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Edited by S. FERRAZ-MELLO, B. MORANDO and J.-E. ARLOT

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INTRODUCTION

This symposium is devoted to the oldest of the branches of Celestial Mechanics: the precise determination and prediction of the positions and movements of Solar System bodies. For short, the problem of the construction of ephemerides *in strictu sensu*. Since the antiquity, many human activities rely on ephemerides and the increasing request of precision has characterized this discipline throughout the time, with the use of the most advanced techniques. The past is so full of great achievements that we are always tempted to focus on them. But the scientific organizers of this Symposium decided to look rather forward and to emphasize those subjects which are expected to be at the center of the developments in the first decades of the next century.

The problem of ephemerides construction cannot be solved without a great deal of theory and observations. The existence of this scientific activity since the antiquity led to many popular misconceptions. Many people, even inside the astronomical community, still believe that Newton's laws with a pinch of relativistic correction in the perihelion motions is the current state of the art in Celestial Mechanics. In reality, however, it is no longer possible to satisfy all accuracy needs without a full consideration of Einstein's general relativity. Moreover, some particular observations are so accurate that investigations on the correctness of some of Einstein's basic assumptions are in progress. Another popular belief concerns the predictability of celestial motions. It is sometimes called the Laplace demon, since the science of Laplace's time was founded on the idea of full predictability of celestial motions. However, Poincaré's work on Celestial Mechanics has shown that chaotic behaviour is the rule in complex deterministic systems. Any deviation grows exponentially and ephemerides valid forever are not possible. This branch of Celestial Mechanics requests precise Physics, precise Mathematics and, above all, precise observations. The next decades are promising. The amount and accuracy of the available observational data is growing at an exponential pace. Modern ephemerides already rely on data obtained by radar and laser ranging, VLBI, VLA, space astrometry, millisecond pulsar timings and accurate CCD ground-based observations.

This Symposium was held under the invitation of the Bureau des Longitudes, Paris, to commemorate its bicentennial. Bureau des Longitudes is

one of the main institutions devoted to the determination and prediction of the positions and movements of the Solar System bodies and this Symposium was the occasion to recognize its notorious achievements during two centuries. The Symposium was presided by Dr. J. Kovalevsky, former director of the Bureau des Longitudes and the leader of its transformation into a modern research center.

The Scientific Organizing Committee was formed by Drs. J.E. Arlot, V. A. Brumberg, A. Carusi, S. Debarbat, S. Ferraz-Mello (chairman), J. Henrard, J. Kovalevsky, Y. Kozai, J.H. Lieske, A. Milani, B. Morando (co-chairman), P. K. Seidelmann, Ye Shu-Hua and B. D. Yallop. The Symposium was sponsored by IAU Commission 7 (Celestial Mechanics), Commission 20 (Positions and motions of asteroids, comets and satellites), Commission 4 (Ephemerides) and Commission 8 (Positional astronomy).

The Local Organizing Committee was formed by Drs. J.E. Arlot (chairman), A. Bec-Borsenberger, L. Bergeal, P. Bretagnon, N. Capitaine, J. Renaudineau and W. Thuillot. Local sponsors were the Ministère de l'Enseignement Supérieur, de la Recherche et de l'Insertion Professionnelle, Centre National de la Recherche Scientifique, Centre National d'Études Spatiales, Institut des Sciences de l'Univers, Institut Océanographique, Observatoire de Paris, Délégation aux Célébrations Nationales and Conseil Régional d'Ile-de-France.

These Proceedings include 20 lectures and 74 communications presented at the Symposium. This is only a fraction of the 26 lectures and 136 contributed papers presented at the Symposium. We are indebted to all authors who understood the practical impossibility of publishing all papers and also the strict limitations on the number of pages of those selected for publication. We are also indebted to a great deal of referees who scrutinized carefully all submitted papers.

This volume is dedicated to Bruno Morando, director of Bureau des Longitudes from 1971 to 1984, member of the International Astronomical Union since 1964, president of IAU Commission 4 (Ephemerides) from 1985 to 1988 and president of the Société Astronomique de France from to 1976 to 1979.

S. FERRAZ-MELLO AND J.-E. ARLOT

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