Le Cas de Sophie K.

written and directed by

Jean-François Peyret

AVIGNON FESTIVAL, VILLENEUVE LEZ AVIGNON,
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REVIEWED BY ALAIN JUHEL

We are all aware of the formidable complexity of the Three-Body Problem in Celestial Mechanics. By splitting Russian mathematician Sofia Kovalevskaya (1850–1891) into three characters, the French playwright and director Jean-Franyois Peyret evokes both the surprising, sometimes even baffling complexity of the uncommon female scholar and one of her masterpieces in the field of dynamical systems. This was the work for which she was rewarded in 1886 with the Prize of the French *Academic des Sciences* and in 1889 with the Prize of the Swedish Academy in Stockholm.

The title of the play sets up these multiple views: *Ihe Case of Sofia K.* refers of course to the mathematical problem, that builds on earlier work of Euler and Lagrange, in which a system of differential equations is solved in closed form by means of elliptic functions. But it may also be understood as a human story, an exploration into the life and mind of a fascinating woman, and this is mostly what Peyret's play is about. Mathematics necessarily brought Sofia face to face with feminism (she had to assert herself in a world of men that was not quite free of preconceptions, despite the early and generous support of Weierstrass, Hermite, and Mittag-Leffler), but there are far more surprising facts for those unfamiliar with her biography. Between the time she attended Weierstrass's private lessons and completed her Ph.D., Sofia traveled to Paris in 1871 with her elder sister Anna and enlisted as a nurse in the ranks of the rebels fighting for the famous *French Commune*. The two sisters looked toward unconsummated marriages, as a means of freeing themselves: Anna set her heart on a paleontologist named Kovalevsky, who happened to prefer Sofia. Marriages of convenience were widespread among the Nihilists, a growing movement among the young Russian *Intelligent-siya*, Kovalevskaya was a sympathizer, albeit a non-violent one. Last but not least, she was a lover of art and literature; she wrote *A Nihilist*, a mostly autobiographical novel, published posthumously. Vera, the heroine, and Sofia's alter-ego, spends a lot of time looking for ways to serve her Great Cause before she finds her own: she will sacrifice herself and marry a rebel sentenced to life imprisonment in Saint-Peter and Saint-Paul's fortress in Saint Petersburg, the most awful jail at that time. Thus she will save him and have his sentence commuted (so to say softened!) to deportation to Siberia. It was the custom for wives to follow their husbands and stay with them until their sentences were served, so Vera's choice had to be considered as a martyr's, and this was precisely the way she looked at it.

There are three Sofias in the story, and three fine actresses on stage: Olga Kokorina, Elina Lowensohn, Nathalie Richard. Do not believe, however, that each is restricted to a single face of Kovalevskaya: this would have been an oversimplification, like limiting the study to steady-state solutions, as seen by a mathematician. The way the three women share the feelings and writings of Sofia could rather be compared with the basins of attraction of a discrete dynamical system with three attractors. (Thinking of a pendulum oscillating over three magnets provides a good picture.) Such dynamics do not show their wonderful and sophisticated *portraits* at once, they are not drawn in a linear way. This play delivers an image of Sofia in a similar manner: we get the pieces of a puzzle mixing childhood recollections, letters, mathematical writings (Kovalevskaya, Poincare). It interlaces the real Sofia and the *Nihilist* Vera she dreams of. This duality was understood by Sofia's friend and biographer, Anne-Charlotte Leffler (Gosta Mittag-Leffler's sister): an internal and restless struggle between two directions of her mind. Should she dedicate herself to Mathematics or . . . to the Revolution? In contrast to a wavering *Hamlet*, Sofia never remains undecided for long: she has energy and resolution, but as she knows that her entire being yearns for an exclusive commitment, the choice she makes at one particular moment never seems to be the right one. . . .

Jean-Franyois Peyret has devised a setting that enhances this feeling of complexity: the three Sofias appear in turn on a large screen in the background. Sometimes these are pictures filmed live by a cameraman (who remains on stage throughout the play), sometimes these fragments of movies were recorded before. Sometimes we see the actress who is actually speaking, sometimes another one who is lis-

tening to her, but always in the foreground. I must confess that I felt the pure-video introduction a bit lengthy (was I so impatient to see the actresses come in? Did Peyret want to whet my appetite?), but then I became comfortable with that mix of on-stage play and movie. I wished the cameraman had not been so close to the three women: he succeeded in being inconspicuous, but I could never put him out of my mind. There is a pianist on stage, too, but his physical presence did not bother me at all: he was a few meters away to the left, and the music, a mix of repertoire and improvisation, was quite in harmony with the acting.

My wife and my daughter went with me to the theater that evening. They have nothing to do with mathematics, they had never heard of Sofia before. As the play began, I felt anxious about their reactions: would they be disconcerted by such a fragmented portrait? One confessed she had mixed feelings; but the play appealed to the second one's fancy. I regard her applause a better proof than mine of Peyret's success! Choosing such a topic—an unexpected encounter, he told a reporter—was obviously not risk-free; it was all the more daring because he refrained from highlighting a romantic vision of the mathematician. On the other hand, he showed great professionalism at work in reading, with all his team, books that try to explain how a mathematician's mind works (Henri Poincaré's *Science et Methode*, jean-Pierre Changeux and Alain Connes's *Matiere à Pensee*). He also managed to meet Kovalevskaya's French biographer Jacqueline Detraz, and invited a well-known specialist of Dynamical Systems, Michele Audin, to a rehearsal so that the actresses could learn Eveiything They Ahvays Wanted to Know About Maths But Were Afraid to Ask. We may consider the result as a success in its display of mathematics to the non-professional, and perhaps also as a victory if it does away with a narrow-minded view of this science. Let us hope that people will walk out of the theater with a recollection of young Sofia wondering at the amazing wallpaper in her bedroom:

*The room remained unfinished for quite a long time, there was just some paper laying on the walls. It hap-*pened to be folios of Ostrogradski's Differential and Integral Calculus Course; it had been bought by my father when he was a young student.* or these words by Poincare (*Science et Methode*), spoken by one of the Sofias:

The scientist does not study Nature because it is useful; he studies it because he gets pleasure from it, and he does because Nature is beautiful. If it was not, it would not be worth studying, and life would not be worth living.

Charles Hermite was known to be a stern-looking person with conservative views. But he could hardly resist Sofia's charm—intellectually speaking. As a testimony, here is an excerpt from a letter he wrote to Mittag-Leffler (June 19, 1882) telling about the very moment when he heard Sofia say that Lindemann had proved that π is a transcendental number: *"I met Mrs de Kowalewsky at her house several tunes: she adds a charming grace to her extraordinary talent as a geometer."*

Jean-Frangois Peyret's play will surely impress every spectator and compel him or her to find out more about Sofia's life (and the political context of those troubled times) and about her works (either *A Nihilist* or Dynamical Systems). Time passed rapidly, and the play lasted only an hour and a half. Many questions remained unsolved, as Peyret must have felt himself . . . He might wrant to carry on with this *work in progress* begun at the celebrated Avignon Theater Festival and complete a larger portrait. But there is a more urgent task to deal with: translating this play into other languages than French.

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Reality Conditions: Short Mathematical Fiction

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Whatever its deficiencies, C. P. Snow's *Two Cultures* [1] concept of mutually incomprehensible dialogue between scientists and others lives on. For as intriguing as the collection of short fiction in *Reality Conditions* might be to mathematicians, it is difficult to believe that many of the stories would appeal to, or indeed be understood by, those on the "other side" of the cultural divide. In one story, the eponymous Topology Man relates what may be music to a mathematician's ears but is unfortunately probably just jargon to the rest of the world:

In a Hausdorff space, like the one we live in, the bad guy . . . can always avoid the superhero . . . because he can get into a disjoint neighborhood out of his reach. But if this was the right sort of non-Hausdorff space, he wouldn't be *able* to avoid me.

But the villain Homotopy responded to this maneuver by growing the basketball at our hero's feet, twisting it around him, and inverting it to imprison the Topology Man. The resourceful topologist reacted:

Endowing the basketball with the topology of a Klein Bottle, I was able to escape. . . . The floor of the basketball court began to deform again. It returned to being flat, but now