

# Preface

Bernhard Riemann is one of those few mathematicians whose work made a profound transformation of mathematics and physics. Not only his results are far-reaching, but his vision and approach to mathematics were directly felt and appreciated by all the later generations of mathematicians.

To say something original on Riemann's work is not easy, not because everything about him is known—far from it, but because it requires a profound reading and understanding of his mathematical writings, which are difficult, involving hidden geometric arguments, sometimes originating in physics and most of all relying on his broad intuitive vision. Besides a familiarity with the mathematical concepts involved, a reader of Riemann's works must be capable of following his very terse style. Anyone who has read his habilitation lecture, *Über die Hypothesen, welche der Geometrie zu Grunde liegen*, has felt its unusual tone. The mathematical ideas are expressed there in a broad and unusual language, and the results are generally stated without supporting proofs or calculations. Furthermore, these ideas are intertwined with philosophical and historical considerations, which may be incomprehensible to a reader who is not sensible to history and philosophy. André Weil mentions this memoir in a letter he wrote to his sister on March 26, 1940, and published in his *Collected Papers* (Springer Verlag, New York, Vol. 1, p. 244–255). He writes the following, talking about algebraic functions of one variable: “It is generally believed that there is nothing left to do on algebraic functions of one variable, because Riemann, who discovered almost everything we know about these functions (I am excepting the works of Poincaré and Klein on uniformization, and those of Hurwitz and Severi on correspondences) did not leave for us any statement of a big problem that concerns them. I am without doubt one of the most knowledgeable persons on this subject; certainly because I had the good fortune (in 1923) to learn it directly from Riemann's writings, whose memoir is of course one of the greatest things that a mathematician has ever written; there is not a single word there that is not of consequence.”

Today, 150 years after Riemann's death, some of his highly original ideas are still poorly known to the mathematical community, in spite of the fact that a large number of books and articles were published on his work. The reason is that these

books often concentrate on the results that are considered to lead to important developments, leaving in the dark some of Riemann's beautiful ideas that deserve to be contemplated and further exploited. Actualizing these ideas and including them in the context of current mathematics is a permanent necessity.

Several essays included in the present volume are the result of reading Riemann's writings, and the others are motivated by his ideas as they appear in the scientific literature.

The decision of editing this book was taken after two conferences held in Strasbourg, the first one on June 12–14, 2014, whose subject was “Riemann, topology and physics,” and the second one on September 18–20, 2014, whose subject was “Riemann, Einstein and geometry,” where Riemann's influence on relativity theory was emphasized. Consequently, this book contains several chapters on the latter theory.

Despite the variety of topics contained in this volume, there is one simple and common purpose, to highlight—hopefully in a new way—some of Riemann's original ideas and their subsequent development.

We would like to take this opportunity to thank Elena Griniari from Springer Verlag for her interest, support and efficient help in this edition, and Manfred Karbe for his invaluable advice.

Editing such a book required hard work. We consider it an expression of our gratitude for all that Riemann gave to human knowledge. His ghostly voice still inspires us all.

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