

Superconductivity: Discoveries and Discoverers

Kristian Fossheim

Superconductivity: Discoveries and Discoverers

Ten Physics Nobel Laureates
Tell Their Story

 Springer

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Preface

This book has a dual perspective; on one hand the often underexposed human side of the life of outstanding scientists, on the other hand the hard facts about how great scientific achievements were made. I would like first to explain this perspective.

Humanity has always benefited greatly from courageous forerunners of progress, new knowledge and useful insights. Some of them have possessed true genius. But what are the circumstances and processes behind great scientific discoveries and profound intellectual advances? What are the driving forces and the motivating push? What roles do upbringing and family background play? Are there some little illuminated common denominators? In what way are the forerunners different from most people? Or, are they after all not so different, except being exposed to experiences that shape them and provide circumstances and opportunities that promote and stimulate their talents more than usual? How can we find out?

In the processes towards the award of the Nobel prizes in natural science a systematic effort is made to find and honour the forerunners, the discoverers of profoundly new truths, those spearheading the quest to move on into new knowledge territory. Surely, documenting 10 profiles and reminiscences like we do in the book you are reading here, will not provide the ultimate answer. Yet, I am convinced there is something to learn from these stories. On the one side there was a great diversity of conditions under which scientific breakthroughs happened, on the other hand there are common features. It is up to the reader to discover the possible red thread.

The second, and main objective of the book is its scientific subject, superconductivity. This is a field where I greatly enjoyed confronting 10 Nobel laureates one at a time and unravel their stories. This field has the advantage of 100 years of continuous development. Thousands of scientists have worked there and had their own dreams, a dozen of them becoming Nobel laureates, from Heike Kamerlingh Onnes in 1913 to Abrikosov and Ginzburg in 2003.

The basis for this book was first laid in 2001 when I completed a round of videotaped interviews of seven Nobel laureates, each of 1–2 hours length, later to be supplied with two more dialogues in 2003, and yet another one in 2004. The topic,

superconductivity, is very much a personal, lifelong fascination since I started research in that field during two years at University of Maryland, 1965–67.

The material was originally intended for, and used in some highly compressed, brief biographical notes in a special chapter of a book I was writing with my physics colleague Asle Sudbø at the Department of Physics at the Norwegian University of Science and Technology in Trondheim. The book was published with the title *Superconductivity. Physics and Applications* (Wiley 2004).

However, having all of this quite original historical material at hand, and doing nothing more about it, did not seem right. Possibly, donating it to an internationally renowned archive, like the Bohr Archives in Copenhagen, could be an alternative, but not fully satisfactory from the point of view of accessibility, and surely also not from an editorial perspective.

Several years after the interviews took place, in 2010, I approached Springer and asked if they were interested in publishing the material, and indeed they were. They had two specific requirements: Each interview should be accompanied by a brief biography, and all questions from the interviewer (KF) should be removed. I was sceptical, but when I tried it out, it did not compromise the contents to any significant extent. The book is unique in the sense that it follows a central theme of physics during as much as sixty years through the stories of 10 Nobel laureates, as told by each of them. It is hoped that it may provide inspiration to new generations of physicists, and even reach a wider audience.

My tasks during recent years as Vice President, and later as President of The Royal Norwegian Society of Sciences and Letters made the work a slow process, so we missed printing the book during the centennial of superconductivity in 2011. Nevertheless, here it is.

Superconductivity covers a huge span of ideas and applications. It takes you from the deepest science, like the much heralded Higgs mechanism, to the most fantastic technology, like recording of magnetic signals generated in your brain by your thoughts and allowing trains to be levitated by superconductivity while travelling at a speed of more than 500 km/h. It turns out that there is no natural phenomenon better suited for the study of the Higgs mechanism than superconductivity. The evidence dates back to 1933, with the discovery of the Meissner effect! Moreover, the experimental facilities, leading to the recent disclosures in the CERN laboratories in Geneva of the likely observation of the Higgs particle, are themselves the greatest manmade scientific wonder in human history. The whole experiment would be totally impossible without the use of superconductivity technology. Due to the recent great interest in the Higgs mechanism, I invited my theory colleague Asle Sudbø to write a special chapter on the Higgs mechanism in superconductivity. It may come as a surprise, even to many condensed matter physicists that the widely known and used theory for superconductivity created by Ginzburg and Landau in 1950, provides an excellent basis for the description and understanding of the Higgs mechanism.

I have to acknowledge a lot of people for their kind assistance. Foremost among these, naturally, are the 10 Nobel Laureates who, without exception, agreed to meet me and dig into their own personal and scientific history, and for most of them,

with amazing accuracy. Most interviews were conducted in the laureates' offices, or in their home. In Europe: in Zurich, Paris, and Cambridge. On the East Coast of the US: in Providence, Schenectady, Princeton, and Tallahassee. On December 11, 2003, the day after receiving their prizes, Abrikosov and Ginzburg were separately interviewed in Grand Hotel, Stockholm, where I found that even the oldest one of the interviewed physicists, Vitaly Ginzburg, at 87, was still sharp as a needle. Since then, two of these 10 great men, Ginzburg and de Gennes passed away. I feel privileged to have captured their impressive stories and parts of their unique personalities through their own words. It seems the time was ripe. Finally, in 2004 I interviewed Josephson in Cambridge.

Rather than polishing the language, I have kept the informal, oral, sometimes lively style from the interview situations in full understanding with Springer. To finalize all interview material, I invited all laureates who are still among us, to read and correct their own interview. In the case of de Gennes, I was kindly assisted by his wife Françoise Brochard-Wytt and his former colleague Etienne Gyon. At the National High Magnetic Field Lab in Tallahassee, the director, Greg Boebinger, was very helpful. Schrieffer had already given me his full consent to use the interview in whatever way I wanted during our interview meeting. I take personal responsibility for the final version of the Josephson text, written as a brief summary in third person since he did not participate in the final round of reading. I also found support in Josephson's Nobel lecture available on Internet. In the presentation of Vitaly Ginzburg, I take the responsibility for the interpretation of the tapes since he was not among us any more when I finalized the transcripts. The soundtrack was clear enough. In all other cases the laureates had every chance to make corrections.

People have commented on my choice of 10 laureates, that it could have been different. My choice was based on the following: First of all, the topic was from the start limited to superconductivity. Secondly, since the book is based on interviews, only those who were still among us during the interview period 2001–2004 could be included. Two of them, de Gennes and Anderson, were not specifically awarded the Nobel Prize for their work in superconductivity. However, it is my personal judgement that their work deeply stimulated the science of superconductivity, and hence should be included. I could have included work on superfluids as well, but chose not to, mostly just to limit the whole project.

The brief biographical notes introducing each interview are just short sketches, or summaries of what I thought were the most interesting and relevant aspects of their story. These are based on the interviews and on available literature, in some cases CV's and personal biographies, in other cases on experiences from scientific collaboration, like with Bednorz and Müller, or on my previous extended biographical work, like in the case of Giaever. To the extent that the biographical notes are similar to those published in the Wiley textbook in 2004, I am indebted to Wiley for permitting me to use those texts or parts thereof whenever I wanted.

Finally, I should like to express my special appreciation for the encouragement received from Claus Ascheron at Springer. Without his continuous support, this book would probably not have materialized. Similarly, I would like to express my

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Trondheim, Norway
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Kristian Fossheim

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