Preface

In 1877 Giovanni Curioni, Professor in the *Scuola d'applicazione per gl'ingegneri* (School of Application for Engineers) in Turin, chose the name *Scienza delle costruzioni* for his course of mechanics applied to civil and mechanical constructions.

The choice reflected a change that had occurred in the teaching of structural disciplines in Italy, following the establishment of schools of application for engineers by Casati's reform of 1859. On the model of the École polytechnique, the image of the purely technical engineer was replaced by that of the 'scientific engineer', inserting into the teaching both 'sublime mathematics' and modern theories of elasticity. Similarly, the art of construction was to be replaced by the science of construction. The *Scienza delle costruzioni* came to represent a synthesis of theoretical studies of continuum mechanics, carried out primarily by French scholars of elasticity, and the mechanics of structures, which had begun to develop in Italian and German schools. In this respect it was an approach without equivalence in Europe, where the contents of continuum mechanics and mechanics of structures were, and still today are, taught in two different disciplines.

In the 1960s of the twentieth century, the locution *Scienza delle costruzioni* took a different sense for various reasons. Meanwhile, the discipline established by Curioni was divided into two branches, respectively, called *Scienza delle costruzioni* and *Tecnica delle costruzioni*, relegating this last to applicative aspects. Then technological developments required the study of materials with more complex behavior than the linear elastic one; there was a need for protection from phenomena of fatigue and fracture, and dynamic analysis became important for industrial applications (vibrations) and civil incidents (wind, earthquakes). Finally, introduction of modern structural codes on the one hand made obsolete the sophisticated manual calculation techniques developed between the late 1800s and early 1900s, on the other hand it necessitated a greater knowledge of the theoretical aspects, especially of continuum mechanics. This necessity to deepen the theory inevitably led a to drift toward mathematical physics in some scholars.

All this makes problematic a modern definition of *Scienza delle costruzioni*. To overcome this difficulty, in our work we decided to use the term *Scienza delle costruzioni* with a fairly wide sense, to indicate the theoretical part of construction engineering. We considered Italy and the nineteenth century for two reasons. Italy, to account for the lack of knowledge of developments in the discipline in this country, which is in any case a major European nation. The nineteenth century, because it is one in which most problems of design of structures were born and reached maturity, although the focus was concentrated on materials with linear elastic behavior and external static actions.

The existing texts on the history of *Scienza delle costruzioni*, among which one of the most complete in our opinion is that by Stephen Prokofievich Timoshenko, *History of Strength of Materials*, focus on French, German, and English schools, largely neglecting the Italian. Moreover, Edoardo Benvenuto's text, *An Introduction to the History of Structural Mechanics*, which is very attentive to the Italian contributions, largely neglects the nineteenth century. Only recently, Clifford Ambrose Truesdell, mathematician and historian of mechanics, in his *Classical Field Theories of Mechanics* highlighted the important contributions of Italian scientists, dusting off the names of Piola, Betti, Beltrami, Lauricella, Cerruti, Cesaro, Volterra, Castigliano, and so on.

The present book deals largely with the theoretical foundations of the discipline, starting from the origin of the modern theory of elasticity and framing the Italian situation in Europe, examining and commenting on foreign authors who have had a key role in the development of mechanics of continuous bodies and structures and graphic calculation techniques. With this in mind, we have mentioned only those issues most 'applicative', which have not seen important contributions by Italian scholars. For example, we have not mentioned any studies on plates that were brought forward especially in France and Germany and which provided fundamental insights into more general aspects of continuum mechanics. Consider, for instance, the works on plates by Kirchhoff, Saint Venant, Sophie Germain, and the early studies on dynamic stresses in elastic bodies by Saint Venant, Navier, Cauchy, Poncelet. Finally, we have not mentioned any of the experimental works carried out especially in England and Germany, including also some important ones from a theoretical point of view about the strength and fracture of materials.

The book is intended as a work of historical research, because most of the contents are either original or refer to our contributions published in journals. It is directed to all those graduates in scientific disciplines who want to deepen the development of Italian mathematical physics in the nineteenth century. It is directed to engineers, but also architects, who want to have a more comprehensive and critical vision of the discipline they have studied for years. Of course, we hope it will be helpful to scholars of the history of mechanics as well.

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Editorial Considerations

Figures related to quotations are all redrawn to allow better comprehension. They are, however, as much as possible close to the original ones. Symbols of formulas are always those of the authors, except cases easily identifiable. Translations of texts from French, Latin, German, and Italian are as much as possible close to the original texts. For Latin, a critical transcription has been preferred where some shortenings are resolved, 'v' is modified to 'u' and vice versa where necessary, ij to ii, following the modern rule; moreover, the use of accents is avoided. Titles of books and papers are always reproduced in the original spelling. For the name of the different characters the spelling of their native language is used, excepting for the ancient Greeks, for which the English spelling is assumed, and some medieval people, for which the Latin spelling is assumed, following the common use.

Through the text, we searched to avoid modern terms and expressions as much as possible while referring to 'old' theories. In some cases, however, we transgressed this resolution for the sake of simplicity. This concerns the use, for instance, of terms like *field*, *balance*, and *energy* even in the period they were not used or were used differently from today. The same holds good for expressions like, for instance, *principle of virtual work*, that was common only since the nineteenth century.

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