INTRODUCTORY REMARKS

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About seventy years ago, Albert Einstein built up its theory of General Relativity and, a few years later, in 1919, a first astrometric measurement of the deflection of light in the vicinity of the Sun (see the frontispiece of this book) confirmed one of the most important predictions of the theory. In addition, this theory had provided an explanation of an important inconsistency that existed between the observed motion of the perihelion of Mercury and the values predicted by the Newtonian Celestial Mechanics.

It took several decades to the scientific community to fully digest the new conceptions introduced by the theory of General Relativity, to understand its background and implications and to learn how to use this new tool. Strange enough, while Celestial Mechanics and Astrometry are to be credited with the first verifications, in the middle of the century, astrophysicists and cosmologists were almost alone to develop the consequences of the theory and to apply it to the study of the Universe. Gravitational redshift, gravity waves and the implications of the theory of the expanding Universe were the priviledged domains of study of relativists. The reasons for such a relinquishment of interest of astrometrists is to be explained by a certain standstill of the improvement of astrometric observations whose accuracy was not sufficient to go beyond what was already established around 1920.

During the years 1965-1975, several new astrometric techniques were developed which permitted to obtain several major results in the field:

- Improvements of the determination of the motion of planetary perihelia using radar observations of planets;
- Tests of the principle of equivalence using hydrogen masers embarked on rockets or through the interpretation of Lunar laser data;
- Better measurements of the relativistic deflection of light through the observation of quasars along the ecliptic using VLBI;
- The discovery of the time equivalent of this effect by measuring the delay of radar observations;
- The interpretation by an emission of gravity waves of the orbital evolution of a double pulsar.

Other techniques were also developed to such a point that the

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introduction of relativistic effects in the interpretation of the measurements has become a must. It is the case of classical Astrometry for which IAU has now imposed a correction formalism, Space Geodesy which works in specific geocentric space-time metrics, time services that try to synchronize distant clocks to a few nanosecond accuracy and, in the nearest future, Space Astrometry with observations to a milliarc second accuracy.

In parallel a considerable theoretical effort was made to develop the relativistic formalism and to understand how astronomical measurements are to be interpreted in the frame of the theory of General Relativity. In Celestial Mechanics, one has to quote the excellent book of V.A. Brumberg ("Relativistic Celestial Mechanics") which unfortunatelly has not been translated from russian. The introduction of the parametrized post-Newtonian formalism (PPN), particurlaly well adapted to the solar system, has also played a major role in these developments. The second order terms have been studied by many authors and several different formulations have been proposed. In ten years, the number of articles on aspects of General Relativity dealing with Celestial Mechanics and the determination of the positions of celestial bodies has been multiplied by a factor five.

It was precisely this development of studies in General Relativity applied to the positioning and the dynamics of celestial bodies that was the main reason to propose this symposium to the International Astronomical Union. The second argument was that this subject has never been chosen as the central objective of a large international gathering. By deciding to sponsor this particular symposium, IAU has acknowledged the fact that the increasing accuracy of astrometric observations and the even much more promising prospects of Space Astrometry make it impossible to ignore the relativistic effects in the observations and in the theories that are built to describe them. So the main objective of this symposium is to describe how, in Astrometry and Celestial Mechanics, one must proceed in order to take correctly into account the relativistic effects of the first order and, in preparation of the future, also of the second order. Among the goals of this meeting, I would consider that the following three are the most important :

1. To agree to some common approach in the introduction of relativistic corrections in the reduction of various types of astrometric reductions and to check that the various approaches presently used are equivalent.
2. To review the present state of the development of the part of General Relativity that deals with the dynamics and the positioning of celestial bodies and to foresee how this knowledge may be improved with the present and future space experiments.
3. To see whether the measurement of some physical quantities affected by Relativity might, if correctly interpreted, produce new determinations of some physical parameters.

But, in the solar system, sorting out the relativistic terms is possible only if one can produce very accurate dynamical theories of motion. The difficulty to significantly assess deviations from theory that may be of the order of a fraction of a second of arc, is above

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all to prove that the observed differences are not due to defects of the theory. This is why, the construction of very accurate classical theories in Celestial Mechanics is also part of the program. By inviting some astrometrists and classical celestial mechanicists to take part in the symposium, we hope to stir up discussions with specialists in General Relativity and to create a mutual understanding and cooperation between two communities that have not yet had much opportunities to meet. The absence of French colleagues who have recently made major contributions in the field will, unfortunately, prevent this goal to be fully achieved.

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