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Prague and the conception of general relativity: Kepler, Mach and Einstein

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In the first part of my talk, I shall argue that Kepler's discovery of his first two laws of planetary motion in Prague in the years 1600 to 1605 can be seen as the first success of Mach's principle. Kepler's intuition was quite unlike that of his predecessors and Newton and strikingly similar to Mach's. In view of the considerable confusion surrounding Mach's principle, I shall try to identify his key ideas, which included a relational treatment of not only position but also time. I will also discuss a penetrating analysis by Poincare of a predictive defect that is revealed when one expresses Newtonian dynamics in relative quantities. On this basis one can formulate a precise criterion that a Machian theory of motion should satisfy. I shall then consider why Einstein did not make any serious attempt to implement a theory of relativity directly along the lines suggested by Mach's and Poincare's ideas and instead followed a brilliantly successful indirect strategy. Finally, I shall consider whether purely historical accidents - such as the creation of general relativity before quantum mechanics - could be closing our minds to new conceptions of time and motion.