

POINCARÉ'S MÉCANIQUE CÉLESTE.

Les Méthodes nouvelles de la Mécanique Céleste. Par H. POINCARÉ. Tome I. Paris, Gauthier-Villars, 1892. 8vo.

THE publication of this new work on Celestial Mechanics, embodying some of the results of the labors of mathematicians in that direction during the last fifteen years, comes as a welcome addition to our knowledge of this subject. Until lately, nearly all treatises have been written with a special object, that of obtaining expressions which can be used by the practical astronomer; the mathematical aspects of the problems solved have been almost entirely neglected. These latter have an interest of their own apart from any use which can be made of them, and it is to the study of such questions that M. Poincaré largely devotes himself. At the same time he points out where they can be applied usefully in the case of the problem of three bodies. But this is not all. Most of the results obtained can be applied equally to the general problems of dynamics where there is a force function, and by the use of a dissipation function could doubtless be applied to any natural problem whatever.

The applications are, however, more particularly made to a satellite system, in the special case when the three bodies move in one plane, as well as in the general case. The limitation generally imposed consists in making the ratios of the masses of two of the bodies to that of the third a small quantity, an assumption which, nevertheless, does not limit greatly the usefulness of the results. M. Poincaré says, "Le but final de la Mécanique céleste est de résoudre cette grande question de savoir si la loi de Newton explique à elle seule tous les phénomènes astronomiques," and for this end to be attained it is absolutely necessary to know whether the developments of the expressions for the position of any heavenly body do mathematically represent that position. In general, the series obtained must be convergent, and it is to the questions on the convergence of such series that M. Poincaré has been able to give some definite answers.

In his introduction, the author points out that the starting point of the present developments of the lunar theory, was the publication in Vol. I. of the *American Journal of Mathematics* of a paper by Dr. Hill entitled, "Researches in the lunar theory." It is true that in this memoir, Dr. Hill has largely occupied himself in obtaining exact numerical and algebraical values for certain inequalities in the motion of the moon; but the general considerations involved at the beginning and end of it are of a far-reaching nature. In par-