

# Preface

There are about 500 books on variational principles. They are concerned mostly with the mathematical aspects of the topic. The major goal of this book is to discuss the physical origin of the variational principles and the intrinsic interrelations between them. For example, the Gibbs principles appear not as the first principles of the theory of thermodynamic equilibrium but as a consequence of the Einstein formula for thermodynamic fluctuations. The mathematical issues are considered as long as they shed light on the physical outcomes and/or provide a useful technique for direct study of variational problems.

The book is a completely rewritten version of the author's monograph *Variational Principles of Continuum Mechanics* which appeared in Russian in 1983. I have been postponing the English translation because I wished to include the variational principles of irreversible processes in the new edition. Reaching an understanding of this subject took longer than I expected. In its final form, this book covers all aspects of the story. The part concerned with irreversible processes is tiny, but it determines the accents put on all the results presented. The other new issues included in the book are: entropy of microstructure, variational principles of vortex line dynamics, variational principles and integration in functional spaces, some stochastic variational problems, variational principle for probability densities of local fields in composites with random structure, variational theory of turbulence; these topics have not been covered previously in monographic literature. Other than that, the scope of the book is the same though the text differs considerably due to many detailed explanations added to make the level of the book suitable for graduate students.

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I. Fundamentals

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