Report of Joint Meeting of Commissions 7, 17, 20, 20a. Monday 8 September 1952

PRÉSIDENT · Prof. G. M. CLEMENCE.

SECRÉTAIRE. Prof. J. F. COX.

Cinquante-quatre membres assistent à la séance. Les rapports préliminaires publiés dans les *Draft Reports*, vol. I, p. 18 et vol. III, p. 2, sont adoptés sans discussion.

La recommandation du Prof. Heinrich, qui apparaît dans le vol. I, p. 18 (Commission 7) et p. 119 (Commission 20) est adopté sous la forme donnée (p. 119), sauf la conclusion qui doit être lue comme suit:

Observers are therefore urged to procure the most careful observations, especially of satellite systems, with the aid of large reflectors.

Est adoptée également la recommandation du Prof. Armellini, reprise dans les termes suivants:

The Commission recommends that the present state of the tables constructed for the rapid calculation of the perturbations of members of families of minor planets should be examined with a view to the rapid method of Bohlin for the groups of families whose mean motions are nearly commensurable with that of Jupiter, indicating what improvements should be introduced and what new work is required.

La parole est ensuite accordée au Dr Ryabov, collaborateur scientifique à l'Institut Astronomique Sternberg de Moscou, qui présente un rapport complémentaire sur plusieurs questions importantes qui n'ont pas été traitées dans les *Draft Reports*.

Voici le résumé de cette communication.

I. QUANTITATIVE CELESTIAL MECHANICS

Investigations connected with the study of analytical theories of the motion of celestial bodies, with the precalculation of their accurate positions, fall into two different categories.

The first is the application of the methods of classical celestial mechanics (the different iteration methods) and the improvement of these methods to make them more applicable to practical use. The second is the construction of new rigid analytical methods, based on different principles, such as the iteration method of classical celestial mechanics.

Many defects may be found in the iteration methods of classical celestial mechanics. Chief among them are the following:

(1) The solution of the equations in many of the problems of celestial mechanics is represented in practice by the first few members of the infinite series. As a rule, the calculations do not go any further than the 2nd or 3rd approximation. Unfortunately we have only slight knowledge about the convergence area of these series and the values of the discarded terms. Hence, in many cases, the practical applicability of this solution is rather restricted.

(2) The classical methods deprive us of opportunity of studying the motions of celestial bodies from the qualitative point of view

The methods of classical celestial mechanics are now in need of a complete revision and reconstruction as they do not sufficiently satisfy modern requirements. A simple example which illustrates the inadequacy of the old methods is provided by the analytical theories of the major and minor planets. The tables of the motions based on these theories, even such excellent tables as Hill's and Newcomb's, do not represent accurately enough the observational data. At present the methods of the numerical integration for the formation of ephemerides of the planets are favoured. However, numerical integration may not replace analytical methods completely.

The methods of strict analytical celestial mechanics are largely based on the work of the Russian mathematician Liapunov. The new methods make it possible not only always to obtain strict analytical solutions of the equations in the form of absolutely convergent series, but also, which is of great importance, to estimate the area of the convergence and of the practical applicability of these series.

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At the Institute of Theoretical Astronomy and also at the Sternberg Institute the periodical solutions in the problem of celestial mechanics based on Poincaré's and Liapunov's strict analytical theories are being studied.

II. Qualitative Celestial Mechanics

At the Sternberg Institute the questions about the character and the trend of the motions during a long period of time are being studied. Great importance is attached to the problem of the stability of the motions. This problem is going to be especially noteworthy in connection with the investigations in the field of stellar evolution, mentioned in Prof. Ambartsumian's report.

Various investigations at the Sternberg Institute concerning the stability of stellar systems are in progress or are planned for the future.

Celestial mechanics, as a rule, has hitherto been mainly concerned with our solar system. Investigations concerned with stellar motions used to be rare. The problems of stellar dynamics were outside the scope of specialists in celestial mechanics. That was a great disadvantage. Celestial mechanics must extend its scope in order to keep step with other branches of astronomy. The study of the motions of stars and stellar systems is a problem in celestial mechanics of immediate importance.

Two general problems in celestial mechanics may therefore be recommended for investigation:

(1) The revision, reconstruction and practical application of the methods of celestial mechanics to solve the present problems.

(2) The inclusion of stellar systems in the sphere of celestial mechanics.

La parole est ensuite accordée à Mrs Sophia W McDonald, Professeur de Mathématiques à l'Université de Californie, Berkeley (Etats-Unis) dont l'intervention est résumée comme suit:

At the University of California, a redetermination of the tables of v. Zeipel for the group one-half, was undertaken (cf. *Proc. National Academy of Sciences of the United States*, 1922). The range of applicability of our tables was assumed to be the same as that assumed by v. Zeipel, namely, mean daily motion between 550 and 650 seconds of arc, and angles of inclination of the plane of the orbit and angle of eccentricity of the orbit, each less than 10 degrees.

It was subsequently established that these arbitrary limits placed on the elements of the orbit were much too small, and that the tables could be shortened without loss of accuracy. During the course of the work the shortened tables have been applied to many cases far beyond the originally adopted limits, and accurate results have been obtained.

The new tables, both numerical and logarithmic; the formulae needed in the development of the general perturbations; the mean elements; and the results of applications of the tables to 34 minor planets, have become available within recent weeks in *Publications of the Lick Observatory*, vol. XX, 1952, 'Tables of General Perturbations for a Group of Minor Planets which Includes the Group One-Half with Applications to Thirty-Four Cases' The shortened tables now presented have been applied to many cases which are not considered within the group one-half.

In these 34 cases, the mean daily motions have ranged up to 736 seconds of arc, the angles of inclination and eccentricity up to 15 degrees, and in one case even to 24 degrees. The period for which the developments have been made has in all cases extended from the date of discovery to a current epoch; the longest extends over 97 years, while in only three cases has it been shorter than 58 years. No residual has been as large as 0·5 degree; in general the residuals are quite small.

The number of minor planets for which general perturbations can be developed with the aid of the tables given in *Publications of the Lick Observatory*, vol. XX, is large. The tables can be used for about one-third of all minor planets discovered to date.

(For the second part of this meeting see under Commission 20.)

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