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CONTENTS

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RECENT ADVANCES IN DYNAMICS[1]

A HIGHLY important chapter in theoretical dynamics began to unfold with the appearance in 1878 of G. W. Hill's researches in the lunar theory.

To understand the new direction taken since that date it is necessary to recall the main previous developments. In doing this, and throughout, we shall refer freely for illustration to the problem of three bodies.

The concept of a dynamical system did not exist prior to Newton's time. By use of his law of gravitation Newton was able to deal with the Earth, Sun, and Moon as essentially three mutually attracting particles, and by the aid of his fluxional calculus he was in a position to formulate their law of motion by means of differential equations. Here the independent variable is the time and the dependent variables are the nine coordinates of the three bodies. Such a set of ordinary differential equations form the characteristic mathematical embodiment of a dynamical system, and can be constructed without especial difficulty.

The aim of Newton and his successors was to find explicit expressions for the coordinates in terms of the time for various dynamical systems, just as Newton was able to do in the problem of two bodies. Despite notable successes, the differential equations of the problem of three bodies and of other analogous problems continued to defy "integration."

Notwithstanding the lack of explicit expressions for the coordinates, Newton was able to treat the lunar theory from a geometrical point of view. Euler, Laplace, and others invented more precise analytical methods based upon series. In both cases the bodies which are disturbing the motion of the

[1] Address of the vice-president and chairman of Section A—Mathematics and Astronomy—American Association for the Advancement of Science, St. Louis, December, 1919.