Smulsky J.J. New Astronomical Theory of Ice Ages. "LAP LAMBERT Academic Publishing", Riga, Latvia, 2018. 132 c. ISBN 978-613-9-86853-7. (In Russian).

Annotation

This book examines the actual side of the problem: how our world works, why the observed phenomena occur and why they change. The new Astronomical theory of the ice ages is based on the problems of the evolution of the orbital and rotational motions of the Earth. They are one of the most difficult tasks of contemporary science. The problems are solved, and the book presents their results, which are accessible to the wide circle of readers. This is achieved through 63 drawings and graphs, which also make the book compact and informative. The material in the illustrations considerably exceeds the text of the book, and it will serve as a basis for further research in various fields of science. For those who want to understand the origins of the results, to check and make sure of their fairness, and maybe even get them, the book presents the material in the Appendices.

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INTRODUCTION

In the first third of the 20th century Milutin Milankovitch (Milankovitch, 1939) created the Astronomical theory of Ice ages, which is also called the Astronomical theory of climate change. In it, the Earth's insolation at different latitudes is calculated on the basis of three parameters: the eccentricity e of the Earth's orbit, the angular position of the perihelion $\varphi_{p\gamma}$ and the obliquity ε. This theory includes three problems: the orbital motion of the bodies of the Solar system, the rotational motion of the Earth and the problem of insolation of the Earth depending on the parameters of its orbital and rotational movements.

M. Milankovitch's solutions consistently repeated several generations of researchers (Brouwer and Van Woerkom, 1950; Sharaf and Budnikova, 1969; Berger and Loutre, 1991; Laskar et al, 2004a; Edvardsson et al, 2002). However, they all went in the same way, which over the centuries was developed in celestial mechanics. We went the other way (Smulsky, 2016a). We did not copy the equations of the predecessors, but we derived them from the original foundations. Secondly, in the derivation of equations we sought to introduce minimal simplifications. And, thirdly, the tasks were solved by numerical methods, while using the most high-precision versions or creating new ones. For the first and third tasks, our independent studies have confirmed the predecessors' research. But the results of the rotational motion problem are different. The amplitude of oscillations of the obliquity ε is seven times larger. These fluctuations give rise to changes in insolation that explains the climate oscillations in the past.

The book examines the actual side of the problem: how our world works, why the observed phenomena occur and why they evolve. The history of the problem, different aspects of its understanding and the contribution of various authors to its development are not considered here.

The underlying problems of the astronomical theory of the evolution of the orbital and rotational movements of the Earth are among the most difficult tasks of contemporary science. They are solved, and the book presents their results, which are available for understanding by a wide range of readers. This is achieved through 63 drawings and graphs. This abundance of illustrated material in the book makes it compact and informative. The material in the illustrations is much larger than the volume of this book, and it will serve as a basis for further research in various fields of science.

For those who want to understand the origins of the results, to check and make sure of their fairness, and maybe even get them, the book presents the material in the Appendices.

The book has 7 chapters and 4 Appendices. In the first chapter, the evolution of the orbital and rotational motions of the Earth is considered. First, in the figures and graphs, the basic characteristics of these motions in ordinary space and in a spherical coordinate system are presented. Then, changes in the parameters of the orbital motion for 6 thousand years and 1 million years, and rotational motion for 1 million years are considered.

The processes occurring on the Earth depend on the relative change in the Earth's orbit relative to its equator. At different time intervals from 0.1 to 10 thousand years, the evolution of the relative motion parameters is shown. In the same chapter, the results of the solutions are compared with the observations and results of other authors.

In the second chapter, the evolution of the angle of inclination between the planes of the Earth's orbit and its equator (i.e. obliquity) is considered, as well as the Earth's insolation for 200 thousand years ago (ka). The change of Earth's insolation on the latitude is given in the contemporary epoch and in the warmest and the coldest epochs. At the interval of 200 ka 13 insolation periods of climate change were introduced. At the interval of 50 ka they are compared with the paleoclimate and it is shown that the main events: the Holocene optimum, the penultimate and last glacial periods, and also the warm period between them are consistent with the insolation periods.

In the third chapter, the evolution of the obliquity and insolation of the Earth for 1 Ma is considered. The climate changes caused by insolation are analyzed, its gradations are introduced in the form of 6 levels, for example, for cold: moderately cold, cold and extremely cold. Further, the evolution of the obliquity and insolation for the 2nd, 3rd, 4th and 5th millions of years are also considered.

These results are summarized on graphs for 5 Ma. Here we also consider the evolution of the parameters of the orbital and rotational movements of the Earth for 5 Ma. Evolution of the parameters of the orbital motion for 100 Ma is presented in Appendix 2, and rotational one for 20 Ma is in Appendix 4.

In Chapter 4, the changes in the obliquity and insolation are given at million-time intervals, beginning with the 6th Ma on the 20th Ma. On all these graphs, as well as on the previous ones, for comparison, changes of these parameters are given according to the previous Astronomical theory of climate. Here, we also compare insolation along the latitude of the Earth to the most extreme epochs for 20 Ma.

The fifth Chapter analyzes the types of climate caused by insolation for 20 Ma. Periods with climate levels: extreme cold and extreme warm are distributed unevenly. The characteristics of the climate at million-time intervals are introduced: calm, normal and restless. Their statistics are given.

In Chapter 6, the changes of insolation with a detail of 1 year are given from 5 ka to 2050 year at different latitudes of the Northern hemisphere. The short-period oscillations of insolation with the period of 18.6 years and less are shown and their causes are indicated.

The evolution of the obliquity and insolation in future epochs are considered at intervals of 200 thousand and 1 million years. The main properties of the climate are such one as in the past epochs. When compared at million-time intervals it follows that the next million years is characterized by a more relaxed climate than the previous one.

"Chapter 7. Comparisons, additions and verification" is devoted to additional issues that expand the application of the new Astronomical theory of climate change. In section 7.1, yhe insolation periods of paleoclimate are compared with marine isotope stages (MIS) for 5 Ma. The stages of MIS are defined by the change heavy isotope of oxygen ^{18}O in sediments of the World Ocean. As a result of the analysis it was found that the MIS does not reflect changes in the paleoclimate.

In section 7.2 the motion of the Sun in the sky at different latitudes, in different parts of the day and year is considered in detail. On this basis, the duration of the day, including the polar day and the moments of its occurrence are shown. The results are presented in graphs and illustrations, both for the contemporary epoch and for other epochs.

In section 7.3, the evidence of the presented results is considered. The problem statement in the new and former Astronomical theories is considered. The new statement formulates four problems, and evidence is presented for each of them. The physical reason for the difference between the new theory and the old one is also explained here.

The Appendices contain the differential equations of orbital and rotational motions of the Earth, evolution of the orbital motion for 100 Ma and the rotational for 20 Ma. The precession of the Earth’s rotation axis and its fluctuations in detail is studied in different coordinate systems. The statistics of the fluctuations of the obliquity is analyzed for of 20 Ma.

This book is intended for a wide range of readers. It is of interest to researchers in the fields of Earth Sciences, Astronomy, mechanics and physics. The book can be used by students and postgraduates in the preparation of term papers and dissertations.

The presented results of new Astronomical theory of climate change are basing on the solution of the Earth’s orbital and rotational motion problems on the supercomputers of the Siberian Supercomputing Centre in the ICMMG SB RAS, Novosibirsk, Russia.

This book is the result of my 30 years of work at the Institute of Earth Cryosphere, Tyumen Scientific Centre, SB RAS. At different stages, I was helped by young colleagues, many of whom were students. At many important stages my sons: Leonid J. Smulsky and Yaroslav J. Smulsky are helping for mine. I express my gratitude to all of them.

All comments and suggestions please send to:
625026, Tyumen, Malygina str., 86, Institute of Earth Cryosphere, Russia.

The Prof. Vladimir E. Zharov's Review of the book is published in [1]: http://wgalactica.ru/smul1/smulski/Papers/RecenziaZhCrZem.pdf.

1. Zharov V.E. Review of the monograph of J.J. Smulsky "New Astronomical Theory of the Ice Ages" (Riga, Latvia, Lambert Academic Publishing, 2018) // Earth's Cryosphere, Vol. 23, No. 3 (95), 79-81. DOI: 10.21782/KZ1560-7496-2019-3(79-81).