Weierstraß's Complete Works ... some pages after the article [Weierstraß 1861] already mentioned here on page 46, with the indication (p. 296 of the volume) that these notes

> were published, with the permission of the author, by Frau v. Kovalevsky as part of her paper *Über die Brechnung der Lichtes in cristallinischen Mitteln.*

"Do with my notes what you find good", Weierstraß had written to Sofya (letter from 17 October 1884 [Bölling 1993, p. 322]).

It is amusing to see that a recent editor-in-chief of *Acta Mathematica*, Lars Gårding, several years after having expressed his discontent with the publication of this article in this journal—a publication that one of his colleagues, Lars Hörmander, even termed "disastrous" (see our page 238)—wrote a text on Sofya's mathematical work in which he amplified and inflated its role in Sofya's œuvre. This is the chapter dedicated to the papers of Mittag-Leffler and Kovalevskaya in a book on mathematics in Sweden before 1950 [Gårding 1998, Chap. 8], where after eight and a half pages on Gösta, we find two on Sofya. These begin with the text on Cauchy–Kovalevskaya that I have already quoted on page 83 (thirty-two lines) and conclude with a paragraph on the solid (twenty-eight lines). Between the two, forty-two lines are dedicated to "double refraction" (the incorrect article). In defense of the author: it is the part of Sofya's work of which he is incontestably a specialist.

It would not be useful here to reproduce Gårding's text on the solid. I have already dwelled quite long on this problem, and I hope with clarity. But just for fun, because of a delightful typo. The final phrase (which is thus the final phrase dedicated to Sofya in the entire book [Gårding 1998] reads: "In present terminology, this means that most of the motions of a rigid boy [sic] about a fixed point are chaotic". And when will we get a book on typos and their relation to the unconscious?