Chapter 9
Ada: Poet of Computing

A One Person Opera Libretto

Britta Schinzel

Abstract This text will describe the libretto for a one person opera about Ada, countess of Lovelace, its development, and with it Ada's life and work. There was a big challenge to make audible and visible her abstract mathematical abilities and her insights into the capabilities of computers at the early time of the nineteenth century, as well as her (first) programming, of e.g. the Bernoulli-numbers. In particular logistic problems of the staging arising from a one-person opera are described. The solution is found with the intertwining of an oratorium-like form with stage imaging and projections, electronic devices and tuning.

9.1 Introduction and Intentions of the Libretto

My friend, the composer Viola Kramer gave me the task to write a libretto for a one person opera about Ada, countess of Lovelace, who is said to have written the first computer-program, a program for Babbage's analytical engine, which, although still mechanical, had the structure of today's von Neumann-computers. Being a mathematician and computer scientist, and with no experience in writing libretti I hesitated to undertake this, but having worked in gender studies in computing, I already knew about Ada's history (see e.g. Oechtering et al. 2001). But how can I compose mathematics, music, computers and poetics into a text to be set into music?

We wanted to use as much technology and as many IT-gadgets as possible for the staging and the stage design. And to make transparent the findings of Gender Studies w.r.t. computing within the stage design. Technology opens up world and at the same time locks off other possibilities of development, which might have been preferable in one or the other respect. In particular the socially effective information technology and its code implicitly contains social conditions and desires, which are baked into it by design, performing inclusions and exclusions.

B. Schinzel (✉)
University of Freiburg, Freiburg, Germany
e-mail: schinzel@modell.iig.uni-freiburg.de

H. Werthner, F. van Harmelen (eds.), *Informatics in the Future*,
DOI 10.1007/978-3-319-55735-9_9

9.2 Short Biographical Notions and Historic Setting

Ada Augusta, countess of Lovelace, was born as the daughter of the noble Annabella Milbanke, who was skilled in mathematics and all the actual sciences, and the poet Lord Byron, who was described as an emotional, romantic, excessive and immoral person. The marriage was extremely unhappy and Annabella divorced soon after Ada's birth. In the following she tried to suppress any sign of Byron's character showing up in Ada's development. Mathematics she considered as a good disinfect against too much sentiment and poetry. And Ada was enthusiastic for mathematics and science, but also of arts and music, and more and more she also combined these with her poetical, philosophical and emotional interests. Already as a young woman of seventeen she took interest in Charles Babbage's computing engines and understood their function to the largest extent. For some time she was able to persist in her mathematical activities also during her marriage and as a mother of three children, and as such she did her great mathematical programming work. But finally this was not possible any more, both for family reasons and because the scientists, Babbage especially, would not allow her to cooperate any longer, and she started to gamble. As a young woman of thirty-six she died from cancer.

At the time where Ada lived, gender order was clear and unquestioned, although it was quite differentiated according to social layers. Scientific work was mainly left to the rich, and to be able to make one's living on it was extremely rare. The possibility to work at all was much more restricted for noble women than for women in general. So it was kind of a scandal that a countess would deal with mathematics and machines. Scientists sometimes were more open to women performing it, like Ada's teacher and mentor Mary Summerville. But for them on the other hand it might have been scandalous that Ada—as she did—would ascribe machines and electromagnetism poetical, psychical and social potential. On the other hand at her time there also existed a relation between romanticism and machine phantasms, as poetry of the time would thematize: E.T.A. Hoffmann's singing automaton Olympia, or Hans Christian Andersens "The Emperor and the Nightingale", and Mary Shelley's Frankenstein. But Babbage himself had designed his machines for mathematical and statistical tasks, as well as for economic calculations, which—as Ada had foreseen first—clearly would have social impact.

The special fascination of Ada's character was the confrontation between rationality and passion, virtue and excess, technology and fate, progress and everlasting humanness, planned determinism and chance, sovereignty and subordination, a pattern that repeated throughout all her life, as a prolongation of the conflict between her mother Annabella Milbanke and her father Lord Byron. Within these antagonistic pairs both her personal life and the course of the world history are glued together. The mother appears as the key figure: her virtue contains all hopes and all cruelties of the dialectics of the Enlightenment and its beliefs in progress—and the ideals of the French revolution: Robespierres famous "virtue necessarily and inevitably has to reign by terror!", might hold as a motto for her. It is a

remarkable point, that here a woman represents rationality and the man emotions. And that the virtuos mother at least once realizes that she lacks something for her perfection—and without mercy she fights this insight in her daughter. Ada is thrown onto this arena and tries to stand her ground. Her attempts in gambling seem to be like a metaphor, collecting all this together in a nutshell.

9.3 Logistics, Production and Staging

The opera is conceptioned as an oratorium, like Bach's passions or Handel's Messiah. The only person acting on stage is Ada, but there are several choirs and one recitative to tell the story, and this in past tense. Everybody else speaks in present tense. The sentences have to be short and simple, and monologues have to be designed as dialogues. The text has to fit to the rhythms of the composer, and only the music should transport feelings, not the text.

The first difficulty was the order of sequence: if I follow her life chronologically I have to start with her lonely and cruelly controlled childhood. But the main theme of the opera is how she became the first programmer, the first person who had set a complicated algorithm into a sequence of declarations for punched cards to be performed on a computer. To present this abstract thinking achievement as the starting point of the drama, would hardly be understandable and would make listeners fall asleep. The second problem derived from the one-person concept, and this together with the demand to bind her story into the present. The third difficulty was to pack the story into four consistent scenes. It should point out her relationships to her mother Annabella Milbanke, to her father, the poet Lord Byron, the different scientists with whom she had contact, to Charles Babbage, the inventor of the Differential Engine and later the Analytical Engine, but also to her husband and the three children. Moreover her affection to technology, mathematics, to the computer and its programming had to be dealt with.

For these reasons and because of the one-person-concept the libretto turned out to be primarily a logistical problem. We decided to present four scenes, defined by the themes

1. Mother, relationship between father and mother, education
2. Males, father, poetry and relationship between science and poetry
3. Mathematics, technology, computer
4. Sickness, gaming, edictedness and death

Of course all these themes should relate to the epoch, the life feeling and episteme of Ada's life time, the technological uprise, with steam engine and first iron track based transportation, the new scientific discoveries, like electricity and magnetism, as well as the philosophical views, the beginning of Victorianism in England. All this is also culminating in Ada and her social environment, her mother and her friends, who mostly were scientists. Of course it is also demanded to point out all the later developments which Ada had foreseen incredibly wide looking.

Moreover the difficulties for a woman (see Oechtering et al. 2001), even for a noble one, to participate in scientific work, e.g. to receive scientific literature, because she could not enter a library, and her husband had to copy it for her; or to publish under a female name, she had to do it with her initials only.

A chronological sequence was not possible with the four scenes, because the themes would have to be taken up many times through Ada's life. Therefore each scene should be chronological for itself, but for dramatic reasons, not too strictly.

9.4 The Acts

9.4.1 Biografic Background

According to her biographers' storytelling (e.g. Woolley 2005) her studied, rational and mathematically trained, self controlled, religious, but also haughty mother Annabella Milbanke with her extremely shocking experiences with Lord Byron had determined Ada's education and life to a large extent, ambivalently. They had met in London, where Byron made a proposal of marriage to the "princess of parallelograms", which she first refused, but then she was attracted by the famous, dangerous and scandalous man, and fell in love with his glooming verses in the poem "Giaur". She found an excuse to marry him: she wanted to lead him onto the path of virtue. The marriage was a sensation in London, and it remained a journal's theme. The marriage immediately turned into a hell. When Annabella also found Marquis de Sade's "Justine" in his bookshelf, and she guessed that he continued a relationship with his half-sister Augusta in her own house—his daughter Medora with her was born shortly before Ada, she decided that he was lost to hell and gave up bettering him. She ordered a psychological expertise about him—it is said that it was the first one to be made in history—which assured that Byron was not sick, neither mentally nor psychically. Then she proceeded to the divorce, which was not easy for a woman at that time, and she had to make his severest sins public in order to be able to keep her daughter. From this time she followed Byron with her hate until his, and even until Ada's early death. Byron had fled her and his debts to Greece, where he died, never having seen his daughter Ada. Ada, as a last revenge to her mother's coercion and surveillance, had determined to be buried in her fathers grave. Although Annabella supervised Ada until the last minute in her life and let nobody else approach her dying bed, did not attend the funeral of her 36 years old daughter.

This marital discord was termed a symbolic item in Victorianism: It was the representative arguing between the romantic spirit, stemming against progress, and modern rational mathematical humanity in the industrialized world. And it was a media event—the press jumped on the contrahents in just the same brutal and defamatory manner as it does today (as Woolley mentions, the reference to Lady Diana is close). Annabella called it the newspaper-war, which accompanied also

Ada until her death, because the British society wanted to know what would be the outcome of this connection between genius, poetry and mathematics, infidelity and jealousy, freedom and riotousness, love and hate, virtue und depravity.

I will describe the contents of the acts and I will intertwine it with the stage design. Each scene acts chronologically from the beginning to her early death.

9.4.2 Act 1 Ada as a Child, Education and Relation to Her Mother

Annabella anxiously observed the development of her daughter, in cool distance, also in space, she met her seldom, subdued her under a strict regime of an exactly planned education, performed by childcarers and house teachers and you later by Annabellas friends, whom Ada called the furies. With a very strict controlling education, giving science, religion and ethics which should hinder a free development of her mind, a counterpart to any sign of her father's biological inheritance, his poetic, scandalous and bacchanal character. Annabella wanted to "suck his blood away from her heart", as Byron wrote in one of his poems.

In an opera you have to plug immediately into the course of the story. Therefore the opera starts with Ada in a cage, where letters and books are reached through the holes by hands or by letter doves. Surveillance cameras are installed in the stage. Ada sings that the only way to stand the situation was to deal with her mathematics books. But then she starts to dance, the cage flattens on the floor, and she walks on the lines.

The choir of lifted forefingers gives instructions to Ada and threaten her.

The recitative now reports that: Ada was a very lively child, full of phantasy, also in technical respect. Very early she was interested and gifted in geometry, architecture, biology, she read a lot and had interest in philosophy, poetry and fine arts, which she often also performed: singing, dancing, playing music instruments, woodcarving, and writing stories. Unfortunately in her mother's eyes, but and in fact fortunately the stimulations in mathematics science and technology did not have the anesthetic impacts, deterrent effects on Ada, in the contrary she was enthusiastic.

Ada developes a flying machine. She calles herself a letter bird, probably a metaphor for her wishes to be freed from the mother-prison.

The recitative reports: with fourteen she became limb and blind;

She is shown in a wheel chair, has to be fed.

Recitative: It took more than three years until she could start to move again, but then she also started to oppose. Whereas Annabella was steadily kept with her own health, drove from one spa to the other, the many manifest sicknesses of her daughter did not tangle her, neither her nervous breakdowns, nor a later cholera, which she hardly survived. Until the end control, moral leading and suppressing the father's properties were Annabella's main concern. And in the end she used Ada's

cancer to isolate her completely and to convince her that her suffering was the justified punishment for her sins. But it was not Ada, had she not been able to show even in her death a last contumacy in choosing her last sleep at the side of her father. *The family grave is shown on a screen.*

9.4.3 Act 2 Men in Adas Life, Her Father, the Scientists

For Ada men were often possibilities to flee her mothers prison, as e.g. her marriage. She had an extraordinary attraction to men, with her stormy and unpretentious way, her courage and her decisiveness.

Recitative: When the thirty-four year old William King, Baron of Ockam, proposed to marry her, she took it immediately with her nineteen years hoping to escape her mother. In vain, because he was deeply subsidized to her mother.

It is shown on stage, that as a wedding gift Annabella gave her a large portrait of Lord Byron, whom she had never seen before. In Kings library she also found her fathers's works Childe Harolds and Don Juan, as important texts showing the relation between her parents—and herself mentioned. Ada realizes what she had missed up to then: poetry which reflected feelings as something acceptable, even necessary to gain complete humanity!

Moreover she realized that Babbage's machines which had found her burning interest since she heard of them in queen Victorias palace, would allow her to connect rationality with feelings, mathematics with poetry. The happyness it gave her exceeded all other joys which marriage and children, journeys or horse riding. She had found the symbiosis of mathematics and poetry, of mother and father in herself.

Soon she had three children, whom she educated according to the newest principles of Pestalozzi. Soon the children because a burden which prevented her form continuing her mathematics' and computing interests.

At the same time she gradually approached her father's spaces and ways of life and dismissed her mother's influence.

She had many male scientist friends, like Mary Sumervilles son Woronzow Graig, the mathematician and Augustus de Morgan, the "electrician" John Crosse, and Charles Babbage, with all of whom she exchanged lots of letters, with the latter often more that one a day. But her tries to be e.g. Faraday's or Babbage's assistant obviously was too much for the time. Anyway Ada continued her studies. Crosse also was the cause for losing her husband's and children's fondness until, sick and weak, she again was completely extradited to her mother.

9.4.4 Act 3 Ada's Relation to Mathematics and Technology

Ada met Mary Somerville (Pohlke 2015), who already had made magnetic experiments, solved diophantine equations, and computed planet ways. With her she went to Babbage's soireès and immediately was enthusiastic in his "difference engine". She studied the powers of steam engines, able to drag trains on iron tracks, electricity in the new telegraphs and experimented with magnetic powers. She was one of the first to drive with the railway from London to Southampton, and realized that this kind of transport and time machines, together with the telegraphs' potentials of synchronizing trains arrivals and departures would change the world completely.

one hears the whiring, buzzing, chirping of the telegraphs, jarring of the iron trains, whistling of the steam engines

> Ada: look what we have detected by now: electricity, magnetism.
> CEM (choir of electricity and magnetism): sss sss bang!
> Ada: did it exist before?
> CEM: of course! lightenings whitened the heaven, thunder-detonation
> Ada: but now not only God can lighten, we humans are also capable to do it!
> CEM: the compass shows the way to the north *(map with* compass*)*
> Ada: but magnetism also intrudes into the human body.
> She also attended mesmerist magnetic sessions (Franz Anton Mesmers hypnotismus occulta), which were taught to be able to set psychical energies free and to heal.
> Ada: Mesmerists are healing with Magnets! *(Spins of the H-atoms align within the magnetic field and swing back)*
> CEM: caution, caution, this is not scientifically verified!
> Ada: "In a mesmeristic session I had a curious feeling, it was an unnatural mental and bodily sensation". I would like to understand this mechanism.
> a single high pointed CEM-voice: Hypnosis, Hypnosis!
> Ada: My doctor treats me with magnetism, *(a MRT-tunnel with a human head to bone measured in it is seen) Music: knocking, rattling, buzz of the radiowaves in the MRT with measuring.*

Moreover she underwent a phrenological investigation, which should estimate her character, because her mother had undermined her self-esteem—which approved her doubts in her normality and psychical sanity. At that time it was not yet possible to differentiate physical phenomena from occult ones. Similarly 50 years later this again was blurred with the detection of X-rays. This gives the opportunity to point out the connection between George Combe's (see Combe 1819) phrenology and the Nazi race-ideology, but also the relations to today's cognitive- and neuroscience.

Babbage was beset by measuring, numbers, tables and statistics (see Babbage 1961). He measured everything, also life items in numbers, and he also co-founded a life insurance. He also was interested in business in order to finance his machines. When he had developed further his universal freely programmable "analytical engine" (see Babbage 1999), Ada was excited. She understood that unlike the

former difference engine, which could only perform a fixed sequence of computations on a computational board, the analytical engine was able to perform variable processes in dependence of the former computation. This mechanical machine was similar to today's computer architectures, it divided memory and computational board, the latter consisted of a small set of basic operations. Control was performed in analogy to weaving machines by "chains of punched cards".

Ada approached Babbage to allow her to cooperate and give her duties. The opportunity arrived with a lecture given by Babbage in Torino, which Menabrea, an Italian officer had protocoled in French. Ada should translate it into English. Her work on analysis, design and programming the analytical engine on several examples, especially the numeric computation of Bernoulli numbers struck Babbage. He saw that Ada had completely understood his machine and its potential of programming, even better than himself, and proposed that she should add her own comments to the translation. Ada worked several months on these "remarks", until the text was three times as long as the original one (see Lovelace 1842). There she describes in detail, which problems could be solved on the machine, and in which manner the operations should be organized. According to the architecture she introduced variable cards and operation cards, and developed sets of punched cards for solving different algebraic and trigonometric problems. The interplay between the cards was organized in such a way that the flow of computation allowed all the possibilities of flowcharts: forking, iteration and recursion. Her work culminated in a program for computing the Bernoulli numbers, which Babbage had set up in his lecture, where she already used tables and diagrams as representations (see Hellige 2003).

Ada, though understanding the mechanisms of the machine, she also ascribed it metaphysical properties, saw not only social, but also poetical, musical, graphical, geometrical and philosophical potential in it (see Schröter 2015). She even realized that it would be able to treat relations, e.g. to learn musical harmonies, which would result in the possibility to compose music pieces of any kind. In fact in this machine she saw her salvation, because so she could connect poetics, music and feelings with rational science, mathematics and technology, a symbiosis which she had missed so much—she was happy!

9.4.5 Act 4 Sickness, Ediction and Gambling

After the third child Ada became quite frustrated by her duties in household and child care. But she succeeded to convince her husband to receive more mathematics teaching by Augustus de Morgan and to play the harp.

But when she could not cooperate with scientists any more, she became interested in fortune games with horse races. As she was convinced she would be able to compute a secure winning strategy she continued to play, even when her debts exceeded the family wealth. But the horses did not obey her probability computations, and she continued losing money until she had to ask William to borrow

money from her mother. Since long time she had cut the connection to her, but now she could enter her house again. At this time Ada certainly was already addicted to opium, because her doctor hat treated her with Laudanum against everything: her pains, her heart- and rheuma attacks, her nervous irritations and break downs. She was already severely sick, but just for this reason she wanted to enjoy the rest of her life, and she continued playing fortune games and computing winning strategies. Together with friends who trusted either in her mathematical abilities or in the family wealth, or both, she founded a syndicate, for bookmaking for sports betting. They lost huge amounts of money and the friends began to press her. It became clear that Ada had cancer and her mother entered the sickroom. Ada could not oppose any more, and Annabella removed everybody else from the house. Only her last triumph to be buried in her fathers family grave was left to her and Lord King did not refuse it.

9.5 The Staging

The difficulties arising from the requirement of a one-person opera, where still the important figures, like Annabella, Lord Byron, Lord King, Charles Babbage and other scientists should receive a (whatsoever virtual) voice, have to be met. This is done on one hand by the installing of the choirs and the recitative, possibly recorded in advance, which play the roles with whom the whole story can be told. Ada's monologues are designed as dialogues with her contact persons. On the other hand the staging will support the understanding of contents, especially the abstract ones, working together with the figures. The choirs not only represent groups of people, like the Furies, who, empowered by Ada's mother have to control and survey her, but also virtual realities and physical measures. So for example the choir of raised forefingers will sum up the representation of moral claims set up by Annabella, the Furies, religion and society. The choir of electricity and magnetism may report the respective discoveries, or can warn Ada from drawing too far reaching conclusions about the connection between magnetism and psyche in the context of her mesmerist sessions. The choir of mathematics will report Bert Brecht's insurance-mathematical text: "ich weiß nicht was ein Mensch ist, ich weiß nicht wer das weiß, ich weiß nicht was ein Mensch ist, ich kenne nur seinen Preis". The choir of the twentieth and twenty-first century may tell about the development of phrenology, its assets in eugenics and race theories. It also talks about the development of computers and IT, which Ada predicted.

Stage images and images projected onto the floor are also important actors in this opera. E.g. visualizing the prison, in which Ada feels caged. Also parts of mathematics, physics and technology playing a role here are put into picture, either projected in formulas onto the wall, on screen, or more directly as geometric lines and figures. I also propose, single sentences or formulas to be hung on ads, like Brecht's bible verses in the beggars-opera, on which actors can point. Ada interacts with many of these figures: she dances on lines, on figures projected to the

floor, or is led, restricted and pushed back by them. Also virtual realities and actors, avatars, robots and drones shall appear in projections and connect with the texts of the choir of the twentieth/twenty-first century. Movable surveillance cameras will be fixed everywhere in the cage, and when Ada flees, a video-drone will turn above her head, while the choir of furies sings: "surveillance, control, for this we are prepared. With the greatest pleasure!" Above the telegraph wires at times PRISM and TEMPORA are dragged as text, the images of Bad Aibling, and with this links, e.g. to the EU data-protection etc. appear.

Projections with formulas for computing the Bernoulli numbers, the Riemann conjecture connected with them, the Fibonacci numbers and the golden cut appear when Ada sings the respective texts.

At the same time as many new media and gadgets as possible should be used, reproducing the previously taken tunes, scenes, images, graphic novels and buttons or tweets from social networks. But also diverse media, the internet of things shall be used online at the opera performance, e.g. RFIDs can be used to allow the audience's entrance. Also the cell phones of the audience might become active, e.g. an application with crowd sourcing for Ada's debts, or an application of citizen science to solve the Riemann conjecture.

With the composed music also physical tunes appear, the snuffling of the steam engines, the quieking of the iron wheels on iron tracks, the zirping of the telegraphs, morse-rhythms, thunder, electronic tunes, cell phone ringing, etc. Not only texts are sung but also numbers: a cantus firmus with the Bernoulli-formula is heard, another one with Riemann's Zetafunction, and at the same time the golden cut is projected; the choir of electricity will sing morse signs at a constant tune height and then the Enigma and Alan Turing are shown; the choir of mathematics will sing Babbage's insurance mathematical relations between humans and numbers.

References

Babbage C (1961) On the principles and development of the calculator: and other seminal writings by Charles Babbage and others. In: Morison P (Hrsg). Dover, New York

Babbage C (1999) Über die Ökonomie der Maschinen. Kulturverlag Kadmos, Berlin

Combe G (1819) Essays on phrenology, or an inquiry into the system of Gall and Spurzheim. Bell & Bradfute, Edinburgh

Hellige H-D (2003) Zu der Genese des informatischen Programmbegriffs: Begriffsbildung, metaphorische Prozesse, Leitbilder und professionelle Kulturen. artec-paper Nr. 108, Dezember 2003

Lovelace AA (1842) Sketch of the analytical engine invented by Charles Babbage. By L. F. Menabrea of Turin, Officer of the Military Engineers from the Bibliothèque Universelle de Genève, October, 1842, No. 82. With notes upon the Memoir by the Translator A. A. L

Oechtering V et al (2001) Frauen, Informatik, Geschichte. www.frauen-informatik-geschichte.de/

Pohlke A (2015) "Princess of parallelograms" meets "Queen of Science". In: Kraemer S (Hrsg) Ada Lovelace. Eine Pionierin der Computertechnik und ihre Nachfolgerinnen. Wilhelm Fink, Stuttgart

Schröter J (2015) Bilder Weben, Musik Komponieren. Ada Lovelace und das Universalmedium Computer. In: Kraemer S (Hrsg) Ada Lovelace. Eine Pionierin der Computertechnik und ihre Nachfolgerinnen. Wilhelm Fink, Stuttgart

Woolley B (2005) Byrons Tochter Ada Lovelace – Die Poetin der Mathematik. Aufbau Taschenbuch, Berlin