

CHAPTER 1

INTRODUCTION

1.1 A SHORT HISTORY OF VARIATIONAL PRINCIPLES

Among the first persons to realize the importance of variational problems and the physical significance of their solutions was G.W. Leibniz (1646-1716). In his work, however, mathematical and physical reasoning was closely interwoven with philosophical and theological arguments. One of the aims of his philosophy was to solve the problem of theodizee, i.e. to reconcile the evil in the world with God's goodness and almightiness (cf. [Lz]). Leibniz' answer was that God has chosen from the innumerable possible worlds the best possible, but that a perfect world is not possible. (This infinite multitude can only be conceived by an infinite understanding, which provided a proof of the existence of God for Leibniz.) This best possible world is distinguished by a pre-established harmony between itself, the realm of nature, on one hand and the heavenly realm of grace and freedom on the other hand. Through this the effective causes unite with the purposive causes. Thus bodies move due to their own internal laws in accordance with the thoughts and desires of the soul. In this way, the contradiction between the predetermination of the physical world following strict laws and the constantly experienced spontaneity and freedom of the individual is removed. The best possible world must here obey specific laws since an ordered world is better than a chaotic one. This proves therefore the necessity of the existence of natural laws. The contents of the natural laws, however, are not completely determined as is the case for geometric laws but are only determined in a moral sense, since they must satisfy the criteria of beauty and simplicity in the best of all possible worlds. This leads Leibniz even to variational principles. This is because