

IAU SYMPOSIUM No. 78  
“NUTATION AND THE EARTH’S ROTATION” (*held in Kiev, May 1977*)  
AS A FIRST STEP IN THE CONSIDERATION OF  
THE NON-RIGID EARTH NUTATION THEORY

Ya.S. YATSKIV<sup>1</sup>, A.A. KORSUN<sup>2</sup>,

Main Astronomical Observatory, National Academy of Sciences of Ukraine  
27 Zabolotnoho St., Kiev, 03680 Ukraine  
e-mail: <sup>1</sup>yatskiv@mao.kiev.ua, <sup>2</sup>akorsun@mao.kiev.ua

## 1. THE BEGINNING

The Journées 2007 will take a look into the future of the nutation theory. But what that future will look like depends to some extent on what the past was. So, the authors try to have a look back into the beginning of the discussions on the new theory of nutation which took place at the IAU Symposium No. 78 “Nutation and the Earth’s rotation” held in Kiev thirty years ago.

The theory of nutation used before 1984 in the reduction of astronomical observations was based on the assumption that the Earth is a rigid body. For this model a single coefficient of nutation in obliquity called the constant of nutation was adopted in the IAU System of Astronomical Constants. Others coefficients of nutational terms were related by the rigid-Earth theory to the constant of nutation.

The IAU (1964) System of Astronomical Constants (Fricke et al., 1966) was the first attempt to develop international standards that were appropriate to the reduction of high precision of astronomical measurements. For the computation of nutation Woolard’s rigid-Earth theory along with the constants listed in his classical work (Woolard, 1953) was adopted. The constant of nutation used by Woolard was based on observational results, namely the Newcomb’s value  $N = 9''.210$ .

The astronomers who set up that system of constants admitted that a revision would be necessary very soon. Due to great progress made in space research such revision took place in twelve years.

W. Fricke was a man of action for the creation of an improved system of astronomical constants once again. The work on this system was shared by three Working Groups formed by the IAU Commission 4 in 1970. “Each of the Working Groups (Precession, Planetary Ephemerides, Units and Time-scale) consisted of members of various Commissions. About 40 astronomers have actively contributed to the tasks. A Joint Report of the Working Groups containing six recommendations was edited by R. L. Duncombe, W. Fricke, P. K. Seidelmann and G. A. Wilkins and submitted to the IAU General Secretary. The Executive Committee decided that the recommendations should be discussed in a joint meeting of IAU Commission 4, 8 and 31 with the view to its being adopted in Grenoble. The Joint Meeting took place on August 26, and the recommendations were adopted.” (Fricke, 1976).

In spite of the large discrepancies between the rigid-Earth theory of the nutation and observations the value of the constant of nutation used in previous system of constant (reduced to the epoch J2000) was retained in the IAU (1976) System of Astronomical Constants. Nevertheless, a special recommendation concerned with the nutation theory was adopted by the IAU.

This recommendation was not voted by the unanimity of the IAU members who participated in the Joint Meeting, and a very animated discussion started on two points:

- (i) In any high accuracy computation of the nutation, it is indispensable to take into account the influence of the elasticity of the mantle and of the existence of a fluid core in the Earth; this meant

that it was absolutely necessary to elaborate a new theory for the nutation in order to replace Woolard's theory.

- (ii) One must reexamine the question of the choice of the axis (reference pole) of which the equations of nutation must describe the motion.

One of the authors (Ya.Ya.) took part in this discussion and proposed to hold a special IAU Symposium precisely in Kiev to attack the problem. The background for this proposal was as follows.

At Kiev E. Fedorov and his pupils were actively busy with investigations of the theory of nutation and determinations of nutation coefficients from observations (Fedorov, 1963; Yatskiv, 2000). E. Fedorov made the first attempt to determine the principal nutation term coefficients in obliquity and in longitude separately. He thought it more reasonable to compare his observation results to the predictions of new theory of nutation taking into consideration the effect of an elastic mantle and a liquid core of the Earth. In addition Fedorov assumed that tabular nutation must describe the motion of the axis of angular momentum with respect to the body-fixed coordinate system which was determined from observations. This assumption was in contradiction with R. Atkinson's opinion and the IAU recommendation on the choice of the axis of figure for tabular nutation.

The proposal to hold a symposium on nutation became particularly to the point, and urgent, because of the creation of the FK5 and this was why the idea was actively supported by W. Fricke and Prof. E. Müller as the Assistant General Secretary of the IAU. Later on one of the authors (Ya.Ya.) remembered (Yatskiv, 1998):

"During the years 1973–1976, Professor Edith Müller was Assistant General Secretary of the IAU, and was responsible, in that capacity, of the organization of Symposia and Colloquia, as well as of the Regional Meeting of the IAU. As there is always, at the IAU, more proposals for meetings than possibilities to actually put them on their way, it is a need for the Assistant General Secretary to be of a particular punctuality, and strictly objective. As a rule, one presents proposals for organizing IAU symposia in due time, i.e. at least two years ahead of time. However, during the XVI-th General Assembly of the IAU (at Grenoble, France, 1976), Professor Walter Fricke and myself were forced, because of various circumstances, to ask Edith Müller to make an exception for our project, and to accept that the Symposium No. 78, "Nutation and the Earth's rotation" be held in Kiev, as early as in May 1977.

Edith Müller met us in her office, listened very carefully, and made clear to us that very little time was left to prepare the Symposium. She listened again to our argumentation: I gave her the insurance that the Local Organizing Committee would do its utmost for the success of the endeavour. Then she gave her agreement for the holding of this Symposium, and she convinced the Executive Committee."

## 2. REMEMBERING THE IAU SYMPOSIUM No. 78 "NUTATION AND THE EARTH'S ROTATION"

The objectives of the Symposium were clearly stated, they concerned with two main topics:

- (i) the *choice* of the axis to which the ephemeris of the forced nutation should refer;
- (ii) the *requirements* for an improved series of nutation for computing the ephemeris.

The Scientific Organizing Committee (SOC) was formed as quick as possible. E. P. Fedorov and R. O. Vicente (Co-Chairmen) invited W. Fricke, J. Kovalevsky, P. Melchior, N. Pariisky, M. Rochester, C. Sugava, G. Wilkins and Ya. Yatskiv (who presided over the LOC) to be members of the SOC.

The Symposium was sponsored by the Commission 19 and co-sponsored by Commissions 4, 8 and 31. It was held in Kiev (former USSR) from 23 to 28 May 1977. (May is the most beautiful month in Kiev city).

There were 114 registered participants from 14 countries. Thirty-eight invited and contributed papers were presented at the Symposium, including observational results as well as their geophysical interpretation. The review papers by Wilkins, Fedorov, Yatskiv, Vicente and Melchior provided a sound overview of two main topics of the Symposium. The controversy on these topics, however was very large. This resulted in hot discussions at the Symposium which preceded the adoption of the symposium resolutions concerned with the theoretical and observational studies of nutation. The report on these discussions was prepared by G. Wilkins (1977).

The Proceedings of the IAU Symposium No. 78 on Nutation and the Earth's rotation were edited by E. P. Fedorov, M. L. Smith and P. L. Bender (1977).

### 3. ON THE IAU SYMPOSIUM No. 78 RESOLUTIONS

Three resolutions were adopted, namely:

#### Resolution No. 1

IAU Symposium No. 78 *recommends* that the decision of the 16th General Assembly of the IAU that “the tabular nutation shall include the forced periodic terms listed by Woolard for the axis of figure...” shall be annulled and that nutation of the true pole of date with respect to the mean pole of date should be computed for the motion of the instantaneous axis of rotation of the mantle.

#### Resolution No. 2

IAU Symposium No. 78 *recommends* that the following set of coefficients be substituted for the corresponding coefficients in Woolard's series for the nutation in order to provide a more accurate representation of the forced nutation of the axis of rotation of the Earth due the luni-solar perturbing forces, and that this amended series be referred to as the “IAU (1977) nutation series”.

Period	in $\Delta\varepsilon$	in $\Delta\psi \sin \varepsilon$
18.6 years	+ 9''206	– 6''843
9 years	– 0.091	+0.083
1 year	+0.006	+0.058
0.5 year	+0.569	–0.520
22 days	+0.022	–0.020
27 days	0.000	+0.028
13.7 days	+0.091	–0.083

#### Resolution No. 3

IAU Symposium No. 78 *requests* that the President of IAU Commission 4 set up a small working group of experts to prepare a fully documented proposal for the adoption of a new series for nutation at the IAU General Assembly in 1979, and recommends that the group shall take into account the desirability of basing this proposal on resolution No. 2 of this Symposium.

The former two resolutions were absolved from consideration very soon and the latter was realized by the Working Group on Nutation established by the President of the IAU Commission 4 V. K. Abalakin in 1977. This Working Group presented a report to the IAU General Assembly (Montreal, 1979). What happened afterwards is another story.

### 4. REFERENCES

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