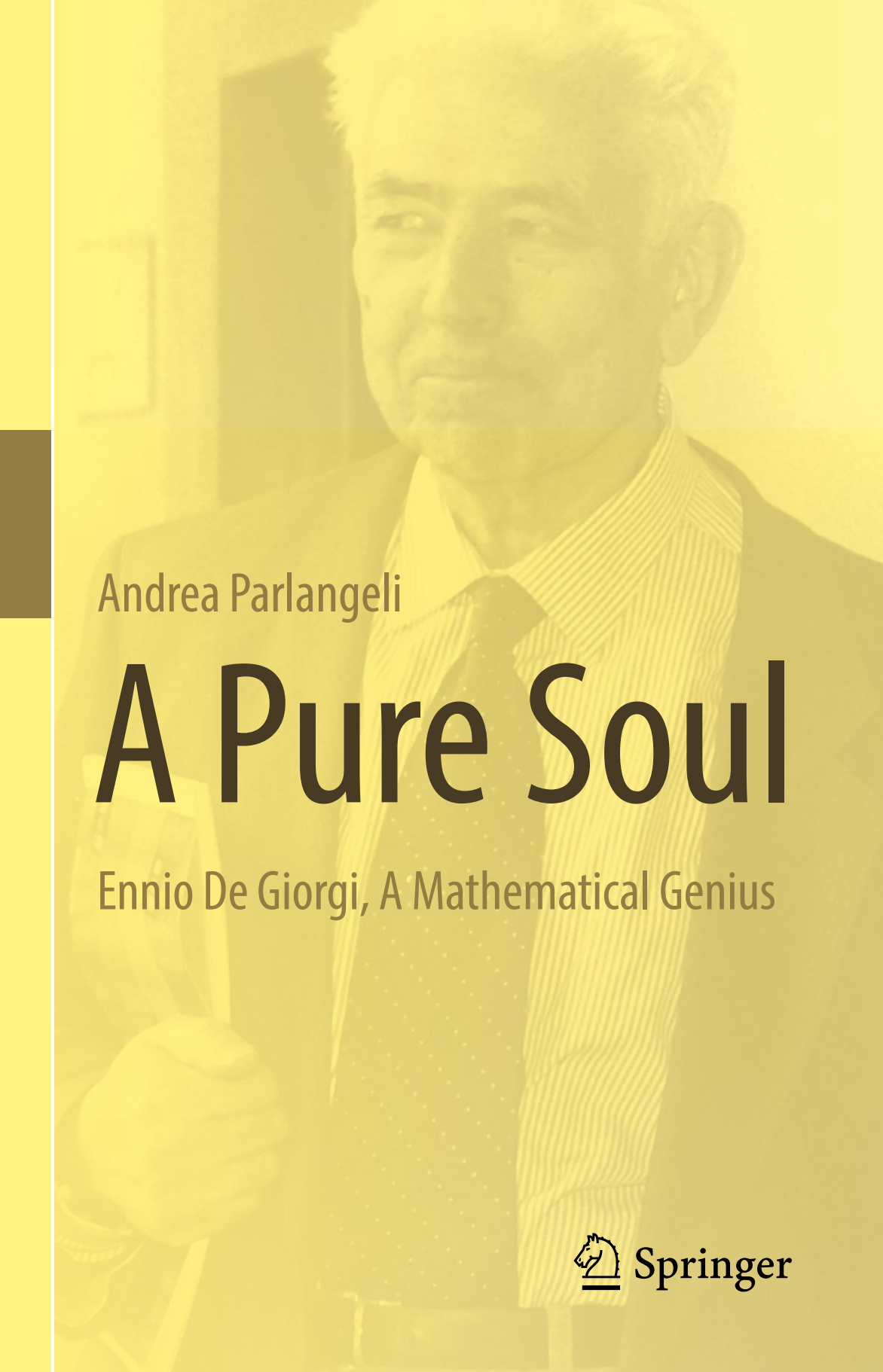

Andrea Parlangeli

A Pure Soul

Ennio De Giorgi, A Mathematical Genius

Springer

A Pure Soul

Andrea Parlangeli

A Pure Soul

Ennio De Giorgi, A Mathematical Genius

Springer

Andrea Parlangeli
Milan, Italy

Translated by Marco Capriz
Plön, Schleswig-Holstein, Germany

Translation from the Italian language edition: Uno Spirito Puro: Ennio De Giorgi, Genio della Matematica, © Edizioni Milella di Lecce Spazio Vivo s.r.l. 2015. Published by Milella, Lecce. All Rights Reserved.

ISBN 978-3-030-05302-4 ISBN 978-3-030-05303-1 (eBook)
https://doi.org/10.1007/978-3-030-05303-1

Library of Congress Control Number: 2018965597

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Nothing is wilder than a pure soul … I think you are an exception.
(Renato Caccioppoli, speaking to young Ennio)
We are mathematicians by wish of the Nation. Ennio is a mathematician by the grace of God.
(Guido Stampacchia)

Acknowledgements

This book is a collective effort that in many ways extends beyond the capabilities of the author. Many of De Giorgi's friends, students, relatives, and acquaintances have contributed to it, with their time, capabilities, memories, and emotions. I am immensely grateful to all of them for their generous efforts. Without their often enthusiastic, sometimes cautious, yet always passionate support, I would not have managed to go further than what had already been published in the books mentioned in the bibliography. I wish to remember and thank, as far as possible, all those who made their contributions, without any pretense of being thorough, indeed asking forgiveness in advance for the inadequate words I will use.

First, I have to thank the entire De Giorgi family for the affection and the support that they gave me during the 30 months of effort that it took to write the first draft of this book, and for all their memories. Rosa, Ennio's sister, is probably the person who contributed most to this biography. The first part of the book, that is, the story of Ennio's infancy and youth, is entirely based on her recollections, and she provided me with photos, letters, documents, and reminiscences. I am equally grateful to Annadina De Giorgi, who gave me precious testimonies and suggested whom I should contact. Also of great help were Andrea Fiocco and Giuseppina Mormando, and all of Ennio's relatives who contributed to this biography with a sense of participation and friendship.

I also have to thank the institutions that consistently gave me their support: the Ennio De Giorgi Mathematical Research Center at the Scuola Normale in Pisa, where I was a guest for 10 days in February 2007, and from where I was able to arrange most of the core interviews of the book, and the Department of Mathematics of the University of Salento (former University of Lecce) in Lecce. At the Scuola Normale, my principal reference point was Luigi Ambrosio, the heir to the mathematical analysis chair also held by Leonida Tonelli and Ennio De Giorgi. He always supported me and assisted me patiently in the correct presentation of the mathematical concepts. The Lecce group welcomed me in a spirit of friendship and allowed me to look for useful information in many boxes of notes, faxes, letters, and documents that were stored there. I am grateful for this, and for their testimonies, to

Michele Carriero, Giuseppe De Cecco, Antonio Leaci, Diego Pallara, and Eduardo Pascali.

I want to thank Antonio Greco, Ennio's roommate during his university days in Rome; De Giorgi's university classmates Maria Giovanna Garroni Platone and Mario Rosati; Fernando Bertolini, who read De Giorgi's degree thesis and who hosted me in his beautiful villa in the province of Modena; Gianfranco Capriz, who even emailed me from Thailand; Ferruccio De Stefano and Dionisio Triscari, who told me of their experiences with De Giorgi in Messina in 1959, and other episodes; Mario Miranda, who sent me the material that allowed me to frame some of the aspects of De Giorgi's mathematics.

Of particular importance were the memories of Enrico Giusti and Enrico Bombieri, who collaborated with Ennio on the definite solution to the problem of regularity of minimal surfaces of arbitrary dimensions, and on the solution to Bernstein's problem. Livio Clemente Piccinini, instead, has been my primary reference point for the solution of Hilbert's nineteenth problem.

I am very grateful for the help received from three directors of the Scuola Normale Superiore: Franco Bassani, Luigi Radicati, and Edoardo Vesentini. Their contributions were of fundamental importance to the biography. Among the teachers in the Scuola Normale, I must also thank Giuseppe Tomassini, who, in the very last days of the manuscript preparation, added some very interesting testimonies.

I would also like to thank Marco Forti, for helping me to reconstruct De Giorgi's complete (and complex) research activity on the foundations of mathematics. His contribution was one of the richest and most passionate. Moshe Breiner and Luciano Carbone, both De Giorgi's students who remember him with affection, were among those who, with great enthusiasm, became passionate about the project and provided me not only with their memories, but also with numerous in-depth suggestions. They also contributed to the final revision stages of this book, which, without them, would have been all the poorer.

I am particularly grateful to Giovanni Prodi, one of Ennio's closest friends from the 1950s, and to his wife Silvia. The efforts that Prodi made to share much that he kept in his memory of Ennio were for me one of the most vibrant demonstrations of how strongly people can be tied together by friendship, even after death. I am also grateful to Emilio Doni, Antonio Ubaldi, and to Cesare and Giovanna Alzati, who helped me to integrate Prodi's memories with what they remembered of the Asmara period.

Antonio Marino and Sergio Spagnolo deserve a special mention, as both were among Ennio's closest friends. Marino was the closest to De Giorgi for all the activities involving civil commitment and Amnesty International: I am very grateful to him for opening at least six huge boxes of documents that he had stored in his cellar for decades. Unfortunately, only a small part of that very rich collection has found its way into this book. Sergio Spagnolo helped me to reconstruct some episodes that only he remembered, such as the charity aid Ennio gave, secretly, to families in need. He has also been a constant point of reference for all the niggling doubts I had on mathematics.

Still in Pisa, it was particularly useful and pleasant to meet with Giorgio Letta, whose memories were rich and spontaneous. I thank Piero Villaggio, who welcomed me into his office (with no computer) in Via Diotisalvi. In Milan, Stefano Mortola gave me precious help in reconstructing all the main mathematical and personal events in Ennio De Giorgi's life over a period of 15–20 years.

I thank Giovanni Bellettini, for explaining to me the mean-curvature motion; Gianni Dal Maso, who spoke to me about Gamma-convergence; Luciano Modica, for his contagious enthusiasm; Carlo Sbordone, who has been useful in providing memories on the connection between Ennio and Neapolitan mathematicians. Paolo Tilli, who was very helpful in reconstructing the events of the final years, and provided me with invaluable support during the whole compilation process; Epifanio Virga, who hosted me in Pavia to explain the relationship between his work on liquid crystals and De Giorgi's.

I also want to thank all those who helped me from abroad: the Brazilian Ubiratan D'Ambrosio, who spoke to me about the 3 months during which he shared his office with De Giorgi at Brown University; the Poles Zdzislaw and Zofia Denkowski, who generously helped to reconstruct De Giorgi's events in Poland; Wendell Fleming, who tirelessly provided numerous testimonies on De Giorgi's connections with the mathematical community that studies measure theory in the United States; François Murat, who spoke to me about Gamma-convergence and Ennio's relations with the French community; Sylvia Nasar, who showed enthusiasm at the very beginning; John Forbes Nash Jr., who commented on the solution to Hilbert's nineteenth problem; Leonid Plyushch, who, from Bessèges in France, and with Massimo Picchianti and Sergio Rapetti acting as intermediaries, was able to check the manuscript sections that concerned him and provided testimony on his liberation; and Dan Stroock, who provided me with interesting comments on Nash's resolution to Hilbert's nineteenth problem.

Many others provided me with help, their memories and testimony, and often their contributions were significant. For reasons of space, I must thank them collectively: Giovanni Alberti, Gabriele Anzellotti, Paolo Baschieri, Carlo Bernardini, Giuseppe Buttazzo, Luis Caffarelli, Lorenzo Carlino, Gian Mario Cazzaniga, Jaures Cecconi, Antonio Chiffi, Andrea Cogliati, Ferruccio Colombini, Mario Curzio, Giuseppe Da Prato, Patrizia Donato, Ivar Ekeland, Fausto, Franco Flandoli, Tullio Franzoni, Margherita Galbiati, Giuseppe Geymonat, Giorgio Israel, Enrico Jannelli, Robert Kohn, Harold Kuhn, Giacomo Lenzi, Enrico Magenes, Don Claudio Masini, Sergio Mercanzin, Giovanni Moruzzi, Andrea Nidiaci, Louis Nirenberg, Robert Osserman, Sergio Parenti, Andrea Porcarelli, Lucilla Bassotti Rizza, Giovanni Battista Rizza, Romano Scalfi, Giorgio Salvini, Romano Scozzafava, Domenico Senato, Raul Serapioni, Sara Stampacchia, Sergio Steffé, Vincenzo Tortorelli, and Nina Uraltseva.

I separately thank those who helped me in other ways: Giovanni Anzidei (Accademia dei Lincei), Simone Bandini, Claudio Bartocci, Serenella Bassani, Dave Bayer (mathematical consultant for the film *A Beautiful Mind*), Maria Pia Bumbaca (Sapienza University archives in Rome), Enzo Caffarelli, Francesco Calogero, Paola Carlucci, Guido Carolla, Luigi Civalleri, Salvatore Coen, Maurizio

Eliseo, Michele Emmer, Stefano Fantoni, Alberto Farina, Fabiola Ferrazzi, Silvana Gaetani, Mariano Giaquinta, Yaron Gruder, Antonella Gregorace, Angelo Guerraggio, Pietro Ingrao, Marisa Lanzillotti (Amnesty International Italia), Vincenzo Letta, Paolo Maria Mariano, Silvia Mazzone, Giuseppe Mingione, Frank Morgan, Francesco Pozzi, Sandro Salsa, Andrea Schiaffino, Jim Simons, Enrico Valdinoci, Victor Zaslavsky, Pietro Zecca.

All interviewees should be thanked twice for having reviewed their interviews, often providing additional comments and details. I thank all those who took care of revising the text, in part or wholly, and in particular Luigi Ambrosio, Moshe Breiner, Aldo Carioli, Martha Fabbri, Roberta Scorranese, Sergio Spagnolo, and my family. Luciano Carbone and Paolo Tilli were also of great help during the revision stages. Any errors that remain are my own. With respect to the English edition, the author is particularly grateful to Epifanio Virga, who strongly supported this translation, and to Luigi Ambrosio, Antonio Leaci, and Paolo Tilli, who gave a careful review, to ensure in particular the correctness of the mathematical expressions.

About the Book

With family roots from both Istria and the South of Italy, adopted by the town of Pisa, profoundly religious, one of the world's greatest mathematicians, strong supporter of the United Nations Universal Declaration of Human Rights, Ennio De Giorgi was one of the sharpest minds of the second half of the twentieth century. In parallel with Nobel Prize winner John Forbes Nash Jr., the protagonist of the book and of the film *A Beautiful Mind*, in 1957, when less than 30 years old, Ennio De Giorgi burst on the world scene for having solved in a remarkable way one of the century's most difficult and studied mathematical problems. This is his story.

Note: This biography is the collective work of the many who contributed towards its realization with their testimonies. This endeavor, efforts notwithstanding, cannot be considered an exhaustive account of the life, works, and personality of Ennio De Giorgi, but is (as De Giorgi might have defined it himself) an "honest attempt" in that direction. The goal of the author is not so much to write an *objective* account of the events of the central character, rather it is to collect and organize the *subjective* testimonies of those who knew De Giorgi, believing it might be the best way to achieve the desired results. The structure and writing style of the manuscript are functional to this purpose.

Contents

Chapter 1
Geese and Rabbits

A few kilometers from the gentle town of Lecce, hidden among the ploughed fields, the villas and the undergrowth, lay the ruins of a nearly forgotten Messapic town called Rudiae. Here, in 239 BC, Quintus Ennius of Rudiae, father of Latin literature, who introduced the hexameter into Roman poetry, was born. It was of him that Nicola De Giorgi and Stefania Scopinich thought when the moment came to decide on a name for the third child with whom God had blessed them. They called him Ennio, following the classical tradition, and breaking with the norm that imposed the names of ancestors on newborns. They may also have chosen the name to highlight their connection with the land in which they had decided to raise a family, Salento, where Romans, Greeks and Messapians lived. For Stefania, who came from Capodistria, this was a brave choice. Those were different times, and women who came from other lands, with their own habits and different mentalities, were viewed with suspicion in Southern Italy. But she was determined to follow the man she loved to the farthest southeastern limb of the Italian peninsula.

Ennio De Giorgi must have felt a strong lifelong connection with the Land of Otranto and with classical literature. Indeed, he never gave up his Lecce residency, even though he lived in Pisa from 1959. He himself loved to recount the words of Quintus Ennius:

Nos sumus Romani qui fuimus ante Rudini (*We are Romans, we who were first from Rudiae*).

Nicola De Giorgi was the son of Salvatore De Giorgi and Rosa Contaldo. Salvatore was a notary in Lizzanello, a small farming community a few kilometers from Lecce. Rosa came from Galatina, a village in the region known for the marvelous frescos of the basilica of Saint Catherine of Alexandria and for the well near the small church of Saint Paul, which until recently disgorged the only water that was said to soothe tarantula bites.

A. Parlangeli, *A Pure Soul*, https://doi.org/10.1007/978-3-030-05303-1_1

Nicola was born in 1884. His father's family was made up of lawyers, notaries and a few farmers.[1] However, Nicola's interests laid elsewhere and he pursued classical studies. After finishing high school he enrolled in the Faculty of Letters at the University of Rome, where he graduated in 1907. He met an archaeologist who was managing a dig in Beirut, Lebanon, and joined him in 1909. Nicola lived in Lebanon for several months, learned Arabic and purchased many books, including a copy of the Koran, which he brought with him on his return to Lecce.[2]

In Lecce, Nicola began teaching at the Scuole Normali, schools that according to an educational reform were later known as teaching colleges. He was slim and agile, well-groomed, and sported a curled moustache. With the onset of the First World War, Nicola was conscripted and ordered to join the Third Army at the border between Veneto and Friuli (in the North East of Italy). At the end of the war (on 4 November 1918) he was billeted—always with the Third Army—in Trieste and later joined a section of the same command located in Capodistria. Fate brought him there on the evening of 2 December 1918. He was supposed to reach an assigned apartment in Via Sartori, but he never found it. He saw a light through a window nearby. Even though it wasn't where he was supposed to be, he decided to try knocking on the door, and entered into the house of Stefano Scopinich, a captain in the merchant navy. He spoke with him, his wife Marianna and his three daughters Marianna, Silvia and Stefania. A particular friendship developed with Stefania. Nicola had so many stories to tell: about the war, the army, and of his far away land. It was a pleasant evening and he was asked to come back again.

The Scopinich family was originally from Lussinpiccolo (on the island of Lussino, off the Dalmatian coast) and were a family of seafarers. Marianna's father sailed to Japan. Stefano Scopinich instead made his way to North America on his vessel *Iris*. With a thick white moustache that curled upwards, Stefano looked like the archetypal old sea dog. As sailing ships were gradually replaced by steamers, he joined the Austrian Navy and was first based in Fiume, where Stefania was born, and then Capodistria. Marianna was the strongest character among the three daughters and she became a math teacher. Silvia and Stefania instead studied at a Hungarian girls' grammar school, where they developed interests in art, music and sewing. They lived in a lively and cosmopolitan environment where many languages were spoken: Italian, Hungarian, French and German.

Stefania was slim and agile and had many interests. She soon fell in love with Nicola and they decided to marry. Sadly, Captain Stefano passed away the year before the wedding, which happened in 1920, in a very restrained ceremony. After

[1] The origin of the De Giorgi surname can be traced back to the Byzantine *geórghios*, which means farmer, and even earlier from the Greek *geos*, which means land. In Latin, the form became *Georgius* and was Italianized in *Giorgio*, with slightly different regional variations. It is a patronymic surname, i.e., deriving from a male ancestor (Giorgio in this case). The De preposition is typical in Southern Italian names.

[2] There Nicola taught Arabic with some success. Among others, he was in touch with one of his relatives, whose name was Cosimo De Giorgi (1842–1922), a well-known scientist in Lecce at the time (a high school is named after him).—R. De Giorgi Fiocco. 24 January 2009.

a brief honeymoon in Venice and Rome, the couple moved into a rented villa in Viale Gallipoli in Lecce.

Their first child was born in 1921. They called him Mario, a name that echoed often in Nicola's family. Two years later Rosa was born, named after her grandmother. Both were susceptible to illness. For this reason, Silvia decided to leave Capodistria to help her sister in Lecce. She was immediately welcomed into the family and became the "good aunt," *"Zia Bona,"* to her niece and nephew.

In 1925, they all moved to a new abode in Via Duca degli Abruzzi. Number 20 was a mansion built in the early part of the century by Raffaele Olita, notary and the husband of Nicola's sister Paola.

It was there that the family eventually established its base and where Ennio kept his residence all his life. It was in this house also that on 3 November 1926 a baby girl with big dark eyes was born. It was Saint Silvia's day and she was also named Silvia (after the "good aunt"). Sadly, fate allowed her only a few months of life.

Stefania became pregnant again in the summer of 1927, and on 8 February 1928, at 5 pm, Ennio Raffaele Paolo De Giorgi was born in the very same mansion.[3] He was a strong and healthy baby and a photo of him shows him smiling on the knees of his mother on the seafront in Santa Maria di Leuca.

Father played with his children, and they joined him on the big bed in the evening while he read them tales of classical mythology.[4] He always brought home a surprise for them when he returned home from work. In the warm season, all would join him on the balcony to watch the stars and to sing songs. Ennio was very small, but, though with some delay, was beginning to walk.

The good times lasted through the summer of 1930. As was their usual practice, they chose a holiday destination in Central Italy, half way between Lecce and Capodistria. The previous year they had been to Grottammare, near Ascoli Piceno; this year, they chose Roseto degli Abruzzi. After a few days Nicola fell ill with typhoid fever, a disease he had probably contracted earlier in Lecce, where at the time a sewage system was being built. The children immediately returned home with Aunt Silvia. Stefania, Marianna and Raffaele instead stayed in Roseto with Nicola.

On 7 August, little Ennio had a premonition: "Daddy is going away—he told his sister Rosa, while standing, scared, on his cot—Dad is flying high, like smoke, towards the sky". A few hours later a telegram arrived in Lecce confirming the death of their father. The news hit everyone hard, but Stefania was especially shaken. According to the traditions of the time, grief was shown in a very public demonstration, with wailing women tearing out their hair. Stoically, she never uttered a word, did not express outward signs of pain, but deep down she was wounded to the extent that her health suffered for years after. She took to wearing black for the rest of her life, and sealed herself in a state of austere widowhood, finding comfort only in her Christian faith and in the constant participation in the masses held in the Jesuit chapel built opposite her home.

[3] From E. De Giorgi's birth certificate.

[4] A. De Giorgi, 24 January 2009.

From very early on, Ennio showed imagination and ingenuity. He was happy, interested in everything around him and he loved to compose and recite poetry. He shunned monotonous games, and in the most common ones added twists and quirks. There he is, *Enniuzzo* (little Ennio), his movements gentle, with dark eyes and hair, confiding in his sister, galloping on his wooden horse, playing with puzzles, bricks, and mechanical constructions. There he is, building structures taller than he is, and knocking them down in one fell swoop. He is the creative one, whereas his brother Mario is steadier and more rational. Ennio is very emotional: he cries often over nothing at all. Like many children of his age, he has an imaginary friend called Benino. He doesn't speak with him directly, however, but through his sister Rosa. He asks questions. And he is not happy until Rosa gives him an answer. There he is, rolling on the big living room carpet, playing with his plastic dogs and cats, while his brothers and their older friends play with a snakes and ladders game they cut out from the back of a biscuit carton.

The children often went to see Uncle Raffaele, who always marveled them with a surprise: the coachman, a car (one of the first Fiats, license plate 414), a map of Ethiopia and Eritrea. Uncle also had a beautiful radio that attracted the attention of all age-groups.

During gatherings at home, family friends observed that Ennio loved numbers and that he was very good at arithmetic. People often asked him to perform calculations; he answered them, but his mother and sister felt it necessary to intervene to distract the grownups' attention away from the small child.

In 1932, at the end of August, Ennio's grandmother and aunts moved permanently from Capodistria to Lecce, with their full load of Biedermeier furniture, to be closer to Stefania. Grandma attracted a lot of curiosity and attention with her aristocratic demeanor and her Venetian accent, so much so that a family friend began referring to her as Queen Margherita. Whenever she was asked if she missed the sea and the ships, she replied that they were no match for the joy of being close to her daughter and grandchildren.

In the meantime, Ennio was looking forward to going to school. He yearned to be independent from his sister, until then indispensable in her role as his scribe for the poems he dictated to her, and as reader of his preferred newspaper comic sections: the adventures of Signor Buonaventura, who started the story penniless and somehow always ended up winning the fantastic amount of one million lire; of Marmittone, a simpleton soldier who seemed to always end up in irons; and other assorted strips of the time. However, Italian law only allowed children who had turned six by the end of December in the year of enrolment to begin their first year in state school. So, in 1933, Ennio started his first year in a private school where his ability to memorize, his quick intuition and his mathematical abilities were soon recognized.[5]

The following year he was enrolled in year two at the local state primary school (called Cesare Battisti in Via Achille Costa). His backpack was always full of books and at times so heavy for his tiny shoulders that he needed the assistance of the housekeeper to carry it to school.

[5] R. De Giorgi Fiocco, in a private communication.

One day this happened in class.

"On a farm, there are geese and rabbits. As you know geese walk on two legs whereas rabbits walk on four. There are 11 animals on the farm and they have 34 legs all together," spoke Don Raffaele Ramirez, Ennio's third-year teacher. "How many rabbits and how many geese are there?"

A hand rises shyly.[6]

"What is it Ennio, didn't you understand the question?" asked the teacher.

"There are five geese and six rabbits," replied Ennio.

"Very good Ennio. But how were you able to reply so quickly? Did you know the answer?"

"No, but it is an easy problem to solve."

"And how would you solve it?"

"If I take 34 and divide by two I get 17, which is the sum of all the two legged animals, and the four legged animals counted twice. I already know that the total number of animals is 11, so the difference between 17 and 11, which is six, must be the number of four legged animals. Therefore, there must be five two legged animals."

Don Raffaele Ramirez,[7] Ennio's teacher for the last 3 years of primary school, was probably the first to fully understand the talent of his youngest student. He often wrote "laudable" in big letters on Ennio's workbooks,[8] and once called Mario De Giorgi[9] aside (who had also been his student) to tell him: "Your brother is a genius!"

Ramirez also noted that Ennio did not have much of an aptitude for more practical tasks.[10] He called him "messy" and "incapable" in drawing, manual work and singing. Nevertheless, Ennio did not worry about these minor weaknesses. He himself once said[11]: "When I was a child I enjoyed solving small problems, but I also had a passion for the construction of small devices and for experimentation in what might be considered 'pre-physics'".

In addition to going to school, Ennio attended a Jesuit congregation in a college near his house (Collegio Argento), which now houses the Provincial Museum of Castromediano. Here, he attended Mass on Sundays, chatted with the priests, watched theatre shows, played football and recited poetry. He took his First Communion in 1935. His sister Rosa remembers that he was quite shy, but nevertheless fervently religious. At home, he read from an old beautifully illustrated 1778

[6] The details of this episode may not be exact, but the gist is recalled by Ennio's sister Rosa (private communication), and by Ennio himself, in an interview with A. Preti, writing for the *Nuovo Quotidiano di Puglia* newspaper. 6 January 1996. Published in [2].

[7] From his old report cards, we can see that Ennio completed his first year of primary school by himself. He then enrolled in the same classes that his brother attended, so that he could have Don Ramirez as his teacher.

[8] M. De Giorgi in [1].

[9] Ibid.

[10] R. De Giorgi Fiocco, 2007.

[11] E. De Giorgi, in the video interview *Intervista con Ennio De Giorgi*, M. Emmer, Pisa, July 1996.

edition of the Bible by Monsignor Antonio Martini inherited from his great-grandfather. It was this book that De Giorgi often quoted from later in life.

The family often vacationed in a seaside resort that uncle Raffaele had restructured in 1934. It was situated at Li Foggetti, between Carmiano and Magliano, about ten kilometers west of Lecce. There, the three brothers got to know the daughters of the owners of the resort and learned the melancholic songs of the Salento region. Songs such as *fimmine, fimmine* and *la Tabaccara* spoke of the harsh conditions that women endured, but others celebrated the happier aspects of life in Southern Italy. Ennio loved those melodies, which were the fruit of his land as much as the ear of corn and the olive branch, and he loved to listen to them when he was back in Salento. He was moved by the harsh life of the farmers. They had to wake at 4 am to harvest tobacco leaves and figs and set them out to dry in the day's sun. And at sunset in the evening they had to draw water from the well by way of a wheel turned by a mule so that they could water the vegetables and flower beds.

In those areas, now defiled by the urban expansion of Carmiano and Magliano, the family found an oasis of tranquility. They returned there every summer until 1940 and befriended the local families. They were together during the evenings and played "under a crystal sky—remembers Rosa[12]—singing to the moon and the stars." The evenings were unforgettable, made pleasant by the light of the oil lamps that were used to walk from one room to the next, because at the time there was no electricity in the area outside the town.

At the end of his primary school years, Ennio enrolled in the same high school that his brothers had attended. During the admission exams Ennio demonstrated once again his lack of skills in practical matters. He misplaced his exam papers and dropped his ink bottle. A member of the exam committee commented at the time[13]: "He's gifted with a great intelligence but how much trouble he causes in the classroom!" Ennio was unfazed. He completed his test and returned home as if nothing had happened, with his clothes stained with black ink.

With his discreet talents, which he never showed off, Ennio often made his teachers feel uncomfortable. This was especially true for his mathematics professor who, after only two lessons, said to him[14]: "De Giorgi, please, let me teach. I'll give you a top grade but don't say anything more, otherwise you will spoil my lesson." This was because Ennio liked playing with math. "I liked to try to find a demonstration to a theorem that was different from the one in the book", he recalled many years later.[15]

On another occasion, Ennio embarrassed his religious studies teacher with an observation on the *Book of Genesis*. He asked how God could have created light before the sun and the stars. He questioned the geography teacher on the methods employed by ancient people to determine with precision the movement of heavenly bodies and the cycling of seasons.

Even though he was quite reserved, Ennio loved company. He liked to play soccer and often spent time with his sister: together, they took long walks along the

[12] R. De Giorgi Fiocco, in a private communication.

[13] Ibid.

[14] M. De Giorgi in [1].

[15] M. Emmer, *Intervista con Ennio De Giorgi*, Pisa, July 1996.

Viale Gallipoli (one of Lecce's main thoroughfares) while chatting, on which they retraced their steps several times. At times, he went with her to see her friends who were all older than he was and liked to cuddle ("coccolare") him.

The news of the death of Uncle Raffaele reached them in 1940. The year after, his wife, Aunt Paola, died as well. Thus, a pillar of stability for the family was missing. It was a difficult period when, on 10 June 1940, they saw Italy enter a world war for the second time. By this time, however, the children were grown and free to move around by themselves.

Mario graduated high school without passing any exams, which had been abolished because of the war, and enrolled in the Law Faculty of the University of Rome. Ennio instead moved into senior high. His humanities professor, Maria Pellegrino, remembers him thus[16]: "He was the smallest and most reserved student, but if the subject interested him he would raise his hand for a poignant observation, or an original solution." He was awarded a top grade in classical Greek and that made waves: teachers and classmates talked about it. Even his mathematics professor, Giuditta Fontana, was impressed. One time, she gave the class an assignment with a process to follow that she had drawn up on a previous day. Ennio followed a different procedure that he thought to be more elegant and concise. The professor was astonished and spoke of it with her colleagues Palamà and De Benedetto, who deemed it quite unusual.

Carlo Bernardini, who later became a professor of physics at the Sapienza University in Rome, was a student at the same high school during that time. Bernardini remembers[17]: "there was a professor of Italian Literature by the name of Alfredo Mazzotta. He was a humanist, a mild-mannered man, a bit dreamy and distracted, and an amateur mathematician. His passion was number theory. He had published a few theorems in the Italian Mathematical Union Bulletin some of which, knowing my secret propensities, he shared with me. Some I understood and some I didn't, but I was completely seduced by his unusual intellectual mix. For Mazzotta, writing well and understanding mathematics went hand in hand. So I applied myself to writing, as I could not compete in mathematics, as opposed to one of my senior schoolmates, who was none other than Ennio De Giorgi, who would become a star of the Italian mathematics world."

Ennio De Giorgi obtained excellent results not only in mathematics, but also in classical studies. He amazed his literature teacher with an essay on *Cantico delle Creature*, one of the oldest texts in Italian by Saint Francis of Assisi, and his favorite poem. He also had in-depth discussions with his philosophy teacher[18] and particularly enjoyed studying history.

---

[16] R. De Giorgi Fiocco, in a private communication.

[17] C. Bernardini, *Fisica Vissuta*, Codice (2006).

[18] While in high school, and always within the limits imposed by his polite demeanour, De Giorgi had heated discussions with his philosophy professor, an intellectually sharp atheist. As a good Catholic, De Giorgi did not agree with many of his ideas, and every now and again he would raise his hand to dispute a point made. He always began shyly with the words "But… actually, I think…". R. De Giorgi Fiocco, 2007.

In the meantime, Mario had found a place to stay in the house of the widow of a general[19] in Rome, but was then drafted into the Army. He left on 28 February 1941 on a train packed with smiling kids, oblivious to the fate in store for them. Thus, Ennio found himself, as an adolescent, quietly invested with the responsibilities of being the only man left in the family. And as such, he would soon have to take care of the women in the family, such as carrying his grandmother wrapped in a blanket to the basement, where they were shielded from the bombings. They became his responsibility, the fact that he was skinny, weak and often ill with the flu and tonsillitis notwithstanding.

Grandma died in 1942 at the age of 87. Rosa enrolled in the University in Rome and at the beginning of the academic year she and her mother left for the capital city, where they found accommodation in a hostel run by nuns. Ennio was left alone in a big house that had suddenly become empty. And in spite of his aunts caring for him, his sister found him sad and melancholic on her return after a few months.

At that time, Ennio had another premonition. He gathered his family members in prayer because he believed his brother to be in danger. And he was right. After training as a sharpshooter in Bologna Mario was stationed in a small town called Villa del Nevoso, on the border between Italy and Yugoslavia, an area where Italian Army troops regularly fought with partisans of the resistance. On the day on which Ennio had worried about him, Mario was supposed to have taken a bus back to his barracks, but was unable to board because it was full. A few minutes later the bus exploded and many of his friends that had boarded ahead of him perished.

The war was becoming ever more oppressing. Poverty and fear spread like incontrollable plagues. Air raid warning sirens often wailed in Lecce, and from 8 pm a strict curfew was enforced, so that the De Giorgi family had to paint their windows blue to prevent light from leaking out. Many sought refuge away from the city and left for the countryside or the mountains of the regions of Basilicata and Abruzzo. Eventually, the De Giorgi family moved to an old house in the village of Lizzanello, not far from Lecce. The house was surrounded by a large garden. It was here that Ennio renewed his passion for rural life and for the farmers who lived in the area, so much so that some believed he would have a future as an agronomist.

Ennio and Rosa were in Lizzanello on 8 September 1943 when the radio broadcast the news of the signing of an armistice. They went up to the terrace to celebrate, especially because they were happy to think that they would be able to hug their brother again soon. It seemed that the nightmare was over, and the following day they returned to town in a horse-drawn carriage.

However, hopes were soon shattered, as the situation revealed itself to be far more confused than initially perceived. Rumors abounded. “The Americans are advancing towards Salento,” “The Germans are setting up pockets of resistance in the Puglia region,” “The king has reached Brindisi” … The De Giorgi family retreated to their home for 2 days as the painful reality dawned on them. Italy was split in two and the Germans were fighting the American advance along the Gustav

[19] General Cesare Bardeloni, who studied radio waves and knew Guglielmo Marconi.

Line. All communications with the North were interrupted and therefore all news of Mario was lost. It was only after a few months that they found out that he had sought refuge in Trieste, where a few relatives of their mother were helping him as best they could. It was only later that they discovered what had really happened. Following the armistice of 8 September, Italian troops had found themselves leaderless and at the mercy of the Germans. Mario managed to escape as he returned to Trieste, and hid in a laundry shop. There, the staff sheltered him and found him new clothes to avoid the danger that the Germans might recognize him as a soldier.[20] Trieste was then in German hands, but life continued as normal in the town in a relatively peaceful way. Mario managed to remain inconspicuous and was even able to continue his university studies.[21]

The months between 1943 and 1945 went by with exasperating slowness: it was a hard time to endure. Medicines were not available, not even on the black market. Soon stocks of products from the northern factories were exhausted and clothes could no longer be found. Rosa recalls that they were forced to make their own summer shoes with some cork and bits of spare cloth. Winter shoes were harder to produce, so old pairs were recycled. It was a leap backwards in time: women went back to sowing and weaving machines and to knitting wool, whereas old clothes were adjusted. Ennio used Mario's wardrobe.

Given the circumstances, Rosa continued her studies in Lecce instead of in Rome. Ennio stayed on in high school. The two siblings often rode their bicycles in search of milk, cheese, potatoes and vegetables.[22] They both helped the Vincentian nuns who looked after elderly people in difficulty.

In February 1945 Rosa finally managed to reach Rome with her mother, to return to University there. The two women returned home for Easter after a disastrous 30-h journey. The situation was ever more unstable. The Germans were abandoning Italy, the liberation committees of the partisans were controlling the northern regions, Mussolini had been executed and his body hung upside down in Piazza Loreto in Milan. The war was coming to an end and the Germans surrendered on 8 May 1945.

The difficulties notwithstanding, Rosa returned to Rome in June to attend her exams. This time, mother stayed at home to await the return of her distant son. Finally, on 7 July, the long wait was rewarded: Mario arrived while Stefania was attending Mass at the Madonna del Carmine church. The family was finally back together, signaling a new beginning. "There were so many problems,—recalls Rosa,[23]—none of us had jobs, we were physically exhausted but we were also sure that we would build our new future." Moreover, Mario had brought with him some

[20] A. De Giorgi and R. De Giorgi Fiocco, 24 January 2009.

[21] R. De Giorgi Fiocco, 24 January 2009.

[22] Because of its location, relatively far from the conflict zones and close to the countryside, fresh food could be found in Lecce, unlike in the rest of Italy, which had been devastated by war. In any case, R. De Giorgi Fiocco remembers that her mother Stefania, having experienced a similar situation during the First World War, always kept adequate provisions.

[23] R. De Giorgi Fiocco, in a private communication.

good news. During those difficult years in Trieste he had managed to graduate with a law degree.[24] Ennio on the other hand, was about to begin his last year of high school.

Italy had just been reborn, and wanted to get rid of fascism and the monarchy. In the spring of 1946, while Ennio was getting ready[25] for his final high school graduation exams, which had been reinstated, Italy was preparing for a referendum that would sanction the birth of the Republic and the Constituent Assembly.

The future mathematician was absorbed in his studies and the results were excellent: he was awarded high grades in Italian, Greek, Latin, physics, philosophy, political economics, art history, natural science, chemistry and geography. He achieved top grades in history and mathematics. He even managed to obtain a good grade in PE. His teachers foresaw a future in philosophy or mathematics for him. Prof. Palamà who, like Prof. Ramirez, declared him a genius, suggested that he might dedicate himself to "pure mathematics." Ennio reflected on his choices for a long time and eventually opted for Engineering. Before beginning his university courses, however, he spent a month on holiday in L'Aquila, in the mountains of central Italy. Here, he was awed by the sight of the Gran Sasso (the Apennines' highest summit) and from this moment, his love of mountains, which he would keep for the rest of his life, was born.

[24] Mario had managed to pass several exams during a 2-year period, and he attracted the attention of his teachers. Salvatore Satta (1902–1975) wanted him as a student and Giuseppe Bettiol (1907–1982) offered him a place as an assistant. However, Mario decided to return to his family in Lecce.

[25] In that same year, Ennio won the Avvocato Antonio Adamucci scholarship, which came with a 5350-Lire prize, and was awarded by the Palmieri high school. It was named in honor of one of the main founders of the Appeals Court in Lecce. Among other winners was the linguist Oronzo Parlangeli (1923–1969), who was awarded the scholarship in 1939–1940.

Chapter 2
Roman Halls

When De Giorgi reached Rome in 1946, the city was on its knees. First of all, it was hard to reach, as the railway lines were so badly damaged.[1] Then there was political instability and poverty; the entire infrastructure had been destroyed and public transport was almost non-existent. It was difficult to move from one end of the city to the other. All this notwithstanding, Ennio was happy because he had found a stimulating atmosphere in the capital, on account of Mussolini attempting to gather there the best university professors in Italy.[2]

In Rome, Ennio could rely on his sister's help: "We kept each other's company. We often met within the faculty buildings, walking along the boulevards of the university area"—remembers Rosa[3]—"or he, as a strong walker, came to visit at the nun's hostel where I was lodging in via Gaeta. There he was well liked by my colleagues who viewed him differently from the majority of university students: he was reserved, kind, thoughtful, and always ready to lend a hand or explain some mathematical issue."

Thanks to his sister he found somewhere to live. He had a room in the family home of one of Rosa's friends. The father, Gaspare Greco, was also from the Salento region like Ennio and was a teller at the Banca d'Italia (the Italian central bank); the mother, Luisa, was a housewife originally from the province of Rome; and their only son Antonio was the same age as Ennio. They lived in a building owned by the bank in Viale del Re (later to become Viale Trastevere), in front of the white palace that housed the Ministry of Education.

---

[1] L. Carlino, one of Ennio's childhood friends, also studying in Rome at the time, remembers [3]: "Train journeys were long and disastrous; at times, you had to try and jump in through the windows, as there were so many people travelling."

[2] Mussolini's objectives were more nationalistic than academic, as the race laws of 1938 demonstrated, with regard to which, in a letter on the political climate in 1974, Ennio De Giorgi wrote, "my antifascist beliefs have strong roots. They are the fruit of a long reflection that began when I was a boy and read with disbelief and disgust the texts of the race laws and continued with my painful war experience." E. De Giorgi in *Una lettera sul clima politico, nella imminenza del referendum sul divorzio*, May 1974. Published in [2].

[3] R. De Giorgi Fiocco, Lecce, 2007.

A. Parlangeli, *A Pure Soul*, https://doi.org/10.1007/978-3-030-05303-1_2