

Cecilia Jarlskog  
*Editor*

# Portrait of Gunnar Källén

A Physics Shooting Star and Poet  
of Early Quantum Field Theory

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Lund, Sweden

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The Last Picture of Gunnar Källén,  
taken on the “order” from his wife, as he put it

Wolfgang Pauli referred to him as “my discovery”, Robert Oppenheimer described him as “one of the most gifted theorists” and Niels Bohr found him enormously stimulating. Who was the man in question, Gunnar Källén<sup>1</sup>? This book attempts to give at least a partial answer to this question.

In addition to being a remarkable scientist, Källén had a very interesting personality, well worth knowing. His appearance on the physics sky was like a shooting star<sup>2</sup>. His scientific interventions caused excitement among young and old. He was not intimidated by anyone and a master of responding in kind, even to Pauli.

Alas he died much too soon, at the age of 42, in a plane crash near Hannover, Germany.

He deserves to be remembered.

---

<sup>1</sup> Källén's, for English speakers difficult last name, can approximately be pronounced as Shellen, with accented last syllable where the “e” is pronounced as in bet or peck.

<sup>2</sup> This remark is due to the distinguished Danish physicist Christian Møller (see Chap. 65).

# Preface

In theoretical physics, history can be largely unfair. In times when there are urgent problems to be solved, it quickly creates a number of “great scientists” and immortalizes them, crowned with glory, in its books. This was certainly the case during the first decades of the 20th century. There were experimental puzzles crying to be solved and in a relatively short time the remarkable fields of special relativity and quantum mechanics were born. Many were those who went to history as great scientists, by contributing to different aspects of this revolution. Without hints from nature, it is very difficult for a theoretical physicist to “show the whole world” how great he/she is, even if he/she were the smartest and most creative scientist of his/her time. Creating a new wave, without experimental hints, is a tremendous challenge. The best (and only?) example is the creation of general relativity, where Albert Einstein “single-footedly” climbed up all the way to the top of the ladder of fame by single-handedly proposing his theory of general relativity. But he could *afford* it, as he was already at the top due to his other contributions which had been prompted by experimental observations. One may wonder what would have happened if Einstein had *only* postulated his theory of general relativity and nothing else. Had the scientific community noticed it and cared enough about it to send expeditions to Brazil and Africa to check his “speculations”?

Källén sometimes expressed his regret for having been born “too late”, as he put it. He had come to Lund University in 1948 as a full-fledged 22 year old electrical engineer who wished to re-orient himself toward theoretical physics. In no time at all he had acquired an incredible amount of knowledge, as it is testified by his very first paper published already in 1949. Indeed, Källén was born in 1926, while the founding fathers of quantum electrodynamics, with whom he compared himself, had been around years before he appeared on the scene. They had almost done it all! Years later, his four years older collaborator, from Princeton University, Arthur S. Wightman said about him:

“At that time I was trying to puzzle out the grammar of the language of quantum field theory, and here was KÄLLÉN writing poetry in the language.”

Here below is a more extended version of Wightman's description<sup>3</sup> of Källén:

“Gunnar Källén's death in an airplane accident, October 13 at Hannover, Germany, is a great personal loss to his many friends all over the world, a loss to research and education in Scandinavia, in which he played an important role, and a loss to theoretical physics where his contributions are well known. Gunnar Källén was a proud continuer of the tradition in quantum field theory established by Wolfgang Pauli<sup>4</sup>. His papers on quantum electrodynamics in the period 1950–1954 carried the non-perturbative approach to quantum electrodynamics forward to a point beyond which very little essential progress has been made up to the present day. I still remember the impact of the *Helvetica Physica* paper of 1953. At the time I was trying to puzzle out the grammar of the language of quantum field theory, and here was KÄLLÉN already writing poetry in the language!

In 1960's Källén spent an increasing fraction of his time on the phenomenology of elementary particles. A by-product of this was his book “*Elementary Particle Physics*”. A typical remark about the book was: “That is the book on elementary particles the experimentalists really find helpful”. Those of us who knew him expected that.

Källén's unflinching adherence to what he thought was essential and true in theoretical physics was combined with personal cheerfulness and friendliness.”

As a second year graduate student from Lund University, Källén was sent to Zürich to attend Pauli's lectures in the 1949 summer session at ETH (Swiss Federal Institute of Technology, a prestigious institute for higher education and research in Zürich). This event staked out Källén's research path for years to come. It was also the beginning of a most fruitful interaction between Källén and Pauli, for almost a decade until Pauli's death in 1958. They were mutually attracted to each other. Perhaps Pauli saw in Källén an image of himself as a young man. Källén found Pauli's approach to physics, his strong opinions, his wit and sharp tongue quite similar to his own. They enjoyed each other's company.

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<sup>3</sup> Wightman's entire article is published in *Communications in Mathematical Physics*, Volume 11, Number 3 (1968–1969) pages 181–182. See also Chap. 64 and 78.

<sup>4</sup> Wolfgang Pauli will be introduced in Chap. 3.

**Källén's scientific work** can largely be grouped into four main categories, namely:

- (1) **Quantum electrodynamics and renormalization**, without using perturbation theory: It was in this area that the young Källén demonstrated his legendary ability to grasp difficult issues quickly as well as his mathematical power and originality. His work placed him in Julian Schwinger's "Hall of Fame of Quantum Electrodynamics". In the literature, his name appears in the Källén-Yang-Feldman formalism, Källén-Lehmann representation and Källén-Sabry potentials. He would have been pleased to see that his "potentials" are used even now, after more than half a century, within a *broad* spectrum of applications whenever precision is required, such as in quantum chromodynamics,  $Z$ -decays, atomic transitions, and exotic atoms.
- (2) **The Lee Model**: The joint Källén-Pauli 1955 paper on the mathematical structure of T. D. Lee's model of a renormalizable field theory added richly to the understanding of a certain class of field theories. The Nobel Laureate **T. D. Lee**, (together with R. Friedberg) has written a special article for this book to honor Källén's memory. Why Källén was at all interested in the Lee Model is described in a chapter in this book by another Nobel Laureate, **Steven Weinberg**, who also gives his views on the future of quantum field theory. Weinberg considers himself as one of Källén's "disciples".
- (3) **The  $n$ -point functions**: Källén devoted several years to the study of these functions, which are the vacuum expectation value of the product of  $n$  scalar fields. He was hoping that this novel approach would help him resolve the issue of whether quantum field theory (specially quantum electrodynamics) is a consistent theory. This was a topic close to his heart, as he expressed it himself. The challenging mathematical beauty and complexity of the  $n$ -point functions appealed to him. Källén loved to solve difficult problems. Pauli disapproved of Källén's involvement in this field of research and warned him that he was wasting his time. Källén disagreed but a few years later he got very disappointed that this line of research did not lead to progress in *physics* that he had anticipated.
- (4) **Radiative corrections in weak interactions**. After having written his book "Elementary Particle Physics", published in 1964, Källén started doing research in this field and for a few years worked on radiative corrections to neutron beta decay. In this volume, **Alberto Sirlin**, a pioneer and expert in this field, gives a status report and discusses Källén's work.

In addition to his scientific heritage, Källén left behind a substantial number of "**disciples**", many of whom became university professors.

The purpose of this book is to present Källén, who was one of the shining stars on the physics sky of 1950's and 1960's. The reader is invited to get to know his unusual personality and become acquainted with some aspects of the history of our science in those days, as related by him and those who corresponded with him. In addition, a selection of his most important and not easily accessible papers is included, for the specialists to enjoy. If the reader is interested in any of his other papers he/she is invited to contact me (CJ) as I have a complete collection.

# Acknowledgements

This book consists of five Parts. The first four contain material of both biographical and scientific nature. In them, there are chapters written to be comprehensible to anyone who wishes to know more about Gunnar Källén and his time. The fifth Part is intended for specialists, as it includes a selection of Källén's articles as well as commentaries that give more information about his work.

As everyone who has ever produced a book perhaps knows, but I (CJ) didn't realize is that producing a book such as this one takes a huge amount of time. I would not have started this enterprise if I had not been reminded, on several occasions, by Professor André Martin at CERN that "someone" should do "something" so that Källén is not forgotten. Thereby, he gave me such a bad conscience that I felt that I had no choice but to plunge into "doing something" and do it as quickly as possible. Indeed, the number of people who personally knew Källén is on constant decline and even some of his students have already passed away.

My most profound thanks go to Professor Steven Weinberg who came to Lund to give the 2009 Källén Memorial Lecture and for his article included in this volume. I am also indebted to Professor T. D. Lee who (together with R. Friedberg) has written an article for this book, to honor the memory of Gunnar Källén. Special thank go to Professor Alberto Sirlin for his assessment of status of radiative corrections in weak interactions and Källén's contributions to this field.

This volume has been further enriched by contributions or comments from Herbert Abels, Sture Allén, James D. Bjorken, Anders Bojs, Karl-Erik Eriksson, Ludwig D. Faddeev, Herbert M. Fried, Stephen Gasiorowicz, Nico van Kampen, Benny Lautrup, Poul Olesen, Afaf Sabry, Raymond Stora, Bengt E. Y. Svensson, Martinus J. G. Veltman and Antonino Zichichi. I wish to express my deepest gratitude to them all.

Special thanks go to Källén's four children and his brother Bengt Källén. Källén's children, Erland, Kristina, Elisabeth and Arne, for their support of this project. Erland – himself a private pilot – upon being asked immediately agreed to write an article for this volume, on the fatal plane accident that took

his father's life. Professor Bengt Källén has contributed with a precious article about his brother.

I have found almost all the material for producing this book in Sweden – primarily in Lund. I would like to take this opportunity to thank the members of the Manuscripts & Archives Division of the Lund University Library for their hospitality during the countless hours that I spent at their reading room. I am also indebted to the staff of the Center for History of Science at the Royal Swedish Academy of Sciences (Stockholm) as well as that of the Royal Physiographic Society (Lund) for their kindness and for letting me go through their precious archives. I have also benefited from visits to the Central Library at CERN.

Finally, sincere thanks go Linda Jarlskog for her gratuitous artistic work - photographing portraits at the home of Arne Källén, as well as scanning and retouching pictures supplied by Kristina Källén, presented in this volume.

Last but not least I wish to thank Jens Vigen, the Head of the CERN Library, whose enthusiasm and good advice have always impressed me. I am also indebted to Christian Caron, the Executive Editor at Springer. I can't imagine a more positive and helpful Editor than he.

Lund, January 2013

Cecilia Jarlskog (abbreviated by CJ in this book)

# To the Readers

For the benefit of the readers, this book starts by giving a bird's-eye view of how the material in this book has been organized.

**Part 1: Youth, Career, Personality, Legacy, Family and Fatal Accident** is primarily of biographic nature and gives an overview of Gunnar Källén's life from childhood to his untimely death at the age of 42. Here, the reader gets acquainted with circumstances which made him into the scientist that he became, among them how he was sent to Wolfgang Pauli's "Court" in Zürich and the impact of this sojourn. I describe his academic career and how a personal professorship was created for him at Lund University – an utmost rare event in those days that had to be approved by the Swedish Parliament. Afterward we follow Källén to his last conference in Vienna, to which he flew piloting a small plane. His tragic death a few months later, while flying to a meeting at CERN, is described by his son Erland.

Part 1 also scrutinizes Källén's personality, his likes and dislikes, and issues such as the origin of his grudge against Julian Schwinger. I describe Källén's genuine interest in the education of young people and his kind fatherly attitude toward them. The reader is also invited to meet a person of utmost importance in Källén's life – his wife Gunnel. The two made a lovely couple and were manifestly devoted to one another as well as to their four children. They used to sign their names together in the form **Gunn<sup>el</sup><sub>ar</sub>**.

**Part 2: Correspondence with Pauli, Heisenberg and Dirac; Källén in Action** dives deeper into a discussion of Källén's unusual personality and his views about science. The material in this Part is largely based on his correspondence (found in Lund) with Wolfgang Pauli, Paul Dirac and Werner Heisenberg. Some of his collaborators are presented in this Part, together with his opinion about them and theirs about him. The reader will find Källén in action, giving talks at conferences and schools. Källén was an exceptionally interesting person on such occasions. His sharp intellect and speed with which he did complicated mathematical computations were legendary, as were also his sharp tongue and lack of respect for authority. Moreover, he "enjoyed a fight", as he put it himself, and the students even more. To see the giants of theoretical physics fight over scientific issues meant that the topics discussed must

have been captivating and of utmost importance. This by itself was a source of inspiration. Who was right or wrong was a secondary issue to the students who usually didn't understand what was going on.

**Part 3: Promotion of Science in His Honor** gives a very brief introduction to the Royal Physiographic Society in Lund and the Royal Swedish Academy of Sciences in Stockholm as well as the Ettore Majorana Center at Erice, Sicily. This Part describes what these promoters of science have done to honor Källén's memory. The next item presented is the written version of a "Källén Lecture" by Steven Weinberg, held in Lund under the auspices of the Royal Physiographic Society. The title of the lecture was "Living with Infinities".

In the second half of 1950's, Källén, as well as several other prominent scientists, spent much effort to understand the renormalization aspects of a soluble model proposed in 1954 by T. D. Lee. In return, now more than half a century later, T. D. Lee honors Källén's memory by a special article for this book, written together with R. Friedberg. The article, "A Soluble Model of 'Higgs boson' as a Composite", constitutes the last chapter of Part 3.

**Part 4: On His Scientific Work** sets the scene for the presentation of a selection of Källén's scientific work. The bulk of the material presented in this Part originates from Källén's correspondence at the Lund University Library. The reader finds Källén proudly informing Wolfgang Pauli of his achievements. His studies of non-perturbative renormalization in quantum electrodynamics lead him to conclude that this theory is inherently sick. This achievement places him in the "Hall of Fame of Quantum Electrodynamics". As is often the case, such a remarkable work prompts controversies. We examine how he deals with them. Afterwards, we follow him through his Lee Model period into his more mathematical work on the  $n$ -point functions, as well as his subsequent transition into particle physics phenomenology. In a special chapter in this Part, Alberto Sirlin gives his views on Källén's work in this domain.

In spite of the fact that Källén often expressed misgivings about the role of stringent mathematics (what he called "epsilonotics") in physics, he loved *applied* mathematics and was very good at it. Wolfgang Pauli considered him to be superior to himself, as we shall see later! In Källén's correspondence there is a manuscript with the title "A Connection Between the Bergman-Weil Integral and the Cauchy Integral". It is marked *not for publication*. There can be no doubt that Källén enjoyed this work of his very much. He sent the manuscript to several people, among them some mathematicians, asking for their comments. This unpublished article is presented in the last chapter of this Part. After all, according to the current rules, reproduction in a book *does not* count as publication.

The **Part 5: Papers and Commentaries** includes a selection of Källén's papers. Of course, these can only be understood by specialists. Nowadays, in the academic circles, the specialists have in general easy access to articles published in many journals – a few clicks is all that it takes! Therefore, primarily articles that are *not* easily available, at least not yet, are included in this Part, for example, his papers published in the journal of the Royal Danish Academy of Sciences, “Matematisk-Fysiske Meddelelser (Det Kongelige Danske Videnskaberne Selskab)”. In addition, commentaries are given on several of Källén's other articles that due to page limit could not be included. The purpose is to briefly inform our interested readers about their contents.

In producing this book, much effort has gone into making it as easy-to-read as possible. Therefore, there are some repetitions in the presented material – this for the benefit of those readers who do not read this book from cover to cover. We apologize to those who do and hope that they may find consolation in the words of the Danish philosopher Søren Kierkegaard:

*“Repetition is the reality and the seriousness of life”.*

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# Invited Contributions

This book contains invited contributions by the distinguished authors listed below, all of whom knew Gunnar Källén personally:

- **K-E. Eriksson** (Chalmers University of Technology, Gothenburg, Sweden): Some Reminiscences of Gunnar Källén's Role in Sweden
- **B. Källén** (Lund University, Lund, Sweden): The Childhood and Youth of Gunnar Källén
- **E. Källén** (Stockholm University, Stockholm, Sweden and European Centre for Medium Range Weather Forecasts in Reading, England): My Father's Passion for Flying and His Mortal Accident
- **T. D. Lee**, together with R. Friedberg (Columbia University, New York, USA): A Soluble Model of "Higgs boson" as a Composite
- **A. Sabry** (Egypt): How it Was to Work With Prof. G. Källén
- **A. Sirlin** (New York University, New York, USA): Källén and Radiative Corrections
- **R. Stora** (CERN, Geneva, Switzerland): Källén's Constant  $M$
- **B. E. Y. Svensson** (Lund University, Lund, Sweden): Some Reminiscences of Gunnar Källén as Supervisor
- **S. Weinberg** (university of Texas, Austin, Texas, USA): Living With Infinities

# Major Sources of Information and References

The *most important* source of information in this book has been the “Gunnar Källén Collection” at the Manuscripts & Archives section of the Lund University Library. It consists of 18 “boxes” that were deposited there after Källén had passed away. They contain his correspondence as well as other documents, such as scientific articles, reviews and referee reports, from late 1958 to October 1968. Only his correspondence with Wolfgang Pauli extends further back in time, to 1949. Here, this archive is referred to as the “**Källén Collection**”.

Källén became a professor in Lund on 1 August 1958. He and his wife designed their new home and the family moved to Lund in the spring of 1959. In Lund, from September 1959 until his death, Källén had a very competent secretary, Ms Margareta Bergsten, who would archive his papers and correspondence. The fate of his earlier correspondence is not known. The disruption caused by his sudden death, followed shortly after by that of his wife, could have been the reason for this unfortunate situation. The material in the Källén Collection is in several languages, in addition to English, primarily in German and Swedish but also to some extent in French and Danish. Unless specified otherwise, the reader can take for granted that any letter in this book, from or to Källén, stems from this Collection.

Another frequently used source of information in this book is the monumental collection of Wolfgang Pauli’s correspondence (Wolfgang Pauli, *Wissenschaftlicher Briefwechsel ...*) in several volumes, edited by Karl von Meyenn. It constitutes a true goldmine for those interested in the history of physics, especially during the first half of the 20th century. In addition to Pauli’s correspondence it also contains some related letters. This “**Pauli Collection**” is an invaluable source of information about Källén, such as Pauli’s opinion about him that he transmitted to others. The letters in these volumes are conveniently labeled in the form [number], where for example [1234] denotes letter number 1234 in the Collection. The Pauli Collection is primarily in German. However, letters in English have been reproduced in the original version but, for example, letters in Danish have been translated into German, actually sometimes by Källén. Whenever the reader encounters a reference of the form “[number] in the Pauli Collection” the source is the above volumes edited by von Meyenn.

The originals of Pauli's letters to Källén are in Lund, together with copies of Källén's letters to Pauli.

Throughout this book, I (CJ) have been responsible for all the translations (from German, Swedish, Danish and French) into English.

For more detailed information about the above Collections, the reader may consult Appendix I-A, at the end of Part 1.

## Biographies

The names of a large number of physicists appear on the pages of this book, primarily those whom Källén encountered on his scientific path. They are presented only briefly to the readers because nowadays a great deal of biographical material is available on the internet, though not all can be trusted and sometimes one finds glaring errors in them. Therefore, we specifically indicate the Nobel Laureates simply because their autobiographies are easily accessible on the internet and are generally trustworthy. Some other sources of information about people are Wikipedia, CERN Courier, Array of Contemporary American Physicists as well as various encyclopedias.

## Reprints and Quotations

This book contains reprints of a number of Källén's articles and quotes from proceedings of conferences and schools. We wish to thank the people listed below who, on behalf of their organizations, have given us the permission to include them in this book. The relevant journal or conference is indicated inside the square brackets. Sincere thanks go to:

- Karl-Fredrik Berggren, President of the Swedish Physical Society [Kosmos];
- Kirsten Hastrup, President of the Royal Danish Academy of Sciences [Mat. Fys. Skr. Dan. Vid. Selsk.];
- Marc Henneaux, President of the International Solvay Institutes [Solvay Conferences 1961 and 1967];
- Levente Istvan Koltai, Head of Rights & Permissions [Springer-Verlag, Acta Physica Austriaca];
- Christophe P. Rossel and Ulrich Straumann, President and Vice President of the Swiss Physical Society [Helvetica Physica Acta];
- Jens Vigen, Head of CERN Library [1956 CERN Conference];
- Roger Wäppling, Chief Editor at the Royal Swedish Academy of Sciences [Arkiv för Fysik and Physica Scripta].

# Part 1

## Youth, Career, Personality, Legacy, Family and Fatal Accident

### Preface

“I wish to thank you very much that you have sent to me Dr.<sup>1</sup> Källén, who turned out to have great skill and talent. He is working both very quickly and [is] very reliable.”

Pauli to Gustafson (1949)

For every error Källén makes I am allowed to make two.

Harry Lehmann’s “Grand Theorem” translated from German (1955)

This Part is mainly about the life and personality of Gunnar Källén. He is introduced by his brother as well as by himself, and his unusual personality is exhibited through his correspondence.

First we follow him on his academic path and introduce those who helped him to get started. Then, we dive deeper into a description of his personality. As an example, we look into the issue of his seemingly hostile attitude toward Julian Schwinger.

We describe his status on the international scene and how he was perceived by his contemporaries. The legacy he left includes not only his scientific achievements but also his “disciples” some of whom, perhaps without realizing it, were much influenced by his strong character and his demand of honesty and rigor.

In the last chapters of this Part, Källén’s wife Gunnel is introduced. Finally, Källén’s oldest son describes his father’s passion for flying and his tragic fatal accident.

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<sup>1</sup> Källén was a second year graduate student and not yet a Dr.

# 1

## Bengt Källén: The Childhood and Youth of Gunnar Källén

In the middle of the 19th century, most people in Sweden worked on farms.<sup>1</sup> When industrialization began, new demands arose, among other things a need for a more systematic education of the population. In 1842, a general school (“folkskolan”) was introduced which developed into a seven year compulsory school and some bright farmer children continued their education. One of these was Gunnar’s paternal grandfather, Anders Persson (the son of Per) who came from a farmer family who for generations had cultivated land on an island east of the Swedish mainland, Öland, at a place called Källa (Swedish for a well). When Anders started his higher education, he changed his family name to Källén based on his place of birth. He ended up as a high school teacher. He married a girl who came from a different background with members from the clergy, military and law sections of the society. Anders died young, leaving his wife with two young sons. Despite these odds, both sons managed to get higher educations and both became teachers.

Anders Olof Gunnar Källén was born on the 13th of February, 1926 in Kristianstad, a small city in the South of Sweden, as the second child to the younger of Anders’ two sons, Yngve, who was a teacher in mathematics and physics. His wife Karin was also a teacher, in Swedish and history. According to the customs at that time, Karin stopped working as a teacher when she had children. There was an elder child in the family, Margit, born in 1924. As an infant she had severe encephalitis which resulted in a moderate permanent brain damage. In 1929 the family was further extended by the birth of Bengt, the author of these lines. In the autumn of 1929, the family moved to Gothenburg where Yngve took up a job at one of the so-called “gymnasiums”, a Swedish school form which corresponds to upper secondary school in the United Kingdom and to senior high school in USA.

Our father had to interrupt his academical training and only got the lowest exam for a teacher even though his capability certainly could have allowed a further academic career. This was for economical reasons; even before he got his own family he had to help to support his mother. I think that his dream was

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<sup>1</sup> Note added by me (CJ): Bengt Källén is the brother of Gunnar Källén. He is professor emeritus in embryology at Lund University. This article was written by him in 2008.



**Figure 1.1** Gunnar to the right with his elder sister and younger brother. Photo taken in August 1930 when Gunnar was 4 1/2 years old

that his eldest son should fulfill what he had not been able to do. A common quotation which was heard at home was “Ille faciet” (he shall do it) which has been ascribed to the Swedish king Charles IX about his son Gustavus II Adolphus, the king who played an important role in the 30 year European war.

It was a typical middle-class family, no real shortage of money but no excesses allowed. This was in the 1930s, the time of the great depression continuing into the Second World War. We lived in a three-room flat and Gunnar and I shared one of the rooms until I left to go to medical school in Lund in 1947. The head of the family was without doubt father – the family structure was very patriarchal. We reacted differently to this – Gunnar accepted the principle and may have carried it into his own married life; I rebelled and took the side of our mother. No bodily punishment existed – it was enough that our father knitted his brows to subdue an obstinate child. Our father had a tendency to get caught up in injustices in life but never compromised. He was confident that he was right and if, for instance, his headmaster had another opinion, the worse for him. And he usually got his way. By his example, we were trained to stand up for our opinions and express them clearly, irrespective of possible resulting inconveniences.

Gothenburg is a major harbour in Sweden and it was therefore often fish for dinner. This was not a great favourite of the children – this was a time when fishes were served with all bones intact, not as rectangular blocks of fish meat.

In order to get the children to eat their fish, our mother used to tell them that you get intelligent by eating fish. Gunnar, aged approximately five, looked at her with unsmiling eyes wide open and said: “Did not Mother get fish when Mother was little?” A repost which became part of family sayings.

At this time, the Swedish school system basically consisted of various choices, taken according to ability (and perhaps economy). There was a four year preparatory school as part of the compulsory seven year school system and you entered school at the age of seven. After these four years, it was possible to leave the main stream education and begin in a school system called “realskola” which you could follow for another five years and then leave with an exam called “realexamen”. After that one could continue to the “gymnasium” (see above) for three years but it was also possible to enter “gymnasium” after four years in “realskola” and then you had four years in “gymnasium”. This period ended in an examination (“student examination”, a graduation) which made it possible to continue with university studies.

We were both sent to school at the age of six, one year before compulsory school age. This meant that we had to attend private schools for the first four years and then had to pass an exam to be allowed to begin in the “realskola”. We attended the same school where our father was a “gymnasium” teacher. Gunnar came home rather upset from that exam because there was only one question which he had not been able to answer: what can the hairs of a badger be used for? He thought that his parents had failed their parental task by not telling him that one could use them for making a shaving brush.

The family was rather intellectual and especially our father demanded maximum school performances from his sons. Margit, for reasons explained above, could not manage ordinary school but followed classes with the exception of some subjects, including mathematics. A school mark for Margit above minimum level caused more pleasure than when the sons came home with top marks – it was just expected. Gunnar was looked upon as the intelligent one and had the highest expectations on him – our father regarded me as second rate. One of my proudest moments was when he should help me catch up with some mathematics after I had spent a couple of weeks in hospital. After the first “lesson” he looked at me and said: “You might not be as stupid as I have thought.” On the other hand, every effort we made in the way of sports was looked upon with suspicion as a waste of time. We both stayed away rather well from sport activities with the exception of rare and very informal soccer games in the back-yard.

Obviously we had hobbies; to some extent we shared them. One such interest was to build and fly model airplanes, driven by rubber strings. We built (mainly Gunnar of course) a large such plane called “Gladan” (“The Kite”) which we flew together. Gunnar was, in contrast to our father, very handy



**Figure 1.2** Gunnar with “Gladan”. Aged about 15

and always put things together in a perfect way. Gunnar had another hobby; he built electric equipments with switches, home-made ampere and voltage meters and signal lamps etc. in the form of a switch-board. Its handling sometimes resulted in short cuts which did not matter much because instead of fuses we had a kind of relays which broke the electricity in case of a short cut. When I look back I must admire my parents who not only had to stand the experiments made by Gunnar but also the biological ones made by me, including bacteria cultures on top of the gas-driven refrigerator and boiling skulls in the kitchen in order to skelet them and having fish tanks scattered over the house. Within reason we were allowed to follow our inclinations to explore the world.

The handy Gunnar was the family repair man. A memorable experience was, however, when we were visiting our maternal grandmother in Stockholm. She had a grandfather clock which did not want to chime the hours, so Gunnar started to repair it. After some work it was ready, and everyone collected around the clock to hear it chime – and it did, 1, 2, 3 up to 12 – and then continued to chime without ending. Gunnar had to get back into the clock-work and I think he managed to get it right but his proud expression up to number 12 suddenly changing to bewilderedness was a pleasure to watch for his nasty younger brother.

Family games were played. Three main games existed: chess, backgammon, and bridge. Gunnar concentrated on chess and looked down on backgammon because there is a definite component of hazard in it. He had no great feelings